Department for
Science, Innovation
& Technology

Evolution of the Research, Development and Innovation Organisational Landscape

Government's response to the Independent Review of the UK's Research, Development and Innovation Organisational Landscape

November 2023

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Ministerial foreword

The UK has always been a world-leading nation in scientific endeavour.

We are the proud home of an amazing array of organisations working at the cutting edge – from our prestigious universities to institutes like the Jodrell Bank Observatory and the Francis Crick Institute, to pioneering businesses like Google DeepMind whose AlphaFold programme predicted the shapes of 200 million proteins - the fundamental building blocks of human biology.

Our scientific institutions are the envy of the globe with talented, creative researchers unlocking bold new discoveries to help us tackle climate change, eliminate world hunger, and find cures for life-threatening conditions such as cancer and Alzheimer's. We have some of the most creative, innovative companies in the world working in sectors that are rapidly evolving and brimming with new, revolutionary ideas.

The UK government is not complacent, however, about what's needed to strengthen the UK's position in the global race for new knowledge and talent.

That is why the Prime Minister created my department for Science, Innovation and Technology – to shake things up and do things differently; to bring together policy, strategy, research and innovation to cement the UK's position as a science and technology superpower by 2030.

Less than a year later and we have already made huge strides towards delivering on those goals.

In March, we published our Science and Technology Framework - a bold ten-point plan to keep the UK at the forefront of global science and technology. A plan backed by £370 million of funding for the five transformative technologies of the future: quantum, AI, engineering biology, telecoms and semiconductors.

We have also secured a bespoke deal with the EU that will allow the UK's top scientists, researchers and businesses to participate with total confidence in both Horizon Europe and Copernicus. It grants the best and brightest of our scientific community access to the world's largest research collaboration programme.

We are also fulfilling our commitment to spend £20 billion per annum in R&D by the end of next year – with every £1 of public expenditure leveraging double the amount of private investment.

Now we need to take action to make our ecosystem of amazing research and innovation organisations a more diverse one. We have announced the world's first AI Safety Institute, helping us to grip the risks of this transformative technology. We are strengthening our public

sector research foundations and putting more funding into our Catapults, to help grow key sectors.

And to make our system more resilient and attractive to investors, I want us to continue diversifying how cutting-edge research and innovation are funded and performed.

That is why my department is partnering with innovators throughout the private, public and philanthropic sectors to generate a new wave of funding into our top-tier research institutions.

Working with tech titans and international investors such as Eric Schmidt and Ken Griffin we have already unlocked over £30 million of new funding for the UK Biobank - the world's leading biomedical database. This will grow its already unrivalled wealth of health data to unlock the next great leaps in our understanding of health and disease.

Through our Research Ventures Catalyst programme, we are also supporting a new generation of trail-blazing scientific institutions. We are backing Focused Research Organisations piloting new, exciting collaborative ways of supporting science in the UK. With up to £25 million of government investment available for each venture, we are bringing together scientists and experts from different disciplines to tackle some of the greatest challenges of our time.

In his independent review, Sir Paul Nurse was right to say that our country has an exceptional story to tell when it comes to science and research. However, his report also underscores the need for greater diversity and resilience within the UK's science and tech ecosystem so that we remain attractive to investors both here and abroad.

This document sets out the first steps toward making that vision a reality as we embark on a comprehensive programme of evidence-based reform.

I would like to thank Sir Paul for his thoughtful and comprehensive review and everyone who contributed to it.

The UK is already one of the greatest science and technology success stories of this decade.

With Sir Paul's insights acting as our guide, we will ensure that the UK remains a global beacon of research, discovery and innovation for decades to come.

The Rt Hon Michelle Donelan MP

Secretary of State for Science, Innovation and Technology

Executive Summary

In a world of increasing challenges and rapid change, advances in science and technology will be fundamental to securing the UK's prosperity and international competitiveness. Science and technology are at the heart of the government's mission to build a stronger economy with better jobs. This will ease the cost of living and ultimately ensure material benefits for everyone: from improved healthcare with shorter wait times in the NHS to tackling the climate crisis and keeping the UK secure.

The creation of the new Department for Science, Innovation and Technology (DSIT) provides a new single point of leadership, coordination and evidence for Research, Development and Innovation (RDI) policy. In March, the UK government published the Science and Technology (S&T) Framework, setting out a clear set of delivery priorities and a strategic vision for the UK to cement the UK's place as a science and technology superpower by 2030. By bringing the government's RDI priorities together with a clear vision for science and technology as a source of strategic advantage, the new department demonstrates the government's commitment to a coherent, long-term approach. Coordinated and facilitated by DSIT, these new structures will also create a clearer sense of strategic direction for the role of UK Research and Innovation (UKRI) as the government's primary public RDI funding body and a globally unique source of scientific and operational delivery expertise across the whole RDI landscape.

The S&T Framework is backed up by ambitious goals. It sets out how the UK will invest in key areas and drive action in collaboration with organisations and researchers across the RDI landscape. Government has already made significant steps in delivering this vision, including:

- Increasing government investment in R&D to £20 billion per annum by 2024/25, up around a third from 2021/22 – expected to lever in double the amount of private investment in the longer run. The increase in investment is focussed significantly on innovation and application, helping to maximise the real-world and commercial potential of the UK's world-leading research.
- Strengthening our partnerships with emerging and leading science and technology nations. This includes negotiating a bespoke deal in the UK's national interest to associate with Horizon Europe, the world's largest RDI collaboration.
- Tough prioritisation to secure the UK's technological leadership in five critical areas of strategic advantage – AI, engineering biology, future telecoms, semiconductors and quantum. For example, government is investing £2.5 billion over the next 10 years to grow our quantum sector, backed by five new quantum missions.
- New initiatives at scale, such as the £320 million Technology Missions Fund, to enhance and exploit the UK's global leadership in using cutting-edge technology to tackle major global challenges such as climate change and healthcare. The Green Future Fellowships programme, backed by a long-term £150 million endowment, will also fund scientists and engineers to develop practical, breakthrough green technologies and climate changes solutions.

- Publishing long-term strategies for semiconductors and quantum to secure the UK's position in these critical technologies, which are vital for the UK's future prosperity and security.
- As committed at the 2021 Spending Review, funding for core Innovate UK programmes – which are successful in crowding in private sector leverage – will rise to £1.1 billion per year by 2024/25. This is over £300 million (66%) more per year than in 2021/22.
- Publishing the AI white paper to guide the use of artificial intelligence (AI) in the UK, to drive responsible innovation and maintain public trust in this revolutionary technology.
- Committing to invest £900 million to build an exascale supercomputer and to establish a new AI Research Resource.
- Hosting the inaugural AI Safety Summit on 1-2 November 2023, convened by the UK to identify next steps for the safe development of frontier AI. Countries attending agreed to the Bletchley Declaration on AI safety, a landmark agreement recognising a shared consensus on the opportunities and risks of AI, and the need for collaborative action. They also agreed to state-led testing of the next generation of models before they are released, including through partnerships with AI Safety Institutes.

The UK government can only implement these long-term and ambitious plans by working in partnership with the UK's unique network of funders and world-leading RDI organisations, whether in the public, private or third sector. This includes partnership with the devolved administrations, recognising each nation's priorities and strengths.

This was recognised by Sir Paul Nurse in his comprehensive *Review of the Research, Development and Innovation Organisational Landscape*, published on the 6th March 2023.

The government welcomes Sir Paul Nurse's Review, which identified that the UK RDI organisational landscape has historic strengths. These include globally respected research institutions and leadership, a talented RDI workforce and clear industrial capabilities. The Review also recognised that without change, the UK risks falling behind other nations.

Sir Paul highlighted that many of the challenges facing the UK RDI system are long-standing and interconnected: from funding sustainability to the mobility of talent between sectors. The government recognises – as did Sir Paul – that many of these issues cannot be resolved overnight. They will need long-term and carefully designed reform with extensive engagement with the sector.

This document therefore establishes a clear direction of travel and a series of short-term actions to improve the organisational landscape, and is a critical first step towards addressing the broader challenges laid out in Sir Paul's Review. In the longer term, Sir Paul's Review and this response will continue to be integrated into the implementation of the S&T Framework, as our foundational guide to cement the UK's place as a science and technology superpower by 2030. Each commitment in this document is being embedded within the relevant strand of the S&T Framework.

This document was developed with consultation and input from devolved administrations, UKRI as the government's key advisory body and arms-length funder, and partners across the RDI landscape. We will continue to work closely with partners to ensure that the UK's RDI organisational landscape is working as effectively as possible.

To cement the UK's place as a science and technology superpower, helping to grow our economy and raise people's living standards, the government is fostering an RDI organisational landscape that is more diverse, more resilient and more attractive to investment – guided by a data driven approach. This means optimising our institutional models and the ways in which the government funds research, but also ensuring that the landscape is stable, sustainable and provides value for money. We must build on our success of leveraging private and philanthropic investment to ensure that the UK is the most attractive place in the world for investment in RDI.

The government's vision for the future of the RDI organisational landscape

Informed by the findings and recommendations of Sir Paul Nurse's Review, the government will work closely with the sector to foster an RDI organisational landscape that is:

1. Dynamic and Diverse

The UK's RDI sector boasts a wide diversity of organisational models and a thriving ecosystem of approaches within each of those models. The Review highlighted the ways in which such diversity is a valuable strength of the UK system. It also identified how policy choices – taken by successive governments over several decades – have resulted in a set of financial and behavioural incentives that risk narrowing the funding and delivery options available.

Our desire to diversify the organisational landscape should not be misinterpreted. UK universities are already globally recognised for their strength and diversity. These strengths span the range of discovery and applied research, innovation, entrepreneurship and attracting global talent, which are critical components in building a strong economy at local and national levels. Our universities are essential to cement the UK's place as a science and technology superpower and will continue to be supported and promoted.

The review highlighted, however, that sustained support for our university sector in recent decades has not been matched by equivalent support and recognition for public sector research or independent non-profit institutes. Government is mindful that universities have other missions than research and some RDI objectives may best be taken forward by different kinds of organisations, as many international research settings have successfully shown.

Public funding for RDI has increased significantly in recent years. In that context, we will continue to support the UK's academic excellence and comparative advantage in discovery-led research. At the same time, we will seek to broaden the scope of our support for new and diverse models of research delivery. Government will incentivise a greater diversity of

organisational models, based on an evidence-based assessment of the UK's national science capabilities, strengths, weaknesses and emerging opportunities.

Government will, as recommended by the Review, build a clearer understanding of the UK's RDI requirements and opportunities. To help secure strategic advantage, government will take an increasingly active role in cultivating a more dynamic and diverse landscape. To do this, government will:

- **Increase the breadth of organisational models…** Government will experiment with different organisational and funding options. We have already begun this process with the creation of the Advanced Research and Invention Agency (ARIA), an organisation exclusively focussed on funding high-risk, high-reward research. More recently, we have created an AI Safety Institute, the first state-backed organisation focussed on advanced AI safety for the public interest. The government will support the creation of a National Academy focussed on mathematical sciences, engaging key stakeholders in the mathematical community on the best way to do so. DSIT has also established the Research Ventures Catalyst programme, which will explicitly fund novel organisational models whose needs are not easily met by current structures. To support this work, we will establish an enhanced Research and Innovation Intelligence capability within DSIT to robustly evaluate different models and provide advice across Whitehall on future trends and opportunities in the UK organisational landscape.
- **Maximise the impact of the UK's world-leading public sector RDI organisations and infrastructure…** We will be more strategic about responding to the UK's national science capability requirements. This includes the assessment of cross-government S&T needs and the role of public sector RDI organisations and infrastructure in meeting those needs. We will do more to capitalise on the collective talent, research and technical capabilities of these organisations, promote collaboration between different organisation types and ensure better alignment with government priorities. Measures will include exploring a sustainable source of funding for Public Sector Research Establishments (PSREs) to better enable them to undertake UKRI grant-based research, raising their visibility through an annual 'PSRE day' and increasing the profile of PSRE and UKRI graduate and degree apprenticeships schemes. Government will also publish a national plan for RDI infrastructure, pursue opportunities to host new international RDI infrastructure and launch a further £25 million funding round for Research and Innovation Organisations - including PSREs - to provide core small and medium-scale research infrastructure.
- **Take an evidence-based, data-driven approach to evolving our RDI landscape…** Government will take steps to improve our understanding of 'what works' when funding research organisations. This will be delivered by a new joint DSIT/UKRI metascience unit, funded with an initial commitment of £10m to conduct experiments to test and robustly evaluate the effectiveness of changes in the funding processes delivered by UKRI and other institutions. We will more consistently use evidence, data and analysis in the government's assessment of UK RDI capacity and capabilities, supporting the Research and Innovation Intelligence Function. This will include regular mapping to guide policy and investment decisions by government and our partners. Through the

S&T Framework, more empirical tracking of metrics will allow government to assess success.

- **Minimise Bureaucracy …** Government is committed to reducing bureaucracy across the RDI system. The government will shortly respond to the Independent Review of Research Bureaucracy led by Professor Adam Tickell. Given the pace of scientific and technological advancements, we must ensure the government can rapidly and effectively make decisions on funding new opportunities as they emerge without getting bogged down in internal bureaucracy.

2. Resilient

To deliver on our long-term science and technology ambitions, we must respond to the challenges and priorities of today and the future. The RDI landscape needs long-term financial stability, access to the best talent in the world and opportunities to collaborate internationally. It requires more exchange of ideas, talent and technology, flowing between business, academia and public sector RDI organisations. Greater diversity is not tenable without the organisations within the landscape being both resilient and adaptable. The S&T Framework provides the stable policy foundation required to secure the resilience of the UK's RDI organisational landscape. To further bolster the resilience of the landscape, government will:

- **Assess financial sustainability challenges …** A sustainable system means institutions of all sizes and specialisms can seize the opportunities available to deliver both high-quality RDI and value for money today and in the future. Government will work with devolved administrations and the sector to optimise research delivery, remove perverse incentives and ensure long-term financial sustainability. To start this sector-wide discussion, UKRI is today publishing new analysis on how research organisations are funded and the financial sustainability risks and pressures they face.
- **Secure the world's best talent …** Access to talent is fundamental to the resilience of every RDI organisation. We must attract top international talent, as well as retain, develop and support existing talent in the UK, to enable the UK to remain at the cutting edge of RDI. We continue to make significant investments in training our next generation of RDI talent, from technicians, engineers, researchers to clinicians. The government is also taking innovative, long-term approaches to fund top RDI talent, such as through fellowship endowments, including the new Green Future Fellowships backed by a £150 million endowment and the long-term world-class Discovery Fellowships backed by a £250 million endowment. The government will continue to increase the UK's competitive advantage in attracting and retaining international RDI talent, building STEM literacy in the population and promoting opportunities through the GREAT Talent campaign. Bureaucratic barriers should be reduced to ensure our organisations operate effectively and incentivise RDI talent to work in the UK.
- **Be international in our approach to RDI …** We will continue to foster an open and international approach to research. Our bespoke deal to associate to Horizon Europe means we can work with the world's biggest R&D programme. We remain committed to supporting the sector to maximise participation in the programme. We continue to invest in joint programmes with other research partners worldwide, such as the International

Science Partnerships Fund. At the same time, we recognise that an increasingly competitive and volatile world means that international research collaboration is under threat from hostile actors who exploit this openness for their own interests. We will work with partners to maintain an open and secure international research ecosystem, where UK international RDI collaboration can flourish. The Research Collaboration Advice Team (RCAT) has been established to advise the academic sector on national security risks in international collaboration.

- **Ensure the system is open and navigable …** We will work with the sector to create the conditions to incentivise a seamless flow of talent, ideas and technology within the RDI landscape, industry and society. This will help to drive national prosperity and create a system that is more resilient and greater than the sum of its parts. This includes clearer signposting of funding and collaboration opportunities to the RDI and private sector, as well as building on work to map the UK's RDI capabilities and capacities. Today, we are publishing the government's response to the independent review of university spin-out companies. Responding to one of its recommendations, we will consider trialling an 'academic returner fellowship' to generate evidence on whether and how such researchers differ from lifelong academics.

3. Investable

The UK has enormous strengths across science, innovation and technology, which have been nurtured over decades. The UK's RDI organisational landscape is one of the most investable in the world, but we can and will go further to attract increased investment. Government is already funding RDI at record levels and there are huge opportunities to capitalise on this and increase the amount of private and philanthropic investment. To do this, government will:

- **Boost private sector RDI investment …** We will continue to support the conditions to promote private sector investment, as set out in the UK Innovation Strategy. We will do this by continuing to develop the direct financial support provided through Innovate UK to incentivise co-investment in innovative and collaborative RDI across the landscape. Alongside this, we will unlock the potential of the UK's innovation ecosystem to support private sector investment in both the RDI landscape and the innovations it produces. This includes improving access to finance through the British Business Bank and providing R&D tax credits to innovative businesses. As part of the government response to the independent review of university spin-out companies, the government will improve funding for proof-of-concept research through a new £20 million cross-disciplinary proof-of-concept fund. Alongside this, we will continue to invest in skills at all levels while supporting the exchange of expertise between publicly funded institutions and private sector. We will continue to develop pro-innovation regulation that enables businesses to test and develop cutting edge products and services.
- **Build world-leading and globally connected innovation clusters …** Government will improve prosperity and opportunities throughout the UK by nurturing innovation clusters. A key example of a cluster is Harwell, one of the world's largest and most important public-private science and innovation campuses. As well as creating the conditions for RDI to thrive in all places, the government is boosting innovation ecosystems and

businesses within them – from Innovation Accelerators, Innovate UK Launchpads, Investment Zones, to supporting the creative industries through the Creative Industries Clusters.

- **Make the UK a world-leader for philanthropic partnerships …** A step-change is needed in how the government works with philanthropy to make the most of opportunities to secure support for UK strategic RDI capabilities and opportunities. Philanthropy, particularly in support of the betterment of our health, is a quiet revolution which the government fully supports. DSIT will work with the Office for Investment to build relationships with the philanthropic community to ensure an ongoing pipeline of funding for high-value RDI institutions. The recently announced UK Biobank philanthropic consortium is a pilot of this approach, showcasing how government can leverage additional funding to support key UK science assets. We are looking to do more through programmes like the Research Ventures Catalyst.

The government cannot deliver these ambitions alone.

To develop this document, we have drawn on the expertise and experience of individuals and organisations in all parts of the RDI landscape and from across the United Kingdom and beyond. We are grateful for these contributions and particularly grateful to Sir Paul Nurse for his comprehensive Review of the RDI organisational landscape that has helped to articulate many of the challenges and opportunities.

Where it has been possible to move fast, government has already implemented many of the Review's recommendations. Most visibly, government has strengthened leadership in the RDI landscape by establishing the new Department for Science, Innovation, and Technology, publishing the S&T Framework and securing the UK's association to Horizon Europe.

As Sir Paul's Review points out, the systemic issues highlighted will require sustained positive change and long-term collaboration. Implementing the commitments in this document will take time and the UK government will collaborate widely with the sector, funders and devolved administrations as we develop detailed plans, integrated with ongoing implementation of the ten strands of the S&T Framework. In some areas, for example on financial sustainability, we will work with the sector to gather better evidence on the issues.

Government will continue this spirit of collaboration, working with the wider sector – academics, researchers, businesses, funders, individuals and organisations – to foster an RDI landscape that is diverse, resilient and investable. These improvements offer the potential for real and long-lasting benefits for our citizens and businesses up and down our country.

Chapter 1: Dynamic and Diverse

Our objectives

The UK's thriving RDI landscape encompasses a wide range of organisational models, from universities, independent research organisations and standalone research institutes, to public sector laboratories, Catapults and other research and technology organisations, and some of the world's most exciting R&D-intensive startups, scale-ups and major industrial players.

Within this broad landscape, fundamental research is hugely important and will continue to be a pre-eminent source of strategic advantage in its own right. In addition to this, a recalibration of the system is needed to ensure we capture the benefits through to application and innovation. The government's record increase in R&D funding in recent years provides an opportunity to both maintain our steadfast and longstanding support for fundamental research and to increase our focus on key technologies, while providing significantly increased funding for innovation and application of research. We need the right mix of organisations in the landscape to respond fully to this opportunity.

Our universities are the envy of the world, and the government is committed to maintaining this. An increased focus on impact, introduced in the 2014 Research Excellence Framework, has encouraged many universities to become increasingly outward facing. While universities are critical to the UK's globally recognised strengths in fundamental research, diversity of approach within the sector is an emerging strength of the UK's RDI landscape. As the Review noted, many universities play essential roles in supporting commercialisation activities in their localities and regions.

Universities deliver 77.5% of the UK's non-business RDI activities, which is significantly more than in other comparable countries (France: 59.8%, Germany: 55.2%, United States: 46.5%).[1] It is clear, therefore, that the strengths of the UK's university system can benefit from being complemented by a wider range of modes of research performance and funding. This is about building the diversity of the system while continuing to make the most of the UK's universities. As part of this, the UK needs to use our public sector RDI organisations and infrastructure more strategically to further national interests. Government wishes to ensure that the range of incentives, including funding for RDI performance, maximise our strategic advantage and cement our place as a science and technology superpower.

No one can predict the next discovery which will fundamentally advance our understanding, generate the next transformation in technology or solve the challenges of the future. However, by actively stimulating greater diversity of research delivery we can increase our chances of fostering these breakthrough moments. The government will focus on achieving our vision for a

[1] Organisation of Economic Co-operation and Development (OECD) (2023) 'Main Science and Technology Indicators' available Indicators", OECD, 2023'. Available from: https://www.oecd.org/sti/msti.htm. [Accessed on 13 November 2023]. For some countries figures are provisional or estimations and definitions differ.

diversity of RDI delivery modes both within and beyond the university system, including by expanding the breadth of organisational models. An essential component to this approach will be government taking a more consistently evidence-based and data-led approach.

The government will nurture a landscape that is even more dynamic and diverse, and which ensures that all organisations in it can reach their full potential by:

1A) Increasing the breadth of organisational models

The Review highlighted that when new strategic or scientific priorities for UK research are identified, the government should consider how these can best be delivered in the context of the existing research landscape. This includes decisions on when to adapt, close or expand existing publicly funded research organisations as well as decisions about creating new ones.

Ensuring the UK draws upon the diversity of research and industrial strengths across the UK will be essential. The UK government will continue to work with the devolved administrations to ensure the development of RDI policy reflects each administration's priorities and the differences in how research is governed, funded and performed. This will include ensuring investment complements rather than duplicates existing activities.

Government will invest in its ability to translate enhanced data and evidence capabilities into strategic analysis and options for new and existing RDI organisations, led by a Research and Innovation Intelligence Function. This will provide advice on future trends and opportunities in the UK organisational landscape. It will also inform our domestic and international research and infrastructure investments to support and enhance the UK's RDI strengths and help direct the pivot towards more application and innovation.

Based on a regular assessment of our national science capabilities, this enhanced function will support greater transparency in how government makes choices about publicly funded research organisations. As demonstrated by the establishment of ARIA, the AI Safety Institute and the Research Ventures Catalyst, government will trial dynamic mechanisms to fund research which can support experimentation in our institutional mix. This applies to funding from the UK government. When appropriate, consideration will be made to hosting new organisations across the whole of the UK, in consultation with the devolved administrations.

i) Prioritising strategic capabilities: analysis of the UK's RDI organisational landscape

The principles for founding, adapting and (where their missions have been completed) closing research performing organisations outlined in the Review are integral to an approach that systematically assesses strategic capabilities in RDI and takes action. The government will use these principles to guide decisions on RDI organisations through the enhanced Research and Innovation Intelligence Function outlined above. The government will adopt a series of tests such as whether the proposed change demonstrates a strategic fit and value add to the system and whether there is a clear plan for financial sustainability of the organisation. This will include

thorough consultation with the RDI sector to ensure that duplication and strategic needs have been fully taken into account.

The AI Sector Study 2022 constitutes a comprehensive evidence base on UK AI organisations. Since this was published, the UK has launched an AI Safety Institute (AISI), which will complement existing organisations in the landscape. The Institute was launched by the Prime Minister to advance the world's knowledge of AI safety by carefully examining, evaluating and testing new types of AI so that we understand what each new model is capable of.[2] The Institute is the first state-backed organisation focussed on advanced AI safety for the public interest. Its mission is to minimise surprise developments from rapid advances in AI. It will work towards this by developing the sociotechnical infrastructure needed to understand the risks of advanced AI and enable its governance. The Institute will establish the UK as a global hub for safety research, deepening the UK's stake in this strategically important technology.

The government has consistently emphasised the importance of mathematical capabilities in the UK. The government will support the creation of a National Academy focussed on mathematical sciences, engaging key stakeholders in the mathematical community on the best way to do so. As part of our commitment to supporting this work, we are willing to back this initiative with up to £6m of seed funding over the next three years, subject to business case.

ii) Diversifying funding opportunities

As a first step to increase the diversity of research delivery, government established the Advanced Research and Invention Agency (ARIA). ARIA was designed with unique freedoms and an organisational model tailored to fund high-risk, high-reward scientific research.

Alongside ARIA, the government is continuing to pilot innovative funding mechanisms which can support the creation of novel institutions. An example is the Research Ventures Catalyst (RVC), a competitive fund for the sector to propose innovative models of research performance. RVC will stimulate the creation of collaborative research ventures, supported by consortia drawn from the public sector, industry and the third sector. The RVC will leverage significant industry and philanthropic investment and enable innovators to explore new types of research organisations outside of the usual settings. An open call for the RVC was launched in June 2023.[3] Over time, the RVC will establish genuinely new ways of performing research, which are additive to the UK's institutional mix.

UKRI is also piloting new ways of delivering funding to support interdisciplinary research which is not routinely funded through existing UKRI responsive mode schemes. In May 2023, UKRI launched the first round of the cross-research council responsive mode pilot scheme. This pilot

[2] Department for Science, Innovation and Technology (2023) 'Introducing the AI Safety Institute'. Available from: https://www.gov.uk/government/publications/ai-safety-institute-overview/introducing-the-ai-safety-institute [accessed on 20 November 2023]
[3] Department for Science, Innovation and Technology (2023) 'Research Ventures Catalyst'. Available from: https://www.gov.uk/government/publications/research-ventures-catalyst [accessed on 13 November 2023]

is designed to support transformative ideas which transcend, combine, or significantly span disciplines and aims to unlock new research, approaches or methods.[4]

Commitments:

The government will:

- Support the most promising applications from the Research Ventures Catalyst open call, and look to fund the ventures that offer innovative approaches to solving complex problems, in collaboration with non-public sector partners.
- Establish a novel research Institute focussed on AI Safety, based on the new evidence-based process for assessing UK R&D capabilities and gaps, following the announcement at the AI Safety Summit.
- Enhance DSIT's Research and Innovation Intelligence capabilities to provide advice on future trends and opportunities in the UK organisational landscape and apply a strategic framework to evolving institutional capability in response to opportunities and gaps in the research landscape.
- Informed by this improved assessment, fund new research capabilities in line with where there are gaps in the existing organisational landscape that cannot be filled by an existing organisation.
- Support the creation of a National Academy focussed on mathematical sciences.

1B) Maximising the impact of the UK's world-leading public sector RDI organisations and infrastructure

The UK has a rich heritage of research and science performed by the public sector. This constellation of public sector RDI organisations (for example, Public Sector Research Establishments and UKRI-owned institutes) and our world-leading RDI infrastructure base is a vital part of the UK's organisational RDI landscape. These organisations vary in their funding models, governance and structures, and deliver a wide range of missions. This ranges from providing critical national capabilities such as the Defence Science and Technology Laboratory, having a long-term focus in a particular field of fundamental or applied research such as the Laboratory of Molecular Biology, maintaining rich collections and archives such as the British Library, or providing capabilities for the RDI system such as the ISIS Neutron and Muon Source.

As part of the Research and Innovation Intelligence capability described in Chapter 1A, government is deploying an evidence-based process to assess the UK's national science capabilities, strengths, weaknesses and emerging opportunities. This assessment may mean

[4] UK Research and Innovation (2023) 'UKRI Cross Research Council Responsive Mode Pilot Scheme'. Available from: https://www.ukri.org/opportunity/ukri-cross-research-council-responsive-mode-pilot-scheme/ [accessed on 13 November 2023]

additional organisations are required to fill a strategic capability gap, for others it may require a review of organisational goals in light of progress made or scientific advances.

Innovative public sector RDI organisational models: Centres of Research Excellence (CoRE)

UKRI's Medical Research Council (MRC) is building on the best features of MRC Units and Centres to give them more flexibility, reduce bureaucracy and enhance partnership opportunities. The new format – MRC CoRE – which will replace the existing unit model, will focus on challenge-led research, which is distinct, disruptive and interdisciplinary, with the potential to be transformative to biomedical research, health research or both within 14 years. There will be just one review point and an expectation of leverage of significant additional investment and partnership with academics and industry. The existing MRC unit portfolio will have the opportunity to transition into this new format alongside consideration of new ideas, through a competitive process seeking to establish 30-40 CoREs over the next decade.

To deliver on the ambitions of the S&T Framework and cement the UK's place as a science and technology superpower, enhancing and unleashing the capabilities of our physical and digital RDI infrastructure and public sector RDI organisations must be an integral part of the plan.

Responsibility for public sector RDI has become widely dispersed across UKRI and government departments. With the creation of the DSIT, there is now a dedicated government department to champion public sector RDI organisations, which range from UKRI institutes to PSREs.

The Review recognised that in recent decades the UK's public sector research capacity has reduced in a trajectory which is out of step with our international comparators. Government therefore commits to reassessing the position of public sector RDI organisations in the overall picture of the UK's national research capability.

PSREs are a unique group within the public sector landscape of RDI organisations. From the National Physical Laboratory to the UK Health Security Agency, PSREs deliver science and research for public good, advise government and ensure that the UK can lead and keep pace with the speed of technological change. Many of them play a vital role in critical infrastructure and public safety, giving the UK strategic and sovereign control through directed research. It is important that they continue to work closely with sponsor departments and across government. The government's ambition is to support organisations to achieve their full potential in delivering the UK's RDI priorities as well as to realise their economic value and to support levelling up. To achieve this ambition, government will:

i) Clarify the role of public sector RDI organisations in meeting key national science and technology needs

Research organisations in the public sector are in a unique position to lead the way in delivering the government's science and technology priorities. Government is assessing the UK's national S&T capability and identifying gaps. We will work with public sector RDI organisations to ensure their missions meet key national S&T capability needs while supporting departmental investment decisions.

Departments and their sponsored PSREs have already taken great strides to maximise and leverage research capabilities. For example, the Ministry of Defence have improved how research is commissioned by the Defence and Science Technology Laboratory to ensure it is aligned with the departmental strategy and is delivering benefit for the UK. The Department for Energy Security and Net Zero and the UK Atomic Energy Authority (UKAEA) are working closely to develop a robust plan to outline how the UKAEA will deliver key government objectives, including a commercial fusion power station by 2040.

The Advanced Quantum Metrology Laboratories at the National Physical Laboratory, Teddington. Image courtesy of NPL.

Missions will be underpinned by measurable objectives that are agreed and regularly reviewed by the sponsor department and their PSREs. In the longer term, the government will ensure each department has in place a clear and robust long-term plan developed in partnership with their PSREs to deliver their missions and articulate their role in supporting wider departmental

and HMG priorities. The sponsorship role will be used to provide support and drive increased effectiveness. In 2022, the PSRE Value Framework published by GO-Science provided a set of common principles to support departments in assessing the value and performance of the PSREs they sponsor and gave departments a blueprint on how to use their PSREs to deliver the science capability needed by the department and wider government.[5]

Research Institutes are a key part of the UK RDI landscape, whose missions deliver across the research spectrum. UKRI's research councils work with their institutes on delivering their missions, which tend to be specific to their particular area of specialism in RDI. Some UKRI institutes provide core national capability for the UK, such as NERC's British Geological Survey.

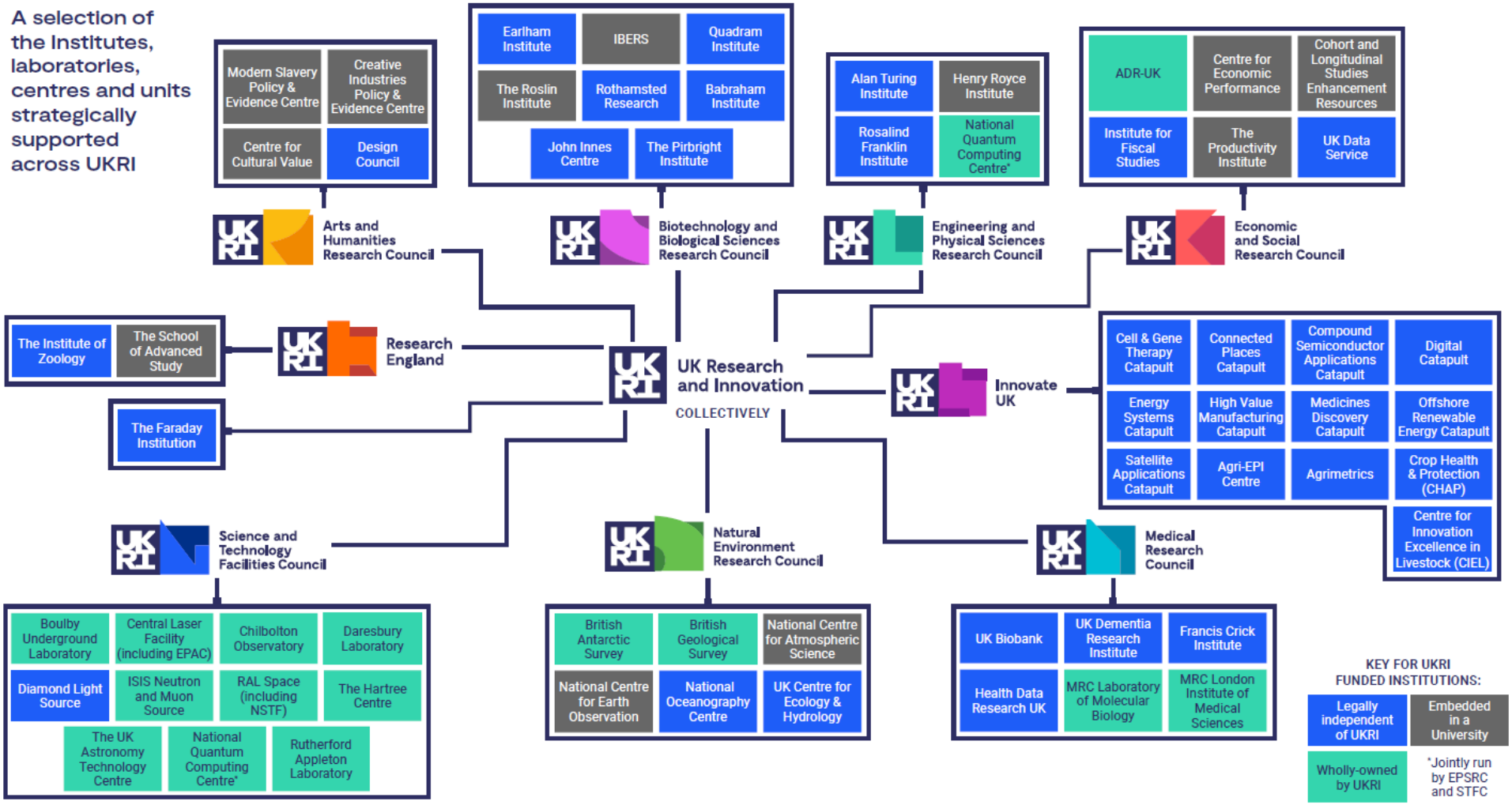
There is a wide diversity of operating models within UKRI institutes. This diversity allows the form of the institute to be tailored to the organisation's function. For instance, a more distributive operating model may enable an institute to support wider government strategic missions such as levelling up, by enabling adoption of knowledge and skills across the country.

ii) Improve public sector RDI organisations' operational environment, strengthening their ability to deliver their missions and respond to emerging national science and technology needs

Public sector RDI organisations must have the agility to respond to emerging national science and technology needs. The Review identified significant operational barriers preventing PSREs working effectively within government and realising their potential. Considerable progress in RDI could come from projects at the intersection of different disciplines and organisations supporting different departmental missions and we want to unleash this potential.

Government will continue to work with PSREs to consider sustainable funding solutions and ways to reduce barriers to collaboration. It will explore how we can better facilitate more interdisciplinary projects between PSREs, institutes and government departments, including where these make use of our research infrastructure. As mentioned below, DSIT will shortly be launching a further round of a fund worth £25 million for Research and Innovation Organisations, including PSREs, across the UK to provide funding for core small and medium-scale research infrastructure. The Review highlighted a specific issue regarding barriers for PSREs applying for and winning grants awarded by other government departments and organisations, particularly UKRI, given grants are funded at less than 100% of the full Economic Costs. We will explore how barriers to collaboration between PSREs and other government organisations can be reduced. This will include exploring whether providing a source of co-funding to PSREs which conduct significant in-house research will better enable them to bid for and complete UKRI grant based research, where that research is funded at less than full Economic Cost.

[5] Government Office for Science (2022) 'Public Sector Research Establishment Value Framework'. Available from: https://www.gov.uk/government/publications/public-sector-research-establishment-value-framework [Accessed 13 November 2023]



UKRI-supported institutes, laboratories, centres and units[6]

[6] UKRI (2023) 'UKRI-supported institutes, laboratories, centres and units'. Available from: https://www.ukri.org/publications/ukri-supported-institutes-laboratories-centres-and-units/ [last accessed 13 November 2023]

iii) Raising visibility and understanding of the critical contribution of public sector research capability across government, academia and industry

The government agrees with the Review that more can be done to promote public sector RDI organisations capabilities and enable them to collaborate on research.

Amplifying the role of PSREs across government and externally will be a key element of DSIT's agenda to deliver on our science and technology ambitions. To support this, government will produce a guide for working with PSREs that will assist departments, institutions and industry in better understanding what PSREs are as well as the benefits of working with them.

To celebrate these jewels in the crown of the UK RDI landscape, government will host an annual PSRE Day to showcase the work of PSREs, promote collaboration and raise the profile of their important work across government and Parliament.

PSREs and their sponsor departments are already moving forward with measures to publicise the range of PSRE capabilities and how links can be increased across the public sector and with industry. DSIT and the Department for Energy Security and Net Zero are trialling a series of showcase events to promote the National Nuclear Laboratory across government.

UKRI provides strategic core funding to many public sector RDI organisations, as well as funding a wide variety of research performing organisations. This includes over 60 institutes, Innovate UK's Catapults and research infrastructure across the UK, spending £2,875 million over this Spending Review period. To help increase visibility and understanding of the organisations it funds, UKRI published its Institute Explainer and continues to raise the profile of the wide range of research missions and activities of its Institutes.[7] Many of the strategically supported institutes are wholly owned by UKRI, but others are legally independent, and some are embedded within universities. As referred to in Chapter 1C, government is committed to gathering regular high-quality evidence and mapping into routine practice.

iv) Building a world-class public research workforce and improving the evidence base of RDI workforce challenges

Maintaining and expanding our public sector science capability depends on attracting and retaining a talented R&D workforce within the public sector. Our PSREs alone employ 17,000 scientists, delivering strategic national RDI priorities. Our ambition is to ensure that careers in public sector research are attractive to a new generation. PSREs and UKRI institutes have put in place comprehensive graduate and degree apprenticeship schemes to develop their talent pipeline and so that existing institutional knowledge and skills can be shared. This highly talented workforce is central to the UK staying ahead of its competition. Particularly at a time when national and personal finances are strained, this must be achieved while obtaining

[7] UK Research and Innovation (2023) 'Explainer: How UKRI's Institutes support Research and Innovation.' Available from: https://www.ukri.org/publications/explainer-ukris-institutes/explainer-how-ukris-institutes-support-research-and-innovation/ [Accessed on 13 November 2023]

maximum value for money for UK taxpayers. This section addresses specific issues related to the public sector workforce whereas RDI talent as a whole is addressed in Chapter 2B.

The Review noted the impact of government pay controls on recruitment and retention of our public sector R&D workforce. Pay setting arrangements for the Civil Service, including some employees in public sector RDI organisations are set out in the annual pay remit guidance.[8] This guidance sets out the balance between ensuring that government is attracting the best and brightest to work for the Civil Service and rewarding hard-working staff fairly, while ensuring the sustainability of public finances, delivering value for money for taxpayers and considering economic conditions. Organisations must consider recruitment and retention and ensure public money is put to the best possible use in the most efficient way. The guidance currently provides many freedoms for public sector RDI organisations to address further recruitment and retention issues, subject to a business case. One way of doing this is for organisations to create recruitment and retention allowances to support swings in the market rate for RDI workers. Business cases are robustly assessed to ensure sustainability of public finances and deliver value for money for taxpayers.

Public sector scientist working in the Forest Research Tree Health mobile field laboratory in July 2022. Image courtesy of Forest Research.

[8] Cabinet Office (2023) 'Civil Service Pay Remit Guidance, 2023 to 2024'. Available from https://www.gov.uk/government/publications/civil-service-pay-remit-guidance-2023-to-2024/civil-service-pay-remit-guidance-2023-to-2024#:~:text=1.-,Scope%20and%20purpose%20of%20the%20pay%20remit%20guidance,and%20other%20arm's%20length%20bodies [Accessed on 13 November 2023].

Government recognises that some public sector RDI organisations face immediate challenges as they compete for rare skillsets and the brightest minds. We have identified from initial evidence that some of our public sector RDI organisations experience R&D workforce challenges in specific fields and seniority levels. Building a full picture of the nature of these pressures is an important step to forming a targeted and effective approach. Government will continue to work with the sector to improve the evidence base of RDI workforce challenges, drawing on robust quantitative data, for us to explore the merits of supporting further flexibilities for the sector. The Government Science and Engineering (GSE) Profession is also exploring options to increase skills retention, skills capability and attraction through appropriate reward options. This includes establishing best practice approaches to reward across the profession, with a diverse range of critical roles / skills in scope. Implementation will remain with departments and they will be encouraged to use the best practice guidance for their core and partner organisations.

v) A strategic approach to physical and digital RDI infrastructure that builds upon the UK's RDI strengths

Research, development and innovation infrastructure are facilities, resources and services that are used across the RDI landscape to conduct research and foster innovation in their fields. They have a key role in developing and creating clusters of excellence where co-located public and private activity can amplify innovation, investment and growth. They include major scientific equipment and facilities such as Diamond Light Source, the UK's national synchrotron, which produces intense beams of light enabling researchers to study anything from new medicines and viruses to jet engines. They also include knowledge-based resources, collections, archives and scientific data assets, such as UK Biobank, the world's most significant source of data and biological samples for health research. Infrastructure is critical to all RDI sectors, from the physical, environmental and life sciences, to the arts and humanities and social sciences, and is a key part of cementing UK's place as a science and technology superpower as set out in the S&T Framework.

We are investing in RDI infrastructure across disciplines: the Convergent Screen Technologies and performance in Realtime (CoSTAR) programme

UKRI's CoSTAR programme is setting up four new state-of-the-art research and development facilities, including one at Pinewood Studios. These will drive the next generation of screen technology and on-set virtual production and will be designed to establish national infrastructure for multidisciplinary applied creative RDI. This is supported by £75.6 million of UKRI investment and £63 million from industry. It is expected to create more than 820 new jobs across the UK.

The government agrees with the Review on the importance of physical and digital RDI infrastructure to RDI in the UK and the need to maximise the benefits of investment. The government has a key role in taking decisions on the policy and financial frameworks which influence the makeup of RDI infrastructure, and in long-term planning which sets clear direction while respecting organisations' operational independence.

Polar infrastructure: RSS Sir David Attenborough, supported by UKRI's Natural Environment Research Council. Image courtesy of UKRI.

Working with stakeholders and the research community, DSIT is developing a long-term national plan for RDI infrastructure that will set out our domestic and international priorities, address challenges in accessing RDI infrastructure, and aim to foster greater participation and collaboration across different users in the RDI landscape. We are already engaging UKRI and other stakeholders on the development of this plan. Setting out a plan for the next 10 years will provide resilience in the landscape, support our priority technology choices and provide long-term assurance to our facilities as they seek to answer some of the biggest questions in science and technology. To inform this long-term approach, we are developing a framework of consistent metrics that measure the impact of investment in RDI infrastructure domestically and overseas.

We are already maintaining our cutting-edge RDI infrastructure and capabilities by investing £593 million in 2023/24 (rising to £625 million in 2024/25) through UKRI's research councils and Research England as part of the World Class Labs programme. This is in addition to a £481 million investment in major RDI infrastructure through the UKRI Infrastructure Fund. The Infrastructure Fund portfolio includes investments in UK Biobank,[9] the RICHeS state-of-the-art national infrastructure for the heritage sector,[10] and the world's most powerful laser facility, Vulcan 20-20.[11] This year, DSIT is piloting a Policy Framework to overlay consideration of

[9] UKRI (2023) 'UK Biobank in £127.6m move to Manchester Science Park'. Available from: https://www.ukri.org/news/uk-biobank-in-127-6m-move-to-manchester-science-park/ [Accessed on 13 November 2023]
[10] UKRI (2023) 'UK's creative industries benefit from significant funding boost'. Available from: https://www.ukri.org/news/uks-creative-industries-benefit-from-significant-funding-boost/ [Accessed on 13 November 2023]
[11] UKRI (2023) 'UK science facility receives £85m for world's most powerful laser'. Available from: https://www.ukri.org/news/uk-science-facility-receives-85m-for-worlds-most-powerful-laser/ [Accessed on 13 November 2023]

government priorities with Infrastructure Fund investment decisions, facilitating the assessment of bids against broader strategic drivers, alongside project and portfolio considerations.

Strategic approaches to prioritising RDI infrastructure investments: the UKRI Infrastructure Advisory Committee

A new strategic approach is already being applied to decision-making on research infrastructure investment. DSIT is currently piloting a policy framework that provides strategic guidance on government priorities on large investment allocation on infrastructure.

The Infrastructure Fund was established as a cross-cutting fund to enable UKRI to take a long-term portfolio approach to the prioritisation of major research and innovation infrastructure projects, addressing House of Lords and NAO recommendations for research capital investment prioritisation. It supports time bound activity to develop new infrastructure, significant upgrades or decommissioning costs.

UKRI's Infrastructure Advisory Committee (IAC) is an independent expert committee responsible for evaluating and prioritising investment options submitted to the Infrastructure Fund. It takes a comprehensive portfolio approach to UKRI infrastructure, maximising the value of our investments in research infrastructure. The policy framework sets out government priorities for the IAC to consider when making infrastructure investment decisions.

The government has announced game-changing investments in the UK's world-leading compute capacity. Edinburgh will host the UK's next-generation exascale supercomputer, 50 times more powerful than our current top-end compute system. Working with UKRI, government has also invested £300 million in a dedicated AI Research Resource (AIRR) at the Universities of Bristol and Cambridge. Alongside the establishment of the AI Safety Institute, this will allow the UK to maximise the benefits of AI and data while supporting critical work into frontier risk mitigation and the potential and safe use of the technology.

RDI infrastructure also underpins critical capabilities in our PSREs, other public sector RDI organisations and the wider system. Last year, the Department for Business, Energy & Industrial Strategy (BEIS)/DSIT ran a £31 million pilot competition to fund small and medium-scale research infrastructure in PSREs. Successful bids included high performance compute capability for Bioinformatics Scotland, high-end lab equipment such as mass spectrometers for the Royal Botanical Gardens Kew and equipment to assist the digitisation of collections at the Natural History Museum. Following the success of this pilot, we will shortly be launching a further round of this fund worth £25 million, expanding the scope to all research and innovation organisations across the UK.

The Square Kilometre Array Observatory global headquarters, Cheshire. Supported by UKRI's Science and Technology Facilities Council. Photo credited to SKAO.

Some infrastructure is too big in scale and scope or broad in geographic reach to be developed by any one country alone. The government agrees with the Review on the importance of international RDI infrastructure to science and innovation communities across the world and in the UK. Global collaboration on RDI infrastructure keeps the UK at the forefront of global science, establishes enduring international partnerships, opens up opportunities for UK industry and provides our researchers with access to world-leading capabilities and training not achievable by individual countries alone.

We will strategically invest in important international RDI infrastructure which sustains the UK's scientific edge. Through UKRI, the UK already invests more than £300 million annually in major international infrastructure such as CERN (European Organization for Nuclear Research), the European Molecular Biology Laboratory (EMBL) and the Square Kilometre Array Observatory (SKAO). We will ensure decisions on our long-term infrastructure portfolio are made strategically, considering future UK research needs, investing alongside our global science partners and maximise the benefit of that investment.

In October 2023, the UK Strategy for Engagement with CERN was launched by the Secretary of State for Science, Innovation and Technology. The strategy sets out our ambition to maximise the benefits of investment in CERN over the next ten years, across a number of measures. Our vision is to unlock the full potential of our investment in CERN and remain central to its continued success by working with our partners to lead scientific discovery and inspire the next generation. Whilst this strategy is targeted at CERN, it reflects the strategic thinking that we will apply across the entire international RDI infrastructure portfolio in which the UK participates, ensuring we maximise every opportunity and realise the full potential that arises from our memberships.

We also agree with the Review on the great value for the UK in leading and hosting international RDI infrastructure. We already host the headquarters of SKAO at Jodrell Bank near Manchester and the EMBL European Bioinformatics Institute (EBI) near Cambridge. EBI stores, shares and analyses data produced by life scientists all over the world, including providing access to AlphaFold's AI protein structure predictions in collaboration with DeepMind. It also operates valuable research and training programmes and has established significant industry partnerships, such as the EMBL-EBI Agri-Tech Consortium aimed at responding to global food security challenges.

As set out in the S&T Framework, we will pursue opportunities to host new international RDI infrastructure, including those funded by Horizon Europe. This will attract inward investment and talent and open up opportunities for UK industry. We will work with global partners through groups like the G7-mandated Group of Senior Officials on Global Research Infrastructures (GSO:GRI) to facilitate planning, coordination and information sharing on infrastructure investments.

Commitments:

Government will reassess the position of public sector RDI organisations in the overall picture of the UK's national research capability through the following commitments.

We will:

Optimise the role of public sector RDI organisations in meeting key national science and technology needs by:

- Developing an assessment of cross-government S&T capability needs and review with departments on an annual basis.
- Working with sponsor departments to set long-term PSRE science missions and plan the capabilities needed to deliver them.

Improve public sector RDI organisations' operational environment, strengthening their ability to deliver their missions and respond to emerging national science and technology needs by:

- Exploring how barriers to collaboration between PSREs and other government organisations can be reduced.
- Exploring a sustainable source of funding for PSREs to support them undertaking UKRI grant based research funded at less than full Economic Cost.
- Committing to reducing the UKRI bureaucracy burdens on PSREs, consistent with the government's Response to the Review of Research Bureaucracy.

Raise visibility and understanding of the critical contribution of public sector research capability across government, academia and industry by:

- Publishing guidance for working with PSREs aimed at government departments, universities, businesses and institutions.
- Raising awareness of these unique capabilities across government and beyond in partnership with the Chief Scientific Advisers (CSA) network and by delivering an annual PSRE day.

Building a world-class public research workforce and improving the evidence base of RDI workforce challenges by:

- Continuing to work with the sector to improve the evidence base of RDI workforce challenges within public sector RDI organisations, drawing on robust quantitative data, for us to explore the merits of supporting further flexibilities for the sector.

- Increasing the profile of PSRE and UKRI graduate and degree apprenticeship schemes, and exploring a joint postgraduate scheme across PSREs.
- Establishing a best practice approach (developed by the GSE Profession) to support recruitment and retention of talent.

Take a strategic approach to **physical and digital RDI infrastructure** that builds upon the UK's RDI strengths by:

- Publishing the UK government's long-term national plan for RDI infrastructure, establishing our ambition and strategic priorities, and provide confidence by setting long-term direction.
- Developing a framework of consistent metrics that measure the impact of investment in RDI infrastructure domestically and overseas.
- Launching a further £25 million funding round to provide core small and medium-scale research infrastructure, expanding the scope from PSREs in the pilot last year to all Research and Innovation Organisations.
- Implementing the five goals of the UK Strategy for Engagement with CERN over the next decade, working with all members of the UK CERN community.
- Pursuing opportunities to host new international RDI infrastructure in the UK, including RDI infrastructure supported by Horizon, to benefit from inward investment, talent exchange and reaffirm the UK as a global RDI infrastructure leader.

1C) Taking an evidence-based, data-driven approach to evolving our RDI landscape

Government agrees with Sir Paul that all funders and research organisations should make decisions based upon a comprehensive understanding of the RDI landscape. Government will improve its understanding of 'what works' when funding research organisations or collaborating across disciplines. More consistent use of data, evidence and analysis of UK RDI capacity and capabilities will guide government decisions on evolving the landscape to enable the organisations within it to work more effectively. While increasing funding for RDI, a data-driven approach will also ensure that government investment is more effectively targeted.

i) Metascience

Investing in RDI is vital to the UK's economic growth and prosperity. However, it is not just the quantity of that investment that matters but also the quality. How research is funded is critical to accelerating scientific breakthroughs and innovations. There is a growing global 'metascience' movement, where researchers are turning the lens of scientific inquiry to the practice and funding of science itself, with the aim of improving the effectiveness of our RDI systems.

To support this, government is creating a new metascience unit. The unit will be jointly run across DSIT and UKRI, with an initial funding commitment of £10 million. The unit will deliver a

competitive grants programme to support research collaborations that increase our national and global understanding of questions like: What makes a researcher more likely to make bold discoveries? How do we best incentivise replicable research? And how will the jobs of scientists change in light of technological progress, such as the rise of AI? The unit will also conduct experiments to test and robustly evaluate the effectiveness of changes in the funding processes delivered by UKRI. Joint governance of the unit across DSIT and UKRI will ensure that the metascience evidence base produced through the programme is relevant to, and can directly support, both policymaking and the delivery of public R&D funding.

ii) Regular mapping and analysis of the capability, funding and impact of RDI intensive organisations

The Review highlighted that there is no single comprehensive picture of UK RDI capability. Government recognises that gap and will ensure we develop a more comprehensive understanding and mapping of the UK's RDI landscape nationally and across the UK's regional clusters of RDI excellence.

Understanding the organisations and spread of investment across the UK research landscape is a continuous endeavour and fundamental to the success of our metascience plans and to better coordinate and direct public sector spending on RDI. This is why we are embedding mechanisms to improve understanding into DSIT's core mission – particularly around impact and outcomes – of the UK's RDI organisational landscape. Through the S&T Framework, more empirical tracking of metrics will allow government to assess success.

This will include more comprehensive mapping of public sector science activity and impact so that we better understand where public money is being spent on science and the impact it is having. We will particularly focus on where public investment is working alongside private sector investment and activity to create and grow clusters of RDI excellence across the UK. Mapping will reflect each administration's competencies. For instance, the Scottish Government will support the priority areas set out in their Innovation Strategy through nurturing the development of successful Innovation Clusters. A systematic approach will be taken to the identification, evaluation and growth of priority Scottish clusters that will promote excellence and encourage best practice.

An important part of this will include government curating more comprehensive data and its analysis to inform strategic long-term decision-making. This means better coordination of data collection and new ways to use and visualise all data collected on our RDI investments. A key feature of this will be a reduction in duplicate requests for information through a single source of consistent information for all RDI investments across areas such as institutions, talent, infrastructure, critical technologies and innovation.

Ultimately, decision makers must be equipped with enhanced data, evidence and analysis. This lays the foundations for strategic and evidence-informed choices about the organisations that underpin the UK's national research capability.

Commitments:

The government will:

- Establish a joint metascience unit spanning DSIT and UKRI, with an initial funding commitment of £10 million.
- Gather regular high-quality evidence and mapping into routine practice.

Chapter 2: Resilient

Our objectives

Government recognises that RDI organisations have been facing various challenges to their resilience. This includes their long-term financial sustainability, ready access to talent and uncertainty surrounding association with Horizon Europe. Tackling these challenges and building a resilient environment is essential for all organisations to thrive.

To prepare for the future, the government will make changes to enhance the resilience and strength of the RDI landscape and the organisations that operate within it. That means addressing the financial sustainability of the system and ensuring access to the best talent in the world.

2A) Assessing financial sustainability

The government agrees with the Review that our objectives for the funding system should be to optimise research performance, remove perverse incentives and ensure the long-term financial sustainability of organisations in the sector. The government commits to increasing its understanding of the challenges facing the sector, with stronger joint working between DfE and DSIT – as government departments with elements of responsibility for universities – as well as devolved administrations and funders of RDI. Any changes to the funding framework for research, as recommended by the Review, will need to be considered in the context of a future Spending Review.

i) Risks to the financial sustainability of the research system

The Review highlighted that there are clear risks to the financial sustainability of the UK research system. Enhancing the resilience of our system presents significant opportunities to ensure the UK can continue to produce world-leading RDI, be on the front foot in responding quickly to exciting new opportunities and withstand external shocks. The system is complex – featuring a range of different organisations with public, private and philanthropic sources of funding – meaning there are several factors impacting the financial sustainability of different organisations. Consequently, an unsustainable system could eventually create localised failures that result in wider detrimental impacts to critical national capabilities. It may also

create systemic failures that would significantly decrease the quantity and quality of research overall. Both of these would require major, costly interventions to fix. The government views financial sustainability as a necessary enabler of both long-term efficiency and the government's ambition to cement the UK's place as a science and technology superpower.

Universities play a unique and important role in delivering high-quality RDI across the UK. They are significant recipients of public funding for research but are also partners with the government in the development of the research system. There is considerable investment in research projects in universities with the expectation that universities will co-invest from their own funds, an expectation which is borne out by the mission of many universities and their consequent investment strategies. Over the years universities have increased their own funding of research; this emphasises that universities are not contract research organisations for the government but are significant actors in their own right in the RDI system.

The Office for Students (OfS) has a statutory duty to monitor and report on the financial sustainability of the higher education providers it regulates in England, with equivalent responsibilities undertaken by funding bodies in the UK government and the devolved administrations. In the OfS' most recent report on financial sustainability, they note that the short-term viability of most providers is not currently a concern, but there is "an increasing financial sustainability risk for some providers in the longer-term, particularly if multiple risks materialise at the same time."[12]

The government recognises the pressures facing UK universities and other important research performing organisations, including from increased inflation and a higher cost of borrowing in the immediate term. Many universities have significant debt burdens. On average, external borrowing as a percentage of total income for the wider university sector is not inherently concerning (average of 29.5% for UK higher education providers in 2021/22),[13] however larger research-intensive universities have a higher level of borrowing-to-income than larger teaching-intensive universities (~15 percentage points in English universities) and are therefore more vulnerable to interest rate increases.[14]

It is a strength of the UK that our universities can attract students from across the world, many of whom are part of our talented researcher workforce. However, UK universities have a significant vulnerability to potential disruptions of international student supply. A significant proportion of UK Higher Education Provider income (21.3% in 2021/22) comes from international students, and international fee income is increasingly used to support our world-class research.[15] 2021/22 student record data indicates that Chinese students account for approximately 22.3% of all overseas students. A further 18.6% of overseas students were from

[12] Office for Students (2023) 'Financial sustainability of higher education providers in England – 2023 Update'. Available from: https://www.officeforstudents.org.uk/publications/financial-sustainability-of-higher-education-providers-in-england-2023-update/ [Accessed on 13 November 2023]
[13] HESA (2023) 'Key Financial Indicators'. Available from: https://www.hesa.ac.uk/data-and-analysis/finances/kfi [Accessed on 13 November 2023]
[14] Office For Students (2023) 'Financial sustainability of higher education providers in England – 2023 Update', p 30. Available from: https://www.officeforstudents.org.uk/publications/financial-sustainability-of-higher-education-providers-in-england-2023-update/ [Accessed on 13 November 2023]
[15] HESA (2023) Available from: https://www.hesa.ac.uk/data-and-analysis [Accessed on 13 November 2023]

India, 3.4% from the United States, 2.6% from Hong Kong, 1.8% from Malaysia and 6.5% from Nigeria.[16] As the Review noted, this reliance on students from specific domiciles (with China and Hong Kong together making up 24.9%) makes the financial sustainability of the sector vulnerable to potential geopolitical or foreign-domestic developments.

Other concerns within the research sector include the sustainability of pension schemes, the need for investment in facilities and industrial relations. If organisations are not financially sustainable for the long term this could impact their ability to carry out high-quality RDI.

Whilst most publicly funded research in the UK is carried out by universities, the system is highly complex with a wide range of actors who all have their own drivers, incentives and funding mechanisms. These actors – from research institutes, PSREs and other research performing organisations, to a wide range of funders such as businesses, charities, government departments and the devolved administrations – need to be factored into any consideration of the sustainability of research. As we seek to diversify the organisational landscape, our understanding of the sustainability of the system will need to evolve.

As autonomous institutions take decisions to manage these risks, they may choose to scale back plans to invest in research. Individual organisations could also close research hubs or scientific infrastructure. There is also a chance that individual organisations which are more vulnerable and who either cannot or do not make efficiency savings might be forced to close. While the government has not been presented with evidence of these risks materialising at present, many of these possible scenarios risk the UK losing critical expertise or infrastructure.

It will be important for government, UKRI, devolved administrations, other funders and the sector to work together to understand and distinguish between the different risks: short-term pressures, long-term structural problems, and unanticipated shocks and discontinuities. These all affect the overall resilience of the system, but each will impact on institutional risk appetite in different ways. More sophisticated joint work is required to increase our understanding of these issues, for example, on the likelihood of research-intensive institutions significantly deprioritising research into areas of UK strategic advantage.

ii) Examining the current funding framework

The government notes the discussion in the Review about the policy of paying 80% full Economic Cost (fEC) on research grants. The implementation of the full Economic Cost arrangements in 2007 made clear that universities were expected to make choices over which projects they bid for, and chose to invest in themselves, contributing 20% of the full costs of the projects. In turn the government recognised that another stream of public funding, Quality-related Research (QR) Funding, should go to universities to support their own choice of new research directions, in addition to the choices of the government and research councils, and to help them in making decisions about the projects they should bid for from the research councils, charities and other funders. This ‘Dual Support’ system was codified in the Higher

[16] Overseas students include all non-UK domiciled students.

Education and Research Act 2017 and was intended to support a sustainable research system balanced with encouraging efficiencies across the sector.

Any restructuring of this research funding settlement would come with significant trade-offs. For example, uprating the fEC rate would likely either result in government procuring a smaller amount of research directly, or result in a shift in the balance of dual support away from QR. The government will work with the devolved administrations and the sector to identify the best path forward to achieve our mutual goals of optimising research delivery, removing perverse incentives and ensuring long-term financial sustainability. The government is aware, however, that there is a disparity between current fEC policy at 80% and the reported cost recovery rate on TRAC for UK institutions (68.7% in 2021/22).[17] UKRI is currently investigating the causes of this disparity and the government will consider the findings in due course.

Improving our understanding of financial sustainability within the RDI system: UKRI financial sustainability analysis[18]

UKRI has been building understanding on the financial sustainability of the research landscape using systems-thinking, quantitative analysis and through engagement with the sector. The work demonstrates the interconnectedness between research, teaching, knowledge exchange and innovation. This analysis shows the value of the UK's dual support system and the role that both un-hypothecated funding and project-specific funding play in supporting a resilient research endeavour. UKRI has published some of the data and analysis it has collated to demonstrate how research organisations are funded and the financial sustainability risks and pressures they face. Sharing this analysis is intended to prompt further discussion between government, UKRI and the sector on this topic.

Alongside this, the government is committed to an evidence-based examination of the current funding framework for research in universities, research institutes and other research performing organisations and will incorporate this improved evidence into its Spending Review planning. It is essential that we consider the funding system as a whole across a variety of organisation types and incentives to avoid unintended consequences. This will build on existing strands of activity and stakeholder discussions, including with the third sector. For example, Research England is initiating a review of its approach to strategic institutional research funding in 2023.

[17] Office for Students (2023) 'TRAC data' Available from: https://www.officeforstudents.org.uk/data-and-analysis/trac-data/published-data-2021-22/ [Accessed on 13 November 2023]; Office for Students (2023) 'TRAC data'. Available from: https://www.officeforstudents.org.uk/data-and-analysis/trac-data/published-data-2021-22/ [Accessed on 13 November 2023]

[18] UKRI (2023) 'Research financial sustainability data' https://www.ukri.org/publications/research-financial-sustainability-data/

iii) Assurance and Accountability Mechanisms in QR Funding

The government agrees with the Review that the mechanisms surrounding QR funding are not fully understood by some within the sector and welcomes the opportunity to lay out clearly the current assurance framework.

UK universities receive strategic institutional funding from Research England, Department for the Economy Northern Ireland, Higher Education Funding Council for Wales and Scottish Funding Council to support research and knowledge exchange activities as part of the dual support funding system. Across each administration, this un-hypothecated funding is for research or research-related activities while individual spending decisions are driven by the strategic priorities of universities. Strategic institutional funding is essential to provide a stable foundation for long-term RDI in universities.

Research England currently provides almost £2 billion of QR funding to universities in England each academic year.[19] There is a robust assurance framework for QR, which is primarily based on regular national assessment of institutions' research quality through the Research Excellence Framework (REF). The REF provides assurance and accountability for government that the university research system is sustainably producing excellent, impactful research. In this way, the REF is a crucial feature of the assurance environment for university research. Any changes to the accountability regime for QR must be viewed in the context of the overall purpose and burden of the REF exercise itself.

In Scotland, the Scottish Funding Council has begun a programme of co-development with the sector to introduce new, more frequent, research accountability and assurance processes from AY24/25. In Wales, the Higher Education Funding Council for Wales has recently revised its QR allocation methodology to ensure that it is more focussed on increasing the quality of research. In Northern Ireland, the Department for the Economy is currently working to develop Outcome Agreements (OAs) in 2024/25 to provide increased accountability for public funding. Research England is currently undertaking a programme of work to improve the transparency around the uses and effectiveness of strategic institutional research funding. This work will include engaging with universities. As discussed above, Research England anticipate being able to work with the sector to pilot a variety of possible new approaches to transparency from 2025 before agreeing and implementing any final frameworks.

Commitments:

The government will:

- Examine the current funding framework for research in universities, research institutes and other research performing organisations and incorporate the evidence from this work and from the Review into its Spending Review planning.
- Engage widely with the sector on the financial sustainability of research.

[19] Research England (2023). 'Research England grant allocations 2022 to 2023.' Available from: https://www.ukri.org/publications/research-england-grant-allocations-2022-to-2023/ [Accessed on 13 November 2023]

- In England, through Research England initiate a review of the approach to strategic institutional research funding within the context of the broader research funding ecosystem. This will include building the evidence base to clarify the purpose and value of this funding stream and reviewing the effectiveness of current research funding streams.

2B) Securing the world's best talent

The government agrees with the Review that UK RDI organisations need access to a large and varied base of skilled, technical and entrepreneurial talent. RDI organisations and the landscape need to be resilient to changes in the workforce and wider economy, with a steady supply of individuals with the right skills to carry out high-quality, innovative research in a diversity of research settings. To attract and retain talent, government and the sector need to support individuals from across society to develop careers in RDI and develop mechanisms for them to move between roles across the landscape. The reputation of our world-leading institutions is a key factor in convincing talent to come to the UK, and the measures in this response aim to secure that reputation for the long term. However, reputation is not the only factor. The UK also needs to foster an inclusive, diverse and productive RDI workforce and working environment – in order to remain a great place to live and work. This includes having a navigable immigration system, enabling individuals to focus on research and supporting a diversity of clear career pathways within and between RDI institutions.

i) Attracting global talent

The global race for talent in science, innovation and technology is fiercely competitive. This is particularly true for the highly mobile and specialised talent which our RDI organisations need to enable them to undertake long-term research. The government aims to make the UK the best place in the world for scientists, innovators and entrepreneurs to live and work.

As set out in the S&T Framework, by 2030 the UK will establish a clear competitive advantage in attracting international talent to the UK. We will ensure this approach meet the needs of our RDI organisations, building their resilience for the long term.

Our high-skilled visa system enables UK based research projects to directly hire the talent they need. This includes the flagship Global Talent visa which provides a fast-track pathway for highly skilled individuals.[20] The GREAT Talent campaign promotes and showcases the strengths of the UK's RDI sector. It aims to inspire, inform and attract highly skilled international talent, providing key information about living, working and locating to the UK.[21] We will make it easier for innovative UK science and technology businesses to offer internships and research placements to talented AI researchers in their early careers, by

[20] Home Office (2023) 'Apply for the Global Talent visa'. Available from: https://www.gov.uk/global-talent [Accessed on 13 November 2023]
[21] Research and development (R&D) support in the UK (2023). Available from: https://www.great.gov.uk/international/content/investment/how-we-can-help/research-and-development-rd-support-in-the-uk/ [Accessed on 17 November 2023]

establishing a new dedicated visa scheme for temporary workers. It will give emerging AI talent from around the world the experience of living and working in the UK, enabling them to build networks and connections, and encouraging them to anchor their careers here.

The government is committed to ensuring the UK's wider immigration system supports economic growth and that we remain a world leader at attracting and retaining top researchers, scientists and innovators. Implementation of the S&T Framework will ensure we can focus on securing the highly skilled talent – from technicians, engineers, researchers to clinicians – for RDI organisations across the landscape.

ii) Supporting talent through fellowships

The government supports research talent to build and develop a career in and between RDI organisations across all career stages through significant investment in talent schemes. Supported by £634 million of investment in this Spending Review, the four National Academies (the Royal Society, the British Academy, the Royal Academy of Engineering and the Academy of Medical Sciences) run a range of global and prestigious talent schemes that support and fund scientists, researchers and innovators.

To cement the UK's place as a Science & Technology Superpower, the government recently announced the Green Future Fellowships, delivered by the Royal Academy of Engineering and backed by a £150m endowment, which will fund researchers, scientists and engineers to develop practical, breakthrough green technologies and climate changes solutions.

The government will also fund the long-term world-class Discovery Fellowships, backed by a £250 million endowment, which will fund and support emerging top mid-career talent in STEM to conduct groundbreaking research in the UK. Research projects will span a broad range of STEM subjects, which could include government priority science and technology areas such as engineering biology and quantum, ensuring the UK remains at the cutting edge of scientific research. UKRI's Future Leaders Fellowships also support top talent in universities, businesses and other RDI environments to develop the next wave of RDI leaders. The programme enables universities, research institutes, independent research organisations and businesses to develop their most talented early career researchers and innovators, and to attract top talent from the UK and abroad.

iii) Training and skills

The government agrees with the Review that we will not be able to achieve a resilient landscape without long-term planning of the UK's future STEM workforce to service the growing demand for specialised RDI skills.[22]

In line with our data-driven approach to understanding the resilience of our RDI landscape, the Department for Education's Unit for Future Skills (UFS) is developing a Skills Dashboard to understand the supply and demand of science and technology skills for priority

[22] Skills and Productivity Board (2022) 'Understanding current and future skills need'. Available from: Understanding current and future skills needs, p.12. [Accessed on 13 November 2023]

technologies.[23] Combined with intelligence on the RDI system, this data will enable all players in the landscape to take action to plan for the long term resilience of our RDI organisations.

The S&T Framework has set out the government's ambition to create an agile and responsive skills system, which delivers the skills needed to support a world-class workforce in STEM sectors and drives economic growth. To ensure a high level of STEM literacy in future RDI organisations, we are investing in STEM education at all levels. The Prime Minister has launched the Advanced British Standard, through which all students will continue studying maths up to the age of 18, supported by initial funding of £600 million over the next two years.[24] The government is also taking action to address the shortage of technician level STEM skills that was highlighted in Sir Paul's Review.[25] We are supporting more people to complete an apprenticeship or a Higher Technical Qualification, rolling out more T Levels and establishing our network of 21 Institutes of Technology. These actions mean that the future workforce in RDI organisations will have broad STEM literacy.

Researchers at the Henry Royce Institute, University of Manchester. Supported by UKRI's Engineering and Physical Sciences Research Council. Image courtesy of UKRI.

[23] Department for Science, Innovation and Technology (2023) 'The UK Science and Technology Framework' Available from: https://www.gov.uk/government/publications/uk-science-and-technology-framework/the-uk-science-and-technology-framework. [Accessed on 13 November 2023]
[24] Department for Education (2023) 'The Advanced British Standard: everything you need to know'. Available from: https://educationhub.blog.gov.uk/2023/10/05/the-advanced-british-standard-everything-you-need-to-know/ [Accessed on 13 November 2023]
[25] Department for Education (2021) 'Skills for Jobs: Lifelong Learning for Opportunity and Growth'. Available from: Skills for Jobs: Lifelong Learning for Opportunity and Growth (publishing.service.gov.uk) [Accessed on 13 November 2023]

iv) Research Culture and Bureaucracy

Organisations need to create rewarding career paths and a healthy culture to attract and retain talented staff. The R&D People and Culture Strategy, published in 2021, sets out how we are developing the research workforce we need within our world-class RDI organisations. It outlines actions to ensure that careers in RDI are open to people from all backgrounds, working within environments that nurture and get the best out of them.[26]

In September 2023, UKRI published its response to a call for input on a new deal for postgraduate research (PGR), setting out what UKRI will do to help ensure postgraduate research continues to meet the needs of government, funders, research organisations, employers and researchers and innovators themselves. UKRI has already taken a number of steps over the last two years, including increasing their minimum stipend by nearly 20% in cash terms between academic years 2021/22 and 2023/24.[27] The Scottish Funding Council have also formed an Advisory Group on supporting Scotland's Postgraduate Researchers to provide advice on opportunities to support PGR students in Scotland, including research culture. We welcome that different funders, providers and arms of government are now coming together to look at the issues that face postgraduate researchers in the UK.

The government agrees with the Review that a healthy research culture enables researchers to focus on their core RDI activities. As the Review highlighted, reporting and audit should be replaced by a culture of confidence and earned trust. Government is committed to working with partners across the sector to reduce bureaucratic burdens associated with R&D. Too much time is spent by our talented RDI workforce on unnecessary bureaucracy which is preventing them from spending their time on what they were trained to do: high-quality research. This finding was echoed by the Independent Review of Research Bureaucracy, led by Professor Adam Tickell.[28]

Government is aiming to publish its response to the Independent Review of Research Bureaucracy in early 2024. This will include new measures by government funders relating to assurance, applying for funding, in grant management and other areas, and sets out how the government will work to harmonise and simplify assurance requirements. These actions will support RDI organisations operating across the landscape.

v) Career paths for clinical researchers

The Review highlighted that clinicians face particular challenges developing a career balancing research, postgraduate training and the pressures of clinical service. The UK government, research funders (such as the National Institute for Health and Care Research (NIHR) and UKRI's Medical Research Council), devolved administrations and the wider sector are taking

[26] BEIS (2021) 'Research and Development (R&D) People and Culture Strategy'. Available from: https://www.gov.uk/government/publications/research-and-development-rd-people-and-culture-strategy [Accessed on 13 November 2023]
[27] UKRI (2023) 'UKRI publishes stipend and postgraduate research consultation'. Available from: https://www.ukri.org/news/ukri-publishes-stipend-and-postgraduate-research-consultation/ [Accessed on 13 November 2023]
[28] BEIS (2022) 'Review of research bureaucracy'. Available from: https://www.gov.uk/government/publications/review-of-research-bureaucracy [Accessed on 13 November 2023]

action across the landscape to support the career path of clinical researchers and to ensure that UK RDI organisations can benefit from the experience of clinicians.

As the largest funder of health and care research training in England, the Department of Health and Social Care (DHSC)-funded NIHR has developed a comprehensive clinical academic career pathway, strengthening research careers for a wide range of healthcare professionals and under-represented disciplines and specialisms.

Government is committed to continue working with stakeholders and partners to ensure research experience is recognised and rewarded. These actions being taken across the landscape will boost individuals' ability to undertake flexible careers at the interface between research, clinical practice and teaching. In turn, this highly qualified workforce can support RDI organisations to be resilient in the face of economic change.

Support for clinicians to develop careers in research

Many research funders provide targeted support for clinicians at all stages in their career. UKRI's Medical Research Council (MRC) provides support for clinicians through clinical research training fellowships for registered healthcare professionals to undertake a doctoral degree or to reacquire research skills.

MRC-funded Clinician Scientist Fellowships support registered healthcare professionals to establish themselves as independent investigators and Senior Clinical Fellowships support registered healthcare professionals to become internationally recognised leaders in their field.

The Academy of Medical Sciences also supports a range of talent schemes for clinicians to carry out research. For example, the Future Leaders in Innovation Enterprise and Research (FLIER) awards develop future leaders who can create collaborations across academia, industry, the NHS and government to drive innovation.

DHSC is working with devolved administrations, NHS England and NIHR to develop a UK-wide research workforce plan to build a sustainable and supported research workforce. This plan, combined with the recently published NHS's long-term workforce plan and changes to NHS pension schemes, will provide greater flexibility and clarity on the future of research and research careers within clinical and health and social care settings and ensure a resilient supply of talent to meet demand from RDI organisations.

In line with the Review's recommendations, government, funders and RDI organisations are working together to ensure the UK attracts and retains top talent and fosters an inclusive, diverse and productive RDI workforce and working environment. Taken together, these actions will enhance the long-term resilience of our future RDI landscape.

Commitments:

The government has:

- Established fellowship schemes such as the UKRI Future Leaders Fellowship and schemes delivered by the four National Academies.
- Supported more people to complete an apprenticeship or a Higher Technical Qualification, rolling out more T Levels and establishing our network of 21 Institutes of Technology.
- Worked with UKRI to agree actions that UKRI will deliver to progress the New Deal for Postgraduate Research, which includes commitments to work collaboratively across government and with a variety of PGR stakeholders on a wider package of support for postgraduate research students, particularly those with disabilities, children or caring responsibilities.

The government will:

- Develop and deliver the Advanced British Standard, through which all students will continue studying maths up to the age of 18, supported by initial funding of £600 million over the next two years.
- Award funding through the Green Future Fellowships, backed by a £150m endowment, which will fund researchers, scientists and engineers to develop practical, breakthrough green technologies and climate changes solutions.
- Support the new Discovery Fellowship, backed by a £250m endowment, with the first round of applications expected to open in 2024.
- Develop a Skills Dashboard to understand the supply and demand of science and technology skills for priority technologies.
- Continued implementation of actions and commitments from the R&D People and Culture Strategy.
- Publish the response to the Review of Research Bureaucracy in early 2024, with work already underway to implement its recommendations.
- Continue to develop a comprehensive clinical academic career pathway, strengthening research careers for a wide range of healthcare professionals and under-represented disciplines and specialisms. We will continue working with stakeholders and partners to ensure research experience is recognised and rewarded in clinical academic careers.

2C) Being international and resilient in our approach to research

UK RDI organisations will continue to be at the heart of the international research community, convening and collaborating with partners across the world. International R&D collaborations and partnerships deliver solutions to shared global research and innovation challenges (such as securing food, nutrition and health security for all), which help millions of people globally and keeps the UK at the leading edge of science and technology.

The Prime Minister announced an UK-EU agreement on the UK's association to Horizon Europe and Copernicus on 7th September 2023. This marked a landmark moment for scientific and space collaboration between the EU and the UK. This deal is the right deal for the UK – something that UK researchers and businesses have been asking for.

In negotiating a bespoke deal with the EU, UK researchers and businesses can participate confidently in Horizon Europe, the world's largest programme of research cooperation. This provides UK researchers and businesses with a stable base for international collaboration and makes sure we are on track to cement the UK's place as a science and technology superpower by 2030.

The Horizon Europe Guarantee provides support for researchers, businesses and innovators who were unable to receive Horizon Europe funding while the UK was in the process of associating. As of the end of September 2023, 2,654 guarantee grant offers have been made, with a total value of £1,395 million.[29] That guarantee has been extended to cover all remaining Horizon Europe Grant calls that are funded under work programme 2023, with association taking effect from work programme 2024 onwards. UK researchers can now apply for Horizon Europe funding with the certainty that all successful UK applicants will be covered, either through the UK's association or through the guarantee for the remainder of the programme.

Association to Horizon Europe means that the UK can work with our European partners while also continuing to invest in joint programmes with other science powerhouses worldwide. This will not only open up scientific cooperation between UK RDI organisations and EU RDI organisations, but also with those in Norway, New Zealand and Israel who are part of the programme – and countries like the Republic of Korea and Canada are also looking to join.

i) International partnerships

Government is putting science and technology at the heart of our international relationships, in line with the aims of the Integrated Review (IR) and the IR Refresh.[30] Bringing together multiple countries and using the expertise of universities and the private sector produces game changing technologies, innovations and evidence. Through equitable, open and secure international RDI partnerships and collaborations we can foster prosperity, build global resilience and help solve the most pressing global challenges.

Since 2022, we have signed a number of bespoke memorandums of understanding (MoUs), which are driving deeper mutually beneficial bilateral relationships along the innovation pipeline – from deep science collaboration to policy dialogues – with a range of priority partner countries, including Switzerland, India, Japan, Singapore and Israel. More will follow in the coming months.

[30] Cabinet Office (2023) 'Integrated Review Refresh 2023: Responding to a more contested and volatile world'. Available from: https://www.gov.uk/government/publications/integrated-review-refresh-2023-responding-to-a-more-contested-and-volatile-world [Accessed 13 November 2023]

The International Science Partnerships Fund (ISPF), managed by DSIT, puts RDI at the heart of our international relationships, supporting UK researchers and innovators to work with peers around the world on the major themes of our time: planet, health, technology and talent. ISPF is delivered by a consortium of the leading RDI organisations from across the UK, which includes: UKRI, the UK National Academies, the British Council, the Met Office, the National Physical Laboratory, the UK Atomic Energy Authority and Universities UK International. ISPF will have up to £319 million this Spending Review period, allowing UK researchers and innovators to collaborate with international partners on multidisciplinary projects.

Global collaboration under ISPF will give researchers and innovators access to global talent, large-scale facilities, research ecosystems and markets, to swiftly move forward ideas to greater maturity, applicability and commercialisation. It will stimulate research impact in line with the UK's plan to cement our place as a global science and technology superpower, as set out in the Integrated Review. This will support the foundations for long-term prosperity and delivery of our wider diplomatic objectives. We support science and research partnerships with developing countries that focus on mutually agreed priorities, as these have the greatest impact.

Our Official Development Assistance (ODA) R&D investments are an important part of the international RDI landscape. Our ODA R&D investments, delivered by the Foreign, Commonwealth and Development Office (FCDO), DSIT, DHSC, the Department for Environment, Food and Rural Affairs (DEFRA) and the Department for Energy Security and Net Zero (DESNZ), allow us to bring the UK's world-leading RDI sector into equitable, open and secure partnerships with researchers and innovators across the developing world, and with other allies who share our commitment to open science for global good. Collectively these drive the scientific response to the biggest global challenges.

These investments are in addition to the UK's multilateral partnerships that deliver RDI infrastructure. Together, they offer unique capability to researchers, present opportunities for UK industry and drive talent exchange. As discussed in chapter 1B, the UK already invests more than £300 million annually in international RDI infrastructure like CERN and the EMBL, and we are also pursuing opportunities to host new infrastructure funded by global partnerships, attracting inward investment and ensuring we remain at the forefront of global science capability.

ii) Open and secure international research collaborations in a more contested and volatile world

The government will continue to foster an open and international approach to research. Science is fundamentally a global endeavour with greatest progress achieved through meaningful and inclusive collaboration. Rapid progress on global challenges cannot be achieved without a globally inclusive, cooperative approach. However, we recognise that an increasingly competitive and volatile world means that international research collaboration is under threat from hostile actors who exploit this openness to further their own authoritarian interests. We will work with like-minded partners through multilateral fora such as the G7 to

maintain an open and secure international research ecosystem, where the UK's international research collaboration can flourish.

The activities of hostile actors undermine the shared international trust across academic communities that underpins open and productive research relationships. The success of the UK as a world-leading research nation has been built on trust in secure communities, organisations, systems and ways of working. That success is now under threat as these components of effective research practice are being disrupted.

The government has committed to embedding a systematic approach to handling national security risks around international R&D collaboration by 2030.[31] DSIT, as the government department responsible for research security policy, is responsible for delivering this commitment.

Our approach is actor agnostic and recognises that there is no single solution to address the threats to the UK research base. Our response requires a whole-system approach across the breadth of research organisations, policy and activity. Therefore, across government, we are implementing a range of legislative and non-legislative measures to address research security issues. These measures are targeted and proportionate to reduce the risk of unintended consequences and a chilling effect on legitimate collaboration.

Central to our approach has been the provision of support to the research sector. Since 2019, the government has provided sustained advice through the National Protective Security Agency and National Cyber Security Centre 'Trusted Research' campaign, which helps UK industry, universities and research performing organisations to make informed decisions about international collaboration and how to effectively manage associated risks.

DSIT has also established the Research Collaboration Advice Team (RCAT) to provide advice to the academic sector on national security risks in international collaboration. The RCAT's advisory service commenced in March 2022. RCAT advisers have engaged over 130 research institutions, and addressed over 350 specific queries, including many complex issues which have resulted in targeted mitigations of national security concerns.

The threats facing the research sector are ever evolving and becoming increasingly complex. Therefore, the Integrated Review Refresh 2023 includes a commitment to "launching a new and comprehensive review of legislative and other provisions designed to protect our academic sector, to identify what more we could or should be doing."[32] DSIT is leading this review which is due to conclude by April 2024.

[31] Department for Science, Innovation and Technology (2023), The UK Science and Technology Framework, Available from: https://www.gov.uk/government/publications/uk-science-and-technology-framework [Accessed 20 November 2023]
[32] Cabinet Office (2023) 'Integrated Review Refresh 2023: Responding to a more contested and volatile world'. Available from: https://www.gov.uk/government/publications/integrated-review-refresh-2023-responding-to-a-more-contested-and-volatile-world [Accessed 13 November 2023]

Commitments:

The government has:

- Negotiated a bespoke deal in the UK's national interest to associate to Horizon Europe and Copernicus; we will work with the sector to maximise UK participation in Horizon Europe.
- Allocated £319 million to the International Science Partnerships Fund, allowing UK researchers and innovators to collaborate with international partners on multidisciplinary projects.
- Collaborated with others who share our commitment to open science for global good, including new research and development partnerships on climate resilient agriculture, and co-developing new and technologies, products and health service innovations tailored to LMIC needs.
- Initiated new major research collaborations, such as the UK-CGIAR Science Collaboration Centre that links world-leading UK research centres and CGIAR research programmes with national partners in developing countries to transfer UK expertise and science into LMIC partners.
- Established the Research Collaboration Advice Team (RCAT) to provide advice to the academic sector on national security risks in international collaboration.
- Launched a comprehensive review of the protections that have been put into place to protect the higher education and academic sector from hostile threats. This is to understand whether there is more we could or should be doing to counter what is an evolving and increasingly complex threat. The Department for Science, Innovation and Technology, which is responsible for research security policy, is leading this review.

The government will:

- Have embedded a systematic approach to handling national security risks around international R&D collaboration by 2030.

2D) Ensuring the system is open and navigable

We will increase the resilience of the RDI landscape by encouraging greater movement of people, ideas and technology both within the RDI landscape and out into society, helping to drive national prosperity and creating a system that is greater than the sum of its parts. This includes clearer signposting of funding and collaboration opportunities.

i) Ensuring the system is navigable

Government agrees that the RDI landscape could be strengthened through better movement of ideas, technologies and people between all organisations in the sector – both public and private. Creating the right conditions for a seamless flow of RDI talent will require the whole sector to work together. DSIT will work in partnership with UKRI to design incentives to make this happen.

UKRI has established mechanisms to turbocharge interactions. These measures include Infraportal and the Innovation Hub which make it easier for the RDI sector and industry to learn about the UK's RDI organisations and how they can collaborate with them.[33,34]

The Innovation Strategy launched by Wales sets out aspiration for Wales to be a leading, innovation based nation

Wales Innovates, the Welsh Government's new Innovation Strategy for Wales recognises the importance of the broad and diverse range of actors which exist within the RDI landscape in Wales. These include academic, public and third sectors, industry, innovation assets such as our Advanced Manufacturing Research Centre - part of the High Value Manufacturing Catapult network – and the Life Science Hub and funding providers. The strategy sets the direction within four mission themes, Education, Economy, Health and Wellbeing and Climate and Nature. These mission themes align with our Wellbeing of Future Generations Act, and Programme for government to support delivery and impact against our policy commitments.

This includes funding for the Wales Innovation Network (WIN), which aims to build capacity in the Welsh RDI system through collaboration between institutions. WIN raises the profile of RDI within Wales and the UK, provide a forum in which participants can share expertise, and make it easier for Welsh universities to form partnerships and share infrastructure. It also supports collaboration with a wide range of private, public and third sector bodies, strengthening knowledge exchange throughout Wales.

Devolved administrations have taken different approaches to increasing collaboration and cohesion across the landscape. Through the Scottish Funding Council, the Scottish Government has invested significantly to drive creation of transformational partnerships through initiatives such as Innovation Centres, Alliances for Research Challenges and Interface, which continue to drive collaboration across themes and organisations and contribute to world-leading RDI in the economy.

To further understand priority technologies, emerging sectors and areas of strengths, DSIT is mapping private sector investment across the country. DSIT is committed to developing a comprehensive map of the UK's clusters of RDI excellence. This will show thousands of RDI clusters across the UK, with many options to filter these by technology, sector, and metrics of growth and investment, and includes public RDI infrastructure. This can be used by public, private and philanthropic investors to guide decisions about supporting and accessing research.

[33] UKRI 'The UK's Research and Innovation Infrastructure Portal'. Available from: https://www.infraportal.org.uk/ [accessed 17 November 2023]
[34] Innovate UK 'The Innovation Hub'. Available from: https://ukinnovationhub.ukri.org/ [accessed 17 November 2023]

Better guidance and information on how to work with our RDI organisations is needed. As a first step, DSIT has published the 'Working with Catapults Guidance'.[35] This guidance aims to assist government departments in better understanding what Innovate UK's Catapults are as well as the benefits of working with them to deliver government priorities. It also provides some detail on potential routes and best practice for working with them. DSIT will explore expanding guidance to other organisations within the RDI landscape, such as PSREs (see Chapter 1: Diverse).

Interface: enabling business-academic collaborations

Interface connects ambitious businesses with Scotland's academic knowledge base, creating opportunities to collaborate with leading thinkers and world-class expertise. Its mission is to deliver environmental, economic and social prosperity in Scotland.

Interface's support for businesses is delivered in two key strands. First, Interface facilitates introductions to academia and enables access to the knowledge, skills, facilities and technologies of universities, colleges and research institutes. Second, it also raises awareness of resources and funding opportunities available to support the development and delivery of collaborative projects. In 2022/23 Interface enabled 313 projects between businesses and Scottish universities, colleges and research institutes.

Businesses benefit from introductions to academia, access to laboratory space, workshops and highly specialised equipment and in-house expertise. They can also access talent through collaborative projects with students, graduates and early-stage career researchers who bring fresh perspectives and innovative ideas as they are exposed to cutting-edge research and emerging trends in their academic studies.

ii) Ensuring the system is open and transparent

Government is committed to being as transparent as possible in the data it holds and its research interests. Many departments have signed up to implementing Research Integrity principles.[36] These include being as open and transparent as possible with publicly funded research, which should be free to access, wherever possible, released promptly and in a way that promotes public trust.

As a new department bringing together the five technologies of tomorrow under one roof, DSIT is already improving the shared understanding of the UK's public, private and not-for-profit institutional landscape. This is part of DSIT's ambitious programme of reform to be an enabler of innovation across government. As a first step, the government will publish an overview of

[35] DSIT (2023) 'Working with Catapults: guidance for government departments. Available from: https://www.gov.uk/government/publications/working-with-catapults-guidance-for-government-departments [Accessed on 13 November 2023]
[36] Government Office for Science (2023) 'Implementing the Concordat to Support Research Integrity within government'. Available from: https://www.gov.uk/government/publications/implementing-the-concordat-to-support-research-integrity-within-government#full-publication-update-history [Accessed on 13 November 2023]

how DSIT has allocated its R&D budget over the financial years 2023/24 to 2024/25 (since the department's creation) to partner organisations and departmental programmes.

A new tool has been launched which brings together all Areas of Research Interest (ARI) documents from across government departments in a one-stop shop.[37] ARIs are lists of research questions or topics which government departments and agencies would welcome more research on to inform their policies and help close the evidence policy gap. This new database allows anyone accessing it to search for particular areas of research interest and find out what the main research questions facing government departments are.

Whilst we have better data on research performed by the higher education sector, there is limited data and evidence readily available on other RDI organisations. The Publicly Funded Research and Innovation Organisations Report, for the first time, collects information about the activities, collaboration with other actors within the RDI landscape, workforce and finances of publicly funded research organisations.[38]

Commitments:

The government has:

- Through UKRI, launched the Innovation Hub and Infraportal.
- Published the 2023 Update to the 'Catapult Network Review' and 'Working with Catapults Guidance'.
- Published the Publicly Funded Research and Innovation Organisation Survey to increase transparency about the role of publicly funded research organisations.
- Launched a new tool bringing together all Areas of Research Interest documents from across government.

The government will:

- Develop a comprehensive map of the UK's clusters of RDI excellence, to be published in the coming months.
- Publish a breakdown of DSIT's R&D budget over the financial years 2023/24 to 2024/25.

[37] Areas of Research Interest (2023) 'Areas of Research Interest'. Available from: https://ari.org.uk/ [Accessed on 13 November 2023]
[38] DSIT (2023) 'Insights from the 2022 survey of publicly funded research and innovation organisations'. Available from: https://www.gov.uk/government/publications/insights-from-the-2022-survey-of-publicly-funded-research-and-innovation-organisations

Chapter 3: Investable

Our objectives

The government's plan is to cement the UK's place as a science and technology superpower by 2030 and has laid out a clear vision in the S&T Framework that the UK's RDI investment will match the scale of this ambition. Delivery of this ambition will catalyse private, philanthropic and public sector investment in RDI and boost the innovation activity of firms across the UK, generating economic growth. The private sector is key to delivering this. Building on the commitments of the 2021 UK Innovation Strategy, the S&T Framework sets out a clear vision and action government will take on issues ranging from finance and skills to regulation and procurement, all of which are crucial to optimising the conditions for increased investment into innovation.

The Long-term Investment for Technology and Science (LIFTS) is one way we are crowding-in private investment

The government is committed to its long-term objective to unlock more institutional investment into productive areas of the economy, ensuring that savers stand to benefit from the growth of the UK's most innovative companies. The British Business Bank (BBB) launched the £250 million LIFTS initiative in May 2023 to crowd-in investment from institutional investors, particularly Defined Contribution (DC) pension funds, to support the growth and ambitions of the UK's most innovative science and technology companies.

The government has continued to prioritise RDI investment and has committed to invest £20 billion in R&D in 2024/25, expected to leverage double the amount of private investment in the longer run. Government cannot deliver the scale of investment required on its own. Cementing the UK's place as a science and technology superpower requires greater coordination and partnerships between the public, private and third sector to ensure that the UK's RDI organisations reach their full potential and attract maximum private and philanthropic financial support. The government will ensure that the landscape is:

3A) Boosting private sector RDI investment

Unlocking business investment to drive innovation-led growth is key to tackling global challenges and generating economic growth. Businesses fund the majority of R&D that occurs in the UK, spending £46.9 billion in R&D in 2021.[39] Our RDI landscape needs to facilitate and

[39] Office for National Statistics (2021) 'Business enterprise Research & Development'. Available from: https://www.ons.gov.uk/economy/governmentpublicsectorandtaxes/researchanddevelopmentexpenditure/bulletins/businessenterpriseresearchanddevelopment/2021 [Accessed on 13 November 2023] Office for National Statistics (2021) 'Business enterprise Research & Development'. Available from: https://www.ons.gov.uk/economy/governmentpublicsectorandtaxes/researchanddevelopmentexpenditure/bulletins/businessenterpriseresearchanddevelopment/2021 [Accessed on 13 November 2023]

sustain a strong pipeline of investable innovation propositions to continue to attract both domestic and international capital – for example, venture capital into innovative start-ups is essential to helping them scale and reach their potential.

The UK's R&D tax reliefs have an important role to play in helping businesses to invest in R&D in a fiscally sustainable way. At Autumn Statement 2022, the Chancellor announced that the government would rebalance the R&D tax reliefs to ensure taxpayers' money is used as effectively as possible to support innovation. At Spring Budget 2023, the government announced a new permanent rate of relief for R&D intensive loss-making SMEs, worth around £500 million per year. The increase in the R&D Expenditure Credit rate means the UK now has the joint highest uncapped headline rate of tax relief in the G7 for large companies.

We are leveraging private sector investment through the UK Research Partnership Investment Fund (UKRPIF)

The UK Research Partnership Investment Fund demonstrates how government funding can leverage significant co-investment from a variety of sources to develop research infrastructure and improve the RDI landscape.

Supported by a government investment of £900 million in projects to improve higher education facilities across the UK, the UKRPIF has secured commitments of over £2 billion of co-investment from industry partners, charitable organisations and philanthropic donors to date.

One project supported by the fund is the Institute of Advanced Automotive Propulsion Systems at the University of Bath, which is spearheading development of future ultra-low and zero emission vehicles. The Institute has been developed in partnership with local companies, businesses, the Automotive Council, the Advanced Propulsion Centre, making the Institute a hub for training as well as attracting automotive SMEs in the region.

We have been increasing funding for innovation because we recognise the importance of translating scientific ideas into economic growth across the UK. As committed at the 2021 Spending Review, funding for core Innovate UK (IUK) programmes – which are successful in crowding in private sector leverage – will rise to £1.1 billion per year by 2024/25. This is over £300 million (66%) more per year than in 2021/22.

Many Innovate UK programmes support businesses to thrive. The IUK Innovation Loans programme is one example, which offers flexible, affordable and patient repayable finance to support late-stage business R&D. Since 2017, this programme has committed £181 million to 207 businesses and leveraged £280 million of private investment. Another example is the Innovate UK Investor Partnerships programme. This programme provides professional investor advice and capital to highly innovative businesses on their journey from concept to commercialisation, scale and growth. Since 2017, it has supported SMEs with £59 million in

grant funding. These SMEs have gone on to access a further £537 million of follow-on funding from investors.[40]

The UK is a global hub for advanced manufacturing. On Friday 17th November, the Chancellor announced a £4.5bn package for the advanced manufacturing sector to increase investment and growth. This package builds on recent investment wins, such as the £4bn gigafactory and the £600m invested to build the next generation of electric Minis. It will ensure that the government can continue to help create jobs, grow the economy and secure the future of great British manufacturing. This is part of the UK government's focus on improving the business environment for advanced manufacturing to ensure the UK is the best place to start, grow and invest in manufacturing.

i) Embedding pro-innovation regulation

The UK is in a global race to attract the innovation activity of businesses to stimulate jobs, productivity and growth. Innovation-friendly regulation is critical to achieving these ambitions, playing an important role to translate R&D investment into real-world, marketable products and services that could, in future, be scaled across domestic and international markets to the advantage of the UK.

The Science and Technology Framework sets out the government's strategic vision and approach to making the UK a science and technology superpower by 2030. It recognises the critical role of a pro-innovation approach to regulation and standards. It also highlights the importance of stimulating demand for science and technology, attracting investment while representing UK values and safeguarding citizens.

The Pro-Innovation Regulation of Technologies review, led by Sir Patrick Vallance and subsequently by Dame Angela McLean, identifies opportunities and enablers for pro-innovation regulation of science and technology sectors with high potential to attract investment and enable growth of UK-based businesses and the economy. The recommendations outline proposals on how to prioritise and drive pro-innovation regulation across the government, on how regulators can foster innovation, and how the government and regulators can work together effectively.

Recognising that not only is each regulator different, but the markets and innovations being trialled and tested are different as well, we encourage regulators to leverage a vast range of pro-innovation tools, including experimental approaches such as regulatory sandboxes.

Regulatory sandboxes offer supervised real-life or simulated test environments (digital or physical) where innovators can trial new products, services or business models, sometimes under relaxed regulatory requirements. For example, the Office for Nuclear Regulation (ONR), in partnership with the Environment Agency (EA), delivered a 'first of its kind' regulatory sandbox which explored the regulation of specific applications of AI within the nuclear industry

[40] UKRI (2022) 'Innovation Loans'. Available from: https://www.ukri.org/councils/innovate-uk/guidance-for-applicants/guidance-for-specific-funds/innovation-loans/ [Accessed on 13 November 2023]

to help improve the sector with benefits to safety, security, and the environment. This project was funded by the Regulators' Pioneer Fund (RPF).

Beyond regulatory sandboxes, DSIT continues to evolve a blend of delivery approaches as part of our broader pro-innovation approach to regulation:

- Since 2020, DSIT (and BEIS) has sponsored the Regulatory Horizons Council to provide independent expert advice to government on areas where regulatory reform can support technological innovation. The Council is currently working on a regulatory review on quantum, and scoping projects on engineering biology and space. It has previously advised on regulation for areas including genetic technologies, artificial intelligence as a medical device and drones.
- DSIT provides strategic grant funding to regulators and local authorities via the RPF, supporting novel or experimental regulatory approaches to help develop a UK regulatory environment that encourages business innovation and investment. Established in 2018, we have already delivered two RPF funding rounds issuing grants to 35 projects totalling over £13 million. In the current (third) round, we have allocated up to £12 million for 24 projects led by regulators and local authorities.
- Beyond this, we lever a number of tools to provide support and constructive challenge to regulators, standards organisations and policy officials on their regulatory approach.
- The government delivers the Freeport Regulators' Engagement Network (FREN), a network of Freeports and regulators. Its aim is to support businesses within Freeports in navigating regulatory challenges when developing, testing and applying new ideas and technologies.
- DSIT also facilitates the Regulators' Innovation Network (RIN), a collaborative group of UK Regulators aiming to drive the adoption of new technologies through innovation-friendly regulation. It promotes collaboration and the exchange of best practice between regulators.

The Life Sciences Investment Programme (LSIP) supports UK businesses

The LSIP is a £200 million initiative managed by British Patient Capital designed to address the growth equity finance gap faced by high-potential UK life sciences companies. This is expected to attract at least a further £400 million of private investment. Through LSIP, we make cornerstone commitments to later stage life sciences venture growth funds with a strong UK focus, typically investing between £50 million and £100 million in each successful fund.

ii) Promoting innovation organisations

The UK boasts a wide range of RDI organisations across the public, private and third sectors.[41] These range from TWI, which specialises in innovation, knowledge transfer and solving problems across all aspects of manufacturing, fabrication and integrity management, to the

[41] Association for Innovation, Research and Technology Organisations (2023) 'AIRTO'. Available from: https://www.airto.co.uk/about/members/ [Accessed on 13 November 2023]

Advanced Manufacturing Research Centre, which is a world-class centre for research into advanced manufacturing technologies used in the aerospace, automotive, medical and other high-value manufacturing sectors.

To ensure that the benefits of innovation are spread throughout the country's RDI organisations, we are investing over £145 million in Innovation Centres to boost areas of strategic advantage throughout the country through a high growth sector boost. For example, we are bringing together five centres of Technical Excellence in Manchester, St Helens and Middlesborough to form a decarbonisation consortium across industries from steel innovation, low carbon cement and paper innovation; and investing in batteries innovation centres across the country to contribute to our ambition for 130 GWh capacity in batteries by 2035.

Innovate UK's Catapults play an important role in the UK innovation ecosystem, acting as key vehicles for leveraging and mobilising private RDI, both directly and indirectly, to support the government's objective of cementing the UK as a science and technology superpower.

The Offshore Renewable Energy Catapult supports businesses in the North-East and Scotland

The Offshore Renewable Energy Catapult is the UK's leading technology innovation and research centre for offshore renewable energy. It plays a key role in delivering the UK's net zero targets by accelerating the creation and growth of UK companies in the offshore renewable energy sector.

In Blyth, the Catapult's high voltage laboratory is one of the few facilities in the world which can test pioneering cable technology, allowing an increased transmission between turbines at higher-capacity wind farms. This is a vital factor in reducing the cost of offshore wind.

In 2016, the Catapult supported JDR cables to bring this technology to market, which has been pivotal to their announcement of a £130 million investment in a new North-East cable manufacturing plant, creating 170 highly skilled jobs and safeguarding 270 more.

Innovate UK's Catapults boast a unique network of collaborations, specialist knowledge and expertise, cutting-edge facilities and tailored SME support, which attract private investment in UK innovation. They act as anchor organisations to attract foreign investment, by providing access to UK expertise through international partnerships across the globe. A 2021 business survey found that in 44% of cases surveyed, the project would not have happened without Catapult support, and in 37% of cases the project would have been slower.[42]

Innovate UK's Catapults have a track record of developing clusters of excellence across the UK, encouraging private investment into the area, resulting in local growth, productivity gains and the creation of high-quality jobs. Building on their track record of attracting major industry

[42] BEIS (2021) 'Catapult network review 2021: how the UK's Catapults can strengthen research and development capacity' Available from: https://www.gov.uk/government/publications/catapult-network-review-2021-how-the-uks-catapults-can-strengthen-research-and-development-capacity [Accessed on 13 November 2023]

and foreign direct investment, we are investing a further £50 million in Innovate UK's Catapults in 2023/24 through the high growth sector boost, expected to leverage significant private sector investment over time.

As discussed in Chapter 2D, ensuring that the RDI landscape is open and navigable is crucial to help businesses innovate. Innovate UK KTN uses its connections to more than 300,000 innovative businesses and individual innovators to connect ideas, people and innovation communities, in turn helping businesses achieve their innovation goals. This is resulting in more business investment in RDI and a faster time to market. Connections and collaborations are supported across sectors, academia, and businesses, as well as across the interfaces of technologies.

The government has also published a review of the arrangements for university spin-out companies, led by two leaders in the field of academia and venture capital – Irene Tracey, Vice-Chancellor of Oxford University and Andrew Williamson, Managing Partner of Cambridge Innovation Capital.[43] The government response lays out how government will work with universities and investors to improve the process of spinning out, from licensing deal terms to founder support programmes. As part of this, the government will improve funding for proof-of-concept research. Through UKRI, we will create a new £20 million cross-disciplinary proof-of-concept fund, modelled on the recent interdisciplinary responsive mode pilot for basic and discovery research.

Creating a major area of investment for global pharmaceutical companies: the University of Dundee

The University of Dundee's Centre for Targeted Protein Degradation, which opened in January 2023, is one of the UK's leading centres for biological sciences research. The Centre focuses on a new class of drugs that work with a cell's natural processes to target and degrade the proteins that cause disease.

Funding from the Scottish Funding Council's Research Excellence Grant (REG) has helped the university to meet the full costs of research projects and leverage competitively awarded grants from the European Research Council, UK Research Councils and others. Initial public funding stimulated investment of over £36 million from global pharmaceutical companies between 2016 and 2022, plus commercialisation income of more than £1 million. In 2017, Amphista Therapeutics was spun-out with co-founding venture capital investor Advent Life Sciences, resulting in £6 million in Series A financing in 2020 and a further £40 million in Series B financing in 2021.

Commitments

The government has:

[43] HM Treasury (2023) Available from: 'Independent review of university spin-out companies'. Available from: https://www.gov.uk/government/publications/independent-review-of-university-spin-out-companies Accessed 21 November 2023]

- Published a response to the independent review of university spin-outs, working with universities on a commitment to spin-out deal terms that are attractive to investors.

The government will:

- Invest £145 million in RDI organisations in areas of strategic advantage via a high growth sector boost for RDI organisations in 2023/24, to leverage private sector investment across the country in priority areas including health and life sciences, net zero, transformative technologies and security.
- Of this, invest a further £50 million in Innovate UK's Catapults, expected to leverage significant private sector investment over time.
- Improve funding for proof-of-concept research, by creating a new £20 million, cross-disciplinary proof-of-concept fund through UKRI, modelled on the recent interdisciplinary responsive mode pilot for basic and discovery research.

3B) Building world-leading and globally connected innovation clusters

Strengthening innovation clusters and the RDI organisations anchored within them is a top priority for building our Innovation Nation. Having more centres of world-leading and globally connected innovation clusters will improve productivity and drive growth throughout the UK. This will require significant investment from both domestic and overseas companies.

The government is providing targeted support – from Innovation Accelerators, Innovate UK launchpads, Investment Zones to Freeports – to help innovation clusters grow and promoting investment into their RDI organisations.

DSIT has developed an interactive digital tool to map innovation clusters across the UK. To be released in the coming months, the tool will provide users with unprecedented visibility of the UK RDI landscape. The tool is expected to be crucial in driving innovation-led growth, including by: supporting government to make even more informed decisions about how to support innovation across the country based on an enhanced understanding of existing clusters; driving private investment through showcasing RDI strengths, assets and opportunities across the UK; and supporting collaboration and development within and between clusters.

i) Boosting innovation ecosystems

Announced in the 2022 Levelling Up White Paper, government is investing £100 million to pilot Innovation Accelerators to support three city regions (Glasgow, Greater Manchester and West Midlands) to become major, globally competitive clusters of research and innovation.

The programme is pioneering a new model of RDI decision-making that empowers partnerships of local leaders to harness innovation in support of regional economic growth. These partnerships comprise local government, business and RDI institutions from across each city region, working collaboratively with the UK government.

The UK hosts world-class innovation campuses

Co-locating scientists, innovators and businesses around world-class large-scale research infrastructure can massively accelerate discovery and innovation, with clear benefits including increased productivity, new business creation and faster growth. The Science and Technology Facilities Council (STFC), part of UKRI, operates two exciting and innovative campuses at Harwell and Daresbury. These campuses, which are public-private joint ventures, host many of the UK's largest research infrastructures, including the Diamond Light Source, the ISIS muon and neutron source, the National Quantum Computing Centre and the Hartree National Centre for Digital Innovation. This concentration of National Laboratories and facilities, in close proximity with high-tech businesses, is unique and is a key asset for the UK.

Harwell Campus is host to an array of world-leading research infrastructure, with recent investments totalling almost £1 billion. It is the home to over 6,000 researchers, engineers and innovators working on site. It also provides access to world-class top-end scientific infrastructure to over 10,000 academic and industry users every year. With visions to grow Harwell into the world's largest and most important science and innovation campus, the broad and diverse RDI based community are able to exploit a vast range of deep scientific and engineering expertise based on the campus to drive the technological development for the good of UK industry.

Sci-tech Daresbury is a national science and innovation campus and enterprise zone located in the Liverpool city region. It is home to more than 150 start-ups, scale-ups and global giants who are working side-by-side, together with some of the brightest minds in science at STFC's Daresbury Laboratory. Sci-Tech Daresbury is a major asset in driving digital innovation in the North-West of England, attracting globally significant innovative businesses such as IBM and most recently PsiQuantum.

Sci-Tech Daresbury in the Liverpool City Region (left) and UKRI's Research Complex at Harwell, Oxfordshire (right). Images courtesy of UKRI.

The 26 transformative RDI projects funded through the Innovation Accelerators will attract private R&D investment, create new jobs, boost regional economic growth, and develop the technologies of tomorrow. The ambition is that public funding for the programme will generate

2:1 private co-investment in the longer term. To support the delivery of this objective, business leaders chair the Boards overseeing each of the partnerships and 59 private sector organisations are included as formal partners across the funded projects.

As part of the wraparound offer to the Innovation Accelerators, DSIT and the Department for Business and Trade are working together to increase private investment in RDI in the three city regions by:

- Promoting regional strengths and opportunities at sector-focussed international events encouraging companies and individuals to invest in the UK.
- Increasing regional understanding of current and planned programmes in their areas which are being delivered through the British Business Bank.
- Identifying policy opportunities to strengthen innovation ecosystems through improved access to finance.

Government has also recently announced the Regional Innovation Fund, which provides £60 million funding across the UK in 2023/24 to sustain and boost capacity for university and business engagement. The pilot Regional Innovation Fund will harness the strengths of our universities in support of regional economic growth, providing an immediate funding boost to support university commercialisation activity and university-business collaborations in the regional economy. Within England, the fund will go to universities across all regions to enable them to engage more closely with businesses and regional innovation clusters. The fund will particularly target high performing universities in areas with lower levels of RDI investment, taking account of up-to-date performance in regeneration funding.

ii) Supporting businesses across the UK

Innovate UK Launchpads will build on local innovation strengths to support SMEs to deliver jobs, growth and high productivity. For each Launchpad, Innovate UK, part of UKRI, will invest up to £7.5 million for business-led innovation projects and wraparound support. This may include funding for R&D, access to innovation specialist support, and opportunities to network and collaborate. Each Launchpad will be unique, being targeted at a specific innovation cluster and geographical area. Following the piloting of launchpads – the Net Zero Launchpad centred on Tees Valley and the Advanced Manufacturing Launchpad centred on Liverpool City Region – a further eight will be rolled out across different parts of the UK so far, backed by a share of £75 million.[44] These will build upon existing clusters of high-tech innovation in each region, from renewable energy in Southwest Wales to health technologies in Yorkshire.

The government is also fostering more specialised research in clusters which can nurture our globally renowned Creative Industries sector, worth £108 billion to the UK every year.[45] The

[44] UKRI (2023) 'Regional SME innovation clusters to receive up to £75 million boost to economies'. Available from: https://www.ukri.org/news/regional-sme-innovation-clusters-to-receive-up-to-75m-boost-to-economies/ [Accessed on 13 November 2023]

[45] Department for Culture, Media and Sport (2023) 'Creative industries sector vision: a joint plan to drive growth, build talent and develop skills'. Available from: https://www.gov.uk/government/publications/creative-industries-sector-vision/creative-industries-sector-vision-a-joint-plan-to-drive-growth-build-talent-and-develop-skills [Accessed on 20 November 2023]

£120 million Arts and Humanities Research Council Creative Industries Clusters Programme promotes partnerships between universities, academics and businesses to leverage private co-investment in nine locations across the UK. The clusters draw from some of the UK's best performing and creative companies, from the screen industries and digital storytelling to fashion and video games. It brings businesses, organisations and Britain's world-class universities together to ensure the Creative Industries continue to flourish.

The Investment Zones programme will also support the development and growth of clusters. These will increase local innovation capacity, attract investment and, above all, strengthen the private sector – which is the engine of economic growth. They will focus on five priority sectors: digital/technology, life sciences, green industries, advanced manufacturing and creative industries. Government has confirmed that eight places in England – Greater Manchester, the North-East, South Yorkshire, West Midlands, Liverpool City Region, West Yorkshire, Tees Valley and East Midlands – and two in Scotland – Glasgow City Region and the North-East of Scotland – can host Investment Zones so far.

Commitments

The government has:

- Recognised the importance of translating scientific ideas into economic growth and so have been increasing funding for innovation.
- Committed to investing £100 million to pilot Innovation Accelerators to support three city regions, as announced in the 2022 Levelling Up White Paper.
- Announced an additional eight Innovate UK Launchpads so far.
- Continued to support specialised creative industries clusters through the £120 million AHRC Creative Industries Clusters Programme.

The government will:

- Boost support for universities in areas with lower levels of R&D investment through the Regional Innovation Fund, which provides £60 million funding across the UK in 2023/24.
- Develop a comprehensive map of the UK's clusters of RDI excellence, to be published in the coming months (see Chapter 1).

3C) Making the UK a world-leader for philanthropic partnerships

Government recognises the huge potential from philanthropic funding for science, innovation and technology. The UK is fortunate to have a diverse range of charitable funders which support vital research in the UK, particularly in support of medical research. Examples can be found within members of the Association of Medical Research Charities group, which

collectively spent £1.99 billion on research in the UK in 2022,[46] as well as Wellcome, which spent £1.4 billion on urgent health challenges in 2021/22.[47]

The field of venture philanthropy is a new and increasingly important funding pool for science and technology. It is high-value and liquid, with global private foundations' assets valued at over £1.8 trillion and annual expenditure valued at more than £400 billion.[48] Crucially, philanthropy has evolved, and many individuals want to use their capital to change the world through science and discovery.

By demanding few, if any, returns, philanthropic capital can be put into high-risk, high-potential projects where the market is still nascent and commercial deals would otherwise fail. For instance, the Moderna and AstraZeneca vaccines benefited from significant philanthropic capital. Similarly, philanthropist Stephen Schwarzman donated £185 million to Oxford University to create a new humanities centre, including a new Institute for Ethics in AI.[49]

DSIT is partnering with the Office for Investment (a joint unit between No.10 and Department of Business and Trade) to unlock further opportunities for philanthropic funding for UK science and technology capabilities. This will build upon the Office for Investment's ongoing work to raise private sector investment, having raised over £30 billion of committed future investment into the UK since its launch in November 2020.

The 2021 UK Life Sciences Vision committed to focusing on specific Missions to tackle the UK's biggest healthcare challenges.[50] The Missions are intended to apply a Vaccine Taskforce-type approach by bringing together industry, academia, the third sector and the NHS to collaborate to make progress in these disease areas, by advancing early disease prevention, diagnosis, monitoring and developing breakthrough products and technologies to save lives. In 2022, we launched five of these Missions in the disease areas of: Dementia, Cancer, Mental Health, Obesity and Addiction, with over £210 million of government investment, and in 2023, have appointed world-leading experts to be the Mission Chairs to shape the direction and drive progress.[51] The Missions intend to leverage further investment, both philanthropic and industry, from the wider sector to increase the scale of the ambition.

[46] Association of Medical Research Charities (2023) 'homepage'. Available from: https://www.amrc.org.uk/ [accessed 13 November 2023]
[47] Wellcome (2023) 'Wellcome Annual Report 2022'. Available from: https://wellcome.org/reports/wellcome-annual-report-2022 [accessed 13 November 2023]
[48] Citigroup (2022) 'Philanthropy and the Global Economy v2.0'. Available from: https://www.citigroup.com/global/insights/citigps/philanthropy-and-the-global-economy-v2 [accessed 13 November 2023]
[49] University of Oxford (2023) 'Groundbreaking ceremony marks start of Schwarzman Centre construction' Available from: https://www.humanities.ox.ac.uk/article/groundbreaking-ceremony-marks-start-of-schwarzman-centre-construction [accessed November 13, 2023][49] University of Oxford (2023) 'Groundbreaking ceremony marks start of Schwarzman Centre construction' Available from: https://www.humanities.ox.ac.uk/article/groundbreaking-ceremony-marks-start-of-schwarzman-centre-construction [accessed November 13, 2023]
[50] OLS (2021) 'Life Sciences Vision' available from: https://www.gov.uk/government/publications/life-sciences-vision [accessed November 13, 2023]
[51] DHSC (2022) 'Prime Minister launches 'Dame Barbara Windsor Dementia Mission'' available from: https://www.gov.uk/government/news/prime-minister-launches-dame-barbara-windsor-dementia-mission--2 [accessed November 13, 2023]

i) UK Biobank

To pilot a programme of work to encourage philanthropic capital injections into the UK's RDI organisations, the government has launched a consortium of philanthropic funders to support UK Biobank.[52]

UK Biobank's large freezer stores biological samples from 500,000 participants. Image courtesy of UK Biobank.

UK Biobank is the world's most significant source of data and biological samples for health research, and contains genetic, lifestyle and health information from half a million UK volunteers. Research utilising UK Biobank's world-leading resources is a major contributor to the advancement of modern medicine and treatment and has enabled several scientific discoveries that improve human health. This is why UK Biobank receives significant support from Wellcome and the Medical Research Council, as well as the British Heart Foundation, Cancer Research UK and the National Institute for Health and Care Research.[53]

Government is committing up to £25 million to spur at least equal industry and philanthropic support. To date, government has agreed £16 million funding with philanthropists which will be matched by the government. This funding will provide vital support for new research at UK Biobank and will be an unrestricted grant dedicated to UK Biobank's core research. Vitally, it

[52] DSIT (2023) 'Philanthropic partnership unlocks £32 million for the future of best-in-class UK Biobank' available from: https://www.gov.uk/government/news/philanthropic-partnership-unlocks-32-million-for-the-future-of-best-in-class-uk-biobank [accessed November 13, 2023]
[53] UK Biobank (2023) 'Our funding' available from: https://www.ukbiobank.ac.uk/learn-more-about-uk-biobank/about-us/our-funding [accessed November 13, 2023]

will support UK Biobank's financial sustainability through the diversification of its funder base and looks to crowd-in even greater funding.

This is in addition to £154 million of investment in UK Biobank from the UKRI Infrastructure Fund and MRC/DHSC core funding. This transformative funding will help create a new state-of-the-art facility in Manchester, enabling UK Biobank to meet rising demand from UK and international researchers and attract further industry investment.

ii) Research Ventures Catalyst (RVC)

As described in Chapter 1, the RVC is a pilot funding mechanism with an objective to increase organisational diversity within the RDI landscape. Central to the RVC's approach is the leveraging of significant philanthropic and industry investment into novel research organisations. Collaboration with partners from philanthropy will diversify the funding base of these research ventures.

Commitments

The government has:

- Established a new programme of work led by the Office for Investment to unlock philanthropic investment into the UK's world-leading RDI organisations.
- Diversified UK Biobank's funding streams developing a philanthropic consortium, match-funding up to £25 million of philanthropic funding. The Research Ventures Catalyst programme will further seek to leverage philanthropic funding.

Conclusion

Meeting our plans to cement the UK's place as a science and technology superpower by 2030 will take a concerted and sustained effort across all of government and throughout organisations across the RDI landscape. Sir Paul's Review has provided a comprehensive and important analysis of the UK's current RDI landscape and how we must respond collectively to the challenges and opportunities both now and in the future.

This response sets out ambitious actions that government and the sector are taking to build a diverse, resilient and investable organisational landscape for RDI in the UK. Among the measures discussed in this document are the piloting of innovative organisational models, embedding data, evidence and foresight into our approach, maximising the impact of public sector RDI organisations and expanding philanthropic funding into research organisations.

Implementing many of the commitments in this document will take time. By integrating Sir Paul Nurse's insights with our long-term vision – the S&T Framework – we can make enduring progress on long-standing, interconnected issues facing the RDI organisational landscape. We must do this together – working in partnership with the sector, devolved administrations, and experts across the landscape. This response must be seen alongside the creation of DSIT as a single point of leadership and coordination, the government's record investments into RDI – £20 billion per annum by 2024/25 – and the negotiation of a bespoke deal to associate with Horizon Europe, the world's biggest RDI collaboration.

An RDI landscape that is more diverse, resilient, and investable is a cornerstone of our long-term approach and will be a crucial part of growing our economy and raising people's living standards for decades to come.

This publication is available from: https://www.gov.uk/government/publications/research-development-and-innovation-organisational-landscape-an-independent-review

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