RUSSELL
INTERNATIONAL
EXCELLENCE
GROUP

Russell Group submission to the Spending Review 2015

Summary

- Our world-class universities are anchors for growth in their regions. They should be considered as strategic assets for the UK around which advances in research and future business growth can be catalysed – enhancing productivity and leading to the creation of jobs and prosperity. A long-term commitment to science, research and innovation, focused on excellence, is needed to provide stability for the future and ensure the UK can maximise its potential.

- Investment in leading research is an indispensable component of the UK's economic competitiveness, and the key to its future growth. The dual support system plays an essential part in sustaining research of the highest quality, and the combination of stable core funding and competitively awarded grants ensures the diversity and breadth of research in the UK – this is vital for curiosity-driven research, which produces the biggest economic pay-offs in the long run.

- Higher education delivers considerable benefits to the economy, society and to individuals. However, the focus needs to be on quality, ensuring that funding is sustainable. Tuition fees should rise in line with inflation as the current level of funding makes it difficult for our universities to remain internationally competitive and ensure students' expectations of a world-class learning experience can continue to be met and exceeded. In addition, support for the teaching of high cost medical, health and STEM subjects critical for future growth and the future of our healthcare system should be increased.

- World-class infrastructure is needed to facilitate the very best environment for research and teaching. We welcome the Government's commitment to increase research capital investment in real-terms, including through RPIF, but a clear commitment is also needed to support the on-going resource costs associated with capital facilities.

- The UK needs to create the right environment for new ideas to develop and grow into commercial success. The Higher Education Innovation Fund (HEIF) is vital in facilitating innovation and the impact of our research as well as promoting entrepreneurialism and engagement with businesses, including SMEs. The availability of proof of concept funding and financial and tax support for early stage ventures and R&D should be enhanced.

- Stronger links should be built between Innovate UK and universities to help bring research ideas closer to market faster. However, it would be counterproductive to increase Innovate UK funding at the expense of investment in basic research, which provides the pipeline for new technologies and knowledge underpinning innovation.

- Our world-class universities are efficient, effective and highly productive, but international competition for the best talent and for high-value business R&D investment is fierce. The UK is in danger of losing ground on key areas of research to

countries such as China, France and South Korea that are pumping billions into research excellence and where the proportion of GDP spent on R&D is much higher.

- Regulatory and information requirements on our universities are excessive – particularly for universities which have a long track record of excellence. They are costly and risk stifling innovation and should be far more risk-based and proportionate. This applies to several areas including access, visas and quality assurance.

- To strengthen the UK by capitalising on its university powerhouses, we identify the following key priorities for action:

Priority actions

- Strengthen the pipeline for growth and jobs by increasing investment in excellent science, research and innovation, boosting this as a proportion of GDP
- Continue to ring-fence the science and research resource budget and maintain the dual support system – ensuring the UK can compete internationally
- Increase the tuition fee cap in line with inflation
- Underpin future growth by increasing funding for high cost STEM subjects
- Prioritise quality over student number expansion if resources are constrained
- Properly fund on-going resource costs associated with operating, maintaining and up-grading world-class capital facilities
- Enhance the availability of proof of concept funding and better target existing tax incentives to help universities develop and commercialise early stage technologies
- Build on HEIF and target it to support research-intensive universities and increase the availability of Impact Acceleration Accounts, which complement HEIF
- Ensure any increase in Innovate UK's budget is not at the expense of basic research
- Maintain RPIF in the long-term and provide a longer lead time for projects
- Protect the budget for world-class health education and lift caps on international medical and dental student numbers
- Ensure the UK can offer internationally competitive packages to attract and retain the most able students for postgraduate study
- Ensure the regulatory and quality assurance requirements on universities are risk-based, proportionate and appropriately light-touch and robust where necessary

1. Context for this spending review

1.1 We understand that in order to achieve the goal of eliminating the deficit by 2019-20, government departments will be expected to deliver £20 billion of cuts to departmental budgets over the next four years. We are very concerned that as a result of protection in other areas there is a danger that major cuts may fall on non-ring fenced departments including BIS. Following the 2010 Spending Review, the BIS budget has already been cut by 25% in real-terms with further in-year cuts of £450 million for 2015-16 already announced. The potential for further cuts implies a serious, long-term threat for the UK's research, innovation and higher education systems.

1.2 Investing in research, innovation and higher education offers a valuable opportunity to Government to build a more resilient economy and to create highly skilled jobs across the country. Our universities are powerhouses for economic growth and prosperity, and any cuts to funding for world-class research, innovation and higher education would be entirely counterproductive for the long-term health of the UK's economy. It is important to note that any cuts to research, innovation and higher education budgets would do significant long-term damage, which could not be rectified simply by future investment. Such an approach would create uncertainty for universities and investors, weakening the science and research base and long-term private sector investment.

2. World-class universities are anchors for growth

2.1 Now that the economy has returned to growth there is an opportunity to cement and build on the recovery, recognising that in highly developed economies such as the UK, growth increasingly needs to come from investments in research, innovation and human capital– all areas in which the role of universities is critical[1].

2.2 **Our world-class universities are anchors for growth in their regions and should be considered as strategic assets for the UK around which advances in research and future business growth can be catalysed.** Universities provide short, medium and long-term perspectives, which businesses and public sector organisations can draw upon to grow and enhance their operations.

- Through research and innovation, universities generate radical new ideas and new knowledge, vital incremental improvements enhancing productivity and intellectual property, which can be exploited to develop new products and services.

- Universities play a critical role in providing the talent pipeline for the future. Graduates and postgraduates represent the skilled labour force that will be increasingly important to the UK. They can also be transformative in re-skilling and up-skilling people who are already in work but choose to return to higher education as a mature or part-time student.

[1] For example: Corado, C. et al, *Intangible capital and growth in advanced economies: measurement methods and comparative results* Discussion Paper 2012/06 (June 2012) https://spiral.imperial.ac.uk/bitstream/10044/1/9913/6/Haskel%202012-06.pdf; Aghion, P. et al, *Investing for Prosperity* Report of the LSE Growth Commission Skills, Infrastructure and Innovation (September 2013) http://www2.lse.ac.uk/researchAndExpertise/units/growthCommission/documents/pdf/LSEGC-Report.pdf; Manyika, J. et al, *Manufacturing the future: The next era of global growth and Innovation* (November 2012) http://dl.njit.edu/mnj/MGI_Manufacturing_the_future_Full_report_Nov%202012.pdf; and Wyckoff, A., 'Knowledge is Growth', OECD Forum 2013 http://www.oecd.org/innovation/knowledge-is-growth.htm

- Universities also provide stability in turbulent times, providing businesses with solutions to mitigate risks when the economic environment is uncertain.

2.3 Russell Group universities work in partnership with a whole range of companies, from large multinationals to small, local SMEs and public sector organisations such as the NHS and other Agencies. Increasingly, businesses and universities are developing new concepts through cooperation and open innovation frameworks and our universities are world leaders in collaborating with business. Indeed, reports from the World Economic Forum consistently rank the **UK amongst the best countries in the world for business-university collaboration**[2].

2.4 **Our universities are major contributors to the UK economy, with the effects being felt right across the country.** The size and scope of our universities makes them a prominent UK and international industry in their own right:

- Our universities support more than 300,000 jobs and generate an economic output in excess of £32 billion a year.

- They are often the largest employers in their area: on average employing more than 3.5 times as many staff as other universities (6,200, compared to an average of 1,700 at other UK HEIs).

- Russell Group universities are a major export industry, generating overseas earnings of over £4 billion per annum.

- Over the five-year period 2012-13 to 2016-17 Russell Group universities are investing around £9 billion of their own resources in major capital projects, which are expected to deliver gross value added (GVA) with a current value of £44.3 billion for the UK economy.[3] These projects are expected to support more than 98,500 UK jobs and will generate £4.89 GVA for the UK economy for every £1 invested.

2.5 Russell Group universities play a key role in their local communities and take their civic responsibilities extremely seriously. **Our universities are drivers of 'place'-based innovation**, working with business, LEPs, City Regions, local authorities and others to provide local leadership and help to develop local innovative capacity and promote the creation of highly-skilled jobs.[4]

2.6 The contribution of leading universities is not purely economic. They offer a unique environment in which intellectual inquiry and discovery can flourish and the boundaries of human knowledge and understanding are continuously extended. Their research, innovation and teaching deliver improvements in the nation's health, quality of life, culture and environment. Universities provide intellectual leadership and deliver widespread benefits to millions of individuals and to society.

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[2] *The Global Competitiveness Report 2014-15*, World Economic Forum, September 2014: http://www3.weforum.org/docs/WEF_GlobalCompetitivenessReport_2014-15.pdf

[3] http://www.russellgroup.ac.uk/policy/publications/the-economic-impact-of-research-conducted-in-russell-group-universities/

[4] For example, a number of Russell Group universities are actively engaging in setting strategy for LEPs in their regions and participate on LEP boards. The West of England LEP has asked the University of Bristol to develop its Knowledge Exchange strategy, coordinating across the four HEIs in the LEP region. Our universities have also often been instrumental in securing investment for the knowledge economy where City Deals have taken place including in Birmingham where the University of Birmingham and Birmingham Children's Hospital have secured matched government funding, as part of the Birmingham City Deal, to build the £24 million Institute of Translational Medicine.

2.7 The UK's universities have **a strong track record in increasing cost-effectiveness** and the UK research base is already **highly productive** compared to our international competitors:

- While the UK represents just 3.2% of world R&D expenditure, the country produces 15.9% of the world's most highly cited articles and is now first on research quality (assessed by field-weighted citation impact) [5].

- The UK produces more research outputs (including articles, citations, downloads and patent citations) per researcher or per unit of R&D expenditure than China, Japan, the US or Germany[6].

- 75% of the most highly cited articles are produced by Russell Group researchers[7]

2.8 An area where our universities are increasingly looking to maximise investments, is in capital expenditure. Through RPIF and in other collaborative arrangements they are helping to **leverage investment** from business, charities and others to multiply initial public investment. Where appropriate this has enabled **sharing of facilities and equipment** with each other, with other universities and with industry to enhance access and reduce duplication. For example:

(a) A partnership between five Russell Group universities (the Universities of Oxford, Cambridge and Southampton, Imperial College London and University College London (UCL)), operating under the banner of the Science and Engineering South Consortium (SES), works to optimise shared infrastructure and training. Major facilities for research in the physical sciences, biosciences and engineering and in High Performance Computing are shared with the Equipment Sharing Project Database currently providing access to 237 facilities at Cambridge, Oxford, UCL, Imperial and Southampton (including 64 facilities and over 2,350 individual items of equipment within Cambridge alone). The database is widely used having been accessed by around 1,700 individual users over the past year. The universities also engage in the strategic planning of new infrastructure investment. The Consortium's STFC portfolio is worth approximately £150 million; about a third of the national commitment.

(b) In the north of England, a collaboration of eight research-intensive universities including seven Russell Group universities (Durham University, Newcastle University, the Universities of Leeds, Liverpool, Manchester, Sheffield and York) as well as the University of Lancaster - the N8 Research Partnership - works to maximise the use of new and existing research assets. These include through N8 High Performance Computing, an EPSRC-funded initiative to operate and enable academic and industrial access to Polaris, an SGI HPC cluster which is capable of a peak performance of 110 trillion operations per second – the approximate equivalent to half a million iPads.

(c) In the South West and Wales, the Russell Group universities of Bristol, Exeter and Cardiff have entered into a partnership with the University of Bath, as the GW4 Alliance, working together across all academic activity and collaborating in common areas of shared facilities, learning, training and development. Initiatives such as the GW4 equipment database, which provides access to over 1,300 pieces of state-of-the-art equipment, have enabled the development of a strategic approach to regional assets, identifying opportunities to develop these, and ensuring efficient procurement

[5] International Comparative Performance of the UK Research Base – 2013, Elsevier
[6] International Comparative Performance of the UK Research Base – 2013, Elsevier
[7] SciVal analysis for the Russell Group

and appropriate external use. GW4's Building Communities programme aims to build communities of academic interest with the ability to leverage in more funding and create greater impact; so far the programme has funded 47 projects to a total of over £1 million.

(d) The Sir William Dunn School of Pathology at the University of Oxford has collaborated with Oxford Brookes University in a partnership to buy a state of the art scanning electron microscope, with BBSRC funding. The facility is actually based at Oxford Brookes and will give biomedical sciences researchers access to state of the art technology for the production of extremely high-resolution 3-dimensional images of cell structure. It will support cell biology research at both universities, plus the plant cell biology research communities UK-wide.

2.9 Russell Group institutions have also been both proactive and successful in diversifying their sources of income and in attracting investment through philanthropy and from the private sector.[8] But such efforts alone cannot replace public investment.[9]

2.10 In terms of engagement with private sector funders of research, the Russell Group attracted £903 million in contract research in 2013-14 (76% of the total to UK universities) in addition to collaborative research arrangements where public funding is also involved. This activity directly benefits the UK, bringing in vital foreign direct investment, supporting high-value and high-skill research jobs, as well as underpinning the creation of new knowledge and innovations that deliver major social and economic benefits[10].

2.11 **In short, the UK's higher education system is world-class and our research-intensive universities are crucial to growth and prosperity. There remains a strong case for sustained public investment in the country's leading universities. A long-term commitment to science, research and innovation is needed to provide stability for the future and ensure the UK can maximise its potential.**

3. Research

3.1 The UK currently enjoys a world-leading position in producing excellent research, having built up a powerful and highly productive research base over the course of many years. The results of the 2014 Research Excellence Framework (REF) show that the very best research is concentrated in Russell Group universities and that these universities are also leading the way in delivering impact from this research,

[8] Over the last six years, Russell Group universities have managed to grow their external income substantially (by £697 million - an increase of 47 per cent) drawing on their critical mass of research expertise to build and strengthen their relationships with businesses. (HESA stats 2008-9 to 2013-14) In 2013-14, Russell Group universities raised over £626 million in new philanthropic funds, 78% of the total for all UK universities.

[9] There is evidence to show that private and charitable investors cannot replace public funding of the research base in response to a withdrawal of government funds and that the private sector would not be expected to ever fully fund research and innovation due to a number of market failures. See Main, S., *Leverage from public funding of science and research: Analysis of how public funding of science and research leverages investment from private, charity and international sources* Report produced for the Department of Business Innovation and Skills (June 2013): http://www.rcuk.ac.uk/RCUK-prod/assets/documents/documents/LeverageReport.pdf

[10] An excellent example includes the University of Warwick's long-standing collaborative relationship with JLR, which has led to the establishment of the £100 million National Automotive Innovation Campus (NAIC) to enable academic and industry teams to work together and address the shortage of skilled R&D staff in the automotive supply chain.

demonstrating that our universities are 'impact-intensive' as well as research-intensive[11].

3.2 Our universities' research is delivering a range of wider economic benefits from efficiency savings to public services to private sector productivity gains. Our universities' research generates billions of pounds in returns to the UK economy and leads to the creation of new businesses and high value jobs – including through the spinning out of companies, and through the creation of whole new business sectors, such as the graphene production industry and the fibre laser manufacturing sector.

3.3 The critical mass of talent and expertise within an institution means world-class universities are able to respond much more quickly to meet the challenging timescales required by business and government. Research conducted at Russell Group universities has been shown to benefit the UK's economy, businesses and government policy, as well as improving health and quality of life, and makes a significant contribution to our culture and society. In some disciplines, impacts can be delivered fast (some business management and economics research, for example, in less than a year), others take more time and require sustained investment, but more importantly excellent research often continues to deliver impact benefits over a long period of time.[12]

3.4 **Annex A** provides a number of illustrative examples of the type of impact that Russell Group research has delivered. These examples are from a sample of 240 REF impact case studies analysed for a report we will be publishing later this year. Our analysis of just these 240 case studies demonstrates direct and indirect benefits of at least £21 billion[13] from an initial investment of £199 million, for example:

- Russell Group universities' research has delivered hundreds of millions of pounds worth of efficiency savings for UK public transport systems, and lifesaving improvements to NHS healthcare systems, lowering patient waiting times, increasing survival rates and improving patient care.

- The discovery of high fibre lasers, for example, has boosted business productivity in a range of sectors from car manufacturers, and aerospace companies to medical component manufacturers, whilst the development of genome sequencing technology has made a very significant contribution to the success of the global DNA sequencing market, which is projected to be worth $10 billion by 2017.

- Our universities' research has also enhanced policy-making in a range of areas including the delivery of high-speed broadband, the management of environmental risks, and the use of recognition technology in immigration systems to achieve efficient and effective outcomes for government and the public.

[11] Our universities produce over two-thirds (68 per cent) of world-leading research (rated as 4* - the highest rating) originating from all UK universities. Russell Group institutions also account for 68% of the research deemed to have had outstanding (4*) impact in terms of reach and significance and more than half of research in our universities results in outstanding impact, compared to less than a third in other universities. To view the impact case studies, see: http://impact.ref.ac.uk/CaseStudies/search1.aspx

[12] Of a sample of 240 Russell Group REF impact case studies, 89 per cent had an on-going impact often many years after initial impacts have been delivered.

[13] These include business values, sales values, value to UK economy, savings, royalties and licensing.

- In terms of new businesses created as a result of research in the case studies, eleven new businesses alone generated over 4,300 jobs and eight new businesses will have an estimated value of £3.9 billion in total by 2017.

- Return on investment for our sample is substantial too: roughly 4.5 times initial investment in terms of businesses created and 100 times the initial funding for the wider economic benefits[14].

3.5 Public investment through multiple funding sources is critical to supporting this excellent research and ensuring impact can be delivered. The UK's dual support system plays an essential part in sustaining research of the highest quality, allowing universities to be responsive to current socio-economic needs, to build expertise in new and emerging fields and adjust to changing priorities.[15] **The combination of stable core funding through the funding councils (including mainstream QR, RDP, business QR and extremely valuable charity QR element), and competitively awarded grants from the Research Councils ensures the diversity and breadth of research in the UK[16]**.

3.6 The provision of public funding for excellent research enables leading universities to strengthen their links with businesses and contribute to productivity growth in the private sector. **Public investment in R&D, including research conducted by universities, is strongly correlated with private industrial productivity growth**, delivering an average return of 20 per cent after only three years.[17] Support for basic research in particular has been shown to deliver greater market sector productivity impact than other types of spending as well as generating a high rate of return on investment.[18]

3.7 Public funding for research is also most effective when distributed on the basis of true international excellence, with a clear recognition of the importance of critical mass.[19] It

[14] The data relates to research detailed in 48 Russell Group impact case studies, and the investment was received from public, private and third-sector sources.
[15] OECD 2011 and Institute for Prospective Technological Studies 2011
[16] As an example of how QR money can be used in diverse ways, Queen Mary University London used QR funding alongside other sources to set up and support the Queen Mary Bioenterprises (QMB) Innovation centre, the largest purpose-built commercial laboratory space currently available for rent in London which provides business incubation support for new ventures and is a hub for entrepreneurial activity. To date the QMB has created and/or safeguarded 437 full-time jobs and assisted 195 businesses, including QMUL spin-outs and multi-million pound biotechnology companies.
[17] UKIRC, 'The Economic Significance of the UK Science Base' (2014): http://www.rsc.org/globalassets/04-campaigning-outreach/realising-potential-of-scientists/research-policy/research-innovation/economic-significance-uk-science-base-2014.pdf
[18] Haskel and Wallis, 'Public support for innovation, intangible investment and productivity growth in the UK market sector' (2010): http://spiral.imperial.ac.uk:8080/bitstream/10044/1/5280/1/Haskel%202010-01.pdf
[19] Research shows that concentrating public research funding into research excellence is correlated with rising external sources of income through contract and collaborative research with business. This means that investing in universities with a critical mass of research excellence maximises the impact of public funding as such universities are best able to leverage further funding from private sources. See footnote 14. Furthermore, a recent HEFCE report on the value of QR funding outlined the economic and social benefits derived from QR funding (which is allocated based on excellent performance in the REF). The research also found that there is a positive relationship between both QR funding and Research Council funding – allocated competitively - and the generation of external income - a proxy for the impact accruing to external organisations including businesses. See PACEC and Centre for Business Research, University of Cambridge, 'A Review of QR Funding in English HEIs: Process and Impact' (2014):

has been shown that public funding to Russell Group universities leverages in double the proportion of private funding compared to other universities in the UK.[20]

3.8 International excellence should be the fundamental criterion for allocating Research Council funding. However, where a high threshold of excellence has been confirmed, and where a robust case can be demonstrated, it is acceptable to consider geographical issues in the funding balance.

3.9 **The continued ring-fencing of the science budget is essential** in demonstrating the Government's long-term commitment to science and research, and protecting that investment from being diverted to other more short-term policy priorities. Other spending commitments should not be added to the ring-fenced science budget unless accompanied by concomitant funding.

3.10 Public benefits from science and research require sustained public investment over years or even decades. The essentially flat-cash settlement for the science and research budget in the UK has meant that the value of public investment in science and research has been steadily eroded over time as a result of inflation since 2010-11, and is now worth over £300 million less per annum than in 2010-11. If a flat-cash settlement is continued to 2019-2020, the value of the ring-fenced science resource budget will have declined by over £600 million annually, or even more depending on inflation levels which may rise in coming years.[21]

3.11 At the same time as the value of research funding has been under pressure, universities have themselves been working hard to deliver efficiency savings. RCUK's annual monitoring of progress against Wakeham efficiency targets has shown that leading universities have worked well at achieving their targets, but now these targets have become increasingly punitive. They have in effect delivered a 10% cut to three-year research funding grants and a cut of over 13% for five-year grants.

- Even before Wakeham efficiencies were implemented, UK universities delivered over £1.38 billion in efficiency and cost savings over the period 2005-11[22].

3.12 Within this context, the extent to which further efficiency targets would incentivise greater efficiency as opposed to simply representing further cuts to the UK's capacity to undertake high quality research is questionable. After four years of year-on-year efficiency targets, it should be acknowledged that there is a limit to the savings universities can realistically be expected to make in this area whilst still undertaking research on a sustainable basis.

3.13 Increased costs and global competition mean that **the UK's comparative performance in research cannot be maintained indefinitely on current levels of investment** and we return to this in the final section of this paper.

4. Higher education student numbers and funding

4.1 It is essential that the country's universities continue to provide the graduates and postgraduates who will become the skilled labour force and leaders needed for the

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http://www.hefce.ac.uk/media/hefce/content/pubs/indirreports/2014/A,review,of,QR,funding,in,English,HEIs/2014_qrreview.pdf

[20] *What is the relationship between public and private investment in science, research and innovation?*, Economic Insight report for BIS (July 2015)

[21] Calculated using the Treasury's GDP deflator in 2010-11 prices

[22] UUK, 2013,*Working for a Smarter, stronger sector efficiency and effectiveness in higher education progress report*, page 5

future development of the UK's economy and society. However, high quality higher education needs proper funding to be sustainable.

4.2 We have always said that quality higher education should be prioritised over quantity, especially in times of limited funding. We are therefore concerned that the Government has chosen to allocate limited funds to growing student numbers so substantially. In some subjects this policy has led to less funding per student – for example in high cost STEM subjects, see below – and we are concerned that the quality of provision will suffer with such a significant expansion of numbers.

4.3 We would be extremely concerned if the substantial funds required to pay for additional students were taken from the already very stretched budget for research and high-cost subjects.

4.4 Providing higher education for everyone who wants it will require substantial long-term contributions from public funding and will present challenges for any future government that is unwilling or unable to continue to fund this. **At a time of constrained public funding the total number of undergraduate places should not be maintained or increased at the expense of quality in higher education.**

4.5 Investment from increased undergraduate fees has been crucial to universities at a time when Government teaching grants have been cut and other budgets are being stretched. The current fee regime has enabled Russell Group universities to invest in maintaining a world-class student experience as well as offering generous support to disadvantaged students. However, the cap on fees is fast being eroded by inflation. Coupled with constant pressure on areas such as funding for high-cost STEM subjects and the commitment to invest in access measures, this means that the current first-rate teaching experience our universities provide may be unsustainable in future.

- The £9,000 tuition fee cap in England set in 2012 is now only worth £8,200 due to inflation and could be worth as little as £7,700 by 2017.

4.6 The effect of inflation on the tuition fee cap risks damaging our leading universities' international competitiveness in teaching in the long run. Tuition fees should now rise in line with inflation to help ensure that students' expectations of a world-class learning experience can continue to be met, and exceeded. We welcome that the Government has signaled its intention (in the summer Budget) to allow universities offering a high quality educational experience to index-link fees from 2017-18. **Good teaching and facilities require proper investment. The indexing of fee caps would help maintain levels of investment in HE in real terms.**

4.7 Russell Group universities are committed to fair access and invest substantially in supporting students from less advantaged backgrounds. In 2015-16 the 20 Russell Group universities in England alone will be investing £234 million in scholarships, fee waivers, bursaries and outreach activities aimed at the most disadvantaged – with additional investments being made across the Devolved Administrations. Student Opportunity funding through HEFCE recognises the extra costs associated with widening access for students from disadvantaged backgrounds and also helps universities to improve access and provision for disabled students.

5. Subjects underpinning economic growth

5.1 Russell Group universities play a critical role in teaching and research in many strategically important subjects, including a number that are vulnerable. Our universities have a high proportion of students in disciplines such as science,

technology, engineering, mathematics (STEM subjects) and languages, which are important for the future growth of the UK's economy. It is vital that such disciplines are properly funded.

5.2 Tuition fee income alone cannot cover the high costs of STEM subjects such as medicine, engineering, chemistry and physics. Teaching costs for these are significantly higher than other subjects because of the requirement for expensive laboratories and equipment –and for practical hands-on experience in the field and elsewhere to develop the skills that will be valuable to employers and in future researchers. It is therefore essential that the remaining teaching grant available to HEFCE continues to be targeted at high-cost and strategically important subjects in order to secure their financial sustainability.

5.3 We were pleased by the Chancellor's commitment in the 2013 autumn statement that there would be extra funding for high-cost STEM subjects, but it is important that this money is for investment in existing STEM places and not simply new provision. A welcome uplift in funding per student from 2015-16 was subsequently promised and so it was disappointing when HEFCE revealed in March this year that funding per student in 2015-16 for very high-cost students (Band B+) would actually decrease from £1003 per student to £832 and that the rate for Band B subjects would only remain at £1,500, rather than increasing. **Further cuts to teaching confirmed in the revised grant letter from HEFCE in July are therefore even more disappointing.**

5.4 Russell Group universities are disproportionally affected by any funding shortfalls in high-cost subjects as they teach a high proportion of students in those subjects.[23] **We have estimated that there is currently a funding shortfall of over £72.5 million a year for teaching high-cost subjects to home/EU students at Russell Group universities in England alone**, this puts significant pressure on other important activities and is not sustainable in the long-term.

5.5 It is essential that the Government honours its commitment to provide extra funding for high-cost subjects in 2015-16 and beyond as has previously been promised.

- It would be possible to cover the £72.5 million shortfall in funding for most Russell Group universities by increasing Band A to £10,750, Band B to £2,500 and Band B+ (including the Band B element) to £2,750.

- Even then some individual subjects would still be underfunded. The way to address this would be to have a much more granular approach to banding of high cost subjects and to support universities in covering the real costs.

5.6 **The shortfall in funding high-cost subjects is increasing with time and needs to be addressed as a matter of priority. BIS funding through HEFCE to support the costs of teaching science and engineering subjects, which underpin future growth, should be increased.**

[23] Russell Group universities represent 15% of higher education institutions in the UK and teach roughly 22% of all undergraduates. However, in 2013/14 Russell Group universities in England taught 45% of Band B+ and 39% of Band B Home/EU first degree students. Overall they taught 40% of total Band A, Band B+ and Band B Home/EU students. Band A = clinical stages of medicine and dentistry courses and veterinary science, Band B+ = physics, chemistry, chemical engineering and minerals, metallurgy and materials engineering and Band B = other laboratory-based subjects.

6. Innovation

6.1 World-class universities are a crucial part of a nation's knowledge base and absorptive capacity, creating the knowledge and scientific breakthroughs essential to innovation, which underpins long-term economic growth and economic wellbeing. Russell Group universities contribute out of all proportion to their size on key economic measures, and are highly effective and successful in the commercial exploitation of their research. In 2013-14, our universities accounted for:

(a) 76% of the total income from contract research to UK universities (and made up 78% of those universities with contract research with commercial businesses worth more than £5 million)
(b) 63% of the total income from collaborative research involving both public funding and funding from businesses to UK universities
(c) 71% of the intellectual property income generated by UK universities
(d) 61% of active spin-outs which survived for three years[24]

6.2 Spinouts and start-ups associated with Russell Group universities and their academics and graduates also create a significant number of jobs in their own right, employing 11,293 full time equivalent staff in 2013-14.

6.3 In order to continue reaping the benefits of the innovation and economic impact developed from our universities' research and knowledge transfer activities, the UK needs a range of effective public support mechanisms, including those that can leverage additional investment and incentivise on-going business-university collaboration.

Proof of concept and early stage funding

6.4 There are still gaps in the UK's funding pipeline to take a research idea through to a final product or service, including problems in accessing 'proof of concept' funds and sufficient venture capital. The availability of this type of funding is vital for universities in developing products and technologies to commercialisation (helping to bridge the so called 'valley of death'), and should be enhanced. For example:

- Funding for proof of concept and proof of market activities through Innovate UK's SMART scheme could be made available directly to universities to enable more good ideas to be developed for commercialisation or spinout.

- Similarly, Innovate UK's Catalyst Fund, providing discipline-focused proof of concept funding in biomedical science, agricultural technology, energy and industrial biotechnology, could be expanded further.

6.5 Government tax measures are also valuable in supporting early stage companies to develop products and technologies to commercialisation. The Enterprise Investment Scheme (EIS) and its extension into the Seed Enterprise Investment Scheme (SEIS) are helpful in providing low-risk capital for start-ups and should be maintained. These tax-efficient investment funds could be better targeted to enable investment in early stage high-tech companies including university spinouts. In particular, removing restrictions around the timeframe in which a fund must invest would help universities to use these schemes more effectively.

[24] HE-BCI Survey data, 2013-14

6.6 **The UK needs to create the right environment for new ideas to develop and grow into commercial success. It is important that the Government continues to support universities' efforts to build strong links with business and public services and to establish their own spinouts and other commercial activities. The availability of proof of concept funding and financial and tax support for early stage ventures should be enhanced.**

Higher Education Innovation Fund (HEIF)

6.7 The Higher Education Innovation Fund (HEIF) is extremely effective in developing knowledge-based interactions between universities and businesses, and facilitating innovation, which results in economic and social benefit to the UK. It allows universities to invest in a full range of knowledge exchange activities and is also one of the few remaining funding sources providing sufficient flexibility to leverage additional funding from external sources.

6.8 HEIF is currently worth £160 million per year, with the bulk of this money (around 70%) coming from within the science and research resource budget. Research has shown that HEIF funding results in a return on investment of more than six-fold and the return is greater where research intensity is greater.[25]

6.9 Russell Group universities use HEIF to fund a wide range of activities including: increasing interactions with businesses including SMEs; enhancing technology transfer activities; supporting Proof of Concept funding before seed and further capital becomes available; and providing enterprise education for staff and students and support for starting a business.[26]

6.10 HEIF allocations are rightly performance based, with institutions only eligible to receive an allocation if they exceed a £250,000 allocation threshold related to their external income earnings and performance of the sector overall. However there is also a cap of £2.85 million on the amount of money individual institutions can receive – restricting the ability of research-intensive universities to receive funding in proportion to the full scale or excellence of their knowledge exchange activities. This cap should be raised significantly, as has been the case following previous HEIF rounds.

[25] Coates Ulrichsen, T., 'Knowledge Exchange Performance and the Impact of HEIF in the English Higher Education Sector' (2014): http://www.hefce.ac.uk/media/hefce/content/pubs/indirreports/2014/KE,performance,and,the,impact,of,HEIF/2014_keheifimpact.pdf

[26] For example: HEIF funding helped the University of Exeter to secure a £2 million collaboration with Astra Zeneca to create a unique global centre to boost the effectiveness and safety of vital new drugs for both patients and the environment and to secure high tech jobs in the South West that would have been lost as a result of the closure of Astra Zeneca's Brixham Environmental Lab. Furthermore, the University of Cambridge has used HEIF funding to support its Centre for Entrepreneurial Learning (CfEL), which delivers entrepreneurship training for the University as well as nationally and internationally. More than 16,000 people have participated in CfEL programmes and events over the last decade and the University has introduced a Postgraduate Diploma in Entrepreneurship.

6.11 **HEIF is vital in facilitating innovation and the impact of our research as well as promoting entrepreneurialism, engagement with SMEs and other key knowledge exchange activities. Consideration should be given to equivalent instruments in the Devolved Administrations to ensure that knowledge exchange can be supported across the UK.**

Impact Acceleration Accounts

6.12 We welcome moves by most of the Research Councils to develop Impact Acceleration Accounts (IAAs) that provide funding for knowledge exchange activities based on recent institutional research funding history. This funding is complementary to HEIF and universities have substantial autonomy in how these funds are used. In particular research-intensive universities are using IAA grant funding for proof of concept work, frequently with SMEs. **On-going support for IAAs should be given a high priority.**

Innovate UK

6.13 Innovate UK has now become established as a key part of the UK's innovation landscape with a budget that has increased well ahead of inflation from just £320 million in 2011-12 to around £500 million for 2014-15. Its activities complement research and innovation activity funded through the Research and Funding Councils and elsewhere in Government[27].

6.14 We welcome the fact that Innovate UK's funding commitments with universities are starting to increase and that the organisation's own data shows how the return on investment it makes more than doubles where academic partners are involved:

- Innovate UK's collaborative R&D projects with two or more academic partners deliver £9.67 per £1 invested, while those with no academic partners deliver £4.22 per £1 invested[28].

6.15 Innovate UK's network of Catapult Centres has the potential to be a significant national asset for the UK if research excellence is at the heart of their operations and if long-term funding is available that will allow them to deliver meaningful benefit. However, creating Catapult Centres from scratch outside of the research base risks duplicating existing capabilities in universities and making the UK research base appear unnecessarily complicated to new business collaborators. Catapult Centres based outside the university system will also risk being disconnected from the teaching and professional development activities that are integral to universities. As Hermann Hauser recommended in his 2014 review, Catapults should be engaged directly with the UK's excellent research-intensive universities, enabling them to build on areas of existing strength and international comparative advantage.[29]

6.16 More **extensive linkages with key universities** across Innovate UK programmes could help to bring radical ideas from basic research through to market ahead of our competitors. But, **it would be counterproductive to increase funding for Innovate**

[27] A good example of on-going Innovate UK support directly involving universities is the Knowledge Transfer Partnership (KTP) scheme, which often has a significant impact on small and medium-sized businesses in particular. One KTP project at the University of Glasgow, for example, resulted in a growth in turnover of 40% for a local SME by enabling the commercialisation of semiconductor technology and associated processes.
[28] Source: Innovate UK, 2013
[29] Hauser, H. 'Review of the Catapult network: Recommendations on the future shape, scope and ambition of the programme' (2014)

UK at the expense of investment in basic research, without which the development of new technologies and products from excellent research would not be possible.

7. Capital

7.1 The UK's position as a world-leader in research and higher education and the benefits that flow from this for the economy and society will only be maintained if our research-intensive universities have the facilities and equipment needed to compete with better-resourced institutions internationally.

7.2 We are therefore pleased the Government has committed to maintaining capital funding for science and research in line with inflation at £1.1 billion a year until 2021.

7.3 The maintenance of the highest standards of equipment and facilities helps to sustain the research and teaching environment, attracting highly sought-after internationally mobile researchers as well as high levels of international R&D investment.[30]

7.4 While very large, specialist infrastructure such as synchrotrons, neutron sources and telescopes are operated primarily on an international or European basis, the majority of research undertaken in the UK relies upon access to small and medium-scale research infrastructure. Much of this infrastructure is located within leading research-intensive universities where it can also be used to deliver an excellent teaching and learning experience. Provision for infrastructure on this scale must continue to be at the heart of the Government's capital investment strategy including through RPIF and as part of Research Council grants. The provision of capital funding directly to HEIs by a formula mechanism is also extremely valuable as it provides the freedom and certainty to invest in areas of scientific opportunity identified by our world-leading researchers.

7.5 A key on-going challenge is that the running costs associated with any new capital infrastructure must be met long after the initial funding has run out. In addition to maintenance and running costs, technological advances mean that scientific equipment can become obsolete in a relatively short timescale and require upgrading to maintain a facility's capabilities and competiveness. It would be helpful to have resource element separate from project resource, but tied to the original capital investment, to ensure facilities and equipment can operate to full capacity, and to enable vital upgrades and maintenance for the long-term.

7.6 General running costs are compounded by the requirement to meet energy-related targets both to reach external commitments, such as funding council carbon targets, and to control increasing institutional energy costs. As a result, the most efficient and sustainable means of spending capital funds may be through refurbishment – bringing old and out of date buildings up to modern energy and educational standards – rather than in new builds, which might have greater immediate appeal.

7.7 HEFCE's report on the financial health of the sector in March 2015 highlights the major change over time in how universities expect to fund capital investment.[31] The level of capital funding provided through public grants has significantly reduced since 2009-10 meaning that institutions must fund such investment from internal sources, which are

[30] The proportion of non-UK nationality academic staff is around 34% at Russell Group universities compared to an average of 20% for other UK HEIs. Much of the cutting-edge research infrastructure at our universities is also co-funded by charities, business and international partners.

[31] HEFCE, 'Financial health of the higher education sector: Financial results and TRAC outcomes 2013-14' (2015): http://www.hefce.ac.uk/media/HEFCE,2014/Content/Pubs/2015/201507/HEFCE2015_07.pdf

increasingly stretched, in order to secure their long-term sustainability. Our universities have responded to the challenging funding climate by implementing efficiencies in order to invest in capital projects that will have a major long-term return for the economy – as we have described in our report on the *Economic impact of the capital investment plans of the Russell Group universities*[32].

7.8 **World-class infrastructure, particularly buildings and equipment, is needed to facilitate the very best environment for research and teaching. We welcome the Government's commitment to increase research capital investment in real-terms to 2021. A clear commitment is also needed to fund the on-going resource costs associated with operating, maintaining and up-grading capital facilities.**

Research Partnership Investment Fund (RPIF)

7.9 The success of our universities in leveraging external investment through the Research Partnership Investment Fund (RPIF) has demonstrated the extent to which public and private partners see great benefit in such collaborations:

- Over £400 million has been allocated so far to 27 projects (including 21 at Russell Group universities), attracting over £1 billion of investment from business and charities.

7.10 Without RPIF, projects such as the £150 million Research and Translation Hub at Imperial West, which will have space for 50 spinout companies alongside 1,000 researchers and will support innovation on an unprecedented scale in London, would not have been possible. We therefore welcome the announcement at Budget 2015 that the Government will invest an additional £400 million in RPIF over this Parliament.

7.11 **RPIF should be maintained in the long-term as it provides a unique opportunity to leverage significant external investment into important capital projects at the UK's leading universities. Committing to maintain RPIF and providing a longer lead-time for projects to apply for funding would better suit business' planning cycles and further improve the quality of bids.**

7.12 Business investment in research and innovation is globally mobile and the UK needs to do whatever it can to attract investment here against very strong international competition. If we can attract the really important strategic investments through future rounds of RPIF then other activities will follow.

8. Health education

8.1 The UK has a world-class reputation for medical, dental and nursing education – in particular because of the excellent research-based teaching at Russell Group medical and dental schools, which is characterised by strong relationships with clinical practice.

8.2 However, the medical, dental and wider health education system in the UK is facing significant pressures. Instability in permitted intake numbers for universities, poor modelling of likely demand by government agencies, the development of unfair market distortions because of restrictions on international students, and cuts to funding for nursing are undermining the system and are putting incredible strain on the UK's world-leading universities. The current level of the benchmark price for nursing, for example, does not reflect the cost of delivering nursing education and training and this

[32] http://www.russellgroup.ac.uk/policy/publications/the-economic-impact-of-research-conducted-in-russell-group-universities/

issue will need to be resolved in order to prevent high quality education partners from withdrawing from nursing education[33].

8.3 We welcome the Government's commitment to increase investment in the NHS by £8 billion per year by 2020, but it is **essential that the budget for world-class health education is protected** within this in order to support high-quality teaching and address chronic workforce shortages in the NHS which have come about due to long-term under-investment.

8.4 Opening up medical and dental places to more international students would provide a significant economic boost to export earnings, create a level playing field with private medical and dental schools, and provide greater security against any future demand growth in the UK for medical and dental professionals. We would therefore like to see the **Government making it a priority to lift caps on international student numbers in medicine and dentistry**:

- International medical and dental student number caps should be lifted – potentially being doubled in the first instance – with more flexibility introduced to allow universities to manage intake numbers. Tariff (SIfT) payments from DH to hospitals for these international students should be maintained or at least modified[34].
- International caps should be removed altogether where overseas students are fully funded to cover both the BIS/HEFCE and DH contributions associated with their training (so called 'off quota' arrangements).

9. Investing in postgraduates

9.1 Postgraduate students are essential to a successful knowledge economy and the future academic workforce. It is vital that the brightest graduates are able to realise their full potential for further study while maintaining and enhancing the country's strengths in research and innovation.

9.2 The UK has a strong international reputation for high-quality postgraduate education (both research and postgraduate taught) and Russell Group universities are major centres of postgraduate study:

- In 2013-14 there were 184,000 postgraduate students at Russell Group universities.
- Between them, our 24 members account for a third of all postgraduates and 55% of postgraduate research students in the UK.

9.3 The Chancellor is right to help ensure there are no barriers to participation in postgraduate study by introducing a postgraduate loan scheme and considering other support options too. A postgraduate qualification can have a significant effect on the

[33] An analysis of the funding for pre-registration education for nursing shows a current funding shortfall of at least between 7.6% and 11.5%. This analysis is based on costings taken from an independent strategic cost review conducted by JM Consulting on behalf of the Department for Health and HE sector in 2007/8. In addition, a guaranteed annual uplift in the BMP has not been delivered, and so this equates to a real terms cut of 1.7% in 2014-15, compounded with a further cut of 1.1% in 2015-16.

[34] The tariff payment (previously called Service Increment for Teaching, or SIfT) is given to hospitals for all medical and dental students to cover facilities and human resources required to support students in their clinical training years.

employability of the graduate, especially for those initially in a non-graduate job, even within a very short period of labour market entry.[35]

9.4 We welcome the government's reassurance that the significant investment in postgraduate support will not create additional regulation, restrictions or costs in the future or divert funds from existing budgets for research and teaching. We are also pleased that the loans are not restricted to certain subjects and we will want to see a system that is clear and simple to understand so that most students – particularly those with the most potential - considering postgraduate study can be sure they will receive financial help if required. Indeed the Government should consider how costs could be contained further by prioritising support for the brightest candidates.

9.5 As well as support for postgraduate taught (PGT) students, it is important that the vital contribution postgraduate research (PGR) students make to the UK economy is recognised and facilitated. **Russell Group universities compete globally to recruit the most able postgraduate students**, but it is increasingly difficult to do this when universities elsewhere, for example in the USA, are able to offer greater financial support towards the costs of study – in particular at PGR level.

9.6 Current funding for postgraduate researchers comes from a diverse range of sources, within which public funding is an essential component. **The Government must continue to support postgraduate research students through Research Council and Funding Council grants**, and, if possible, increase overall investment in this critical component of the UK's research base.

9.7 We would also like to see Government support efforts to raise funds for postgraduate scholarships through philanthropy and business contributions e.g. **match-funding for philanthropic donations or additional tax incentives**. This could be an effective way for the Government to meet its objective of increasing participation in postgraduate study and could support universities' own efforts to increase postgraduate participation. If more funding is not made available then many of the best students will choose an institution outside the UK where financial support is more readily available**.**

9.8 Postgraduate research is a crucial first step in the development of a research career and for many high-level technical and professional roles in industry. It would be counterproductive to reduce this funding in order to increase loan support. An increase in funding would enable more students to enter research degrees, increase the pipeline of highly skilled research-trained postgraduates into the labour market, and strengthen the competitive position of the UK's research base and its universities.

10. Future competitiveness

10.1 Whilst the UK maintains a world-leading position in research excellence, public investment in our research base and universities is far lower than our international competitors. This relatively low level of investment means it is increasingly difficult for the UK's leading universities to compete with better-resourced institutions internationally:

- The UK's investment in R&D as a proportion of GDP ('R&D intensity') is well below the OECD and EU averages. In 2012, the UK spent 1.63 per cent of GDP on R&D.

[35] *Postgraduate Taught Scholarship Scheme – Widening access to postgraduate study and the professions.* An interim briefing by the University of Sheffield on a pilot intervention by six universities to offer funding solutions and assess demand for postgraduate study from graduates with widening participation characteristics*:* https://www.sheffield.ac.uk/polopoly_fs/1.412725!/file/PSS_Interim_Report.pdf

By comparison, the EU-15's average R&D intensity was 2.06 per cent, the OECD average was 2.37 per cent and China's spending was 1.95% GDP.[36]

- Whilst higher education expenditure on R&D (HERD) and government expenditure on R&D (GOVERD) have consistently increased as a percentage of GDP in countries across the OECD, EU and emerging nations, in the UK, total HERD and GOVERD as a proportion of GDP was lower in 2012 than it was in 2007.[37]

- In 2015, an international comparison of national HE systems found that the UK's HE sector ranks second out of 50 countries for output but 26th for resource inputs.[38]

10.2 Countries such as China, France, Germany and South Korea have invested strategically in a small number of research-intensive universities in order to maintain and enhance their research and learning infrastructures – making such institutions more attractive as partners for multinational R&D businesses.[39] China in particular has reaped the benefits of increased investment in science and research, growing its share of global research production from 5.6 per cent in 2003 to 14 per cent in 2012. Its citation impact (long below world average) is also steadily improving.

10.3 The UK's lack of investment in R&D relative to our international competitors is reflected in our falling position in terms of innovation performance compared to other EU countries.[40] A BIS commissioned international comparative analysis noted whilst the UK continues to punch above its weight in research excellence, its relative standing is being eroded by competition from emerging nations and continued investment in the UK research base is essential to remain a research leader in future.[41]

10.4 There is now a real danger that a lack of public investment will lead to the UK falling behind our competitors in some key areas of research for the future. For example:

[36] OECD MSTI database. The EU-15 countries are: Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, the Netherlands, Portugal, Spain, Sweden and the UK.
[37] This also applies to Canada, Hungary, Iceland and Israel. OECD Science, Technology and Industry Outlook 2014
[38] Universitas21 Ranking of National HE Systems 2015
[39] For example:
- Over a decade to 2011, around ¥30 billion (£2.8 billion) was invested in a select few Chinese research-intensive universities to help them achieve world class status. A further ¥10 billion (£950 million) is being invested to create research bases in China's mid-west universities.
- In France, more than €7.7 billion (£6.3 billion) has been allocated to the "Excellence Initiative" (IDEX) since 2010 to create eight campuses bringing together leading institutions to compete with the best universities in the world. In 2014, an additional €2 billion (£1.6 billion) has been announced as the second wave of funding to establish between three and five new IDEX campuses.
- By 2017, a total of €4.6 billion (£3.8 billion) will have been invested in Germany's Excellence Initiative which aims to create 43 clusters of research excellence and 11 excellent universities.
- South Korea is investing £1.2 billion over seven years to 2019 through its BK21 Plus programme to further cultivate a small number of research-intensive universities.

[40] The UK is now ranked 8th in the EU's Innovation Scoreboard and categorised as an "Innovation Follower", not an Innovation Leader. The UK was previously ranked 5th in 2010 and 6th in 2011 and has lost out to the Netherlands, Belgium and Luxembourg. It is worth noting that the Netherlands and Belgium have both increased investment in research as a proportion of GDP since 2010.
[41] 'International Comparative Performance of the UK Research Base: A report prepared by Elsevier for BIS' (2013)

- Recent investments into state-of-the-art research facilities in regenerative medicine and stem cells are very welcome, but the UK is underinvesting in this field compared to international competitors.[42] In 2012, UK public sector investment in regenerative medicine was around £77 million whilst China's national stem cell funding commitment is estimated at more than 3 billion RMB (over £300 million) for the 5-year period from 2012 to 2016.[43] The US spends more than any other country on stem cell research: in 2010, for example, National Institutes of Healthcare spent $1.2 billion on stem cell research and private sector funding may be ten times as much.[44]

- The UK and US have been the global leaders in high-energy particle colliders, but this position is under threat from China. Beijing's Institute of High Energy Physics is proposing to build a so-called 'Higgs Factory' by 2028, with a particle accelerator that is twice the length of the Large Hadron Collider (LHC) at CERN, Europe's particle-physics laboratory in Switzerland. Proposed investment of US$ 3 billion to create a next-generation super proton–proton collider would put China at the forefront of international particle physics. [45]

- The lack of Research Council support for bioprocessing research since the end of the 1990s has resulted in a 'missing generation' of skilled researchers, many of whom emigrated overseas. This has undermined the UK's ability to support UK bio/pharma manufacturing, industry and academia. Efforts are now being made to rebuild the bioprocessing research community with Research Council and industry investment in interdisciplinary research groups at our leading universities.[46]

10.5 **Public investment in R&D leverages investment from private, charity and international sources, rather than replacing funding from these sources**. As noted above, there is robust evidence to show that public investment in R&D leverages further private investment delivering an average return of 20 per cent after only three years. The strength of the UK's research base is also a significant factor in maintaining a high level of FDI into the UK:

- In 2013, expenditure on R&D performed in UK foreign owned businesses increased by 11% compared to the previous year and constituted 54% of total expenditure.[47]

[42] These include the Francis Crick Institute, unique partnership between the Medical Research Council (MRC), Cancer Research UK, the Wellcome Trust, UCL, Imperial College London and King's College London, which undertakes collaborative, multidisciplinary biomedical research including in the field of stem cells, and the MRC Centre for Regenerative Medicine (CRM) at the University of Edinburgh.
[43] http://www.researchtrends.com/issue-36-march-2014/stem-cell-research/
[44] BIS, 'Taking Stock of Regenerative Medicine in the UK' (2011)
[45] Proposal reported by Gibney, E., 'China plans super collider', *Nature* (22 July 2014) http://www.nature.com/news/china-plans-super-collider-1.15603 and Banks, M., 'China pursues 52 km collider project' *Physics World* (26 August 2014) http://physicsworld.com/cws/article/news/2014/aug/20/china-pursues-52-km-collider-project
[46] For example, the Biorenewables and Bioprocessing Research Group at the University of Nottingham specialises in sustainable manufacturing and treatment of chemicals and materials from renewable resources. The group is truly interdisciplinary (covering engineering, biology, chemistry and materials science), and collaborates with internationally leading groups in the UK, Europe, Australia and the USA.
[47] ONS, 'Business Enterprise Research and Development, 2013'

- Between 2000 and 2011, the most consistent growth in overseas-financed R&D has been in the HE sector: with an average annual increase of nearly 9% over the period.[48]

- The strength of our research base enables the UK to attract high levels of inward investment and the best international researchers to locate within our centres of excellence, underpinning innovative business and research clusters.[49]

10.6 Whilst other countries have increased spending on R&D recognising it as essential to building a thriving and competitive knowledge economy, and for securing further business investment, the UK's investment in R&D as a proportion of GDP has declined significantly over the last decade.[50] **We ask the Government to increase the UK's investment in R&D as a proportion of GDP in order to retain our competitive advantage internationally and capitalise on our university powerhouses as centres for research, innovation and growth**.

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[48] BIS, 'Innovation Report 2014: Innovation, Research And Growth'
[49] For example, multinational pharmaceutical firms are found to locate their R&D operations near to world-class rated chemistry departments in UK universities. UK-Innovation Research Centre 'The Economic Significance of the UK Science Base: A report for CaSE' (2014)
[50] ONS statistics

Annex A – Delivering impact from excellent research

The following illustrative examples of REF impact case studies demonstrate how excellent research conducted at Russell Group universities has delivered economic growth, business productivity, public sector efficiency, positive social impacts and wider improvements to health and quality of life.[51] We will be producing a more extensive analysis of research impact later this year, updating our previous publications on the economic and social impact of research at Russell Group universities[52].

Leading the way in automotive radar systems: University of Birmingham
Two decades of radar research at the University of Birmingham have been vital to the development of the automotive radar industry, making a significant financial contribution to Jaguar Land Rover (JLR) and other car manufacturers. Birmingham's research and development of 'adaptive cruise control' (ACC) radar, which enables a vehicle to maintain a safe distance from vehicles ahead automatically, and 'blind spot monitoring' (BSM), are helping to improve road safety for all road users and increasing vehicle sales revenues. Both ACC and BSM are now integral to the JLR range (since 2008, JLR has sold more than 47,000 vehicles equipped with ACC and more than 126,000 with BSM) and other car manufacturers are also incorporating it into their vehicle design. Manufacturers including BMW, Daimler Benz, Fiat and Volvo have benefitted further from Birmingham's expertise via work for the EU Technical Committee working on European standards for radar.

Major improvements in the effectiveness of stroke prevention: University of Oxford
Results from two separate studies at the University of Oxford have been used to redesign stroke-prevention services in the UK and elsewhere, significantly reducing the cost of care to the NHS and preventing tens of thousands of people from suffering strokes. One study (named EXPRESS) showed that urgent use treatments after minor 'warning' events reduced the risk of major stroke by 80% compared with standard treatment. This strategy is now being rolled out across the UK, with the expectation of preventing about 10,000 strokes per year and saving the NHS up to £200 million in acute care costs alone. The second study has made important advances in understanding how best to prevent strokes related to high blood pressure, which is the most common cause of stroke, with major implications for the identification of individuals at risk of stroke and for effective prevention.

Improving safety and driving down the cost of deep water oil and gas platforms and offshore wind turbines: Imperial College London
Researchers in Imperial's Department of Civil and Environmental Engineering Offshore have developed a new design paradigm, dubbed the Imperial College Pile (ICP) approach, to support deep water oil and gas platforms and offshore wind turbines. Liaison with industrial collaborators, including OWC, Atkins and Senergy has identified substantial savings on multiple individual projects, totalling at least £400 million to date as a conservative estimate and improved safety standards. There are also far larger (but more difficult to estimate) cost benefits arising from the ability to safely and reliably develop more challenging offshore platforms worldwide, allowing for the exploitation of marginal resources, including highly challenging deep-water settings. The ICP approach is now included in American Petroleum Industry (API-2011) standard and ISO design guidance, and is used by Shell as their main design method for all new platforms.

[51] All REF impact case studies can be viewed on the HEFCE database at the following link: http://impact.ref.ac.uk/CaseStudies/
[52] Economic impact: http://www.russellgroup.ac.uk/policy/publications/the-economic-impact-of-research-conducted-in-russell-group-universities/
Social impact: http://www.russellgroup.ac.uk/policy/publications/the-social-impact-of-research-conducted-in-russell-group-universities/

Outstanding return on investment in genome sequencing research: University of Cambridge
BBSRC-funded research at the University of Cambridge which led to the development of genome sequencing technology has made a very significant contribution to the success of the global DNA sequencing market, which is projected to be worth $10 billion by 2017. The spin-out Solexa-Illumina holds 66% of the global sequencing market, generating an annual turnover in excess of $1 billion and employing over 2,000 people worldwide. The technology has enabled the creation of a number of companies providing personal genomics services, including Genomics England which is running a four-year project to sequence 100,000 genomes, and has had a direct impact on human health, including more effective treatment of rare cancers.

The discovery of graphene driving economic growth in the UK and overseas: University of Manchester
The discovery of graphene at the University of Manchester led to the creation of the graphene production industry, with rapid global uptake of new graphene technologies generating significant public and private investment including $200 million of recent commercial investment in graphene production across 210 companies from blue-chips such as IBM and Samsung to start-ups. Over 55 new companies have entered the sector with at least 24 formed since 2008. The commercial activity surrounding graphene has been matched by global shifts in public research and innovation funding of at least $2.4 billion, as governments have moved to facilitate graphene research and commercialisation. University of Manchester scientist Konstantin Novoselov received one of the first European Research Council starting grants to investigate the 'Physics and Applications of Graphene' in 2007. With fellow Manchester professor Andre Geim, he went on to win the 2010 Nobel Prize for Physics for his work.

Innovation in transport systems: University of Leeds
Computer software developed from EPSRC-funded research conducted at the University of Leeds has delivered between £230 million and £920 million worth of cost savings to public transport systems in the UK alone between 2008 and mid-2013. The research into transport crew scheduling led to the spinning out of a successful software company, Tracsis, and its software is now used by over 40 bus and train companies. Success led to the Tracsis floatation on the London Stock Exchange in November 2007 with a market capitalisation of nearly £53 million at the end of 2013 and annual turnover of over £10 million.

Improvements in survival and quality of life for people with cystic fibrosis: Queens' University Belfast
Research in clinical medicine at Queen's University Belfast has resulted in the development of a new drug, Ivacaftor, to treat cystic fibrosis (CF) with sales worth $113 million in the first nine months alone leading to outstanding improvements in survival and quality of life for people living with cystic fibrosis. The drug has now been approved by the FDA and EMA and is licensed and funded in USA, UK, Ireland, France and Germany. The new drug also has a very significant societal impact for people with CF, demonstrating real hope that a wide range of mutations may indeed be treatable in future. This research delivered over £50 return on investment for every £1 which supported the initial research within a year of the drug being available.

The development of new 'fast-acting' insulin drugs: University of York
Collaborative research between the University of York's Structural Biology Laboratory (YSBL) and Novo-Nordisk, the Danish multinational pharmaceutical company, has led to the development of new insulin drugs used to treat millions of diabetic patients worldwide with drug sales totalling over $6 billion annually. The 16-year collaboration has helped Novo-Nordisk to become the leading developer and world's largest producer of recombinant insulin

for treatment of diabetes. Insulin derivatives that stem directly from structural work carried out within YSBL in the university's Chemistry Department are now the standard treatment for insulin-dependent diabetes for some 35 million patients worldwide, meaning the research has had major health impacts on diabetics not just in the UK, but across the globe.

Developing energy efficient technologies with businesses: University of Nottingham
The University of Nottingham's unique development of six Creative Energy Homes on campus provides a living test-site for leading firms including E.ON, BASF and others, allowing them to work with Nottingham to investigate the integration of energy efficient technologies into houses. Despite the businesses sponsoring the project never having designed or built zero-carbon homes before, working in close collaboration with Nottingham has enabled the construction companies to develop the techniques, skills and expertise necessary to meet the latest industry challenges. The project has enabled a number of developers and contractors to establish themselves in the field of low-energy housing, winning contracts and building housing developments worth millions of pounds.

Improving carbon accounting to respond to climate change: University of Edinburgh
Research into carbon accounting and benchmarking conducted at Edinburgh Business School's Centre for Business and Climate Change since 2008 has led to the development of international benchmarks for corporate performance on carbon accounting, and has helped governments, businesses and investors change the ways they allocate funds, supporting a shift towards lower-carbon alternatives. The research proved that sustainability benchmarking can improve corporate carbon management and led to more than £500,000 of business investment from supermarket and mobile telecoms companies in the development of carbon benchmarks and a successful spin-out company, ENDS (Environmental Data Services) Carbon, which has benchmarked over 1,000 companies for 20 corporate clients. In 2010, the international Carbon Disclosure Project launched the 'Carbon Action' initiative based partly on benchmarking research at Edinburgh – recruiting over 90 global institutional investors with £4.5 trillion of assets.

Maths research delivering life-saving results: Cardiff University
Research conducted at the School of Mathematics at Cardiff University has delivered lifesaving improvements to UK healthcare systems as well as realising net efficiency gains of £1.6m per year in one hospital emergency department alone (at University Hospital of Wales). The results include lowered patient waiting times, increased survival rates and improved patient care. The application of mathematical models in a variety of contexts has helped contribute to reducing the mortality of trauma patients across South London by 54%; reduced the mortality of stroke patients across South London by 60% through the creation of a new Stroke Unit, based on the research findings; and provided hospital capacity planning tools in use across the UK. This work has been disseminated nationally and internationally, in the media and at a range of events designed to engage the public with mathematics including outreach activities involving over 500 school children.

Revolutionising industrial material processing: University of Southampton
Research undertaken at the University of Southampton has led to the creation of a new business sector in the generation of highly efficient and practical fibre laser technology. The application of the research has revolutionised areas of industrial material processing and enabled the development of specialist components for high-end industries as well as an array of new medical devices, procedures and manufacturing technologies adopted by a range of sectors. Beneficiaries of the research include car manufacturers, aerospace companies, food and consumer goods manufacturers and medical component manufacturers. In particular, as a result of research, there has been a 30% increase in the number of surgical stents manufactured with fibre lasers worldwide. The research is also directly responsible for the commercial success and sustained growth of a spinout company,

SPI Lasers (SPIL) Ltd, which has an annual turnover of over £40 million and employs more than 250 people in the Southampton area.

Applying ultrasonics research in a range of industrial sectors: University of Warwick
Inspection techniques developed by the Warwick Ultrasonics Group focusing on non-destructive testing (NDT) have addressed industrial needs across a range of sectors including heavy manufacturing, nuclear energy, food, petrochemical, transport, aerospace, power generation, equipment manufacturing and service industries. The research has led to significant industrial investment, improvements in capability and the realisation of cost savings. A successful company spun-out of Warwick Ultrasonics Group, Sonemat, has commercialised high-performance electromagnetic acoustic transducers (EMATs) - which make it possible to generate and detect a range of ultrasonic frequencies simultaneously, collaborating with a number of companies in the UK and overseas, ranging from SMEs to large multinationals. Among other issues, the research is helping to address the problem of corrosion - one of the most significant mechanisms of structural damage affecting the economy around the world - the current annual cost of which is over 3% of the world's GDP (about US$2 trillion).