Autumn Budget 2024 – representation by the Institute of Physics

The Institute of Physics (IOP) is the professional and learned society for physics in the UK and Ireland. As a registered charity we are dedicated to maximising public good through the advancement of physics and its applications. To realise this, the IOP advocates for the physics sector to be well resourced and supported, from funding for physics research and development (R&D) to resources for STEM education.

While the economic picture constrains the fiscal options available, to achieve sustained economic growth, increased productivity and long-term prosperity, the UK must invest in research and development (R&D). Public R&D investment has a significant multiplier effect, leveraging in private spending of £3.09-£4.02 for every £1 of public R&D spending over the long term.[1]

Investment in physics is a catalyst for innovation and growth. Physics-based businesses span sectors including manufacturing, energy, and services, contributing over 10% of UK GDP, employing more than 2.7 million people (10% of total UK employment) across the UK. Physics-based businesses alone invested £26.0bn of the £49.9bn business R&D spending that made up the majority of the national £70.7bn R&D spend in 2022.[2]

Physics research, innovation, knowledge and skills can play a defining role in the realisation of the Government's following missions:

Kickstart economic growth: Physics-based industries provide good jobs all across the UK. The median physics-based industry annual salary is more than £4,000 higher than the national average[3], and physics-based industries have a higher GVA per employee than the national average.[4] In Great Britain 74% of the physics-based industry workforce is outside London and the South East, compared to 68% of all employment.[5] Physics-based SMEs are an engine for economic growth, with many successful, growing businesses flourishing in less-economically active areas of the UK. ~74% of SMEs in physics-based industries are outside of London and the South East, compared with ~69% of SMEs overall.[6] R&D is also linked to increases in labour productivity, which is vital for economic and wage growth.[7] Supporting physics will support above-average paying jobs, with high productivity and added value, in less economically developed areas of the UK.

Make Britain a clean energy superpower: Most clean technologies are built on physics discovery and innovation and need physics skills for their continued development. 72% of R&D investment from UKRI Research Councils since 2006 in five of the central clean energy technology areas – nuclear, renewables, hydrogen and clean fuels, energy storage and CCUS – has been for research topics classed by the IOP as 'core physics' and 'strongly physics'. We cannot become a clean energy superpower without physics.

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[1] NCUB (2024) Unlocking growth: The impact of public R&D spending on private sector investment in the UK - National Centre for Universities & Business (ncub.co.uk)
[2] IOP Analysis of ONS BERD 2022 dataset (Published 27th February 2024)
[3] IOP analysis of data from ONS dataset: Earnings and Hours Worked, UK Region by Industry by Two-Digit SIC: ASHE Table 5.
[4] Centre for Economics and Business Research (2021) Physics and the Economy. IOP.
[5] IOP analysis of ONS (2022) Business Register and Employment Survey (BRES) via Nomis.
[6] IOP analysis of ONS (2023) Business Counts Dataset. Ignores microbusinesses. Via Nomis
[7] R. A. L. Jones (2023) Productivity, Innovation and R&D. The Productivity Institute.

Break down barriers to opportunity: Studying physics opens up a world of opportunity, with good jobs to be found across the country, and in growing industries such as the green economy. Everyone should have the opportunity to pursue physics, regardless of their socio-economic background, gender, or any other characteristic. The IOP has long campaigned for barriers to physics to be broken down, from challenging stereotypes that have a limiting effect on children's aspirations, to developing solutions to the teacher shortage and ensuring we have enough specialist physics teachers.

So we need to nurture and support a thriving physics ecosystem that will further innovation, discovery, research and growth.

It is now 20 years since Labour launched the 'Science and Innovation Investment Framework' recognising science as one of the key pillars of growth. It is vitally important that this government maintains that ambition and commitment.

Increase R&D investment

- As and when public finances allow, increase R&D investment to match or exceed top OECD countries, to boost economic growth, productivity and job creation across all parts of the UK.
- Maintain support for strategically important physics technologies identified in the Science and Technology Framework. The indication of long-term government support for technologies that are important to the UK's strategic priorities is vital for sustained private investment in these technology areas and indicates to researchers and students that these are areas with long-term potential, further incentivising research and development in these areas.
- Increase support for physics-based business innovation with additional funding for early-stage R&D and development-stage activities, a focus on long-term funding schemes (supporting technology-driven, challenge-led and high-risk, high-reward research), and a more attractive tax environment to promote the commercialisation of new technologies, manufacturing and exports.
- We welcome the stability and long-term commitment of 10-year funding cycles, in line with our R&D Blueprint which sets out the importance of long-term funding. We look forward to discussing further how this will be implemented, and urge the government to provide more detail in the run up to the Spending Review. In the meantime, we would like to offer some early thoughts:
    - 10-year funding cycles must not result in lower overall levels of research funding. Allocating funding further in advance makes it vulnerable to inflation eroding the real-term amount available for research. Equally, changes in fiscal headroom that make more research funding available should not be ignored due to longer-term funding settlements. Any policy should take these considerations into account and be sure to mitigate the risks inherent in longer funding cycles.
    - Research councils should have sufficient funds to advance priority technologies mid-cycle, especially in strategic areas that are emerging and have the potential to contribute to the achievement of the government's five missions.
    - A possible solution, that we would welcome the opportunity to discuss ahead of the Spending Review, is for a 5+5 years funding model, where the last 5 years are indicative

following a light touch mid-term review. This would provide the advantages of sustained funding, a process for addressing change, and some level of longer-term policy assurance.

- This near-term expenditure would stimulate longer term growth through productivity gains and positive externalities from research and development leading to greater long-term revenue for the Exchequer.

Ensure our university physics departments are world-leading and sustainable

- Increase support to allow the proportion of FEC recovered on all publicly funded research grants to be increased, to safeguard the sustainability of the world-leading research that takes place within the higher education sector and ensure long-term capacity exists in all universities, in all parts of the UK, to deliver an increase in research activity.
- Ensure levels of QR funding take account of rising inflation and running costs. Although there have been recent increases to QR funding, a more sustainable balance between QR and Research Council funding will allow universities to continue to forge new partnerships with business and industry, invest in the talent pipeline, build research capacity, support ground-breaking discovery science and use R&D to help power future economic growth.
- If not addressed, financial challenges to the sustainability of universities will inevitably undermine the quality and international competitiveness of the teaching that they deliver. In particular, the combined effects of inflation, increasing costs of teaching, a real-terms decline in grant funding and student fees that have been frozen since 2017/18, mean that in 2022-23, 93 higher education providers reported a deficit (with expenditure exceeding income). Based on their forecasts, 108 education providers will face a deficit in 2023-24 (out of a total of 269 providers).[8] This poses risks to physics research, and the physics skills pipeline, that is powering economic activity. The IOP is currently engaging with senior university representatives and heads of UK physics departments to examine the financial challenges facing physics departments, their causes and possible solutions. We would welcome the opportunity to share our findings and recommendations in due course, to inform the Spending Review.

Maintain and strengthen the UK's international presence and partnerships

- Science is a global endeavour. The UK's physics and wider scientific communities are dependent upon international networks, infrastructures, partnerships and programmes. A strong international presence must be maintained, if we are to remain in the vanguard of scientific discovery and innovation. Openness to talent and ideas has allowed the UK to build strong international ties, valuable and productive research collaborations and world-class shared infrastructure. The Government must both maintain existing, and develop new, international collaboration channels, to catalyse the movement of people between countries, sectors and roles, and facilitate knowledge exchange. Failure to do this puts our ability to deliver world-leading science, and our reputation as a leading nation in international science cooperation, at risk.

[8] OfS (2024) Navigating financial challenges in higher education.

- Innovation thrives on diversity, meaning our research and innovation system must be open to those with valuable knowledge, expertise and experience from all backgrounds. Action is needed to make the UK the destination of choice for the best researchers. Significant concerns remain over the affordability of the UK visa system, especially following the rise in the minimum salary that international skilled workers must meet to obtain a visa, and increased visa fees and health surcharges leading to upfront costs 1,583% higher than the average of leading science nations for the UK Global Talent Visa and 1,138% higher than the average for other leading science nations for the UK Skilled Worker Visa in 2024.[9] The IOP would like to see a significant reduction in the costs for international researchers and innovators and their families to work in the UK, to ensure the UK is an attractive option for global talent.
- The fiscal implications of these asks are mixed. Greater scientific collaboration is likely to be close to cost neutral, as the UK contributes to efforts abroad and receives contributions from other nations on shared projects hosted here. Reducing the financial burden of research visas would likely reduce revenue for the government on a per-visa basis, but would likely attract more high-quality researchers that add significant value to the economy.
- It's important to remember that around one third of the 45 UK Nobel laureates in the sciences between 1969 and 2020 were immigrant scientists[10] – deterring immigrant scientists from working in the UK will have an impact on our ability to deliver world-leading, excellent science, for years to come, with unknowable economic impacts.

Enhanced investment in research and innovation infrastructure

- Investment in international projects and collaborations needs to be complemented by investment in domestic facilities and programmes. This ensures UK researchers (whether from universities, business or government) have access to world-class scientific resources, while also positioning the UK as a location and partner of choice for leading-edge R&D to international researchers and investors.
- Preliminary consultations that the IOP has carried out for a forthcoming project on physics infrastructure have highlighted a fundamental problem in how infrastructure is currently funded: the current approach is a 'batteries not included' mindset, where capital is provided for construction or development, but not for operations or programmes of work. This lack of ongoing investment for maintenance and operations means that there is a real risk that in the long run, UK infrastructure will become dated and 'time out'. The cost of replacing infrastructure will then be significantly greater than investing in its maintenance now.

Build a strong pipeline for the provision of physics education and skills

- Investment in physics education and training is needed to drive economic growth in every region and nation of the UK and secure a more prosperous, sustainable future. In addition to their broad utility across the economy, physics-related knowledge and skills have a critical role to play

[9] Royal Society (2024) Summary of visa cost analysis.
[10] Statista (2020) https://www.statista.com/chart/19646/science-nobel-prizes-by-country-and-immigrant-share/ using data from the Nobel Prize Foundation.

in fuelling technological innovation and addressing some of the most pressing challenges facing society, such as achieving the net zero emissions targets.

- The Government must ensure that high-quality physics teaching and training is available everywhere and for everyone – including by addressing shortages of teachers with a science background at primary schools and of specialist physics teachers in secondary and further education. Availability of a diversity of physics education and training pathways, at all skill levels and in all parts of the UK, will be essential to supporting employers' access to the skills they need and to opening up opportunities for productive careers to all.
- The Government has pledged to recruit 6,500 new teachers, and this must include physics teachers. The IOP estimates an enormous shortage of physics teachers across England – there are currently 6,500 specialist physics teachers but we need a total of 10,000, leaving a shortfall of 3,500.[11] The IOP proposes three means of addressing the shortage of physics teachers: recruitment, retention and retraining. The "3Rs":
  - Recruitment
    - Incentivise initial teacher training (ITT) providers to recruit to targets in shortage subjects including physics.
    - Review the support for high-quality, intensive pre-ITT SKE (Subject Knowledge Enhancement) courses.
  - Retention
    - Teach the sciences separately and, where possible, deploy teachers to teach their main discipline. This is especially important in their early career. Deploying teachers to teach the subjects in which they have expertise will ensure optimum return on investment in specialised teacher training.
    - Significantly invest in an overhauled and nationally coordinated system of subject-specific continuous professional development (CPD) for teachers.
  - Retraining
    - Turbocharge the SKPT programme (Subject Knowledge for Physics Teaching) and provide a bursary to participants and/or their schools. This would provide a formally recognised pathway for established teachers of the other sciences to retrain to teach physics up to GCSE, and is likely to be significantly more cost effective than recruiting and training new physics teachers.

[11] IOP responds to House of Commons Education Committee report on teacher recruitment | Institute of Physics