IOP Institute of Physics

IOP Response to the House of Lords Science and Technology Committee Inquiry: People and Skills in UK Science, Technology, Engineering and Mathematics

The Institute of Physics (IOP) is the professional body and learned society for physics in the UK and Ireland. Enhancing diversity and skills within the physics community is a prominent part of the IOP's strategy. We have undertaken a significant body of research aimed at better understanding the challenges and potential solutions associated with physics-related skills shortages and have substantial evidence relevant to the Science and Technology Committee inquiry into People and Skills in UK STEM. This evidence is outlined in the following four-page summary – with a more detailed annex provided for reference.

Summary of IOP Recommendations

- Government should invest up to £100m over 3 years to develop and deliver a systematic approach to subject-specific professional development and retraining in the sciences as part of a STEM education strategy.

- In England, the IOP supports, and has been instrumental in developing, pilot initiatives to recruit engineers to physics teaching and the roll out of the Subject Knowledge for Physics Teaching pilot to retrain in-service teachers. Such initiatives should be continued and developed further.

- Government should mandate that schools maintain whole school equity plans and require Ofsted to inspect progress against these plans.

- Teachers' standards should be updated to clarify the expectation that teachers help tackle prejudices and stereotypes, and teachers should be supported in meeting these standards through the provision of training in inclusive teaching.

- Government should support the development of training opportunities for graduates and researchers designed to enhance their commercial skills.

- More publicly funded innovation support should be provided for later-stage R&D and innovation.

Summary of IOP Evidence

What STEM skills is the UK lacking and what skills are likely to be in high demand in future?

- Physics makes a significant contribution to the UK economy and underpins much of the science and technology central to UK industries. As a result, physics skills are in high demand among employers and physics academic output is central to maintaining the UK's position as a scientific world-leader[1].

- Physics-intensive industries are a key source of private sector investment in R&D, showing that physics has a key role to play in meeting ambitions to invest 2.4% of GDP in R&D[1].

- Employer demand for people coming through existing physics-based education and training significantly exceeds supply[1].

Are businesses able to recruit people with appropriate STEM skills?

- UK physics-based businesses are reporting that physics skills shortages are limiting their performance in many ways, from their ability to invest in R&D to their capability to scale-up production[2].

- A particular skills challenge faced by UK physics-based businesses is to recruit people with a combination of technical and commercial skills. There is also a high demand for transferrable skills in combination with physics knowledge[2].

- The quantum technologies subsector, which shows huge growth potential, is particularly affected by recruitment difficulties[2].

- IOP has gathered evidence that suggests a high and growing unmet demand for physics skills within business and finance, construction, skilled trades, teaching, digital, and public and regulatory roles. New roles such as data scientists and quantitative analysts were found to be the ones that faced most difficulty in being filled[2].

- More than half of physics-demanding roles don't typically require academic degrees, showing the importance of a technical stream that includes physics knowledge and skills training[2].

- IOP has gathered evidence of trends in regional variation in demand for physics skills. Regions with high unmet demand have reported severe impact on their business performance – with Yorkshire and the Humber, and the North East

[1] See Annex 1, Section 2
[2] See Annex 1, Section 3

identified as the most hard hit regions, and the Midlands and South East England as the least affected[3].

- The private sector has tried to overcome problems with skills shortages through collaboration, outsourcing, training, hosting researcher placements, recruiting from outside the country and making use of public R&D support. Further support would help continue these mechanisms and government should consider providing more support schemes aimed at later-stage R&D and innovation[4].

- Skills shortages associated with later-stage R&D and innovation are a particular area of concern as they pose the risk that physics innovators will look overseas when it comes to manufacturing and scaling up. In addition to lost financial opportunities, this would also further reduce UK capacity for the commercialisation of new technologies[4].

Do cultural influences such as social media have a role to play in increasing uptake in STEM careers?

- Girls, young people of black Caribbean descent, and the socio-economically deprived are significantly under-represented in physics. The causes of this low uptake are societal rather than inherent to the subject[5].

- The two major contributors to this are society's continued reinforcement of negative stereotypes and prejudices that limit student choices, and a severe shortage of teachers with the necessary knowledge and skills to be high-performing physics teachers[5].

- This lack of diversity presents a huge missed opportunity for the reduction of physics skills shortages and the IOP is undertaking a number of projects aimed at tackling the challenge, ranging from our Limit Less campaign, to resources and support for better careers guidance[5].

- Government could play a stronger role in supporting diversification in physics by mandating whole school equity plans, requiring Ofsted to inspect progress against these plans. We are also calling for the revision of teachers' standards to clarify the expectation that teachers help tackle prejudices and stereotypes, and for the provision of training in inclusive teaching[5].

How easy is it to recruit teachers with scientific skills and expertise? What more can be done to encourage highly skilled individuals from all backgrounds to go into STEM education?

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[3] See Annex 1, Section 4
[4] See Annex 1, Section 5
[5] See Annex 1, Section 6

- Studies show that improving the quality of teaching is the single most important factor in improving outcomes, especially for those from disadvantaged backgrounds[6]. There is a specific link between high quality in-field physics teaching to 16 and chances of students choosing physics beyond 16[7].
- Physics is particularly hard-hit by poor teacher recruitment and physics graduates are not entering the profession in the numbers needed. Teacher retention is also a significant challenge for the subject. Nearly 50% of schools in England are forced to deploy out-of-field teachers to cover GCSE physics[8].

- The IOP has supported the development and roll-out of pilot initiatives to recruit in-field teachers and it is vital that this work is continued and developed further as part of a government-led strategy[8].

- Recruitment and teacher retention alone will not provide the teachers required to solve the physics skills-gap. Subject-specific training and re-training, and continued professional development is also important – but lacking in the UK in comparison to other high performing countries. This effect is exacerbated by regional variation in provision and take-up. It is important that these deficiencies are not worsened by changes resulting from the Initial Teacher Training market review[8].

- High quality subject-specific CPD improves teacher retention and student outcomes[8].

- Government can do more to encourage highly skilled individuals from all backgrounds to go into STEM education, and ensure that they make high quality teachers, by implementing a systematic approach to subject-specific teacher development[8].

- We are calling for an investment of up to £100m over 3 years to develop and deliver such a systematic approach to subject-specific professional development and retraining in the sciences as part of a STEM education strategy[8].

- It has been estimated that the total annual return on investment in effective CPD would be up to £500m[8].

[6] https://royalsociety.org/-/media/policy/Publications/2022/2022-01-31-sci-uplift-DfE.pdf
[7] https://www.iop.org/sites/default/files/2020-12/Subjects-Matter-IOP-December-2020.pdf
[8] See Annex 1, Section 7

Annex 1: Supporting Case and Evidence

1 About the IOP and an outline of our interests and work relevant to the inquiry

The Institute of Physics is the professional body and learned society for physics in the UK and Ireland, inspiring people to develop their knowledge, understanding and enjoyment of physics. We work with a range of partners to support and develop the teaching of physics in schools; we encourage innovation, growth and productivity in business, including addressing significant skills shortages; and we provide evidence-based advice and support to governments across the UK and in Ireland. Our members come from across the physics community whether in industry, academia, the classroom, technician roles or in training programmes as an apprentice or a student. However, our reach goes well beyond our membership to all who have an interest in physics and the contribution it makes to our culture, our society and the economy.

One of the three core challenges of the IOP strategy focusses on diversity and skills. We want to build a thriving, diverse physics community and play our part in solving the science, technology, engineering and maths (STEM) skills shortage by ensuring that people, no matter their background or where they live, have access to world-class physics education and training.

In line with this challenge, we have established a learning and skills team with a remit for understanding and responding to key issues, and in recent years have commissioned a number of studies that have provided most of the evidence upon which this response is based. These reports are listed below and will be referred to throughout this annex. This evidence is supported in places by other work carried out by the IOP relevant to skills, including ongoing projects and external evidence where appropriate. Forthcoming research projects will focus on apprenticeships and technical education pathways, and the future skills needs required to drive emerging technology areas such as quantum computing.

Paradigm Shift[9]: To find out more about companies that use physics innovation in their work, the IOP commissioned CBI Economics to undertake a survey of physics-based businesses[10]. This survey included skills-orientated questions designed to understand skills needs relevant to fostering innovation in a business context.

Work-force Skills[11]: In late 2021, the IOP commissioned Emsi Burning Glass to provide new insight on the use of physics skills in the UK and Irish economies, including how it varies across occupations, industries and regions, and whether employers' needs for physics skills are being met.

Limit Less[12]: The IOP has amassed a body of evidence relevant to understanding diversity in the take-up of physics. This included commissioning Censuswide, an international market research consultancy, to conduct two surveys and a series of focus groups to inform our campaign as to the social factors that inform take-up of physics.

[9] Paradigm-Shift-physics-innovation-final-oct-2021.pdf (iop.org)
[10] Defined here as physics-based industries whose enterprises demonstrate ongoing research and development which consistently makes use of physics knowledge (and the R&D activity can be expected to significantly affect the fortunes of businesses within the industry), or where underlying technology supporting the industry requires significant physics knowledge for continued operation.
[11] Workforce Skills Project | Institute of Physics (iop.org)
[12] IOP Limit Less report 2020

Note on scope and the terminology applied in this document

When talking about STEM skills it is important to recognise the vast breadth of the category, which includes skills specific to a broad range of individual sectors, as well as technical skills pathways. 'STEM' is a pragmatic abstraction, but in reality employers' demands are often much more specific, and there has historically been much less understanding of the role of different sciences and their application in a changing labour market. This is a situation that the above referenced reports have sought to address.

We have taken care in this response to distinguish between 'skills shortages' by which we refer to the fact that fewer students are taking up physics than is required by industry as a whole, and 'skills gaps' which relate to the needs of specific sectors that are not currently being met by the education system.

2 Demand for Physics Skills

The Physics and the Economy[13] study commissioned by the IOP in 2022 estimated that physics-based businesses contribute 11% to the UK's GDP. These businesses also account for around 7% of total UK employment, implying high value added per person employed. Occupations with a distinct need for physics knowledge account for 1 in 20 jobs – 1.85 million jobs across the UK and Ireland[11]. These statistics arise from the fact that physics is an underpinning science, a foundation for many other scientific and technological endeavours. As a gateway subject that is prized by employers and admissions officers, physics offers a plethora of prospects for school leavers' future success.

In addition to the shorter and intermediate-term economic argument outlined above, physics academic skills are also important for ensuring that the UK remains a world-leader in pushing the boundaries of understanding and uncovering new frontiers.

Growing and improving the physics-based skills of the workforce has a critical role to play in working towards ambitions to invest 2.4% of GDP in R&D. Indeed, we have shown that, in 2019, R&D taking place in physics-intensive industries[14] was over one third of the UK's total business-conducted R&D[15]. It is also important to recognise that much of physics' economic value is found well beyond R&D, within a wide range of industry settings, from engineering to medicine. So, first and foremost, the IOP stresses that there is a huge unmet demand for new people coming through *existing* physics-based routes.

3 Are businesses able to recruit people with appropriate STEM skills?

- 39% of UK physics innovators[16] reported that skills shortages were a significant challenge to undertaking R&D and innovation[9]. Skills shortages were the third most commonly cited barrier. UK physics innovators report that a lack of relevant skills (46% of respondents) and experience (40% of respondents) is the cause of their recruitment difficulties. Only 11% of physics innovators said they faced no difficulties recruiting.
- This has derailed private sector plans to invest in R&D and innovation, causing delays to projects, missed targets and missed opportunities. 66% of physics innovators reported suspending or delaying R&D activities in the past five years because of skills shortages.

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[13] Physics and the Economy – our latest findings | Institute of Physics (iop.org)
[14] The industries where ongoing physics research is most concentrated.
[15] IOP-Contribution-of-Physics-to-UK-Economy-new.pdf
[16] Defined here as physics-based firms that undertook at least one aspect of R&D or product/process innovation during the past five years

Almost one third said they had missed targets or scaled back production, sales goals or had abandoned activity altogether.

- 45% of survey respondents said that Brexit has had a significant (15%) or moderate (30%) effect on their businesses – with some reporting that they had experienced difficulties recruiting or retaining EU staff or faced legal restrictions on consulting activities.
- The Paradigm Shift survey found that skills shortages are particularly acute at the production and scaling up stage of the R&D and innovation pipeline. 26% of physics innovators said they were either dissatisfied or very dissatisfied with their ability to attract and retain talent at this stage of their innovation journey. This poses the risk of a negative feedback loop where technologies developed in the UK will end up being manufactured abroad, further deepening the loss of skills.
- The most commonly cited skills-related challenge reported (by 52% of UK respondents) was finding people with a combination of commercial and specialist technical knowledge. This mix of skills was seen as harder to find than individuals with commercial skills (24%), specialist physics-related knowledge (29%) or STEM skills more generally (22%).
- Other skills in high demand were 'product and service design' (40%) and 'production or manufacturing skills' (28%).
- Job-posting data[11] revealed a high demand for transferable skills (such as teamworking, communication and problem solving) with a range of emphasis depending on the type of role. For example, public and regulatory and business and finance roles place the highest premium on communication; digital and business and finance roles look for mathematical skills; innovation is highly sought among science, digital and business and finance roles, but feature less in adverts for health and construction roles.
- Companies involved with quantum technologies reported the highest levels of recruitment difficulties at 45% of associated respondents. This is a technology area that includes quantum computing - the market value of which has been projected to be between $300-700 billion by 2035[17].
- A substantial number of physics-demanding roles[18] persist in being hard-to-fill at any one time (nearly 9,000 in June 2021), suggesting a significant level of unmet demand among employers. Postings specifically seeking scientific physics skills were more likely to be advertised for longer and to show signs of high and rising pay, but few of these are for scientific roles. Instead, they were for multi-disciplinary roles in the digital, business and finance, and engineering sectors. Job postings seeking scientific physics skills for digital, and business and finance roles increased by 45% and 36%, respectively, between 2016 and 2019.
- The demand for physics skills is rising fast outside of traditional physics workplaces such as in business and finance and in digital. Physics skills offer some of their greatest value in concert with other skills. The workforce skills study highlighted a pressing demand for physics skills in data science and software - but physics-trained workers need additional IT-based skills to be ready for these roles.
- The demand for physics skills and knowledge is not confined to those with advanced degrees. There are a range of physics-demanding roles at different educational levels, and more than half (53%) of the jobs are in roles which typically don't require a degree. A

[17] quantum-computing-an-emerging-ecosystem.pdf (mckinsey.com)

[18] We define 'physics-demanding roles' as those roles which require a relatively high level of physics skills and knowledge to perform them. In our research, such roles have been defined at both an occupational level and by identifying roles where employers specifically call for physics skills and knowledge. A full account of the methodology applied to categorise physics-demanding roles can be found in the Work-force Skills report.

sizeable minority (46%) typically requiring apprenticeships or intermediate-level academic qualifications such as A-levels, Highers, or Leaving Certificates.

4 Regional variations in skills shortages

- Applications of physics - both direct and indirect - vary across industries and regions: Scotland's greatest strength is in its oil and gas and associated industries, while the East of England has a concentration of scientific R&D. For the East Midlands it is transport manufacturing, and London shows a concentration of roles in air transport. Looking at particular geographic hotspots, the north east of Scotland stands out with more than twice as many jobs as the UK and Ireland-wide average in oil and gas – with Cumbria second-most concentrated, on account of its nuclear energy and shipbuilding industries.
- 29% of respondents questioned as part of the Paradigm Shift study reported that access to a skilled workforce was a primary contributing factor to their decisions on where to locate their R&D and innovation activity.
- Recruitment statistics show that Scotland has the largest concentration of physics-demanding roles with 16% more than the UK and Ireland-wide average. London's size means that its large number of physics-demanding roles represents the smallest concentration, with 26% fewer physics-demanding roles than the UK and Ireland-wide average. However, London has demonstrated high levels of growth since 2010. During the same period the North East has seen a slight decline. These figures highlight the potential contained across physics-based industries for addressing regional inequalities.
- Wales, Northern Ireland and North East England showed the lowest concentration of innovative physics businesses in the UK – with South East England representing the highest.
- Regional patterns in the numbers of physics-demanding roles advertised correlate with areas identified as those where businesses report experiencing challenges undertaking R&D and innovation activity (in particular Yorkshire & the Humber and the North East). By contrast, physics innovators in the Midlands and the Greater South East of England tended to identify fewer challenges. In some parts of the UK, physics innovators signalled that skills-shortages were a particularly pressing challenge. In the East of England, as well as in Scotland and Wales, skills shortages were ranked as the second most important challenge to undertaking R&D and innovation activity, while in Northern Ireland they were the leading concern. More than 40% of physics innovators with R&D and innovation activity in these locations believed that skills shortages were a significant challenge to undertaking such activity.

5 How do businesses respond to skills shortages, and how can government help?

Many of the above observations have been drawn from analyses of the broader physics sector and together make a clear case that action is needed. While skills issues may not always appear sufficient in scale to warrant action at individual subsector levels there are clear commonalities that show potential for being addressed in a strategic way:

- <u>Collaboration:</u> 70% of physics innovators said they collaborate with third-parties to gain access to expertise or skills. Most collaboration occurs early in the R&D/innovation process. The most common times for physics innovators to collaborate is during basic research (60%), applied research (51%) and small-scale prototyping (65%). Collaboration tends to drop off during later stages of the innovation process, with 37% of collaboration taking place during

large scale prototyping/engineering, 28% during the production/scaling up phase, and 22% during the commercialisation stage.
- Outsourcing: 30% of physics innovators reported sub-contracting or outsourcing their R&D/innovation activity.
- Training: Only one in five firms questioned as part of the Paradigm Shift study sought to address skills shortages by raising investment in staff training, reflecting the highly specialised nature of R&D intensive roles and the inherent difficulty of employees switching functions when skills have been developed through academic study. 9% of UK respondents highlighted training costs as a significant obstacle to undertaking R&D activities. Physics innovators would therefore benefit from more certainty over funding.
- Business placements for researchers: Findings on the demand for staff with a combination of commercial and specialist technical knowledge outlined above suggest that education and training providers and physics-based businesses would benefit from working together to explore how to increase opportunities for researchers to gain more commercial experience. For example, researchers could start to develop commercial skills through more business placements at an early stage in their careers. Investment in strengthening university-business links is vital for skills development in the longer term.
- Recruitment from outside the country: Only 11% of UK businesses reported that they had responded to skills shortages by recruiting from outside the country. The corresponding figure for the Republic or Ireland is 33%. This is possibly related to Brexit, and the fact that the Republic of Ireland continues to benefit from access to skills from across the EU. More could be done to plug skills gaps in the UK in the short-term, notably by examining rules around the mobility of international researchers and skilled technicians.
- Public support: Around two out of every five physics innovators saw a role for government in improving access to specialist skills and knowledge. Currently, much of this public support is focussed on early-stage R&D. But the Paradigm Shift study emphasised that difficulties tend to be highest in the later, most capital-intensive parts of the R&D and innovation process. This is the same stage where physics innovators report the highest difficulties with attracting and retaining talent and presents the danger that physics innovators in the UK will look overseas as they move to the manufacturing/scaling up phase. This would represent a missed opportunity for encouraging growth and exports, and risk deepening the loss of vital skills in the UK. Physics innovators therefore see a role for long-term funding schemes to promote the commercialisation of new technologies, while a more attractive tax environment for R&D activity is also seen as a particular priority.

6 Cultural Influences Impacting the Uptake in STEM Careers

IOP evidence[12] identifies that the causes of low uptake in physics among girls are societal rather than inherent to the subject, which indicates there is an opportunity to amplify impact on improving student outcomes in a cost effective way by creating fairer and more inclusive classroom cultures.

Despite the value of the subject as outlined above, physics education remains in crisis and many students, often those in more deprived areas, are being denied the opportunities that studying physics provides. The IOP has identified two main contributors to this crisis; negative stereotypes and prejudices that limit student choices and a severe shortage of in-field[19] teachers with the necessary knowledge and skills to be high-performing physics teachers (explored further in the next section).

[19] Teachers teaching a subject in which they have strong subject-specific qualifications or experience.

- In 2022, physics was the second most popular A-Level subject for boys across England, Wales and Northern Ireland[20]. At the same time physics ranked 16th for girls across the same countries.
- Young people of Black Caribbean descent are the most underrepresented ethnic group in physics between the ages of 16 and 19.
- 70% of physics A-Level students come from just 30% of schools, and those schools are more likely to be in more affluent areas.
- Using the Income Deprivation Affecting Children Index as an indicator of socio-economic background also shows that there are stark differences between participation in physics among young people from families on low incomes compared to those from the least financially deprived families.
- Only 10% of STEM apprenticeships were started by women in 2018/19. Such underrepresentation contributes to an engineering workforce (which our evidence shows relies heavily on physics skills and knowledge) in which only 15% of workers are female, 1.7% are Black, African, Caribbean or Black British, and 11% have a disability.

Together these statistics show that there is a huge missed opportunity for the development of physics skills in the UK. To address the skills shortage we need to broaden the range of people taking up the subject and ensure that every child has access to high quality in-field physics teachers.

Through our Limit Less campaign, the IOP is working to dismantle stereotypes that influence choices from an early age and bring physics-related careers to life for all young people, including through the development of resources for schools and community groups, as well as an ambassador scheme for employers. The IOP-funded ‘Planet Possibility’ initiative helps build a diverse community of future physicists through inspiration, opportunities and careers guidance.

Government should do more to help overturn these stereotypes by mandating that schools develop evidence-based whole school equity action plans, and by requiring Ofsted to inspect progress against these plans to ensure they really do provide ‘opportunity for all’. Whole school equity plans are a useful tool that are already widely used. They help schools strategically coordinate their engagement with, and maximise benefit from the support that is already available to them such as additional maths and English support; guidance on careers and educational pathways; and teacher leadership training opportunities.

These initiatives can be supported by revising teachers’ standards to set out an expectation that teachers will address injustice in their professional practice and actively dismantle sexism, racism, homophobia, ableism and classism in their own work and their schools’. We also ask the government to ensure that all teachers are trained in inclusive teaching and tackling injustice so that they can achieve these robust standards. This should be in both their initial teacher education and their continuing professional development.

Finally, we stress that an important part of the drive to improve diversity in physics is to ensure that the subject is well-taught so that students genuinely develop the capabilities that physics can provide and are enthused and inspired to continue to learn. Our recommendations on how to achieve this are covered in the next section.

[20] Examination results - JCQ Joint Council for Qualifications

7 Recruiting teachers with scientific skills and expertise

Teacher recruitment statistics show physics to be hardest hit of any subject[21], with initial teacher training reaching just 22% of its target last year[22]. A recent Association of School and College Leaders (ASCL) survey into teacher recruitment difficulties has also shown that physics is the hardest subject to recruit teachers for at secondary or post-16 education[23].

DfE data on ITT recruitment shows that physics graduates (or graduates with a solid physics background) are not entering teacher training in the numbers we need[24]. For example, the rate of recruitment of postgraduates into teaching physics is 58% of the value for chemistry and 24% of the value for biology.

It is important to stress that teacher recruitment is only part of the needed response. Teacher retention is also an important part of ensuring a sufficient supply of teachers. As well as there being a shortage of in-field teachers, teacher attrition is highest in the sciences (with half of all new teachers leaving within 6 years).

In England, the IOP supports, and has been instrumental in developing, pilot initiatives to recruit engineers to physics teaching and the roll out of the Subject Knowledge for Physics Teaching pilot to retrain in-service teachers. It is vital that the UK continues to invest in efforts such as these, but it is unrealistic to expect that this alone will close the gap. Creative solutions must be found and developed to provide a wider, more diverse range of students with genuine opportunities to study physics, taught by high quality in-field teachers.

Teaching science is about more than recruiting teachers with scientific skills and expertise. There are skills particular to teaching; the knowledge may come from physics or engineering, but physicists and engineers need to be trained to teach. Currently, the provision of professional development suitable for physicists and engineers entering teaching is piecemeal, hard to find, and of variable quality.

Research by Shift Learning in 2018 on timetables and deployment in England indicated that a shortage of physics teachers forces nearly 50% of schools to deploy out-of-field teachers to teach physics at GCSE level[25]. This affects students' attainment, their enthusiasm for physics, and the chances of them choosing physics beyond 16. Furthermore, physics teachers are being required to teach biology and chemistry (even in schools where there is a surfeit of biology and chemistry teachers). Deploying scarce physics teachers in this way is not only missing out on what they can offer in the physics classroom, it is adding to their workload (as the effort required to prepare lesson plans outside of their core subject is significantly greater), reducing their self-efficacy and contributing to the high attrition rates.

In our Subjects Matter[26] report, we recommend a systematic approach to subject-specific CPD in all subjects to improve quality, retention and the number of out-of-field teachers who are retrained in service.

High-quality CPD has been shown to improve teacher retention and the positive impact of subject-specific CPD in particular is evidenced by the STEM Learning physics CPD programme: 1 in 12

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[21] CBP-7222.pdf (parliament.uk)
[22] https://www.gov.uk/government/statistics/initial-teacher-training-trainee-number-census-2021-to-2022
[23] https://www.ascl.org.uk/ASCL/media/ASCL/News/Press%20releases/ASCL-survey-on-teacher-shortages.pdf
[24] Physics graduates are not entering teacher training in the numbers we need
[25] shift-learning-science-timetable-models-research.pdf (iop.org)
[26] https://www.iop.org/about/publications/subjects-matter#gref

teachers who did not participate in STEM Learning CPD left teaching the following year, compared with 1 in 30 of those who did[27]. This demonstrates the potential of subject-specific CPD to provide a good return on investment even when only considering its impact on retention. Increased morale and professionalism among teachers could also improve the perceived attractiveness of teaching as a career choice, in turn increasing both the number and calibre of potential new recruits.

The Royal Society has noted that subject-specific CPD provision in England compares unfavourably with other high performing countries[28] and there are wide regional variations in its provision and take-up[29]. A fully-funded, systematic approach to developing teachers' subject capabilities – encompassing both their content knowledge and their knowledge of how to teach their subject will ensure that all teachers have access to time-appropriate, quality assured professional development and will improve student outcomes[30].

Government can do more to encourage highly skilled individuals from all backgrounds to go into STEM education, and ensure that they make high quality teachers, by implementing a systematic approach to subject-specific teacher development. This would include an oversight board for teacher development and research in the sciences to ensure the quality of the elements of the system. The IOP has been working with peer organisations to put forward a strong call for action on this issue.

We are calling for an investment of up to £100 m over 3 years to develop and deliver such a systematic approach to subject-specific professional development and retraining in the sciences as part of a STEM education strategy. This represents an additional investment of about £44 m over existing spend. A recent study commissioned by STEM Learning[31] explored both teacher- and pupil-related benefits across varying education levels and estimated that the total annual return on investment in effective CPD would be up to £500m.

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[27] Allen & Sims (2017). Improving science teacher retention: do National STEM Learning Network professional development courses keep science teachers in the classroom? Wellcome Trust/Education Datalab https://wellcome.ac.uk/sites/default/files/science-teacher-retention.pdf

[28] https://royalsociety.org/-/media/policy/Publications/2022/2022-01-31-sci-uplift-DfE.pdf

[29] https://tdtrust.org/2018/01/18/post-code-lottery-teachers/

[30] https://cms.wellcome.org/sites/default/files/2022-02/final-cpd-challenge-evaluation-report.pdf

[31] https://www.stem.org.uk/sites/default/files/pages/downloads/Valuing%20Impact%20of%20Science%20CPD.pdf