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Stepping up R&D, from St. Austell to St. Andrews

December 2019
Innovation

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About the partner

RB* is a leading global health, hygiene and home company inspired by a vision of the world where people are healthier and live better. Its purpose is to make a difference by giving people innovative solutions for healthier lives and happier homes.

Through its two business units, Health and Hygiene Home, RB has operations in over 60 countries and its products reach millions of people globally every day. Its trusted household brands include names such as Enfamil, Nutramigen, Nurofen, Strepsils, Gaviscon, Mucinex, Durex, Scholl, Clearasil, Lysol, Dettol, Veet, Harpic, Cillit Bang, Mortein, Finish, Vanish, Calgon, Woolite and Air Wick.

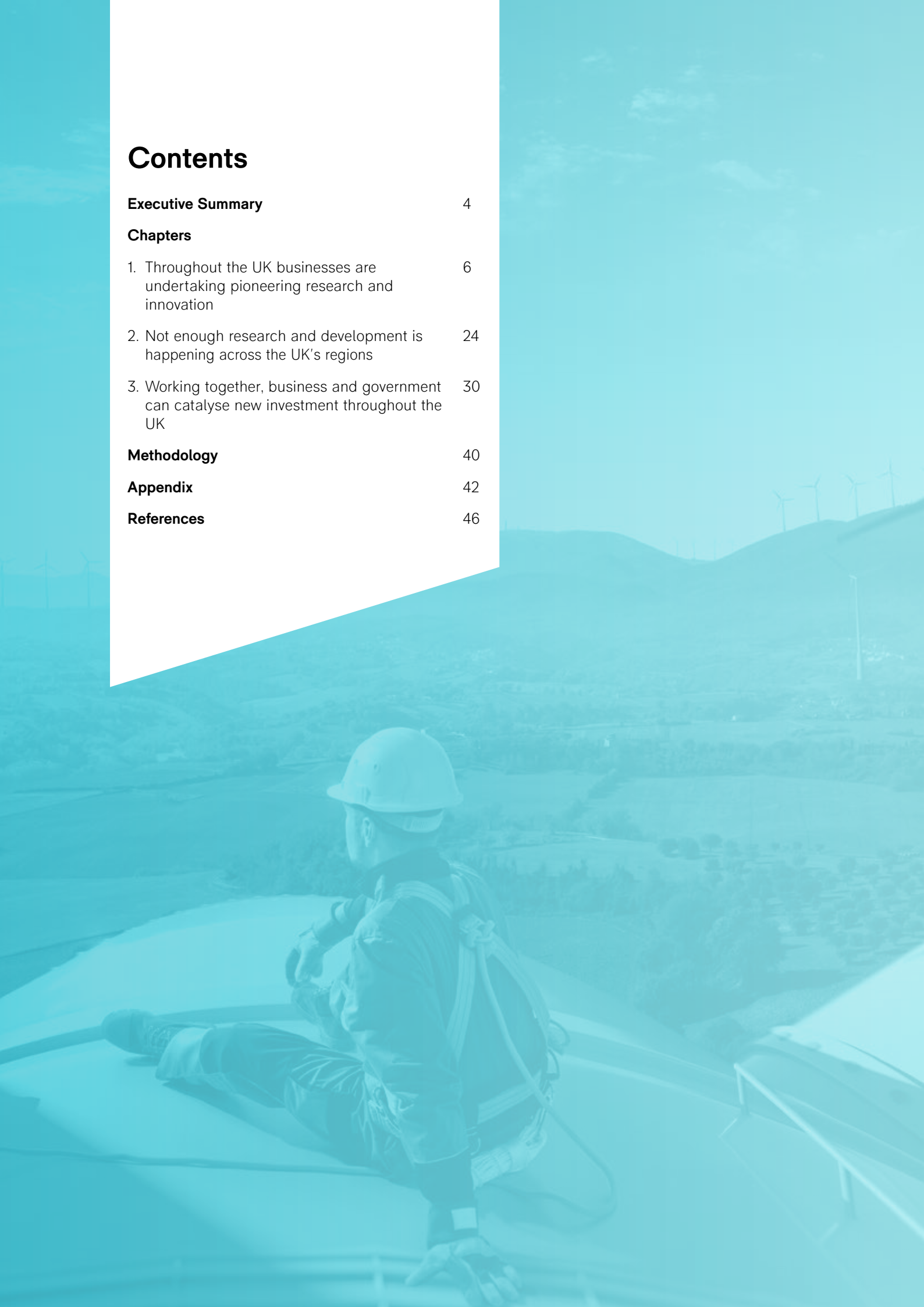
RB's drive to achieve, passion to outperform and commitment to quality and scientific excellence is manifested in the work of over 40,000 diverse, talented entrepreneurs worldwide.

For more information visit www.rb.com

**RB is the trading name of the Reckitt Benckiser group of companies*

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Executive summary

Throughout the UK businesses are undertaking pioneering research and innovation

Across the country are examples of businesses undertaking pioneering research, development and innovation. The projects they are undertaking are frequently high-risk, taking place over long periods of time and with little certainty on commercial potential. But they have radical impact when successful. As well as catalysing new growth markets and high value jobs, business innovation is driving progress on the social challenges of our time and having transformative impacts on everyday lives.

But not enough research and development is currently happening across the UK's regions

UK R&D investment is highly localised. Just three regions account for 52% of UK R&D spend¹ and just five of the UK's forty sub-regions are investing over 3% of GDP² - the cross-party target for national R&D spend. This tail of underperforming regions risks holding back progress in improving the UK's national R&D performance, and with that, progress on regional productivity, competitiveness and growth. While the UK's leading regions will have an important role to play in driving progress towards raising UK R&D spend to 3% of GDP it is unlikely that they alone will be able to accommodate the growth needed to realise the ambition.

Working together, business and government can catalyse new investment throughout the UK

To capture the benefits that flow from innovation-led growth, drive prosperity across the country and realise ambitions to lead the world in challenges like clean growth, healthy ageing, the future of mobility and AI, the UK must take action to catalyse an R&D movement throughout the UK. The size of the prize on offer from doing so is significant. By way of indication, growing R&D across regions could provide a gain of £7.3 billion between 2020 and 2027, closing the gap from reaching government's 2.4% target from £18.3 billion to £16.5 billion.



The next government should take the following steps to catalyse R&D investment and drive prosperity throughout UK:

1. Set out a roadmap for raising UK R&D intensity within its first year of office

- Concerted policy action is urgently needed to turn the dial on the UK's R&D performance. This roadmap should set out a long-term trajectory for government spending and include measures to; ramp up public funding support for Innovate UK, drive innovation through government procurement and push innovation diffusion throughout the economy.

2. Kickstart innovation activity throughout the UK with new 'Catapult Quarters'

- To spur a national R&D movement that capitalises on areas of existing and burgeoning strength government should establish a series of new 'Catapult Quarters' throughout the country.
- Catapult Quarters would be located around anchor institutions like Catapults and Research Technology Organisations (RTOs). They would build on local strengths to incentivise co-location and collaborative activity within designated geographic areas through a targeted benefits and support package, and in some cases regulatory flexibility. This place focussed intervention would serve to accelerate innovation activity around clusters of industrial strength and would represent a bold new approach to innovation policy.

3. Establish robust methods for accountability, monitoring and oversight

- Turning the dial on regional investment performance will require a more concerted focus on evaluating impact and monitoring progress. To support such efforts, UKRI and ONS should work together to develop a new measurement tool to expand the R&D FDI statistics so that it captures regional and sectoral breakdowns of R&D FDI.

Throughout the UK businesses are undertaking pioneering research and innovation

Businesses are the lifeblood of a successful innovation ecosystem

Business is a critical component of the UK's innovation ecosystem. They drive discovery and play an important role in commercialising the brilliant ideas that come from the UK's research base - turning innovative ideas from concept into reality. In the process of innovation, businesses provide key resources and expertise that enable the translation of knowledge into commercial applications. They bring together skills, knowledge, technical resources and financial capital that enable researchers to find real world applications for their innovative ideas. Industry is also an important avenue of funding for the translation of knowledge discoveries into commercially viable products and services – funding £18.7 billion (54%) of all research and development performed in the UK in 2017.³

Throughout the UK businesses are undertaking pioneering innovation that is helping tackle the social challenges of our time

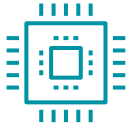
The UK is host to a rich and dynamic array of innovative businesses. Throughout the country businesses are undertaking pioneering innovation that is generating real world impact. Businesses are investing in innovations that are changing industries, creating new high value jobs and helping improve the quality of our everyday lives.

The contribution of business innovation to our well-being and quality of life is significant. Research and innovation help drive a more dynamic and entrepreneurial economy,^{4,5} where knowledge is turned in to commercial success and jobs. This is not just about economic impact though. Research and innovation also lie at the heart of social development and can have enabling social impact.⁶ The invention of the washing machine helped propel women out of household work and free up space for other activities and antibiotics transformed our ability to live longer and healthier lives.

As we look to the future, research and innovation will have an important role to play in driving progress on the social challenges we face as a society. Supporting an ageing population, transitioning to a zero-carbon economy, tackling antibiotic resistance and securing a sustainable food supply will all require significant research and innovation and business will have a central role to play. As the case studies that follow illustrate, R&D intensive businesses are already helping the UK break new ground in areas like renewable energy, the future of battery technology, cybersecurity and healthy ageing.



The UK is host to a range of research and innovation strengths:



Wales is leading in semiconductor technologies

South East Wales is emerging as a world-class centre of excellence in compound semiconductor technologies.⁷ Compound semiconductor products are a key enabling technology that underpin a wide range of technology applications from wireless and 5G connectivity to sensing for autonomous vehicles and healthcare technologies.



Northern Ireland is home to a thriving agri-technology sector

Northern Ireland has an industrial heritage rooted in farming.⁸ Research and development in the sector is being used to develop animal healthcare products and more efficient farm machinery - creating a more productive and sustainable agriculture sector.



The South West possesses the UK's largest aerospace cluster

Home to companies like Airbus, Cobham, Rolls Royce, BAE Systems and Leonardo, the South West is the largest aerospace cluster in the UK and the second largest in Europe.⁹ Aerospace is the fourth largest area of R&D investment in the UK¹⁰ and major focuses of R&D efforts include the light-weighting of aerospace components and decarbonisation through improvements in engine fuel efficiency and propulsion technologies.



The Highlands and Islands is a world leading testbed for tidal devices

The Highlands and Islands is a significant testing environment for wave and tidal devices and has hosted more wave and tidal deployment than in any other location in the world.¹¹ While technologies remain at the early stages of development, the Highlands and Islands' geographical position, with its expanse of coastal waters, make it a prime location for the testing and development of these technologies.



Scotland's Central Belt is at the forefront in quantum technology

Scotland has established itself at the forefront of global efforts in the development and commercialisation of quantum photonics devices. The high concentration of academic and translational assets combined with a 400-strong industrial cluster, provides outstanding potential for positioning Scotland as the go to place for "the development of specialist companies creating new devices and products based on Quantum and Photonic technologies."¹²



The East of England is pioneering the future of life sciences

Cambridge is home to significant clusters in life sciences and information technology. Apple, Google, Microsoft and AstraZenca have all located activities in the area and 16 'tech unicorns' – start-ups worth more than \$1bn – have been created in the city.



The South East is spearheading the UK's space capacity

The South East is home to a growing space cluster centred around the Harwell Science and Innovation Campus.¹³ By offering access to specialist space test facilities and support services, the centre has attracted a number of innovative SMEs and space tech start-ups to locate to the area.¹⁴ The UK space sector has more than trebled in size since 2000 and is R&D intensive sector with 10% of GVA in the industry invested in R&D.¹⁵



The Midlands is fuelling the future of transport

The Midlands have significant industrial and research capacities in automotive, rail and aerospace and is home to significant innovation assets including the Warwick Manufacturing Group and Network Rail's Rail Innovation & Development Centre.¹⁶ Focuses of R&D activities in these sectors include propulsion technologies, carbon emissions and autonomous vehicle technologies.



London is pioneering a new approach to 'civic innovation'

London is aiming to become a 'test-bed' city for civic innovation through an innovation programme sponsored by the Mayor of London.¹⁷ The 'Civic Innovation Challenge' calls on innovators to develop solutions to major civic challenges. Each challenge is sponsored by a leading corporate or public body who help companies test and validate their solutions. This year's programme focuses on three challenges - countering violent extremism online, democratising planning, and making the movement of freight safer, cleaner and more efficient.



The North West is a technology hot spot

A key asset in the North West is The Hartree Centre - a Science and Technology Facilities Council (STFC) funded centre for high performance computing and cognitive computing capability. The centre provides computing capability to a range of industrial users and partner organisations and hosts a number of supercomputing platforms.¹⁸ Key industrial partners of the centre include IBM, Unilever and Atos.



Yorkshire and Humber is supporting the UK's transition to a low carbon economy

The UK is a leading market for offshore wind and Yorkshire and Humber is home to a significant clusters of activity in offshore renewable energy.¹⁹ Organisations in the region have helped pioneer technology that is helping to support cost reduction in offshore wind.²⁰



The North East is at the forefront of efforts to promote healthy ageing

The North East is building a reputation as an international hub for the development of medical science and social research in response to the challenges and opportunities of ageing populations.²¹ The region is host to a thriving life sciences eco-system including innovative NHS healthcare organisations, national centres of excellence and an established pharmaceutical manufacturing sector.²²

New Science and Innovation Centre to be magnet for scientific talent

RB – Yorkshire and Humber



RB provides innovative self-care solutions to help people live healthier lives, to prevent them from falling sick and to help them get well when they do. As a leading health, hygiene and home company, RB has operations in over 60 countries and sells 20 million products a day. Its trusted brands include names such as Nurofen, Strepsils, Lemsip, Gaviscon, Optrex, Mucinex, Durex, Scholl, Enfamil, Nutramigen, Clearasil, Lysol, Dettol and Veet.

By investing in R&D, RB is innovating in consumer health, developing the next suite of consumer health solutions and playing a role in alleviating healthcare challenges. A recent example is the development of the first and only over-the-counter Ibuprofen adhesive plaster. The patented technology enables the continuous delivery of Ibuprofen, into the body through the skin to continuously target pain and inflammation at the source for 24 hours. The clinically proven plaster therefore provides targeted relief from muscular pain and tenderness for up to 24 hours with a single patch. The plaster was developed with the consumer in mind. It has been designed to deliver superior efficacy, be easily applied, to be discrete and flexible for added comfort and, unlike pain relieving gels, the product has no overpowering smell, is mess free and will not stick to clothes making it the ideal 24-hour product. The Nurofen 24-hour medicated patch was voted product of the year (pain relief category) in the Consumer Survey of Product Innovation 2019.

Many of RB's products are researched, developed and exported from RB's UK R&D and manufacturing sites. RB has a 179-year local heritage in Hull and has recently invested £105 million in a new Science and Innovation Centre (S&I Centre). Supported by £6m funding from the Department for Business Energy and Industrial Strategy's Regional Growth Fund, the S&I Centre combines a vibrant office environment with state-of-the-art facilities that put RB, and the region, at the forefront of consumer health innovation. The investment marks a major investment in the region and 200 new jobs have been created in Hull because of its investment programme at the site.



Driving transition to a low carbon energy system

Aura – Yorkshire and Humber



Aura, a collaboration led by the University of Hull, brings together industry partners in the Humber region to harness and drive innovation in the offshore wind sector to drive transition to a low carbon future. Partners include Ørsted, Siemens Gamesa, Offshore Renewable Energy Catapult, National Oceanography Centre, the universities of Sheffield and Durham and the Humber Local Enterprise Partnership.

At the centre of the initiative is the Aura Innovation Centre (AIC), a new £14million centre that will support innovation for offshore wind energy and wider low carbon sectors. By addressing key technical, operational and economic barriers the centre will seek to seize the advantages of offshore wind energy and the key role that will play in a future of low carbon and clean growth. It will enhance the development of the supply chain and associated businesses and sustain the UK's status as a world leader in offshore wind.

The University of Hull won funding of £4 million from the European Regional Development Fund to build the new centre which has been matched by £5.5 million of funding from the University. Over £1.1 m of cutting-edge research facilities are being installed into the centre, including a state of the art printed circuit board suite, augmented reality and large green screen area, virtual reality capabilities, materials characterisation suite, high tech 3D printers capable of printing recycled plastic, carbon fibre and metal as well as a mechanical workshop area.

The world's largest offshore windfarms are being developed off the Humber coast and the development and presence of the AIC will strengthen the region's international standing as a centre of excellence in offshore wind innovation.



Supporting human health through nutritionally enriched food products

Devenish – Northern Ireland



Devenish is a global agri-technology company based in Belfast, supplying quality animal feeds and nutrition for the pig, poultry, ruminant and companion sectors. The R&D portfolio at Devenish focuses on the 'One Health' agenda, a philosophy that health should be simultaneously optimised for animals, humans and the environment.

An example of recent R&D has been the development of the most efficient diet and management regime to naturally enrich chicken meat with an algal source of omega-3 fatty acids, normally found in marine animals such as oily fish.

The development of this product could have notable public health benefits by helping to combat nutritional deficiency. Omega-3's are strongly and consistently associated with protecting people from heart attacks, strokes, Alzheimer's disease, depression, cancer, diabetes mellitus, and improved brain health – all leading causes of death and disability in the UK. However, the majority of the world's population does not consume enough Omega-3 in their diet.

The positive impact of Devenish's 'OmegaPro' products has been demonstrated through trials conducted to scientifically publishable standards, with consumption leading to a 70% reduction of people with a high-risk Omega-3 index – a risk factor associated with heart disease.

Harnessing the power of Artificial Intelligence to enhance cyber security

BT – East of England



As a global network operator, BT's security teams are in a unique market position to comment on the importance and evolution of AI technologies. The company have 16 security operation centres worldwide analysing traffic and data flows, on average processing around 3.6 billion events per hour on our cyber security platform. The security teams use AI to monitor and analyse this vast volume of data, allowing us to identify current threats, and even use predictive analytics to detect incoming cyber-attacks before they are realised. BT research has led to the development of Nexus, an AI-driven tool powered by artificial neural networks, which can be used as one of the first warning signs for analysts facing a potential attack. Innovation around Visual Analytics tools also allows BT analysts to contextualise results, widen their search fields, study the behavioural patterns of advanced persistent threats (APTs) and affect underlying algorithms.

In the longer term, as AI continues to develop, it will become better able to learn from successful responses to cyber-attacks, allowing it to become 'self-healing' and dynamically replicate the best defence strategies designed by human analysts. Throughout these developments, the main benefit will be the enablement of 'augmented intelligence' – whereby human experts can utilise the capabilities of AI to dramatically increase their speed and efficiency, and ultimately focus on more complicated investigations. AI already has a huge role to play in keeping the UK cyber secure at home and a leading exporter of cyber security overseas. As the UK's leading registrar of AI patents, BT therefore welcomes the emphasis Government continues to place on the potential of AI in the UK.



Campus is home to £2 billion of world leading research infrastructure

Harwell Science and Innovation Campus – South East



The Harwell Science and Innovation Campus is an entrepreneurial ecosystem and home to £2 billion of world leading research infrastructure across 710 acres of South Oxfordshire. It hosts over 200 organisations, employing over 5500 people of 60 nationalities.

The Science & Technology Facilities Council (STFC) provides stewardship to the Harwell Campus and enables world leading science through its facilities including RAL Space, Central Laser Facility, ISIS Neutron Source and Diamond Light Source. The facilities support a vibrant community of academic and industrial research users from university groups to large corporates, SMEs and start-ups. Harwell Campus is also home to the MRC Harwell Institute, Public Health England, the European Space Agency and the Satellite Applications Catapult.

The Campus drives multidisciplinary innovation by actively facilitating collaboration locally, nationally and internationally through its sector specific Clusters, which are currently Space, HealthTec and EnergyTec. Each Cluster brings together public organisations, industry, and academia to enable economic growth across the UK.

Companies within the Clusters include: spin-outs from STFC, such as MIRICO which has taken spectrometers developed for space to the oil and gas industry; SMEs such as Rezatec and Open Cosmos that were incubated in the European Space Agency Business Incubation Centre UK; rapidly scaling up companies, like Oxford Nanopore, which recently opened a high-tech manufacturing facility having developed its processes in STFC lab space; as well as multinationals that want to engage with the innovation taking place on a daily basis.

Harwell's vision is to be one of the world's largest and most important science and innovation campuses, where extensive and exciting multi-disciplinary opportunities drive economic growth across the UK.

Innovative low energy insect traps generate £40m revenues

Rentokil – South East



Rentokil is the world's leading commercial pest control company and has invested in the UK to create a global centre for innovation and training. In 2013, Rentokil's innovation team began to work on developing a new solution that would set the highest standard in flying insect control with the lowest environmental impact. Flying insects such as fruit flies, drain flies and house flies can transmit a multitude of different pathogens, making them a persistent problem across many industries.

Rentokil's R&D culminated in the launch of Lumnia - the world's first range of insect light traps to use LED lighting rather than traditional (and heavy energy consuming) fluorescent tubes. Lumnia's LED units use 61% less energy compared to traditional units – passing on the environmental benefits and associated cost reduction to our customers. At night, Lumnia units will automatically adjust to lower light levels ensuring maximum performance but with lower energy usage, cost and emissions than traditional units. Lumnia also avoids the significant waste burden of traditional fluorescent tubes by not using mercury.

Since launch over 88,000 Lumnia units have been sold in over 40 countries with sale revenues estimated to be over £40m to date.



New mineral technologies reduce energy costs and carbon footprints

Imerys Minerals – South West



Imerys Minerals Ltd (IML) is a subsidiary of Imerys, the world's leading supplier of industrial minerals. Located in mid-Cornwall and Devon, IML's activities focus on Kaolin (China Clay) extraction and processing - with the UK being the world's 3rd largest producer and exporter of Kaolin after Brazil and the USA.

Imerys has a global network of R&D centres and it's St. Austell technology centre develops innovative and ready-to-use solutions for industry - transforming a large variety of minerals into high value specialty products. Recent developments have included: an 'opacifying extender' that reduces paint manufacturers reliance on titanium dioxide - reducing costs and carbon footprint; ultra-white roofing granules for reflective roofs - decreasing the need for air conditioning in summer; and functional filter aids for biodiesel purification.

IML also recently joined a European INTERREG consortium "UrbCon" which explores the use of post-industrial mine waste to address the long-term need to lower the environmental impact of cements and concretes. The research focus of the group reflects current societal challenges for the circular economy, urbanisation and the provision of sustainable raw materials.





Government support helps enable new technological development in semiconductor technologies

IQE plc – Wales



IQE plc is a UK headquartered semiconductor manufacturer of wafer products – a technology that underpins a wide range of technology applications, from wireless and 5G connectivity, to optical communications and sensing for autonomous vehicles and healthcare technologies.

Located in Cardiff, IQE has become a world leader in the compound semiconductor industry and is a key partner behind, CSconnected, a cluster of Universities, R&D centres and businesses, that is helping to establish South East Wales as world-class centre of excellence in compound semiconductor technology.

IQE's R&D activities have been key to the company's success and is essential for maintaining and growing technology leadership. The company has a long history in collaborative research and has participated in a number of government funded programmes such as Horizon 2020, Welsh Government (SMART) and Innovate UK calls. Government funding support has enabled collaborative research in a number of key technologies that continue to evolve. Examples include the VCSEL (laser) where IQE developed world leading capabilities in the technology that underpins 3D sensing deployed in smartphones. The seed research led to the development of advanced optical interfaces such as 'pseudo-quasicrystals' which have a wide range of potential commercial applications.



Pioneering solutions to regulatory change in the financial services sector

Hogan Lovells – London



Libor is the single, most costly, repapering exercise any financial institution will have to face. In the years post LIBOR, institutions are facing costs in the region of millions of pounds to tackle the significant legal and administrative challenge of repapering.

In 2019, Hogan Lovells became the first law firm to package and offer a single end to end LIBOR solution at the cutting edge of alternative delivery solutions in collaboration with FTI Consulting and Cogna Law.

Dubbed Hogan Lovells Engage: LIBOR, the innovation combined our expertise with legal project management and advanced technology to offer a cost-effective 'one-stop-shop' for clients preparing for the discontinuation of LIBOR post-2021. It can also be used in conjunction with the transition of other benchmarks such as EURIBOR.

The Artificial Intelligence-based process uses stacked and fully integrated technology including Kira, Ringtail and Contract Express alongside Hogan Lovells' legal expertise and FTI's Contract Intelligence offering. It reduces major time, cost and expense involved in managing complex repapering requirements (a minimum of 30% but increasing as the number of documents grow to the region of 70%) by combining complementary technologies and teaching them to "talk to each other" to deliver a complete solution rather than clients having to use a series of 'standalone' tools.

Owen Mumford files 175 patents in medical device design

Owen Mumford – South East



Owen Mumford is a global leader in medical device design and manufacturing with a commitment to innovation and the environment. With a strong Research and Development (R&D) function, Owen Mumford successfully identifies challenges with existing devices and where possible develops innovative products to address unmet customer needs. This passion to innovate has led to 175 patents being filed, a Queens Award for innovation, and the invention of the next generation of safety pen needle Ateria® SafeControl®; a medical device designed to protect healthcare professionals from needlestick injuries during the injection process and provide confidence in delivering a full medication dose.

As a family owned company, environmental responsibilities are deeply anchored in operations throughout Owen Mumford. With any invention Owen Mumford is always assessing ways in which it can reduce its environment impact and as such some of Ateria® SafeControl®'s components are made with materials (polypropylene) that can be recycled after use.



Company grows to become leading laser supplier following collaboration with University

University of Glasgow – Scotland



A long-running R&D collaboration between University of Glasgow optoelectronics researcher Professor Tony Kelly and Compound Semiconductor Technologies Global (CSTG) enabled the company to transform their business model and expand, through a shift to offering products rather than services. The partnership began by focussing on delivery of a high-performance, low-cost laser device for next generation optical access networks, followed by additional novel products for rapidly expanding home and datacentre markets. Through these outputs, CSTG has grown to become Europe's leading laser supplier, with an 88% turnover increase between 2016-2017. Work broadened to include other products and CSTG was able to enter the Asian market for the first time. The partnership is marked by the seamless flow of graduates, knowledge and expertise between the company and the University for over a decade. The innovative technologies successfully co-produced have enabled CSTG to move up the value chain as a supplier of higher-profit-margin products. On the back of this, CSTG is now one of the world's top semiconductor laser suppliers, with a large share of the market in the US, China and India. CSTG's strong performance and clear potential for additional growth led to its 2017 acquisition by Sivers IMA.

Professor Kelly's initial research was supported by EPSRC (Engineering & Physical Sciences Research Council), enabling understanding of device behaviour and capability to simulate/design devices according to the intended application. Funding mechanisms supporting the long-running work with CSTG included a Knowledge Transfer Partnership focussed on delivering the first product. Work on advanced etching led to Innovate UK funding that resulted in significant manufacturing advances for CSTG, with the potential to become ubiquitous in their products. Additional Innovate UK funding followed, and an EPSRC Impact Acceleration Account grant supported Professor Kelly's secondment to CSTG to develop capability in the 25Gbit/s laser market.



Enabling a more efficient use of airspace

Winsland - London & Scotland



Winsland is focused on delivering high quality aviation consultancy services, with particular expertise in the performance, business and operational aspects of air traffic control, airports and security.

Spotting an opportunity to accelerate flight routing savings, Winsland created a 'big data' model to optimise the 4D positions of military airspace reservations against civil flight routes. The concept builds on changes to the 'flexible use of airspace' developed under the European 'SESAR' air traffic control modernisation programme. As well as helping to ensure military exercises can work safely and efficiently alongside civil flights, the work has the potential to reduce aviation fuel burn by 1% or more through an information feed to military mission planners. At the European level this equates to 1-2M Tonnes of CO2 savings per year, or the equivalent of removing 1 of Heathrow's runways.

Winsland were awarded a T-TRIG grant from the DfT to develop the project. The grant significantly accelerated the work and helped communicate its credibility given DfT role in aviation policy development. The company also received support from Scottish Enterprise and L3C Cloud who provided Winsland access to their high-performance computing.

Business-University collaboration helps councils improve highway maintenance

University of Leeds – Yorkshire and Humber



Dr Phill Wheat from the Institute for Transport Studies at the University of Leeds is helping local councils to improve highway maintenance. By investing in the performance benchmarking statistical tool developed at Leeds, councils are able to drive down costs while maintaining quality and improving customer satisfaction.

Together with performance and benchmarking company measure2improve (m2i), Dr Wheat set up the Cost Quality and Customer (CQC) Efficiency Network. They found that the 92 participating local authorities in 2018/19 made savings of £106.5million a year, compared to what they would have costed had they still been using practices from 2013/14.

The tool provides local authorities with a single reliable measure of performance that allows them visibility of cost, quality and customer perception. In developing the tool, Dr Wheat drew on the work he had completed for the Office of Rail and Road where he found a 37% efficiency gap in relation to rail infrastructure costs and operations, when compared with international best practice. This resulted in annual efficiency targets being set for Network Rail which constrained Network rail to reduce costs from £18.2 billion to £15.8 billion over five years.

To enable a collaborative approach to the highway maintenance benchmarking tool, a network of trust was built between different councils. The CQC Efficiency Network is a forum where best practice is shared, yet confidentiality is respected. In order to make the network effective, Dr Wheat and representatives from m2i ran workshops across the country to explain the benefits of the tool.

The flourishing relationship with m2i and the growth of the network has led to the creation of two roles: a postgraduate researcher at the University and a Network Account Manager at m2i. This exemplifies that working in partnership with the University can lead to business growth and that collaborative projects which are funded initially, can become self-sustaining over time.

The CQC Efficiency Network was made possible by funding from the EPSRC Impact Acceleration Account (IAA). This funding maximises the contribution that engineering and physical science research makes towards new innovation to enable efficient business operation.

Not enough research and development is happening across the UK's regions

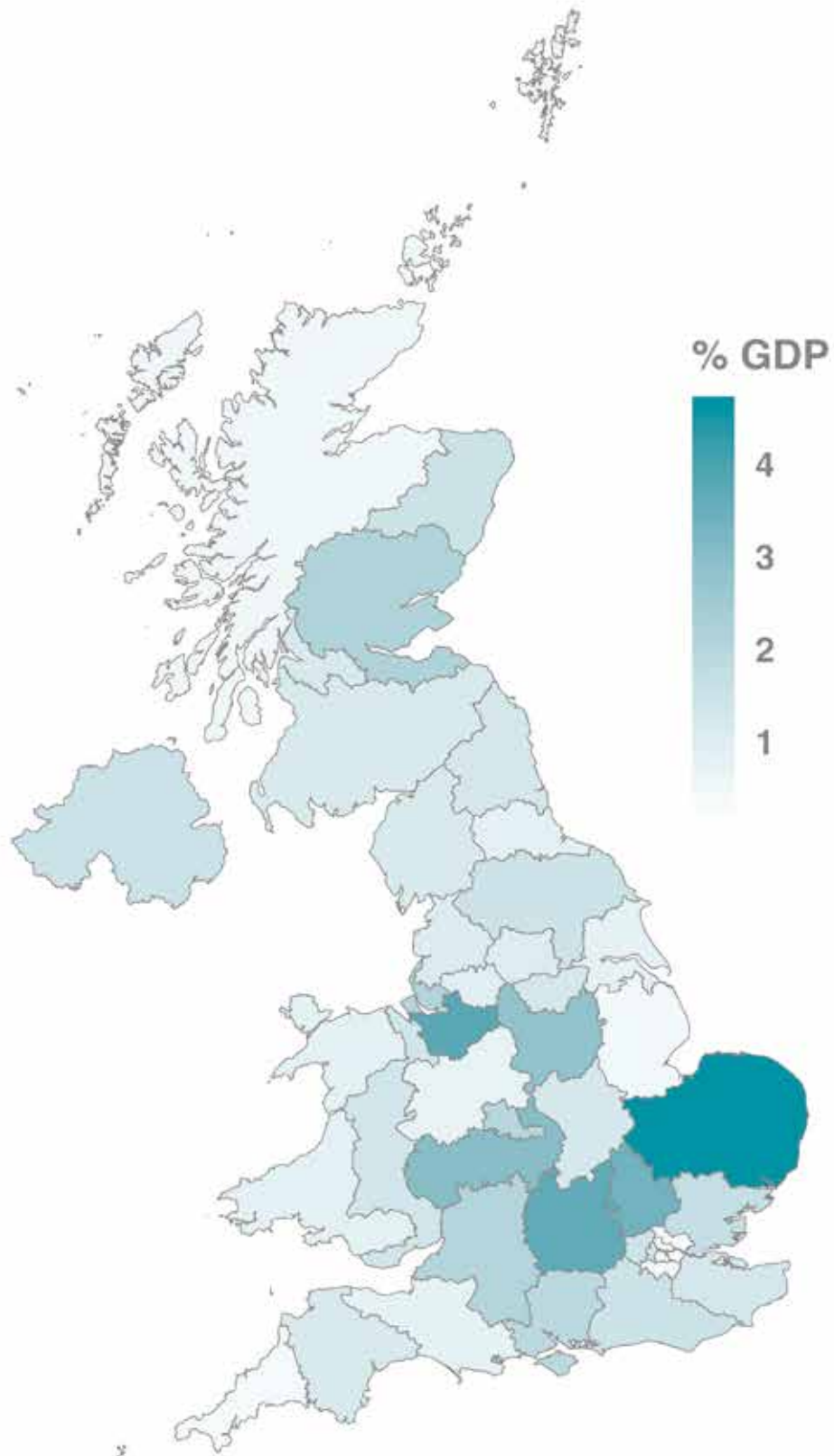
R&D investment is lagging in many parts of the country

The UK is home to innovative clusters like 'Silicon Fen' and the Harwell Science and Innovation Campus which are internationally renowned as centres of research excellence. However, the geographical spread of research expenditure in the UK is highly localised. As it stands, the majority of UK R&D is heavily concentrated in just three regions – the South East, East of England and London – which together account for 52% of total UK R&D.²³ Across much of the rest of the country investment levels are then largely underweight. As **Exhibit 1** lays out, just five of the UK's 40 sub-regions are currently investing over 3% of GDP in R&D and only six are investing at or above the government's target level of 2.4%.²⁴ By contrast 12 sub-regions are currently investing less than 1% of GDP and more than 26 are investing less than 1.5% of GDP.

This tail of underperforming regions risks holding back progress in improving the UK's national R&D performance. While the UK's leading regions will have an important role to play in driving progress towards raising UK R&D spend to 3% of GDP it is unlikely that they alone will be able to accommodate the growth needed to realise the ambition and there are concerns that only focussing on areas of existing high R&D intensity would be an economically inefficient approach.²⁵

The scale of the UK's regional disparities is also problematic for broader regional economic development objectives. R&I can be a driver of local economic impact.²⁶ Collaborative industry projects can spur the creation of innovative clusters that drive local economic impact and the creation of high-quality jobs. And the benefits of university R&D are often transferred into the local economy through the creation and development of spin-off companies. However, the highly localised nature of UK R&D spend in the South East means that many regions are not benefiting from innovation-led growth.

Exhibit 1 Gross expenditure on R&D 2016 by UK NUTS II region (% GDP)



Source: CBI analysis based on Eurostat (2019) Intramural R&D expenditure (GERD) by sectors of performance and NUTS II regions

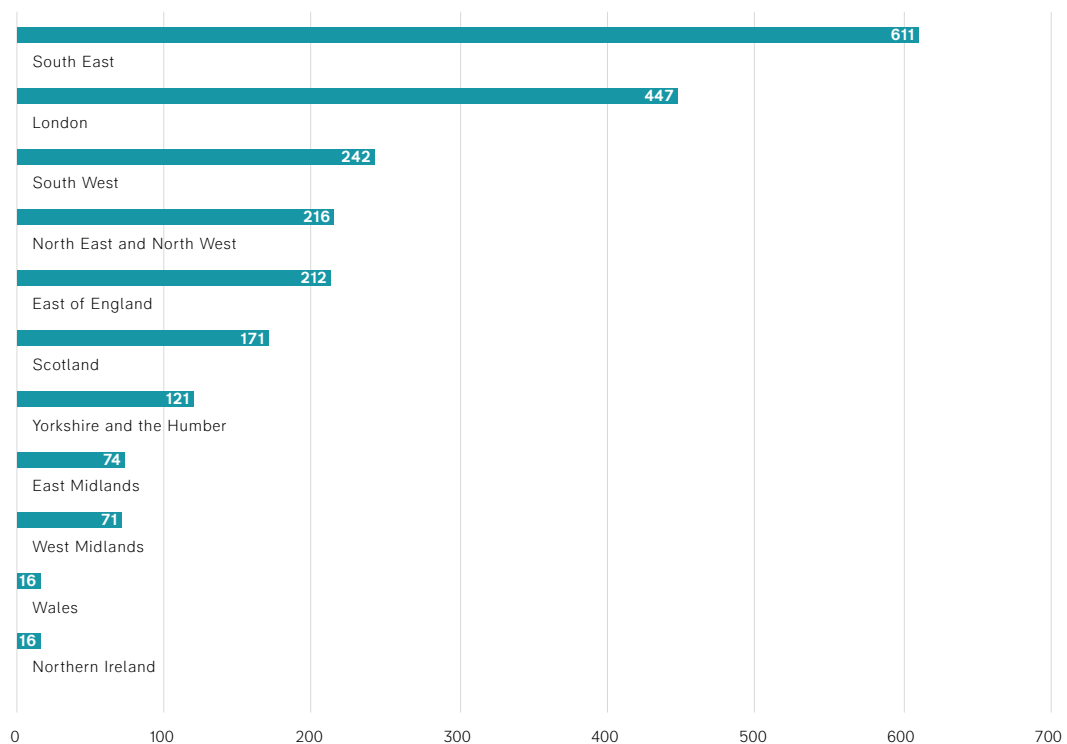


Public funding support is unevenly spread across the country

Alongside disparities in the spread of research expenditure considerable differences also exist in the amount of government and research council funding that is awarded to different regions. As **Exhibit 2** shows, public funding for R&D is heavily concentrated in London and the South East and more limited across the rest of the UK. For instance, in 2017 London and the South East attracted more funding than the next six highest spending regions combined.

Supporting research excellence is an important principle for allocating government funding support. But the current geographic imbalance in research funding risks inhibiting the potential for growth of new innovative capacity in other parts of the country. Alongside supporting excellence, efforts need to be made to support the development of emerging innovation capability. This will require a bigger, more concentrated focus on delivering place-focussed initiatives.

Exhibit 2 Government & Research Council Funding, ONS 2017



Source: CBI analysis based on ONS (2019) Gross domestic expenditure on research and development, UK: 2017

The UK's national R&D performance falls short

The UK's regional investment picture contributes to insufficient national investment in R&D. National investment levels currently stand at around 1.7% of GDP – below the OECD average of 2.4% of GDP and well behind comparator countries like Germany and Belgium who spend close to 3% of GDP.²⁷ The gap between the UK and its international competitors is also getting bigger. While UK investment levels have remained static at around 1.7% for the last 30 years, other countries have been putting in place targeted strategies to drive up national investment levels. In the last decade South Korea has grown investment by 1.5% of GDP and Austria by 0.74% of GDP.²⁸

This stalling R&D performance poses problems for the UK's future growth, productivity and global competitiveness. Between 2000 and 2013 R&I is estimated to have accounted for 40% of productivity gains in the UK.²⁹

International experience suggests that shifting the dial on the UK's R&D performance will require a national R&D movement

International experience shows that it is possible to drive up investment in underperforming regions and suggests that it may be difficult to reach the 2.4% target without stimulating investment throughout the UK. Austria, Czech Republic, Portugal and Denmark have each achieved significant increases in R&D spend in the last two decades and in each case meaningful increases in investment were delivered throughout the country or in regions that were previously underperforming.

Austria for instance grew R&D investment from 2.17% to 3.05% between 2004 and 2015 with spending growth that was split relatively evenly between the country's three geographical regions.³⁰ Around 31% of the increase was delivered by the country's highest performing region, Eastern Austria, while the rest was delivered by Western Austria (39%) and Southern Austria (30%).³¹

The Czech Republic meanwhile raised R&D spend from 1.15% to 1.97% of GDP between 2004 and 2014. Approximately 33% of the increase was delivered by the country's highest performing region, Praha, but the rest of the increase was driven by significant increases in investment in lower performing regions.³² Regions like Strední Morava, Jihovýchod and Jihozápad delivered significant increases in spending as a proportion of the existing base.

In the cases of Portugal and Denmark growth was not as evenly spread across all regions but significant increases were achieved outside of the highest performing regions. Portugal, for instance, raised investment from 0.72% of GDP in 1999 to 1.58% in 2009.³³ Much of this was delivered by the country's top performing region, Lisboa, but considerable increases were also achieved in the Centro and Norte regions. The latter for instance experienced a 720% increase in investment in the region over the period and delivered 32% of the country's overall spending increase. Similarly, Denmark's Syddanmark region grew by 150% between 2007 and 2016, delivering 22% of the country's overall spending increase over the period.³⁴

Various EU countries pursue regionally focussed innovation policies

There are various international examples of innovation policy interventions focussed on developing regional clusters and growing regional investment:

Germany – ‘InnoRegio’ programme

Germany's InnoRegio programme aimed to enhance regional development and competitiveness in East Germany. Conducted between 2001 and 2006 the programme provided financial funding support for company research projects as a way to support the development of innovative clusters. A 2013 policy evaluation study suggested that the intervention was effective in strengthening the regional economic environment and delivered lasting economic impact.³⁵ Participating firms showed increases in the employment of R&D personnel and innovation activity as measured through patent applications.³⁶

France – *Les Pôle de Compétitivité*

France's 'Competitiveness Cluster' programme brings together firms, research laboratories and educational establishments in a defined territory to develop synergies and cooperation around a shared field. The programme aims to encourage collaborative R&D, stimulate the creation of new businesses, bring private and public sector bodies closer together, support regional development and improve the attractiveness and competitiveness of France.³⁷

Special public support is provided to the clusters through the Inter-ministerial Unique Fund (Fonds Unique Interministériel) including; help with setting up domestic and international partnerships, funding loans and grant funding for collaborative R&D projects undertaken in the territory of a cluster.

A significant example is Aerospace Valley – a cluster of 869 aerospace engineering companies and research centres located across South West France and Europe's largest aerospace cluster.

Evaluation of the programme has found a positive leveraging effect of clusters on the financing of R&D performed by member companies - companies involved in a cluster invested more in research and development than others.³⁸

Innovative clusters driving local economic impact in the UK

Various examples show how joined-up action between government, business and universities can support the development of successful innovative clusters that can drive local economic impact in economically lagging regions.

The Advanced Manufacturing Research Centre has attracted high-value industry to Yorkshire

The University of Sheffield's Advanced Manufacturing Research Centre is a cluster of research and innovation centres conducting industry-focussed research in advanced machining, manufacturing and materials. The centre employs over 500 researchers and engineers who work alongside industrial partners on projects that are of practical use to industry.

Since being set-up in 2001 the centre's operations have grown significantly and helped the revitalisation of the industrial landscape of an economically lagging region by attracting high-value industry to the region.³⁹ Large multinationals that have located research and development activities in the region in order to partner with the centre include Boeing, Rolls-Royce, McLaren and BAE Systems.

Warwick Manufacturing Group has helped drive the revitalisation of the automotive sector in the West Midlands

The Warwick Manufacturing Group was founded in 1980 to help businesses overcome barriers to innovation. Based at Warwick University the group comprises of a cluster of research and innovation centres focussed on facilitating knowledge transfer to the automotive and aerospace industries.

The group is considered an international role model for how universities and business can successfully work together. Through partnerships with industry players like Jaguar Land Rover the group has developed a critical mass of research and development capability which has attracted firms to locate activities in the UK and helped drive the revitalisation of the automotive sector in the region.⁴⁰

Working together, business and government can catalyse new investment throughout the UK

Government support plays a crucial role in enabling business R&D

Successful business innovation is the product of a variety of factors. Alongside commercial entrepreneurship and access to a vibrant knowledge base, businesses also require access to skills, funding, collaborative opportunities and testing infrastructure to be able to turn knowledge in to fully commercial propositions. Government plays a crucial role in creating these enabling environments:

- **Sharing risk** - Business R&D is an inherently risky activity for firms. Projects often require significant investment and take place over long periods of time with little certainty on commercial potential. Government financial incentives and funding support helps de-risk investment and can make all the difference for firms with limited resources.
- **Providing skills** - The ability of a company to identify, understand and exploit knowledge developed in other parts of the innovation ecosystem relies on having people with the right skills. Government can play an important role in ensuring there is a talent pipeline with the right mix of STEM and technical skills.
- **Facilitating collaboration** - Research is an area that needs collaboration in order to thrive. Collaboration gives organisations access to a broader range of expertise, knowledge, assets and capabilities than businesses can hold by themselves internally. Government can help spur collaboration through international science and research agreements and frameworks that help address barriers to collaboration like KTPs and the Lambert toolkit.
- **Developing infrastructure** - Before being taken to market, commercial propositions often need to be extensively tested and demonstrated in real world environments. Innovation may work in laboratories and controlled environments but may fail when tested in real world conditions. This late-stage development activity is often costly and relies on capital intensive facilities. Single firms can therefore be unable to make the large investment needed to undertake testing in real world environments. Government can help mitigate this market failure by providing funding support for the development of open access testbed and demonstrator facilities.

Testbeds & demonstrator facilities are key enablers of late-stage research and development

Testbed & demonstrator facilities provide environments for companies to test and demonstrate their technological innovations in real world conditions. They enable companies to validate the technical viability of a product and de-risk the development process by providing environments for experimentation.

As well as advancing technological development, local areas can also achieve significant competitive advantages by facilitating the testing and implementation of frontier technologies.⁴¹ Testing sites can be a pull factor in attracting internationally mobile investment and can also become the location for companies' broader commercial activities.

Testing industrial use cases for 5G

Worcestershire 5G consortium is an industrial 5G Testbed trial funded through government's 'Testbeds and Trials Programme'.⁴² The consortium of partners includes local infrastructure providers, national network operators and research and development facilities. Based at Malvern Hills Science Park, the Testbed provides a platform for businesses to test and demonstrate next generation technologies using the improved network technology. For instance, Worcester Bosch have been using 5G access to experiment with machinery fault detection and preventative maintenance technologies throughout their Worcester factory.⁴³ This is enabling them to react in real time to events happening throughout the factory and to predict machinery failure. QinetiQ meanwhile have been using the testbed to advance 5G security services.

Trialling connected and autonomous vehicles in real-world urban environments

Autodrive was a three-year project that trialled the use of connected self-driving vehicles on the streets of Milton Keynes and Coventry.⁴⁴ The collaborative project had a total budget of £19m, jointly funded by government and industry, and was undertaken by a consortium of members including universities, industry, local authorities and the Transport Systems Catapult.

The project enabled members to make major progress in their respective autonomous vehicle capabilities and helped highlight a number of remaining challenges that will need to be addressed in future trials of autonomous vehicle technology.

Beyond the trialling of capabilities, the project also explored wider issues relating to their deployment – from the implications of adoption on congestion, and the legal, ethical and public acceptance issues that might challenge the technology's success.



Working together, business and government can help spearhead a national R&D movement, stimulate new growth opportunities and cement the UK as a global innovation frontrunner

Positioning the UK as global innovation frontrunner must be a high order priority for government. As this report has shown, research and innovation enables a multitude of social and economic benefits and will underpin progress on the social challenges of our time. But not enough is happening. Investment in R&D needs to be scaled up at material scale if the UK is to capture the benefits of innovation-led growth and realise ambitions to lead the world in challenges like clean growth, healthy ageing, the future of mobility and AI.

Industry investment will have a critical part to play in accelerating new investment throughout the UK, but this will not happen by and of itself. Government support will be needed to leverage new private sector investment, facilitate the development of innovative clusters and attract new investment to the UK.

The size of the prize on offer is significant. A place-based approach to raising UK R&D intensity represents an opportunity to turn the dial on UK's R&D performance while supporting the development of new innovation capacity throughout the UK's regions and nations, driving growth, employment and regional competitiveness. By way of indication, a small increase in R&D intensity across regions could be worth a cumulative gain of £7.3 billion in R&D spend between 2020 and 2027.^I With the government estimated to be £18.3 billion off the 2.4% target in 2027, this gain could see the gap narrowed to £16.5 billion in 2027.^{II}

I International experience shows that significant gains in R&D activity can be realised by ensuring there is growth in R&D across all regions. Applying this to regions in the UK provides an indication of the potential growth rates for the worst, middle and best performing regions on top of their forecast growth rate based on historical performance. The analysis uses average annual R&D growth rates across Czech Republic, Denmark and Portugal to measure the ability of the worst and best performing regions to increase R&D spend. This shows that the best performing regions will increase their capacity (on top of their average forecast growth rate) by less than the worst performing regions since they are likely to be spending closer to their capacity. Additional growth rates (in addition to the forecast growth rate) were assumed to be 1% for the worse performing regions, 0.5% for medium performing regions and 0.3% for the best performing regions. The analysis has been cautious on the assumptions governing how much capacity there is available for regions to increase their R&D intensity and therefore were capacity to be increased further, the gain could be much higher.

II The analysis is based on the same methodology in "Untapped Investment" where CBI analysis estimated the gap from reaching the 2.4% target at £19 billion. This figure has been updated to reflect the latest data available.

The next government should take the following actions to catalyse R&D investment across the UK

1. Set out a roadmap for raising UK R&D intensity within its first year of office

Concerted policy action will be needed to turn the dial on the UK's R&D performance. This roadmap should set out a long-term trajectory for government spending and include steps to:

Ramp up public funding support for Innovate UK

- Raising UK R&D intensity will require significant increases in industry investment. The private sector spends nearly twice as much as government on R&D and international examples show that significant changes in country R&D intensity have only been achievable through substantial increases in industry investment.⁴⁵
- Resource allocated to the UK's main funding arm for business innovation, Innovate UK, is underweight in comparison to the resource dedicated towards the rest of the research councils. Innovate UK's budget is also low in comparison to funding channelled through innovation bodies in other European countries.⁴⁶
- Government should grow funding towards business R&D by allocating 10 per cent of public R&D funding towards a reinvigorated Innovate UK. Increased levels of funding for Innovate UK would provide resource to leverage the business R&D investment needed to grow UK R&D intensity and better fund place-based initiatives like the 'Strength in Places' fund.

Drive innovation through government procurement

- Public procurement is an important lever for driving innovation. With government being such a powerful buyer in the UK economy, its actions can stimulate demand for new technologies, creating marketplaces that induce the development of innovative new products and services. Yet CBI surveys have shown that only 5% of businesses agree that current public procurement processes in the UK incentivise innovation.⁴⁷
- To combat this, public sector commissioners must look to place innovation at the heart of their commercial strategies, wherever possible, and champion an approach to contracts which can support more innovative solutions.

Push innovation diffusion throughout the economy

- One way to drive a bigger market for innovation is to ensure more firms are purchasing new technologies themselves. However, diffusion of innovation through the economy constitutes a blindspot in UK public policy for innovation. UK businesses suffer from a 'failure to adopt' with many UK businesses failing to take-up readily available technologies and management best practice.⁴⁸
- The launch of the Business Basics fund⁴⁹ was a good first step to help encourage technology adoption. Going forwards government must work with business to lead a long-term change in the UK's adoption of technology and management best practice. Government should issue a call for evidence into how the tax system can be used to increase the adoption of digital technologies by business.

2. Kickstart innovation activity across the UK with new 'Catapult Quarters'

A new concept for accelerating cluster development

- To spur a national R&D movement that capitalises on areas of existing and burgeoning strength government should establish a series of new 'Catapult Quarters' throughout the country. Catapult Quarters would build on local strengths and encourage co-location and collaborative activity within designated geographic areas through a targeted benefits and support package.
- Catapult Quarters would be set up around clusters of existing or fledgling industry activity and would be attached to anchor institutions like Catapult centres or Research Technology Organisations (RTOs). For instance, a candidate area could be the semiconductor cluster in the South of Wales. To drive local engagement and buy-in, quarters would adopt locally driven governance models run by industry member organisations, Catapults and LEPs.
- The purpose of the quarters would be to incentivise organisations to co-locate and develop territorial synergies around shared collective themes such as renewable energy or space tech. The longer-term objective would be to foster development of entrepreneurial ecosystems that enhance UK innovation capacity and international competitiveness.
- Catapult Quarters would be agreed through a competitive bidding process. Community interest groups, such as LEPs, Combined Authorities, Catapults and industry stakeholders, would make the case for why a quarter is appropriate for their area, setting out their strengths, capabilities and ambitions. Central government would then have responsibility to award the Catapult Quarter designation to the most competitive bids.

A comprehensive support and incentives offer

- Catapult Quarters would incentivise co-location and collaboration in a local area through a special public-sector package of wrap-around support for member organisations. This support package could include:
 - o Business liaison services, including dedicated account managers, focussed on supporting the onboarding of new members and helping members to set up collaborative partnerships and access funding support. These services could be integrated with the services provided currently by LEPs through local Growth Hubs.
 - o A competitive grant fund focussed on supporting collaborative and applied R&D projects undertaken by members of Catapult Quarters.
 - o A competitive funding stream for the development of open-access testbed and demonstration facilities.

- Funding for Catapult Quarters would be financed through the broader funding uplift to Innovate UK's budget. This funding package should be allocated over a long-term period to enable quarters to bed-in and could include:
 - o Seed funding for the set-up costs of establishing quarters.
 - o A fixed level of base funding for the operational costs of running services.
 - o Long-term funding for the Catapult Quarter grant fund.

Flexible regulatory allowances

- With the emergence of the Fourth Industrial Revolution new technologies are emerging which don't fit existing regulatory systems.⁵⁰ Facilitating the development and deployment of these technologies requires an agile approach to regulation that facilitates innovation while protecting citizens and the environment.
- Catapult Quarters would provide opportune locations for regulatory trialling. Local authorities and regulators could be encouraged to work with Catapult Quarters to develop regulatory environments that enable the testing of technologies in real-world environments - for instance, by introducing temporary regulatory waivers or experimentation clauses. Good examples of where this has been done well before in the UK is with the testing of drones in the West Midlands Combined Authority and autonomous vehicles in Milton Keynes.

An international offer

- Catapult Quarters would be championed and marketed to domestic and international audiences through a dedicated online platform run between UKRI, the Catapult Network and DIT. This platform would present a clear international offer, bringing together information on the assets and capabilities of different quarters.

What is a Catapult Quarter?

A 'Catapult Quarter' brings together all of the services that make current clusters great in a coordinated and consistent package. The support package will incentivise businesses to co-locate and collaborate along a specific locally-relevant theme. CQs would be specific to a geographic area, centred around a Catapult or RTO, and would create an internationally competitive brand for UK innovation.



Government provides

- Business liaison services
- Regulatory allowances
- Open access testing facilities
- A competitive grant fund available exclusively to 'Catapult Quarter' members
- An online marketing platform



Business receive

- Access to an R&D community that fosters knowledge exchange
- Access to testing infrastructure
- Support to set up collaborative partnerships
- Access to a competitive grant fund for collaborative R&D
- Advice on funding support and capital raising options



Local area benefits

- Businesses locate to the area
- Area develops a critical mass of R&D capabilities
- Area benefits from increased international visibility and attracts foreign investment
- Businesses create new high value jobs and local economic growth

An array of potential benefits

- The Catapult Quarters concept could offer manifold benefits for the UK economy and would help bring together efforts to drive progress in raising UK R&D intensity:
 - o By encouraging business co-location the quarters would support the development of clusters of excellence in different parts of the country and help spur the development of new regional markets and local economic growth.
 - o By taking a focus on applied research the quarters would help improve the UK's capacity for commercialisation and enhance the attractiveness of the UK's R&D offer.
 - o By providing environments for companies to test and demonstrate their technological innovations Catapult Quarters would help improve the UK's capacity for late-stage development.
 - o By providing greater international visibility for UK regional capabilities the Catapult Quarters would serve as a pull for internationally mobile R&D investment and could incentivise businesses to anchor broader commercial activities in the UK.
 - o By fostering cluster development Catapult Quarters would represent a long-term intervention in the UK innovation ecosystem.



A potential journey of a company in a Catapult Quarter



— Funding

— Soft support

— Infrastructure

3. Establish robust methods for accountability, monitoring and oversight

Government should work with the ONS to improve the regional measurement of R&D Foreign Direct Investment (FDI)

- Attracting internationally mobile R&D investment to the UK will be an important enabler to the success of Catapult Quarters. Academic literature shows that R&D intensive FDI is a powerful mechanism for enabling the development of clusters⁵¹ and DIT analysis suggests that R&D FDI also has a net positive impact on existing firms in the economy with R&D expenditure by existing firms increasing by around £1,700 on average for every £1 million of FDI occurring in Great Britain.⁵²
- Information on R&D FDI in the UK is currently limited to national level figures meaning that it is not possible to get a regional level breakdown of where R&D focussed FDI is located throughout the UK.
- UKRI and ONS should work together to expand on the R&D FDI measurement so that they capture regional R&D FDI data. Establishing more detailed measures of R&D FDI would help to further understand the factors driving international companies' R&D investment decisions and the impact of regional focussed policy interventions.

Monitor and report on the regional concentration of cross-government funding

- UKRI's Strategic Prospectus and Delivery Plans set out commitments to support growth across the UK and to undertake robust monitoring and evaluation. In support of these commitments, UKRI should undertake an evaluation of public funding which assesses the dissemination of current funding and reports on the appropriateness of the regional balance. In addition, UKRI should also regularly monitor and report on the regional concentration of R&D investment and the spread of cross-government funding for R&D.
- Local Economic Partnerships (LEPs) play an important role in determining local economic priorities and undertake a range of activities to drive growth and jobs creation within their local areas. To support efforts to raise regional R&D investment LEPs should be encouraged to monitor regional R&D investment and to develop action plans for raising investment within their areas of jurisdiction.

Put in place robust oversight frameworks to hold the performance Catapult Quarters to account

- Robust governance and oversight should be put in place to ensure that Catapult Quarters are delivering according to their objectives and are having a real economic benefit. Innovate UK should be given oversight responsibilities and should be willing to phase out funding support for quarters that underperform.

Methodology

This report is based on research with CBI members, including roundtables in Northern Ireland, Scotland and the North East. The report also draws from the CBI's first-of-its-kind 'policy sprint' which brought together businesses, government representatives and other stakeholders from the research and development space.

Sprint methodology involves unpacking a problem, exploring solutions and creating a prototype. A group of people come together to stage a collective enquiry into an issue, exploring current knowledge, identifying gaps and prototyping ideas.

The policy sprint session aimed to develop new and bold policy recommendations to tackle the question: *What actions can be taken to encourage international businesses to increase investment in late stage R&D throughout the UK's regions?*

Methodology for the selection of countries for regional R&D growth rate analysis was as follows:

- UKRI research shows that seven European countries have achieved at least a 0.7% point GDP increase in R&D over 10 years – the scale of increase that the UK is seeking to achieve through the 2.4% target – Austria, Czech Republic, Denmark, Estonia, Finland, Portugal and Slovenia.
- Historical data on R&D investment at NUTS I and NUTS II is available from Eurostat for four of these countries; Austria, Czech Republic, Denmark and Portugal – see https://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=rd_gerdtot&lang=en
- Data is unavailable for each country for every year. Where data was unavailable the time period that most closely matched the growth period was selected.



“Investment in R&D needs to be scaled up at material scale if the UK is to capture the benefits of innovation-led growth and realise ambitions to lead the world in challenges like clean growth, healthy ageing, the future of mobility and AI.”

Appendix

Exhibit 3 Gross expenditure on R&D by NUTS I & NUTS II regions, Eurostat (Million Euro)

Austria (NUTS I regions)

Region	2004	2015	% change	Increase	% of total increase
Südösterreich	1,258.173	2,820.382	124.2	1,562.2	29.8
Westösterreich	1,451.11	3,497.833	141.0	2,046.7	39.0
Ostösterreich	2,540.263	4,180.931	64.6	1,640.7	31.3

Czech Republic (NUTS II regions)

Region	2004	2014	% change	Increase	% of total increase
Severozápad	19.021	49.654	161.0	30.6	1.5
Střední Morava	57.739	222.466	285.3	164.7	8.3
Jihozápad	62.144	262.411	322.3	200.3	10.1
Moravskoslezsko	69.377	187.207	169.8	117.8	5.9
Severovýchod	106.914	268.574	151.2	161.7	8.1
Jihovýchod	140.894	672.342	377.2	531.4	26.7
Střední Čechy	226.951	358.761	58.1	131.8	6.6
Praha	417.054	1,069.247	156.4	652.2	32.8

Denmark (NUTS II regions)

Region	2007	2016	% change	Increase	% of total increase
Nordjylland	258.382	424.166	64.2	165.8	6.2
Sjælland	296.548	323.296	9.0	26.7	1.0
Syddanmark	385.025	964.514	150.5	579.5	21.8
Midtjylland	852.79	1,465.508	71.8	612.7	23.1
Hovedstaden	4,305.571	5,578.494	29.6	1,272.9	47.9

Portugal (NUTS II regions)

Region	2000	2009	% change	Increase	% of total increase
Região Autónoma dos Açores	8.46	28.707	239.3	20.2	1.1
Algarve	15.387	32.9	113.8	17.5	0.9
Região Autónoma da Madeira	31.746	14.523	-54.3	-17.2	-0.9
Norte	82.196	674.132	720.2	591.9	32.1
Centro	139.582	391.853	180.7	252.3	13.7
Alentejo	144.24	85.162	-41.0	-59.1	-3.2
Área Metropolitana de Lisboa	504.978	1,544.322	205.8	1,039.3	56.3



Exhibit 4 Gross expenditure on R&D by UK regions - 2017, ONS 2019 (% of total R&D spend)

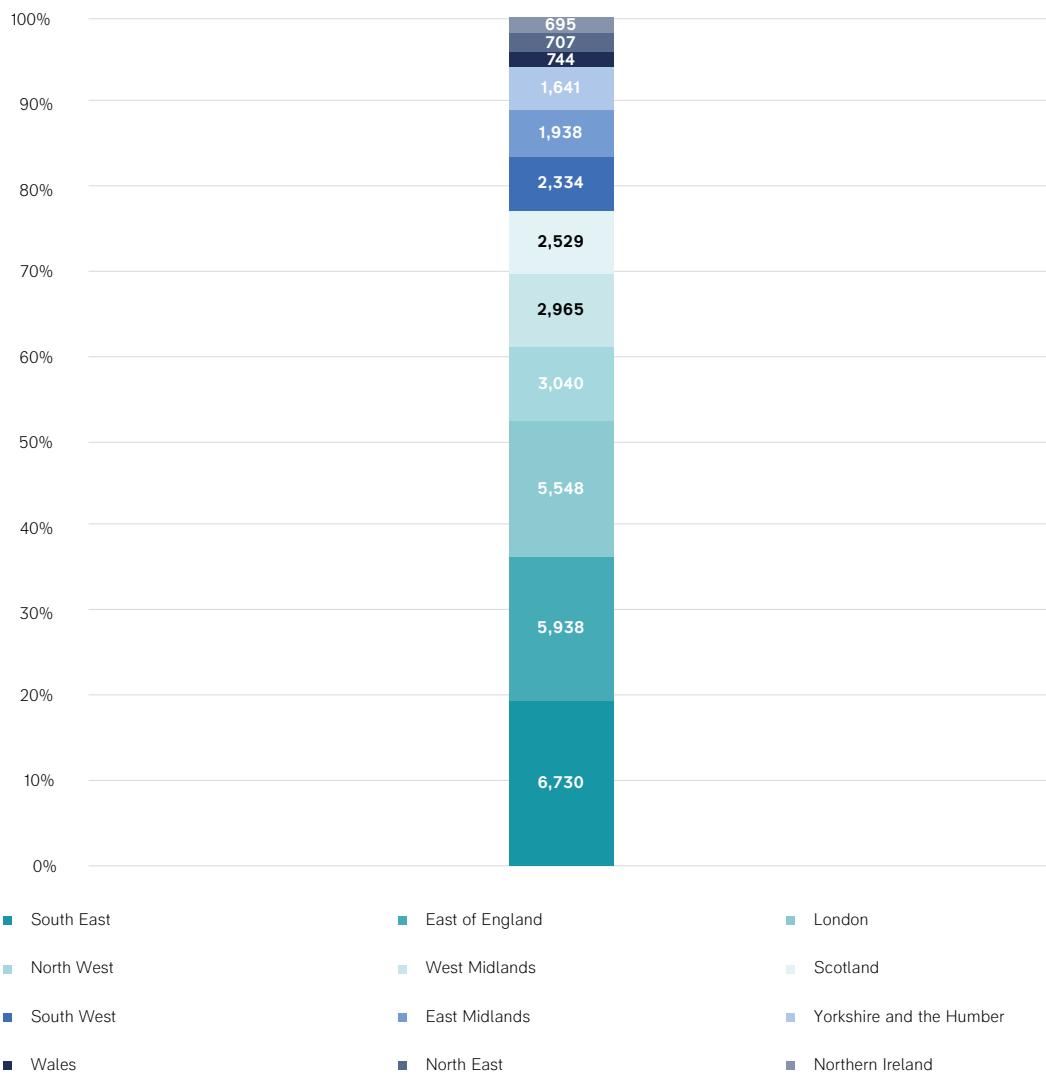
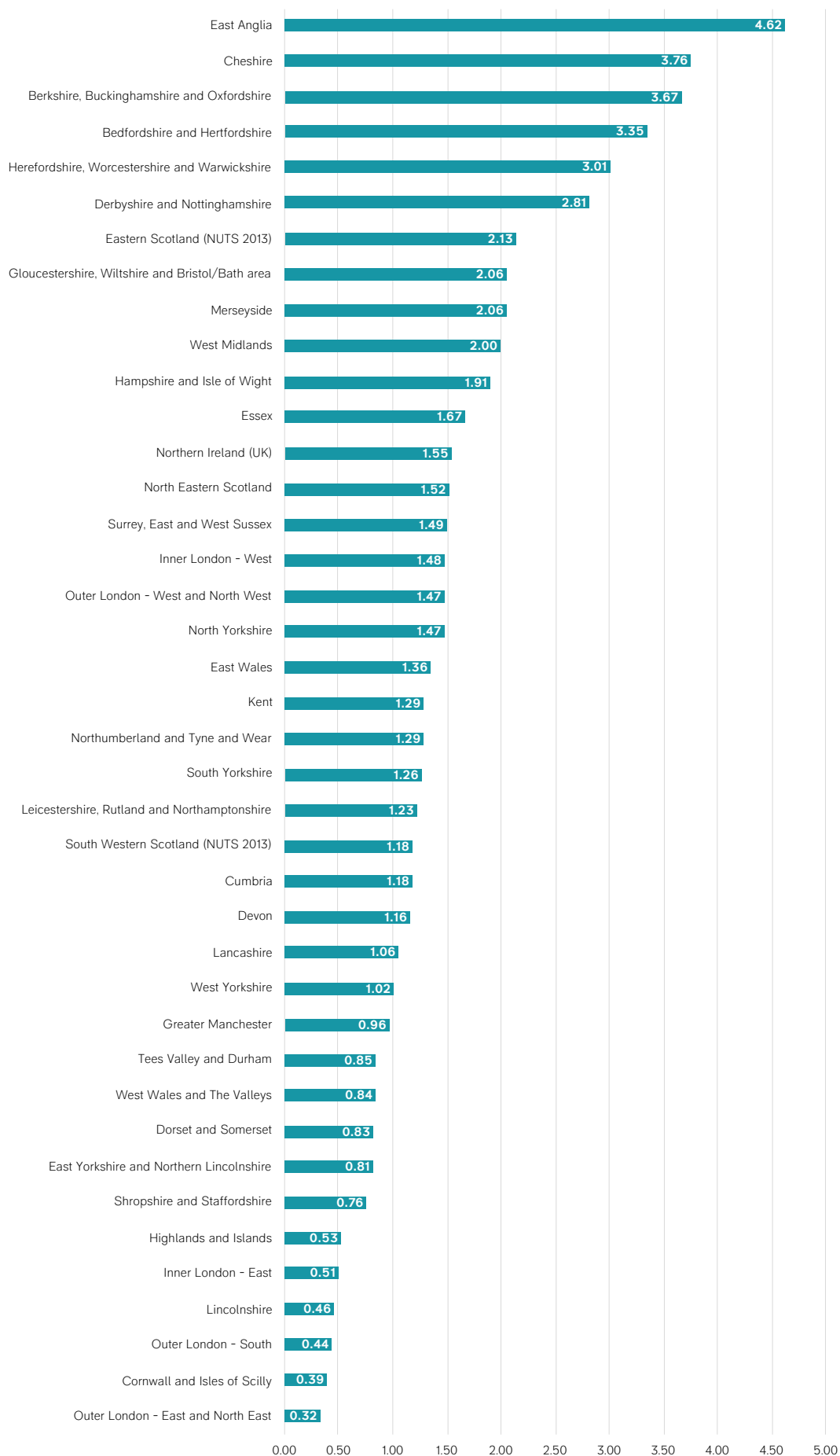


Exhibit 5 R&D as a % of GDP by NUTS II Region - 2016, Eurostat



References

- 1 CBI analysis based on ONS (2019) Gross domestic expenditure on research and development, UK: 2017 – see appendix Exhibit 4
- 2 CBI analysis based on Eurostat (2019) Intramural R&D expenditure (GERD) by sectors of performance and NUTS II regions
- 3 ONS (2019) Gross domestic expenditure on research and development, UK:2017
- 4 OECD (2007) Innovation and growth – rationale for an innovation strategy
- 5 BIS (2011) Innovation and Research Strategy for Growth
- 6 Mazzucato (2018) Mission-Oriented Research & Innovation in the European Union
- 7 BEIS (2017) South West England and South East Wales Science and Innovation Audit
- 8 InvestNI (2018) Northern Ireland Agri-Tech <https://secure.investni.com/static/library/invest-ni/documents/northern-ireland-agri-tech-brochure.pdf>
- 9 BEIS (2017) South West England and South East Wales Science and Innovation Audit, p.19
- 10 ONS (2018) Business enterprise research and development, UK:2017
- 11 BEIS (2019) Maximising the Marine Economy in the Highlands and Islands (MAXiMAR): Science and Innovation Audit
- 12 BEIS (2018) Enabling Technologies in Scotland's Central Belt, Summary Report. A Science and Innovation Audit Report sponsored by the Department for Business, Energy & Industrial Strategy
- 13 UKRI (2019) Harwell space cluster grows to 92 organisations employing 1040 <https://stfc.ukri.org/news/harwell-space-cluster-grows-to-92-organisations-employing-1-040/>
- 14 BEIS (2018) science and Innovation Audit – Upstream Space, p.59
- 15 London economics (2019) Size & Health of the UK Space Industry 2018, p.15
- 16 BEIS (2016) Midlands Engine Science and Innovation Audit
- 17 <https://tech.london/challenges>
- 18 BEIS (2017) Liverpool City Region Science and Innovation Audit
- 19 BEIS (2017) Offshore renewable energy science and innovation audit T
- 20 Ibid.
- 21 North East LEP (2018) Excelling in health and life sciences
- 22 Ibid.
- 23 CBI analysis based on ONS (2019) Gross domestic expenditure on research and development, UK: 2017 – see appendix Exhibit 4
- 24 See Appendix Exhibit 5 for breakdown
- 25 UKRI (2019) 2.4% R&D target: how to generate economic growth through place-based R&D policy
- 26 Hausman (2012) University innovation, local economic growth and entrepreneurship
- 27 OECD (2019) Research and Development Statistics, Gross domestic expenditure on R&D by sector of performance and source of funds
- 28 Ibid.
- 29 Directorate-General for Research and Innovation (2017) The Economic Rationale for public funding R&I and its impact <https://publications.europa.eu/en/publication-detail/-/publication/0635b07f-07bb-11e7-8a35-01aa75ed71a1/language-en>
- 30 CBI analysis based on Eurostat (2019) Intramural R&D expenditure (GERD) by sectors of performance and NUTS 2 regions – (See Appendix Exhibit 3)

- 31 Ibid.
- 32 Ibid.
- 33 Ibid.
- 34 Ibid.
- 35 Brenner, T (2013) Regional Effects of a Cluster-oriented policy measure - The Case of the InnoRegio program in Germany
- 36 Ibid.
- 37 <https://competitivite.gouv.fr/en/home-853.html>
- 38 France Stratégie (2017) Évaluation de la politique des pôles de compétitivité : la fin d'une malédiction? Cited in: The European Monitoring Centre on Change (2018) Competitiveness clusters <https://www.eurofound.europa.eu/observatories/emcc/erm/support-instrument/poles-of-competitiveness>
- 39 Business, Energy and Industrial Strategy Committee (2019) Industrial Strategy: Sector Deals
- 40 Richard Jones (2019) A Resurgence of the Regions: rebuilding innovation capacity across the whole http://www.softmachines.org/wordpress/wp-content/uploads/2019/05/ResurgenceRegionsRALJv22_5_19.pdf
- 41 Nesta (2019) Testing Innovation in the Real World
- 42 Worcestershire Local Enterprise Partnership (2018) Worcestershire's new 5G Testbed places county at forefront of technological innovation <https://www.wlep.co.uk/worcestershire-chosen-government-home-new-5g-testbed-putting-forefront-technological-innovation/>
- 43 Bosch (2019) Worcester Bosch launches first 5g factory trial <https://www.bosch.co.uk/internet-of-things/leading-in-5g-technology/>
- 44 Autodrive (2019) UK Autodrive Final Project Report <http://www.ukautodrive.com/final-report/>
- 45 UKRI (2019) Increasing R&D activity: UK history and international experience
- 46 Cristina Gallardo (2016) Reverse years of cuts, <http://www.researchresearch.com/news/article/?articleId=1364378>
- 47 CBI (2018) Partnering for prosperity - Public Procurement Survey
- 48 CBI (2017) From Ostrich to Magpie
- 49 BEIS (2018) Government launches new fund to support small business growth <https://www.gov.uk/government/news/government-launches-new-fund-to-support-small-business-growth>
- 50 HM Government (2019) Regulation for the Fourth Industrial Revolution – White Paper
- 51 OECD (2008) Government strategies to attract R&D-Intensive FDI <http://www.oecd.org/investment/globalforum/40310856.pdf>
- 52 Department for International Trade (2018) Estimating the economic impact of FDI to support the Department for International Trade's promotion strategy: Analytical report

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