Briefing

What the UK's research, development and innovation sector needs to thrive and deliver prosperity

October 2022

In recent years, the UK research, development and innovation (RDI) sector has shown the importance of investing in research funding, science education, infrastructure and innovation, to help create a buoyant UK economy that improves people's lives and opportunities. It is estimated that investment in RDI can lead to annual rates of return in the range of 20-30% and public investment leverages additional private investment of around 200%[1]. Chemistry and chemical technologies are fundamental to many of the sectors where the UK is an RDI leader. Long-term RDI investment will ensure this strength in the chemical sciences is retained in the UK and continues to deliver considerable economic returns[2].

Chemistry-using professionals make a significant contribution to the UK economy, generating an average of £83 billion per year between 2013-2019 in economic output and returning £3.2 billion (2019) to HM treasury[3].

We urge the Government to put science at the heart of its plan for growth and take a strategic, long-term approach to funding RDI, thus ensuring that the UK remains globally competitive and instilling confidence in private investors. Recognising the current challenging economic circumstances faced by the nation, it is paramount that the increased public investment in RDI set out in the 2021 Spending Review is delivered effectively and efficiently to realise these economic benefits.

Long-term investment in RDI will ensure that the UK is equipped to meet challenges such as mitigating and adapting to climate change, achieving net zero ambitions, improving human health and tackling other emerging global challenges like improving the UK's food and energy security.

We call on the UK government to:

1. **Deliver long-term investment in research, development and innovation to ensure the UK remains a world leader in science**
2. **Provide a welcoming environment for and deliver investment in international research, development and innovation collaboration**
3. **Improve the attractiveness and inclusiveness of research, development and innovation careers and equip people with a broad skill set**
4. **Enable chemistry SMEs across all UK regions to deliver new technologies and drive UK-wide green economic growth**

1. Deliver long-term investment in research, development and innovation to ensure the UK remains a world leader in science

Long-term investment in RDI drives productivity, growth and raises living standards, benefitting individuals and communities across the whole of the UK as well as providing the tools to address global challenges. It is essential the UK Government continues to be ambitious to remain internationally competitive.

Deliver on the commitment to increase investment in UK RDI

The UK Government must deliver on its commitment to increase public investment in RDI and leverage increases in private investment. These increases must be delivered effectively and efficiently, and the benefits should be felt by all members of society.

The Government's commitments to increase public investment in research and development (R&D) to £20 billion a year by 2024/25 and to £22 billion a year by 2026/27 will benefit the country, enable the UK to maintain global competitiveness and contribute to economic growth.

As outlined by the Campaign for Science and Engineering, RDI investment is a key driver of productivity and economic growth[4]. They estimate that public RDI investment gets back 30p a year for every £1 invested and crowds in significant levels of private sector investment in RDI.

Clarity on longer-term RDI investment plans and a stable policy environment are needed to give private and public sector partners, including international investors, the confidence to making their own long-term RDI investment decisions. Funding streams that visibly enable the drivers of science – curiosity, collaboration (between sectors, nations, and disciplines), and leadership - can help to attract private investment that will enable economic growth[5].

Reinforce RDI in the UK's regions and devolved nations to level up

The UK Shared Prosperity Fund (UKSPF) must enable RDI to secure sustainable regional growth in the UK. Any shortfall in RDI regional development funding in UK nations and regions compared to funding levels before EU exit which is not met by UKSPF should be replaced from other funds to ensure that the UK RDI landscape does not suffer.

The Government's levelling up agenda must enable opportunity across the whole of the UK and across industries, including for chemistry-using professionals. Evidence shows that using regional development funding for RDI supports sustainable prosperity in regional economies[6]. It enables local businesses to harness the power of RDI, knowledge, and infrastructure. The UK Shared Prosperity Fund (UKSPF) which will fund regional development as part of the Government's Levelling Up agenda should play an important role in achieving the Government's science ambitions.

UKSPF is replacing European Structural and Investment Funds (ESIF), which the UK received before EU exit. ESIF had become a unique part of the UK's regional funding landscape by adding diversity to the landscape by providing investment based on GDP per capita, with the least developed regions receiving the most funding. ESIF included priority areas on RDI and SMEs which the UK benefitted from substantially. For example, during the previous programme (2014-2020) Wales received an average of nearly £80 million per year[7]. Loss of RDI regional development funding will have a significant and disproportionate impact on future RDI investment for regions if the funds are not replaced. The case study below demonstrates the type of facilities and research in the chemical sciences that have been enabled by ESIF programmes.

Case study: Cardiff Catalysis Institute (CCI)

Catalysis enables chemical reactions to go faster with less energy and is at the heart of most industrial and biological processes: in 2015 the technology underpinned an estimated 80–90% of all products. The CCI is improving the understanding of catalysis, developing new catalytic processes with industry and promoting the use of catalysis as a sustainable technology. Infrastructure and equipment are central to the CCI's research activities, and key to its success. The new CCI Electron Microscopy Facility (CCI-EMF), a world-class facility that will mean a step change in analytical capability, not just for the CCI but for industries, institutes and businesses across Wales, in part was funded by the ESIF programmes.

Ensure uplifts to UKRI's budgets are felt across all disciplines

Uplifts to UKRI's budgets through to 2024/25 are welcome, but the Government must ensure that these uplifts are protected and not eroded by inflation. While core Research Council budgets remain relatively flat, it is important that UKRI supports the breadth and balance of disciplines through other cross-UKRI funding streams.

In the Autumn 2021 Spending Review, uplifts to UKRI's budgets were confirmed allowing UKRI to make longer-term strategic plans through to 2024/25. We welcome the increases to Quality-related Research (QR) funding and Innovate UK's budget, as well as increases to cross-UKRI infrastructure and talent funding. However, we share the concerns amongst the RDI sector that these increases could be outpaced by inflation[8] which could make it challenging for the Government to achieve its science ambitions. It will be important for the Government to monitor the impact of inflation on UKRI's budget.

During the Spending Review period, core Research Council budgets will remain relatively flat. For example, the Engineering and Physical Sciences Research Council (EPSRC) sees a modest increase of £44 million during the period, equating to a 7% increase on the 2021/22 budget compared to Innovate UK and Research England whose budgets increase by 32% and 54% respectively. We urge UKRI to ensure that there is adequate support as is needed for the sustainability and health of each of its disciplines and interfaces within them, through Research Council budgets as well as other streams such as cross-UKRI Strategic Programmes, talent and infrastructure funds.

Future-proof science capability and support the long-term running and operating costs of infrastructure

Future-proof science capability through investment in green and digital infrastructure and provide funding beyond the immediate capital costs to cover long-term maintenance and the staff resources to run, repair and upgrade infrastructure.

The increases to investment in science infrastructure set out in UKRI's budget are welcome, but funding streams must be flexible to support the long-term running and operating costs of existing infrastructure, avoiding a 'batteries not included' scenario, as well as new green and digital infrastructure to future proof the sector.

Like many other STEM subjects, chemistry research and teaching have many high-cost delivery requirements such as the need to meet health, safety and other regulatory requirements, for well-designed and provisioned laboratory spaces, and to employ technical support staff. Furthermore, for the chemical sciences sector to stay competitive, advanced capability enabled by digital technologies will be vital.

Results from a survey of the Heads of Chemistry UK group held in 2021 indicate that many university chemistry departments have insufficient resource to maintain or upgrade equipment and facilities or maintain technical expertise. This could affect what research can be carried out, as well as impact the sector's ability to develop and apply frontier techniques, hamper industry-university collaborations and prohibit the sector's ability to remain internationally competitive.

2. Provide a welcoming environment for and deliver investment in international research, development and innovation collaboration

International collaboration is critical to the success of RDI, and for future economic and international ambitions. It can offer the widest benefits to society when researchers from different backgrounds, be that country, sector or discipline, come together to share knowledge and expertise.

Ringfence public investment earmarked for Horizon Europe for association or longer-term alternatives

The UK Government and European leaders should focus on finding agreement to achieve the UK's association to Horizon Europe. If association is not possible, the UK Government must continue to ringfence the funding earmarked for Horizon Europe programmes for alternatives and Third Country Participation.

Association to Horizon Europe is a vital enabler for the UK's continued growth as an RDI world leader, bolstering our reputation as an international partner and our openness to attracting the best global talent. UK-based researchers have been hugely successful in previous European Framework Programmes and in the initial Horizon Europe calls (which have been supported by UKRI guarantee funding). In the previous programme, Horizon 2020, the UK collaborated with groups in over 160 countries and has received over £7.7 billion in funding via the Programme[9]. UK SMEs have benefitted substantially from the funding and collaborative opportunities the EU offers, receiving nearly £1 billion in funding through Horizon 2020. Of these totals for the UK, the chemical sciences have received more than £850 million and £120 million for chemical sciences SMEs over the Programme's lifetime.

Association to Horizon Europe remains the best outcome for the RDI sector and for the chemical sciences. If the UK is unable to associate to the programme the funding earmarked for Horizon Europe participation must be ringfenced for longer-term alternatives including Third Country Participation.

Chemical scientists identify access to international collaborative networks, knowledge and expertise as some of the most important factors of public R&D funding[10].

Evidence is emerging that it has become harder to retain and attract international talent in chemistry research. Prof Roel Dullens, previously at Oxford Chemistry, moved his entire research group to Nijmegen once UK association to Horizon Europe looked unlikely[11]. We hear the field of chemical physics/physical chemistry is seeing some talented early career scientists move away from the UK. Some UK chemists have also reported increased difficulties in recruiting post-doctoral researchers.

Ensure longer-term alternatives to Horizon Europe advance international collaboration

The Government must engage as widely as possible with the RDI community to develop and evaluate its contingency proposals for longer-term alternatives to Horizon Europe and the alternatives must enable international collaboration.

We frequently hear from our community that the international networks and collaboration, enabled by participating in European Framework Programmes, are the most beneficial components of the programmes. Our community fears this will be the most difficult aspect to replicate in UK alternatives.

Longer-term alternatives must deliver the same combination of benefits for both UK researchers and the UK more widely[12]. Alternatives must: enable discovery research and researcher mobility through long-term, excellence-based funding; encourage wide-reaching collaborative international networks; support Third Country Participation in Horizon Europe; and offer tailored support for SMEs to unleash innovation.

Case study: Smart Separations Ltd[13]

Dr Hugo Macedo arrived in the UK as an ERASMUS student and started his company, Smart Separations Ltd, on his kitchen table in 2013. The company was founded on the back of an Innovate UK SMART award, which enabled him to secure a £43,000 phase 1 grant from the EU's Horizon 2020 SME Instrument scheme, designed to 'boost fast company growth and market-creating innovation'. The phase 1 support gave Hugo and Smart Separations leverage to secure an additional Innovate UK Industrial Strategy Challenge Fund grant and a £1.7 million phase 2 grant from the EU's SME Instrument programme.

Dr Macedo noted: "The SME phase 2 was a game changer for us: it helped us scale-up that technology initially conceptualised in my kitchen, to manufacture these membranes and bring them to market." The company is growing fast, with state-of-the-art facilities in London and Portugal and a team of 25. It has developed two technology platforms: an innovative microfiltration technology based on ceramic membranes with conical pores, and, in response to the global pandemic, a fast-acting antimicrobial coating that is effective against SARS-CoV-2.

In a survey of nearly 5,800 of our chemical sciences community, 84% of UK chemical scientists think that freedom of movement has had a positive impact on UK science and innovation.

In the same survey, 71% of all chemical scientists, 63% of UK nationals, believe Freedom of Movement has had a positive impact on their careers.

Enable an internationally mobile workforce

To achieve the maximum benefits from investment in RDI and in international collaboration, the UK immigration system must be flexible, low cost, and light-touch, as well as adopting a welcoming tone and attitude, so that UK science can continue to thrive and attract talent from all over the world.

The UK currently has several migration routes for people with STEM skills, but they have inherent problems. The Post-Study Work route is valuable, particularly for retaining researchers post doctorate, but does not allow for individuals to go home before applying. The High Potential Individual visa has overly narrow eligibility based on untransparent university league tables and does not recognise the future potential of the applicant. All visas, including the Global Talent visa and the Innovator and Scale-Up visa, incur costs that can be prohibitive.

Analysis on visa costs carried out in 2019 by the Royal Society[14] shows that the UK has some of the most expensive upfront costs in the world for immigrating scientists and their sponsors. These costs are the most significant barrier for many individuals to come to the UK, especially if accompanied by their family. A researcher applying through the Skilled Worker Route for a five-year visa and bringing a partner and two children would have to pay £15,880 up front[15]. These costs are also prohibitive to SMEs, with half of small businesses saying they cannot afford visa sponsorships[16]. This stops innovative SMEs bringing in international STEM talent despite the government's rhetoric on attracting the 'best and brightest'.

3. Improve the attractiveness and inclusiveness of research, development and innovation careers and equip people with a broad skill set

In a 2018 speech, Sir John Kingman, then Chair of UKRI, said that achieving the Government's R&D investment ambitions could require an increase in the scientific workforce of 50%[17]. With people at its cornerstone, delivery of the Government's RDI ambitions will require RDI careers to be attractive and research training models to equip students with the right skills.

Support PhD students and other researchers impacted by the cost of living crisis

To ensure talented researchers remain able to pursue a career in RDI, the UK Government and funders should consider urgently how to support PhD students and other researchers most impacted by the cost of living crisis

A recent report on 'Reducing the precarity of academic research careers' by the OECD describes the contextual determinants of precarity in research careers as "the worsening working conditions for researchers due to changes in the conduct of research, in the supply and demand for doctorate holders, and in research careers, further compounded during the Covid-19 crisis"[18]. In the UK, the issue of low remuneration for researchers has been raised by the government[19], and pension cuts have worsened researchers' dissatisfaction[20]. The OECD report shows that reducing precarity will require a range of interventions[21].

Precarious conditions are being compounded further by the cost of living crisis, posing risks to the ability of talented students to pursue their studies and a career in RDI. We welcome UKRI and Wellcome Trust's announcements that they will raise minimum stipends to reflect the cost of living increases and we urgently call on the UK Government and funders to consider how they will further support researchers most impacted.

Continue the delivery of the R&D People and Culture Strategy

To improve the attractiveness and inclusiveness of RDI careers, the UK Government should deliver the R&D People and Culture Strategy and drive equality of opportunity in RDI.

Our Issues with the culture of research in the UK have been highlighted by several organisations in the RDI sector in recent years[22] and have a negative impact on the attractiveness of academic careers. The government's R&D People and Culture Strategy[23] seeks to address many of these issues, and delivery of this strategy should remain a priority.

The UK Government should work with leaders in diversity and inclusion and organisations in the research landscape, including employers (universities, institutions and companies), funders, learned societies, academies and publishers, to ensure that policy levers and organisational practice make a step change in diversity in research and innovation environments[24].

RSC research into the structural barriers to inclusion of women[25] and minoritised ethnicity scientists[26] has identified an unsupportive academic culture, unequal access to funding and narrow definitions of success as systemic barriers to the retention and progression of these groups.

Ensure postgraduate education equips students with a broad skill set

The UK Government needs to work with postgraduate education funders and providers to ensure that research training models equip students for the diverse range of careers that they will pursue

While postgraduate research training is a valuable route to develop the scientific workforce, figures from the Engineering and Physical Sciences Research Council (EPSRC) show that only 35% of EPSRC-funded doctoral graduates continue their career in academia[27]. Research training models should provide a broader mix of skills in students to equip them for careers in the wider knowledge economy, and potentially improving permeability between academia and industry.

Research into chemistry SMEs has revealed that a lack of business and leadership skills can be a barrier to company growth and productivity[28]. We support EPSRC's recommendation that all students "should have access to opportunities outside of their research project[29]", allowing them to develop additional skills for innovation and leadership. We note the recently announced UKRI scheme to create business-aware researchers[30], and look forward to the evaluation and learnings of this initiative so that successes can be built upon further.

Skills needs are also changing within research. In common with many other fields, digital and sustainability skills are becoming increasingly important in the chemical sciences. The RSC's *Digital Futures* report shows the growing importance of digital chemistry skills[31]. Employers also need candidates demonstrating these skills. Additionally, practising chemists working in academia and industry report a gap between chemical scientists' current skills and knowledge and those needed for green jobs now and in the future[32].

4. Enable chemistry SMEs across all UK regions to deliver new technologies and drive UK-wide green economic growth

Chemistry SMEs are characterised by working on potentially disruptive technologies, with long and uncertain research timescales and high need for capital to develop. Tailored and targeted measures could further develop this sector in the UK and ensure more technologies are able to reach the market, contributing economically across the country and pushing towards novel solutions for global challenges.

Enable chemistry SMEs to unleash their economic potential

SMEs can be the vehicle to develop and commercialise new technologies and drive UK-wide green economic growth, if they can overcome specific barriers to scaling-up and innovation. Holistic support for chemistry SMEs within the wider ecosystem will help RDI companies unleash their economic potential.

While SMEs in chemistry-intensive sectors are around twice as likely to be investing in RDI compared to any other SMEs in the economy, they encounter a range of specific challenges that the environment surrounding them is not structured to address. Chemistry RDI involves long and uncertain timescales, meaning the companies need patient capital rather than investors demanding quick returns. The finance and investment sector also needs the scientific understanding to see the value potential in chemistry SMEs. For businesses to be able to grow and deliver products to market, they need solutions to overcome these challenges in the form of actions to address the equity gap, particularly at later funding rounds to prevent overseas acquisition taking the economic benefits of these technologies abroad.

Chemistry research and innovation also requires suitable premises and specialist equipment. Access to these facilities can be difficult for UK SMEs, particularly outside of the Golden Triangle (London-Oxford-Cambridge). Where it is available, use can be cost-prohibitive or unsuitable in terms of scale, such as in scale-up manufacturing facilities. Recent increases in energy costs also add to affordability issues and the need for additional development and scale-up funding. Government should work to improve access to chemistry RDI facilities across the country, leveraging universities and the Catapult Centres to support SMEs.

Ensure chemistry-intensive SMEs thrive across UK regions

There is strength in chemistry RDI across the UK, not just in the Golden Triangle, and measures to ensure the sector can thrive across regions will have positive impacts on local economies.

While Chemistry SMEs are located around the country, often in groupings of science and research-based companies. Science clusters are not a new idea and are already showing great success in places like Cambridge. Planned development of further science clusters will help addressing shortages in lab space and shared access to equipment and facilities, which have been identified as key issues affecting chemistry SMEs. Additional benefits include peer-to-peer knowledge sharing among SMEs, producing greater innovation successes, and creating local pools of STEM talent who can move between companies without having to relocate. Supporting the growth of these clusters will lead to geographic distribution of economic benefits and additional job creation to support the STEM workforce in these regions.

Contact

The Royal Society of Chemistry would be happy to discuss any of the issues raised in our statement in more detail. Any questions should be directed to policy@rsc.org.

About us

With about 50,000 members in 120 countries and a knowledge business that spans the globe, the Royal Society of Chemistry is the UK's professional body for chemical scientists, supporting and representing our members and bringing together chemical scientists from all over the world. Our members include those working in large multinational companies and small to medium enterprises, researchers and students in universities, teachers and regulators.

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