

Budget 2024 / Spending Review submission

Executive summary

- Scientific research, development and innovation are essential building blocks for economic growth and the UK's national renewal – by improving productivity, driving growth, creating high value jobs across the country and taking pressure off our public services.
- We are in a global science race and investment in critical emerging technologies – such as health tech, quantum, AI and digital infrastructure – is vital for maintaining the UK's scientific and technological sovereignty.
- The science and technology sectors have strong growth potential. The sector currently employs just under 3 million people, with one of the largest employment growth rates in the last decade¹.
- Science is a long-term enabler of opportunity. Investing in skills and scientific capabilities today lays the foundation for the UK's future prosperity and international competitiveness.
- For the UK to be regarded as a reliable investment partner globally, we must stick to our commitments. We fully recognise the scale of the challenge to the public finances. However, due consideration must be given to ensuring that the UK's scientific and R&D base is not eroded by short-term fiscal pressures. Cutting funding for science and R&D to deliver short-term savings could put the delivery of the Government's five missions and the UK's long-term growth and prosperity at risk.
- There is more we must do to ensure that the UK is home to the next generation of cutting-edge scientific talent, discovery, innovation and technology.
- With ambition and commitment, this Government can unlock the benefits of science to improve people's lives and the lives of future generations.

1. Source: Office for National Statistics (2024). Employment by industry and sex, UK, published quarterly, non-seasonally adjusted. <https://www.ons.gov.uk/employmentandlabourmarket/peopleinwork/employmentandemployeetypes/datasets/employmentbyindustryemp13>, (accessed 20 August 2024)

AREA FOR ACTION 1

KICKSTART SUSTAINED ECONOMIC GROWTH SUPPORTED BY STABLE, LONG-TERM INVESTMENT AND COMMITMENT TO SCIENCE, R&D AND INNOVATION

Research discoveries and the development of new products, services and technologies are at the root of innovation, which drives productivity and economic growth and, ultimately, improved living standards across the economy. In an increasingly competitive global environment for R&D talent and investment, Government spending on R&D must keep pace with other nations.

The UK Government's R&D investment growth has remained sluggish at 0.2% over the last decade. 'Flat cash' funding for the Government's science budget over the course of this Parliament would be equivalent to a £1.3 billion real terms funding cut and a nearly £4.2 billion funding gap when compared to the previous Conservative Government's commitment to R&D investment. Cutting science and R&D to deliver short-term savings would be cutting growth off at the roots.

KEY RECOMMENDATIONS

The Government should:

At the Budget

- Index link the government's £20 billion science budget in line with inflation to maintain the confidence of investors and researchers.
- Protect departmental R&D budgets, to improve public services and support the UK's resilience in preparing for and managing pandemics and other emergencies.

At the Spending Review

- Provide the certainty of sustained real terms funding for research over a ten-year time horizon.
- The new government should reconfirm the commitment to invest at least £22 billion in R&D by 2026/27 to maintain confidence for investors and researchers.
- Beyond FY25/26, the UK should re-establish global leadership positions in science and innovation and set an ambition to lead the G7 in R&D intensity.
- Examine the UK's research funding system to put it on a sustainable basis as part of the Spending Review.

AREA FOR ACTION 2

SHOW THE UK IS OPEN FOR BUSINESS TO GLOBAL INVESTORS AND RESEARCHERS

This Government can take bold steps to market the UK as a destination of choice to global investors, innovators and entrepreneurs. Making the UK home to cutting-edge discoveries and innovation would help to improve people's lives by benefitting from new technologies and products, as well as creating more high-value jobs and supply chains.

KEY RECOMMENDATIONS

The Government should:

- develop a single, cross-government highly visible international science strategy to increase foreign direct investment into UK science; and
- reduce upfront visa fees to restore the UK's international competitiveness in attracting top scientific talent.

AREA FOR ACTION 3

BREAK DOWN BARRIERS TO OPPORTUNITY AND UNLOCK THE SKILLS OF THE FUTURE THROUGH REFORM OF OUR EDUCATION SYSTEM

The Government has a once in a generation opportunity to reform our education system so that every young person has the skills for an increasingly data driven, changing world of work. There is a hidden crisis in science education. Young people in the most disadvantaged areas are paying the price, as is our economy.

KEY RECOMMENDATIONS

- The Government's curriculum and assessment review should be ambitious and consider reform of the secondary and post-16 education system to offer a broader and more expansive range of study, including:
 - continuation of mathematical and data education to 18; and
 - the creation of a more equitable single route through the sciences for all students up to age 16.

The Government should also:

- reverse the previous government's cuts to professional development to retain science, maths and computing teachers;
- develop a longer-term sustainable funding solution for professional development for teachers at the Spending Review; and
- invest in young people's future by increasing spend on educational research to create a more coordinated, forward-thinking system.

AREA FOR ACTION 4

GROW THE UK'S AI, DATA AND SUPERCOMPUTING CAPABILITIES AND PROVIDE GLOBAL LEADERSHIP TO SAFELY HARNESS THE BENEFITS OF AI FOR SOCIETY

Artificial intelligence (AI) has the power to transform how we live and work. In today's global knowledge race, it will be important for our economy and society to build, attract and maintain significant computing and AI capabilities in the UK. We also have an opportunity to lead on new technologies that protect public trust and privacy so that the benefits of AI for scientific research and in public services can be maximised.

KEY RECOMMENDATIONS

- Funders, industry partners, and research institutions with computing facilities should be incentivised to actively share essential AI infrastructures such as high-performance computing power and data resources.
- Access to high quality data and interoperable data infrastructures will be critical for supporting the AI industry. The Government should ensure the Digital Information and Smart Data Bill does not risk data adequacy with the European Union. As part of the Bill's implementation, it should:
 - work to provide better data protection guidance for scientific researchers; and
 - publish a national privacy enhancing technologies (PETs) strategy to promote the responsible use of PETs in data governance.

AREA FOR ACTION 5

ACCELERATE PLANS FOR THE CLEAN ENERGY TRANSITION, INCLUDING IMMEDIATE PLANS FOR LOW-COST HYDROGEN ENERGY STORAGE TO STRENGTHEN THE UK'S ENERGY SECURITY

There is a need for rapid and determined action on damaging climate change from decision makers in all levels of government. The UK is well placed to demonstrate global leadership on tackling climate change and protecting our planet for current and future generations.

KEY RECOMMENDATIONS

- Evidence-based net zero technology roadmaps should be produced that identify the route to develop and implement the key sectors and technologies needed to decarbonise the energy system by 2050 to send clear signals to mobilise the private investment needed to reach net zero.
- The Government should prioritise the construction of large-scale energy storage facilities to match the expansion of renewable generation, if it is to reach legally binding net zero targets by 2050 and have year-round security of energy supply.

AREA FOR ACTION 6

PROTECT OUR NATURAL RESOURCES:
THE UK SHOULD TREAT BIODIVERSITY LOSS WITH THE SAME URGENCY AS CLIMATE CHANGE

Urgent global action is needed if we are to prevent further biodiversity loss. In the UK, only 14% of priority habitats are assessed to be in good condition. Protecting the biodiversity of our planet makes clear economic sense and will benefit countries around the world, with an estimated £10 trillion benefit to taking early action.

KEY RECOMMENDATIONS

The Government should:

- develop new approaches to accounting for the true value of biodiversity, drawing on the Dasgupta Review;
- ensure policy to reduce greenhouse gas emissions and adapt to climate change helps to prevent and reverse biodiversity loss; and
- support the development of a global biodiversity monitoring network to help countries meet their biodiversity targets.

Full submission

Introduction

Scientific research, development and innovation are essential building blocks for economic growth and the UK's national renewal – by improving productivity, driving growth, creating high value jobs across the country and taking pressure off our public services.

UK science produces enormous value for our society. We led the world in developing an effective Covid-19 vaccine, building on a strong base in biological sciences that has been cultivated over decades. Underpinning all great innovations lies enormous amounts of research. It is only through decades of experimentation and scientific endeavour that we develop the medicines that we take, the vehicles we travel in, or the phones in our pockets. By investing in research, from university labs to routes to market, we can lead the way as a nation in turning early-stage discovery science into companies and products that can transform lives.

The science and technology sectors have strong growth potential. The sector currently employs just under 3 million people, with one of the largest employment growth rates in the last decade². Scientific development underpins advances across our economy and is essential to delivering the government's five missions, from the development of solar cells for green energy to analytics and forensic imaging to improve crime prevention.

It is also crucial for our national security. We are in a global science race and investment in critical emerging technologies – such as health tech, quantum, AI and digital infrastructure – is vital for maintaining the UK's scientific and technological sovereignty.

Science is a long-term enabler of opportunity. Investing in skills and scientific capabilities today lays the foundation for the UK's future prosperity and international competitiveness.

There is more we must do to ensure that the UK is home to the next generation of cutting-edge scientific talent, discovery, innovation and technology – and to unlock the benefits of science to improve people's lives and the lives of future generations.

This includes:

- 1 Kickstart sustained economic growth supported by stable, long-term investment and commitment to science, R&D and innovation;**
- 2 Show the UK is open for business to global investors and researchers;**
- 3 Break down barriers to opportunity and unlock the skills of the future through reform of our education system;**
- 4 Grow the UK's AI, data and supercomputing capabilities and provide global leadership to safely harness the benefits of AI for society;**
- 5 Accelerate plans for the clean energy transition, including immediate plans for low-cost hydrogen energy storage to strengthen the UK's energy security; and**
- 6 Protect our natural resources: treating biodiversity loss with the same urgency as climate change.**

2. ONS.

AREA FOR ACTION 1

KICKSTART SUSTAINED ECONOMIC GROWTH SUPPORTED BY STABLE, LONG-TERM INVESTMENT AND COMMITMENT TO SCIENCE AND INNOVATION

Science and innovation are a UK success story and an essential catalyst for the UK's national renewal – by improving productivity, driving growth, creating high value jobs across the country and taking pressure off our public services.

Research discoveries and the development of new products, services and technologies are at the root of innovation, which drives productivity and economic growth and, ultimately, improved living standards across the economy.

Unlocking growth, jobs and regional prosperity through R&D

Public investment in science, research and innovation unlocks private R&D investment.

The economic and societal spillover benefits of science, research and development are significantly greater than rates of investment return alone, as set out above³. For example, universities and other publicly-funded R&D organisations are magnets for major industry and jobs in their surrounding region. Examples include Arm at Cambridge, Boeing at Sheffield and Strathclyde, Jaguar Land Rover in Coventry, Siemens in Lincoln, and Unipart in Coventry.

For each £1 of public R&D spend in the UK, it is estimated that this stimulates between £3.09 to £4.02 of private R&D investment in the long term.

How science benefits the economy



New knowledge and ideas

Scientific research produces specific bodies of knowledge and process that can be applied for economic benefit.



Innovation and productivity

The application of bodies of knowledge and process spills over into innovation and productivity gains.



Skilled people and jobs

Scientific research and development (R&D) has a significant impact on human capital, through education and training and the generation of new types of jobs.



Wider economic impacts which are not directly monetised

Science generates important benefits that enable other economic activity, from improved public health to environmental protection and national security.

3. *Science and the economy*, The Royal Society, 2024.

CASE STUDY 1

The benefits of government department-sponsored R&D.

Defra’s Investment in Flood Risk Management Research

Flooding is a major environmental challenge in the UK, causing significant economic and social impacts. The Department for Environment, Food and Rural Affairs (Defra) has been at the forefront of funding research to improve flood risk management and resilience. This has supported various research projects and initiatives which have led to:

- **Improved flood defences**

The funding has enabled the construction and enhancement of flood defenses, protecting thousands of homes and businesses.

- **Innovative solutions**

Research has led to the development of new technologies and approaches, such as natural flood management techniques and advanced flood forecasting systems.

- **Community resilience**

The research has helped communities better prepare for and respond to flood events, reducing the overall impact of flooding.

Lessons learned

This demonstrates the critical role of departmental R&D budgets in addressing environmental challenges and protecting communities. Sustained investment in flood risk management research has not only advanced technological development but also supported economic growth and enhanced community resilience.

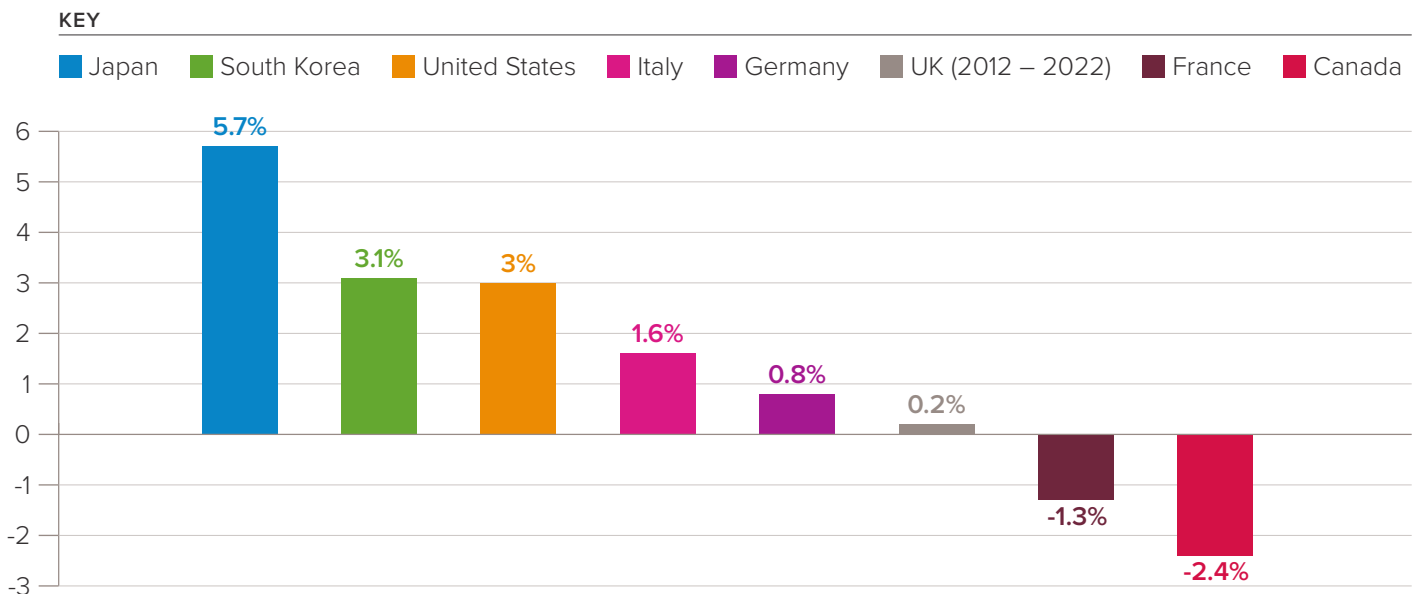
Protecting the UK’s scientific capabilities with sustained real terms investment in R&D

We are in a global knowledge race, particularly in the development of new technologies such as quantum and AI, which have the potential to transform our economy and society. We also live in a geopolitically volatile world. It is crucial for our future prosperity that we protect and grow the UK’s scientific capabilities and technology sovereignty.

In an increasingly competitive global environment for R&D talent and investment, Government spending on R&D must keep pace with other nations. China is increasing its R&D spend by 7% every year until 2026, while the USA has committed an additional \$250 billion to core science and technology budgets. France is trebling the budget of its National Research Agency.

FIGURE 1

Compound Annual Growth Rate (CAGR) of R&D Budget Allocations in G7+1 Nations 2013 – 2023⁴.



4. Adjusted for Inflation and Purchase Power Parities.

Without political ambition and commitment, the UK is at risk of falling behind in this global race. The UK's productivity and levels of R&D investment, as a proportion of GDP, lag behind our international counterparts. The UK is 11th in the OECD for R&D investment as a % of GDP (2.9% in 2021)⁵, behind Belgium, Austria and Finland. The compound annual growth rate for UK Government investment in R&D over the past decade falls below inflation and is outperformed by our international counterparts, while productivity growth also remains sluggish⁶.

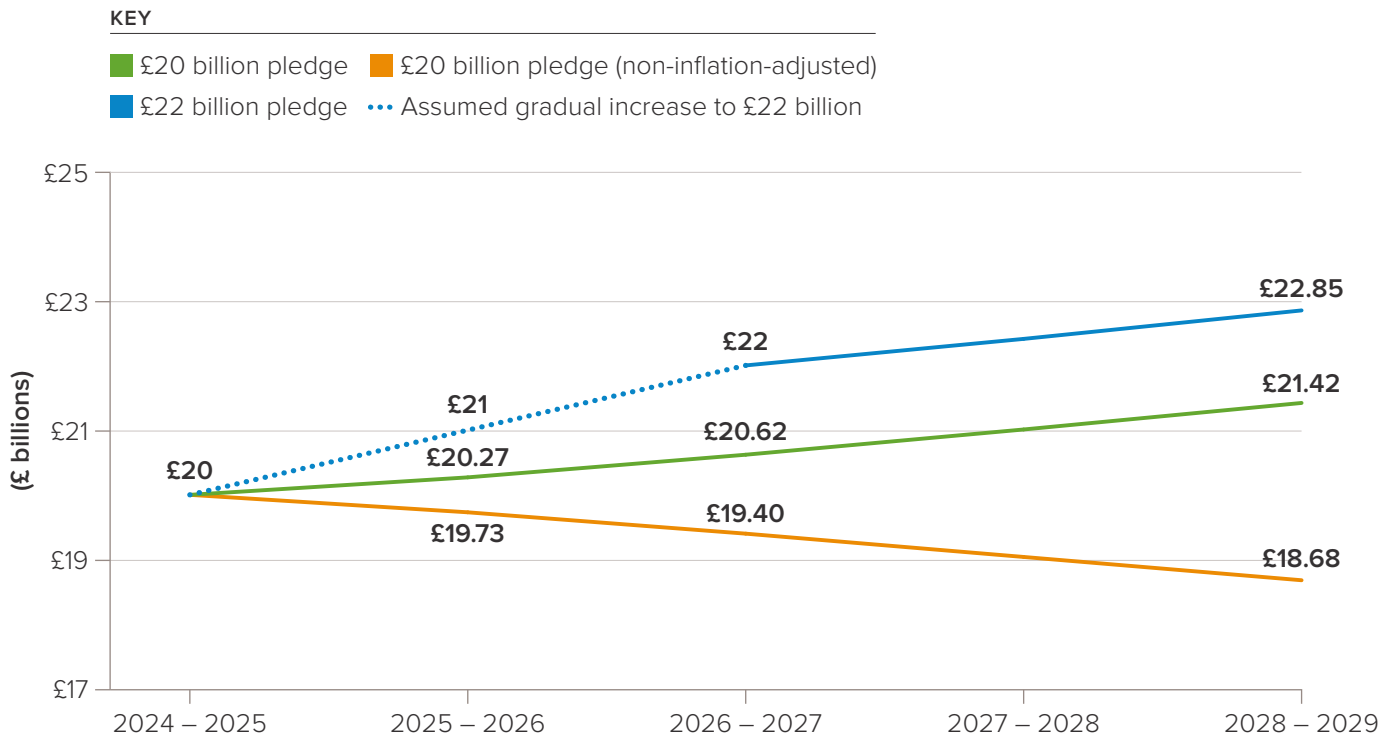
The UK's research sector is also under financial strain. In universities, which account for over 75% of publicly-funded research spending, the full economic costs of research are far out-stripping the income received to fund it; with the 'research deficit' reaching £5 billion in 2021 – 2022⁷. We recognise the wider financial pressures facing the higher education sector and it is vital that the sustainability of research is considered as part of the Spending Review process.

It is therefore vital for the health of the UK's science and research ecosystem that public-funding of R&D is maintained at sustainable and sufficient levels. Cutting science and R&D funding to deliver short-term savings would be a short-sighted and retrograde step investment – tantamount to cutting growth off at the roots. As the graph below demonstrates, 'flat cash' funding for science over the course of this Parliament would be equivalent to a £1.3 billion real terms funding cut and a £4.2 billion funding gap when compared to the previous Conservative Government's commitment. This could have a significant adverse effect on the UK's science capabilities, undermine investor confidence and risk billions of pounds of potential private sector co-investment.

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 £5 billion – the research funding 'deficit'
 in 2021 – 2022.

FIGURE 2

Impact of Inflation on UK Government R&D Budget Pledges (2024 – 2029).



5. OECD (2024), Gross domestic spending on R&D (indicator). doi: 10.1787/d8b068b4-en (Accessed on 17 May 2024).

6. ONS.

7. UKRI, 2023. Source: International comparison of the UK research base, 2019

Driving private sector investment in innovation with decisive, long-term thinking

There are clear steps that a new government can take to re-establish global leadership in science, unlock greater private investment in R&D and improve people's living standards through economic growth and productivity gains.

This includes providing the certainty of sustained real terms funding for research over a ten-year time horizon. Science is a long-term endeavour: the rapid development of the mRNA Covid-19 vaccines, which saved countless lives and billions of pounds, were from advances which were decades in the making. The most advanced scientific nations make a clear, long-term commitment to their science and research priorities. Certainty matters: it provides space for researchers to pursue bold ideas and innovations and a predictable environment for investors.

This government has an opportunity to end the political short-termism and stop-start investment in science and to rebuild the UK's reputation as a reliable investment partner. The Chancellor's commitment to providing stability and certainty and the Labour Party's manifesto commitment to ten-year funding for key research institutions are welcome first steps. We welcome the opportunity to work with the government to make these commitments, which require careful implementation, a reality.

For the UK to be regarded as a reliable investment partner globally, we must stick to our commitments. We fully recognise the scale of the challenge to the public finances. However, due consideration must be given to ensuring that the UK's scientific and R&D base is not eroded by short-term fiscal pressures, which could damage longer term growth prospects. It is crucial that the UK creates an attractive environment for private sector investment by providing policy and regulatory certainty that provides consistent signals to private sector and global investors.

KEY RECOMMENDATIONS

At the Budget

- Index link the government's £20 billion science budget in line with inflation to maintain the confidence of investors and researchers.
- Protect departmental R&D budgets, to improve public services and support the UK's resilience in preparing for and managing pandemics and other emergencies.

At the Spending Review

- Provide the certainty of sustained real terms funding for research over a ten-year time horizon.
- The new government should reconfirm the commitment to invest at least £22 billion in R&D by 2026/27 to maintain confidence for investors and researchers.
- Beyond FY25/26, the UK should re-establish global leadership positions in science and innovation and set an ambition to lead the G7 in R&D intensity.
- Examine the UK's research funding system to put it on a sustainable basis as part of the Spending Review.

AREA FOR ACTION 2

SHOW THE UK IS OPEN FOR BUSINESS TO GLOBAL INVESTORS AND INNOVATORS

This Government can take bold steps to market the UK as a destination of choice to global investors, innovators and entrepreneurs. Making the UK home to cutting-edge discoveries and innovation would help to improve people's lives by benefitting from new technologies and products, as well as creating more high-value jobs and supply chains.

Getting the most from UK science means thinking globally. International collaboration extends the impact and reach of scientific discoveries and innovations. This in turn translates into advances in economic performance, the health and security of people and the planet, and our resilience to national and global-scale shocks. In 2022, more than half of the UK's research output (61.5%) was the result of international collaboration⁸, compared with 26% in 1998.

Following re-association with Horizon Europe, we should maximise the UK's participation in Horizon and future EU Framework Programmes to drive the growth and global influence of our research and innovation. Alongside this, we need a long-term international science strategy which supports global scientific collaboration and leverage greater foreign direct investment to support the growth of UK science, research and innovation.

Marketing the UK science sector as a destination of choice for global investment

Overseas funding and foreign direct investment are crucial levers for growth in a challenged fiscal environment. There are positive spillover effects from this, as companies that base their R&D investments in the UK, typically have a more 'sticky' investment profile which generates further job creation. It is concerning that overseas funding into UK R&D has fallen by nearly a quarter year-on-year (21% from 2021 – 2022) to the lowest point in the last 5 years (inflation-adjusted)¹⁰. The UK government can and should play a more active role in attracting foreign direct and overseas funding into UK science and marketing the UK as a destination of choice for global innovators and entrepreneurs.

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Overseas funding into UK R&D activities fell by nearly a quarter (-21%) to £6 billion between 2021 and 2022.

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More action is needed to encourage global companies to base their R&D activities here and to attract overseas investment. As set out above, this not only includes policy and investment certainty, but also removing barriers to attracting the world's top scientific talent. International researchers and students bring valuable knowledge and investment to the UK. We welcome recognition of this from the new Government, but there is more we must do to strengthen the UK's international competitiveness.

This includes exploring ways to reduce upfront visa costs for scientific researchers, which are some of the highest in the world. Recent analysis commissioned by the Royal Society shows that visa costs have increased by 58% in three years, with UK visa costs on average 17 times higher than our international counterparts¹⁰. The Government should reduce the cost burden on applicants, employers and research and innovation funders and bring costs in line with the UK's international competitors. As the UK's premier route for attracting research and innovation talent, the Global Talent Visa should be the starting point for lifting the costs barrier. Without action, the UK's position as a destination of choice for innovation is at risk.

KEY RECOMMENDATIONS

The Government should:

- develop a single, cross-government highly visible international science strategy to increase foreign direct investment into UK science; and
- reduce upfront visa fees to restore the UK's international competitiveness in attracting top scientific talent.

8. International comparison of the UK research base, 2019.

9. ONS.

10. Analysis of visa costs, 2024 – Fragomen LLP, commissioned by The Royal Society.

AREA FOR ACTION 3

BREAK DOWN BARRIERS TO OPPORTUNITY AND UNLOCK THE SKILLS OF THE FUTURE THROUGH REFORM OF OUR EDUCATION SYSTEM

Education is the most powerful policy lever a government has at its disposal to improve society. It provides future skills for the economy, offers fulfilling job opportunities for all young people and strengthens engagement with wider society. Yet with technology and society rapidly changing, our education system is playing catch-up.

The problem-solvers of tomorrow will need a foundation in science, digital and data skills alongside knowledge of the humanities and creative arts. Currently students are presented with an ‘illusion of choice’, where many are forced to abandon studying for a wide range of skills post-16.

The Government’s reviews of the curriculum and of post-16 education provide an important opportunity to reform our education system and introduce a broader range of study across the sciences and humanities – as is the case in other high-performing economies.

Mathematics and data education for a data driven world

A mathematically and data literate population is key to future economic renewal and for everyone to thrive in our democracy. Our education system needs to urgently adapt to our increasingly data and technology-rich world. If we are to compete with our international counterparts, we must reduce the educational inequalities in STEM and raise levels of maths and data education to equip our young people with the skills for the changing world of work. Change must start now.

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Almost half of all working adults in England have the numeracy expected of an 11-year old.
.....

In maths, there are wide gaps between the lowest and highest achievers, with a long tail of underachievement linked to economic disadvantage. A third of pupils effectively fail maths at 16 every year, and few improve when they retake exams. Only 11% of UK students achieve the PISA higher level 5 (eg modelling complex situations) compared to 41% in Singapore. Socio-economic status is strongly correlated with mathematical performance and the gap between bottom and top quintiles has not improved in 10 years¹¹.

The Government has a once in a generation opportunity to take a new approach. Every child should leave school with the skills and confidence in maths and data to thrive in work and life, so that they can compete for skilled jobs, start new high-growth companies, or plan well for old age.

As part of the Department for Education’s curriculum and assessment review, a new approach to maths and data education should be planned and tested over 2 – 3 years, then implemented over the long term (10 – 15 years) and supported by a task force to lead implementation.

As set out in the Royal Society’s recent *Mathematical Futures* report¹², a new curriculum for mathematical and data education, beginning in early years, must integrate data, statistics and use of digital and computing tools into mathematics so that young people are better prepared for the workplace in a growing economy.

Qualifications and assessment also need to change to demonstrate to employers what young people can do with the skills and knowledge they have. In addition, teachers need to be better supported and trained to embed mathematical skills across a range of subject areas.

11. *Mathematical Futures: A new approach to mathematical and data education*, The Royal Society, 2024.

12. *Ibid.*

Tomorrow's climate scientists – bringing science to life in schools.

Hands on practical science in schools has been declining significantly over time, with only a quarter (26%) of year 10 pupils given access to practical science in school at least fortnightly (Science Education Tracker, The Royal Society, 2024).

The Royal Society's Partnership Grant scheme, funded by the Department for Science, Innovation and Technology, provides funding for young people and their teachers to carry out a practical scientific research project, in partnership with a qualified STEM researcher from academia or industry.

The *Tomorrow's climate scientists* programme empowers students to have a voice in the direction of scientific research around climate change and biodiversity by working with their STEM partner. It also supports students to develop green skills as the UK moves towards a net zero future.

Young people develop key practical skills, gain first-hand knowledge of career opportunities and experience the excitement that comes from carrying out their own investigations, often addressing local challenges. As they problem solve, they develop a can-do attitude and the creativity and imagination that is highly valued by employers. They learn the value of teamwork and collaboration and that everyone, irrespective of background, can benefit from and contribute to scientific progress.

"Crucially important skills have been honed and developed which are industry-relevant and will facilitate positive destinations for all of the students such as university applications, lab apprenticeships and other STEM employment opportunities. All of the students loved the STEM partner input, and guest lectures, and similarly they enjoyed using the nanopore technology and practicing their lab skills."

Berkshire College of Agriculture

More information on the impact of the Partnership Grants programme can be found at royalsociety.org/grants/partnership-grants

Retaining and investing in STEM teachers

The government's plan to recruit 6,500 new teachers is welcome, especially given low levels of STEM teacher recruitment. In 2023/24 DfE only reached 17% of its target for recruitment of physics teachers (computing reached 36% of target; mathematics 63%)¹³. Schools and colleges in disadvantaged areas report greater difficulties in filling teaching posts and problems are particularly pronounced in maths, computing and sciences, with schools struggling to recruit teachers with a relevant degree to the subject they are teaching¹⁴.

The policy to recruit more teachers will fall short if the Government does not also invest in how to retain teachers once they are qualified and working in the profession. Current estimates indicate that some 40,000 teachers leave the teaching profession in England each year.

Evidence shows that access to subject-related professional development is associated with lower attrition rates of teaching staff. A 2021 EPI report commissioned by Wellcome suggests that if schools increased spending on professional development by £500 per teacher per year, up to 12,000 teachers could be prevented from leaving teaching every year¹⁵.

The Government should prioritise funding for continuing professional development (CPD) for teachers, including the restoration of funding for science CPD following cuts made during the previous Parliament. While there would be costs associated with this, these could be offset by savings in recruitment costs from the reduction in churn of teachers leaving the profession.

13. NFER teacher labour market in England report, 2024.

14. EPI *Teaching and Leadership: Supply and Quality* 2020.

15. EPI *The effects of high quality professional development on teachers and students*, 2021.

Investing in research and evidence-based approaches to education

Educational research can provide the best evidence on how to break down barriers to opportunity in the education system. However, current spend on educational research in proportion to the total education spend is tiny in comparison with other public sectors.

Investment in more longitudinal research would allow meaningful evaluation of the effectiveness of education policies and their impact on intergenerational opportunities. This would ensure value for money in future education policy interventions and also support long-term research in emerging areas such as the role of AI in education.

.....

12,000 teachers could be prevented from leaving the workforce each year with a £500 increase in spending on teacher training.

.....

KEY RECOMMENDATIONS

- The Government’s curriculum and assessment review should be ambitious and consider reform of the secondary and post-16 education system to offer a broader and more expansive range of study, including:
 - continuation of mathematical and data education to 18; and
 - the creation of a more equitable single route through the sciences for all students up to age 16.

The Government should also:

- reverse the previous government’s cuts to professional development to retain science, maths and computing teachers;
- develop a longer-term sustainable funding solution for professional development for teachers at the Spending Review; and
- invest in young people’s future by increasing spend on educational research to create a more coordinated, forward-thinking system.

AREA FOR ACTION 4

GROW THE UK'S AI, DATA AND SUPERCOMPUTING CAPABILITIES AND PROVIDE GLOBAL LEADERSHIP TO SAFELY HARNESS THE BENEFITS OF AI FOR SOCIETY

Artificial intelligence (AI) has the power to transform how we live and work. A review commissioned for the Royal Society suggests the valuation of the global AI market (as of 2022) is approximately £106.99 billion¹⁶. Sectors more exposed to AI (meaning that AI can readily be used for some tasks) are seeing an almost fivefold increase in the rate of productivity growth globally¹⁷.

Research is fundamental to developing applications for AI that benefit society, as well as to understanding and managing its potential risks. AI also offers significant opportunities for use in scientific research, such as speeding up drug discovery, but the current 'black box' nature of the technology also poses challenges due to the lack of transparency of the data and inputs used.

Strengthening the UK's supercomputing capabilities: leading a CERN for AI?

In today's global knowledge race, it will be important for our economy and society to build, attract and maintain significant computing and AI capabilities in the UK. Access to high performance computing power has been critical for major scientific breakthroughs, such as protein folding with AlphaFold. Scientists require access to essential data and AI infrastructure to adopt more complex techniques, process higher volume and types of data, and ensure quality in AI-based research.

Funders, industry partners, and research institutions with computing facilities should be incentivised to actively share essential AI infrastructures such as high-performance computing power and data resources. This could include sponsored access to supercomputing and the establishment of regional hubs – akin to a CERN for AI.

Harnessing new technologies to protect privacy and public trust

One of the biggest barriers to AI adoption is trust¹⁸. Access to high quality data and interoperable data infrastructures will be critical for supporting the AI industry. This will involve advancing access to sensitive data through privacy enhancing technologies; incentivising the adoption of open science principles and practices; and investing in data curation and AI literacy across scientific disciplines.

Improving access to data for scientific research

The Digital Information and Smart Data Bill announced in the King's Speech provides an important opportunity to improve access to datasets for scientific research. In doing so, it will be important to put measures in place to maintain public trust in how data is shared and for what purpose. Collaborative analysis and other privacy enhancing techniques have a role to play in positioning the UK internationally as a trusted data partner. The Government should accelerate the development of privacy enhancing technologies and other data-use techniques by establishing collaborative test environments (such as an international privacy enhancing technologies sandbox).

KEY RECOMMENDATIONS

- Funders, industry partners, and research institutions with computing facilities should be incentivised to actively share essential AI infrastructures such as high-performance computing power and data resources.
- Access to high quality data and interoperable data infrastructures will be critical for supporting the AI industry. The Government should ensure the Digital Information and Smart Data Bill does not risk data adequacy with the European Union. As part of the Bill's implementation, it should:
 - work to provide better data protection guidance for scientific researchers; and
 - publish a national privacy enhancing technologies (PETs) strategy to promote the responsible use of PETs in data governance.

16. *Science in the Age of AI*, The Royal Society, 2024.

17. *Global AI Jobs Barometer*, PriceWaterhouseCoopers, 2024.

18. *The UK Productivity Gap: How AI can untap workplace potential*, Workday 2024.

AREA FOR ACTION 5

ACCELERATE PLANS FOR THE CLEAN ENERGY TRANSITION, INCLUDING IMMEDIATE PLANS FOR LOW-COST HYDROGEN ENERGY STORAGE TO STRENGTHEN THE UK'S ENERGY SECURITY

There is a need for rapid and determined action on damaging climate change from decision makers in all levels of government that prioritises the long-term benefit of humanity as well. The UK is well placed to demonstrate global leadership on tackling climate change and preventing further biodiversity loss.

To fulfil our net zero commitments, the Government should develop evidence-based technology roadmaps that are informed and continuously updated by bringing together scientists, economists, social and behavioural scientists and industry. These should send signals to internationally mobile investment through recommending the technologies to deploy, develop or research.

As we transition to increased levels of renewable energy supply, large-scale electricity storage will be essential to mitigate variations in wind and sunshine, such as using salt caverns to store the 100 Terawatt-hours of electricity needed by 2050¹⁹.

KEY RECOMMENDATIONS

- Evidence-based net zero technology roadmaps should be produced that identify the route to develop and implement the key sectors and technologies needed to decarbonise the energy system by 2050 to send clear signals to mobilise the private investment needed to reach net zero.
- The Government should prioritise the construction of large-scale energy storage facilities to match the expansion of renewable generation, if it is to reach legally binding net zero targets by 2050 and have year-round security of energy supply.

19. *Large scale electricity storage*, The Royal Society, 2023.

AREA FOR ACTION 6

PROTECT OUR NATURAL RESOURCES: THE UK SHOULD TREAT BIODIVERSITY LOSS WITH THE SAME URGENCY AS CLIMATE CHANGE

Biodiversity matters. At its simplest, biodiversity is about living nature or life on Earth – different genes, species and ecosystems that comprise the biosphere and the varying habitats, landscapes and regions in which they exist. Biodiversity is the inherited biological wealth of the Earth and has intrinsic value in its own terms. It is also essential for meeting the most basic of human needs – food, water, shelter, clothing, fuel and medicines. Biodiversity regulates nutrient and water cycles, influences climate and helps clean pollution from the environment.

Urgent action is needed if we are to prevent further biodiversity loss. In the UK, only 14% of priority habitats, 7% of woodland and 25% of peatlands are assessed to be in good condition. Protecting the biodiversity of our planet also makes clear economic sense and will benefit countries around the world, with an estimated £10 trillion benefit to taking early action.

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£10 trillion – the benefit from taking early action to prevent further biodiversity loss.

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KEY RECOMMENDATIONS

The Government should:

- develop new approaches to accounting for the true value of biodiversity, drawing on the Dasgupta Review;
- ensure policy to reduce greenhouse gas emissions and adapt to climate change helps to prevent and reverse biodiversity loss; and
- support the development of a global biodiversity monitoring network to help countries meet their biodiversity targets.