

## **Education for Engineering**

### **Submission to the inquiry on *The economics of higher education, further education, and vocational training* by the Lords Economic Affairs Committee**

Education for Engineering (E4E) is the body through which the engineering profession offers coordinated advice on education and skills policy to UK Government and the devolved Assemblies. It deals with all aspects of learning that underpin engineering.

It is hosted by The Royal Academy of Engineering with membership drawn from the professional engineering community including all 35 professional engineering institutions, the Engineering Council and EngineeringUK.

## **Summary**

Our key messages are as follows:

- Engineering is essential for the future prosperity and economic growth of the UK, with engineering-related sectors contributing at least £280 billion in gross value added to the UK economy – 20% of the total. However, there is also a well-documented engineering skills shortage, with EngineeringUK predicting an annual shortfall of 20,000 engineering graduates.
- Higher Education (HE), Further Education (FE) and technical training are all important routes into engineering. In addition, lifelong learning is imperative to ensure that the UK workforce has the skills required to tackle current and future challenges. Therefore, ensuring that the UK has a high-quality post-school education and training system that meets the needs of employers is imperative for addressing the engineering skills challenge.
- **Further education**
  - The FE sector has been denuded of investment for many years and is in critical need of a further substantial injection of funding. This is particularly important now to ensure that the sector has the necessary resources, facilities and infrastructure to support the delivery of the new T-level qualifications.
  - Investment in the FE sector impacts on the quality of provision in numerous ways:
    - addressing the lack of expert FE lecturers in engineering
    - providing funding for FE lecturers' continuous professional development
    - enabling investment in high cost subjects
    - allowing access to industry-standard equipment
    - investing in local skills provision to meet local employer needs
    - improving careers education, guidance and transition to work
    - forging stronger links with employers
    - incentivising progression to higher level qualifications.
- **Technical training**
  - The engineering profession is concerned that funding for the Institutes of Technology should not be spent on additional physical infrastructure. Instead, the £170 million should be used to enable current centres of excellence such as the AMRC in Rotherham, TWI in Middlesbrough and the Bristol Composites Centre to develop networks of FE colleges, close gaps in local provision and provide 'improver pathways' to enable those institutes to provide specialist

training within a coordinated national programme, to ensure national accessibility.

- **Higher education**

- A key concern of the engineering profession is the ability of the UK HE system to cope with any significant increase of interest in engineering. The demand of industry is for graduates who have extensive practical and design experience as well as sound understanding of engineering principles. Courses are therefore necessarily expensive to run and many universities are consequently wary of expanding places or of establishing new provision.
- There is therefore a real need to incentivise universities to invest both in staff and in facilities and ensure that the Strategically Important and Vulnerable Subjects funding and high-cost subject funding are meeting the requirements of engineering higher education.

- **Lifelong learning**

- We need to put in place high quality systems to support lifelong learning, particularly for SMEs. Investment is required in a comprehensive programme of upskilling developed in partnership with industry and training providers to ensure that the UK workforce at all levels, in the public and private sector and in all parts of the UK, has the skills needed to shape and participate in the industries of tomorrow.
- Sector deals provide a crucial opportunity to drive improvements in productivity through, for example, upskilling of staff and expansion of talent pools. Employers need the confidence to invest in training and upskilling by bringing policy stability, and sector deals should ensure that this is addressed at the sectoral level.
- Major infrastructure projects have been shown to be effective incubators for both innovation and upskilling the workforce, and the government should consider how this can be further encouraged.

- **Primary and secondary schools**

- Although this inquiry focuses on post-school education and training, primary and secondary education needs to be considered to ensure that the right incentives, inspection regimes and funding models for schools are in place to nurture and develop interest, engagement and attainment in key subjects that will support the nation's skills needs from a young age. In particular, specialist teacher shortages in STEM-related subjects in schools should be addressed as a matter of urgency.

## The engineering skills challenge

1. Engineering is essential for the future prosperity and economic growth of the UK, with engineering-related sectors contributing at least £280 billion in gross value added to the UK economy – 20% of the total<sup>1</sup>. Some 52% of engineering companies are currently recruiting engineers at technician level and above, with over half of those experiencing difficulties in recruiting the experienced engineers they need<sup>2</sup>. Demand for people with higher skills is expected to rise significantly, with 90%<sup>3</sup> of businesses in engineering, science and hi-tech expecting an increase in demand over the next 3-5 years<sup>4</sup>.
2. The chronic failure to encourage enough young people to become engineers and skilled technicians is a serious threat to the UK's engineering competitiveness. EngineeringUK has undertaken a detailed analysis of the skills demand and supply and have found that there is an annual shortfall of 20,000 engineering graduates<sup>5</sup>. Furthermore, following the result of the EU referendum, there is a risk that the profession is likely to encounter even greater challenges in recruiting sufficient engineers and technicians to meet the needs of industry<sup>6</sup>.
3. Higher Education, Further Education and technical training are all important routes into engineering and lead to advanced qualifications, apprenticeships and engineering employment. Technical qualifications also allow progression into engineering Higher Education, which accepts a range of entry qualifications and equivalences<sup>7</sup>. Therefore, ensuring the UK has a high-quality post-school education and training system that meets the needs of employers is imperative for addressing the engineering skills challenge.
4. In particular, the UK must substantially improve its performance in digital skills and enhance the ability of the education system to keep pace with continuously evolving needs. Digital technology already permeates the world around us in a profound way and creates new opportunities – a trend that is set to accelerate in the years ahead. In 2013, the Commission on Adult Vocational Teaching and Learning identified 'access to industry-standard facilities and equipment, reflecting the ways in which technology is transforming work'<sup>8</sup> as an essential feature of good vocational education and training.

## Further Education

5. The Further Education sector (FE) is a major contributor to engineering education and the principal provider of technical education. FE colleges have been denuded of investment for many years, putting them under increased financial strain and

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<sup>1</sup> [Engineering a future outside the EU: securing the best outcome for the UK](#), Royal Academy of Engineering and Engineering the Future, 2016

<sup>2</sup> [Skills and Demand in Industry Survey](#), Institution of Engineering and Technology (IET), 2016, p12-13

<sup>3</sup> Businesses reporting increased demand minus those reporting decreased demand

<sup>4</sup> *The right combination: CBI/Pearson education and skills survey 2016*, CBI, 2016  
<http://www.cbi.org.uk/cbi-prod/assets/File/pdf/cbi-education-and-skills-survey2016.pdf>

<sup>5</sup> [Engineering UK 2017: The state of engineering](#), EngineeringUK, 2017

<sup>6</sup> [Engineering a future outside the EU: securing the best outcome for the UK](#), Royal Academy of Engineering and Engineering the Future, 2016

<sup>7</sup> [Pathways to success in engineering degrees and careers](#), Royal Academy of Engineering, 2015

<sup>8</sup> Commission on Adult Vocational Teaching and Learning, 2013, p9

impacting on the quality of their provision<sup>9</sup><sup>10</sup>. In 2015/16 spending per student in FE was 10% lower than spending per student in secondary schools<sup>11</sup>.

6. Therefore, FE colleges are in critical need of a further substantial injection of funding to provide high-quality technical education, an investment that would recoup substantial benefits in the form of national prosperity and improved social mobility. This is particularly important now to ensure that FE has the necessary resources, facilities and infrastructure to support the delivery of the new T-level qualifications. However, equipment and resources are just one prerequisite of high-quality engineering education; having specialist engineering lecturers who are up-to-date with industry requirements is equally essential.
7. A further issue is the parity between FE and HE sectors, which are funded at different rates for STEM education and have considerably different student support systems. A study by London Economics for the University and College Union reveals that funding for 16-19 education in FE colleges is equivalent to 42% of higher education funding for an apprentice and 54% for a non-apprentice<sup>12</sup>. Funding is even lower for learners aged 19 or above.
8. There is also a concern that, with the expansion of apprenticeships and technical learning into higher education, the form of teaching and funding that is available to students may be markedly different between those on full-time degree courses, and those studying through other routes. We hope that the Institute of Apprenticeships will maintain oversight of this, and act to prevent a two-tier system emerging. In engineering in particular, the distinction between academic and technical/ vocational routes is blurred, and it is essential that the ability to transfer between pathways is maintained.
9. Investment in the FE sector impacts on the quality of provision in numerous ways:  
*Addressing the lack of expert FE lecturers*
10. If the UK is to lead the world, and benefit from an industrial strategy which puts technical education at its heart, the government must address the current emergency caused by the shortage of specialist, qualified lecturers in mathematics, physics, computing, engineering, and design & technology. The engineering profession has highlighted the fact that the current lack of expert teachers and tutors in FE is a key barrier to for improving the quality and quantity of technical education<sup>13</sup>.
11. Lecturer recruitment and retention is a particularly important issue for STEM subjects as the economy improves and those with STEM skills have more opportunities than ever before. The Industrial Strategy Green Paper recognised this challenge and highlights the task of 'attracting more industry specialists to work in the sector'. The additional annual £500 million to the FE sector announced in the March 2017 Budget will significantly improve developments in this regard. However, given the critical

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<sup>9</sup> [What does skills policy look like now the money has run out?](#) London: Association of Colleges, 2014

<sup>10</sup> [Heading for the precipice: Can further and higher education funding policies be sustained?](#) King's College London, 2015

<sup>11</sup> [Long-run comparisons of spending per pupil across different stages of education](#), The Institute for Fiscal Studies, 2017

<sup>12</sup> [Mind the gap: Comparing public funding in higher and further education](#), London Economics, 2015

<sup>13</sup> [Engineering an economy that works for all: Industrial Strategy Green Paper response](#), Royal Academy of Engineering, 2017

shortages of teachers in the schools system, who tend to receive higher pay<sup>14</sup> than their FE counterparts<sup>15</sup>, this will be a significant challenge.

12. To address this shortage, government should invest in the teaching of these subjects in FE, including salaries of specialist lecturers and increasing eligibility for and the value of bursaries/loans for training to teach. Activities targeted at recruitment to teach these subjects should also be incentivised. This could be funded through unspent funds from the apprenticeship levy.

*Funding for FE lecturer continuous professional development*

13. In order for the FE sector to properly meet the needs of industry, FE lecturers need regular continuous professional development (CPD) to deliver education and training in cutting edge technologies being used by business. For STEM subjects, where there is a significant pace of development in new scientific knowledge and understanding and also in the practice of teaching, it is particularly important that teachers update their skills. However, with little funding for CPD in the FE sector, few organisations offer any subject-specific support for advancing teaching and learning. In addition, the engineering community believes there is a clear need for lecturers in STEM subjects to provide real-life contexts for the theory that they teach, to make the subjects relevant and inspiring for young people. CPD and industry placements can help them to find useful case studies.
14. Long-term professional development programmes for lecturers, including industrial placements, for retention and improved teaching should be developed. The Academy has, for several years, been providing professional development training across a range of engineering subject areas for FE lecturers. This has been on topics such as composite materials, programmable logic controllers, programming and microprocessor control, contextual maths for engineers, mechanical engineering principles and smart materials.

*Investment in high-cost subjects*

15. The engineering profession welcomes the commitment in the recent Budget to increase funding by more than 50% for 16-19-year-olds following college-based technical education routes. However, government needs to be aware of the differential costs associated with different T-levels and introduce a differential funding model to account for this.
16. The expense of installing and maintaining equipment and software, particularly for engineering, is a significant cost factor for FE colleges in providing technical education. Often colleges will subsidise provision of high cost laboratory based subjects from lower cost subjects. In addition, subjects such as engineering necessarily take longer to study than others such as retail. This is reflected in the length of apprenticeships and so should equally be reflected in the length and commensurate funding of college-based provision.
17. The government should incentivise the teaching of high-cost subjects by introducing a differential funding mechanism that would provide colleges with increased student funding for high-cost programmes (such as the new T-levels in engineering and manufacturing and in construction and built environment) and correspondingly lower amounts of funding per student in lower-cost subjects. This would also allow government to incentivise skills training in priority areas as identified in the Industrial

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<sup>14</sup> [http://www.payscale.com/research/UK/Job=High\\_School\\_Teacher/Salary](http://www.payscale.com/research/UK/Job=High_School_Teacher/Salary)

<sup>15</sup> [Workforce data across the further Education sector 2014/15](#), The Education and Training Foundation, 2016

Strategy Green Paper. Additionally, this would also help to remove a perverse incentive for FE colleges to provide low-cost qualifications that do not necessarily benefit the local economy or the economy as a whole.

*Access to industry-standard equipment*

18. Apprentices have access to industry-standard equipment while they are in the workplace. However, according to a survey conducted by the Academy and Gatsby Charitable Foundation, around 55% of 16-18 year olds studying engineering at Level 3 are full-time learners studying in full-time classroom-based settings<sup>16</sup>. Although some colleges have high-quality on-site engineering facilities, many do not have comprehensive industry-standard facilities on-site due to their high cost and cost of updating and maintaining them.
19. Not all colleges offering engineering would require a large amount of expensive equipment if all learners had regular access to up-to-date, industry-standard equipment on a local employer's site. However, our survey found that only 25% of colleges provided non-apprenticed learners with access to equipment at their local employer, with the majority of these positive responses being visits to local industry rather than a formalised equipment- and expertise-sharing agreement<sup>17</sup>.
20. This does not necessarily mean that colleges are not engaging effectively with local employers, but effective employer engagement often benefits apprentices more than full-time learners. The Academy and the Gatsby Charitable Foundation suggested several options and approaches to ensure high-quality engineering facilities are available nationally in the report *Engineering facilities in further education colleges in England*. These include:
  - A large increase in long-term investment in colleges and their facilities nationally.
  - Increased collaboration between employers and colleges, to allow a formalised access agreement to employer-based equipment.
  - Increased collaboration between colleges and universities to make better use of highly equipped university departments.
  - Greater local coherent planning of engineering education to prevent duplication of provision and allocate funding to more specialised institutions to ensure that more expensive, technical education can be available to meet the needs of employers and learners.

*Investment in local skills provision to meet local employer needs*

21. The responsibility for distribution of the skills capital budget for FE largely resides with Local Enterprise Partnerships (LEPs)<sup>18</sup>, although some decisions about the allocation of capital funding are made at the national level.
22. In order to promote growth in the local area, each LEP sets out its priority investment areas in its strategic economic plan. All 39 LEPs feature one or more technical industries in their economic plan, with 30 LEPs seeking to further develop

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<sup>16</sup> [Engineering facilities in further education colleges in England](#), Royal Academy of Engineering and Gatsby Charitable Foundation, 2016

<sup>17</sup> [Engineering facilities in further education colleges in England](#), Royal Academy of Engineering and Gatsby Charitable Foundation, 2016

<sup>18</sup> [www.gov.uk/government/collections/local-growth-deals](http://www.gov.uk/government/collections/local-growth-deals)

engineering and advanced manufacturing industries and others focusing in areas such as IT, energy provision, or life sciences<sup>19</sup>. Clearly, the ability of the local FE provision to deliver high-quality technical education that meets the needs to employers is vital to achieving these ambitions.

23. Longer-term funding arrangement for periods of three to five years would help stabilise FE provision and stimulate colleges and other providers to work with local agencies such as LEPs to better plan and invest in skills provision that meets local employer needs. This would include planning how providers will ensure up-to-date equipment and facilities and specialist lecturers to provide high-quality technical education. Government can hold FE providers to account and judge value for their investment by measuring the destinations of students, attainment, and employer satisfaction. LEPs can also be held to account by measuring the extent to which FE provision is aligned to local employer needs.

*Improving careers education, guidance and transition to work*

24. The 2011 Education Act removed the statutory duty of local authorities in England to provide careers education, information, advice and guidance (CEIAG) to young people, placing that duty instead on individual schools and colleges. At the same time, the Department for Education did not provide any additional funding for schools or colleges – expecting them to provide CEIAG within existing budgets. The department has regularly updated guidance on provision of CEIAG since the change<sup>20</sup>. However, while colleges are aware of the guidance, it is unclear how focused many of them are on this, at a time of significant change in accountability measures, curricula and assessment.
25. Encouraging diversity in the profession is vital and good CEIAG is important for students to understand the full range of future learning opportunities available, with equal status being given to technical pathways alongside traditional academic routes<sup>21</sup>. This is particularly important for engineering due to the many entry routes to engineering domains. As such there is a specific need for young people to understand the progression pathways, the value of work experience and industrial placements and the types of personal and professional characteristics that engineering employers.
26. The engineering profession welcomes the new requirement in the Technical and Further Education Act for schools to admit providers of technical education and apprenticeships to contact pupils to promote their courses. However, there are still pressures on schools to retain students, with each secondary school student worth £6,300<sup>22</sup>, rather than encouraging students to follow alternative progression pathways which might be more suitable.
27. The engineering community supports the recommendations put forward by Professor Sir John Holman in his review of careers education and guidance for the Gatsby Foundation<sup>23</sup>. This focuses on secondary schools but the principles also apply to FE colleges. In particular, all colleges should have a careers education programme. As part of that programme, students should gain a much better understanding of local

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<sup>19</sup> [www.lepnetwork.net/resource-area/document-library/](http://www.lepnetwork.net/resource-area/document-library/)

<sup>20</sup> <https://www.gov.uk/government/publications/careers-guidance-for-colleges--2>

<sup>21</sup> [The class ceiling: Increasing access to the leading professions](#), All Party Parliamentary Group on Social Mobility, 2017

<sup>22</sup> [Long-run comparisons of spending per pupil across different stages of education](#), The Institute for Fiscal Studies, 2017

<sup>23</sup> [Good Career Guidance](#), The Gatsby Charitable Foundation, 2014

and national market opportunities and employer needs. Local Enterprise Partnerships should play a key role in providing engineering careers expertise.

*Stronger links with employers*

28. Employer engagement in education is a powerful tool for influencing young people's career aspirations. The engineering community is connecting engineering businesses to schools through the Tomorrow's Engineers programme and welcomes the establishment of the Careers and Enterprise Company, with which it is working closely.
29. Strong employer links with FE and HE institutions are highly beneficial. They provides real-life contexts for teaching and learning, help students to see the direct line through education to employment and also provide teaching staff with access to latest up-to-date industry practice. The Academy has, for many years, run schemes in both FE and HE to place practising engineers in the classroom to support teaching and learning and real world examples of the engineering subject matter being delivered. Additionally, the STEM Insight scheme, delivered by STEM Learning, provides work placements in industry for teachers.

*Incentivising progression to higher level qualifications*

30. Across all post-16 provision (school sixth forms, sixth-form colleges and FE colleges) students require sufficiently high grades at GCSE to progress to higher qualifications – whether A level or vocational alternatives. For progression in sciences, maths and engineering, schools and other providers now regularly require GCSE grades of A\* or A with some schools accepting B grade for progression. In 2014, for students studying A-level Physics, the modal grade achieved at GCSE in each of the facilitating subjects was A\* and A grades. Despite this, there is less than one grade difference in A-level physics achievement between students who achieved A and B grades in GCSE physics<sup>24</sup>. Additionally, more than 92% of students who achieved a B in GCSE physics and went on to study A-level physics passed<sup>25</sup>.
31. From the perspective of the school or college, if students do not achieve well at A level, this will reflect badly on the provider's performance measures, and if they drop out of a high-level qualification, schools or colleges are punished financially. There is therefore no incentive, and indeed many disincentives for schools and colleges to be proactive in driving up progression in STEM subjects, despite calls from employers and government for higher skilled workers to improve productivity in the UK.
32. Students entering the FE sector may not have sufficiently high grades in maths and sciences to progress to higher level qualifications. As a consequence, they are likely to be placed on GCSE equivalent courses for a further two years – effectively re-sitting GCSEs but in a different set of subjects (often vocational subjects such as car maintenance). The FE sector needs to have incentives put in place to drive up progression to more challenging material. It also needs considerable additional maths support and resources to ensure that students can keep up with the material being presented to them. Core maths plugs a critical gap for students progressing to higher level courses with a quantitative element<sup>26</sup>.

## **Technical Training**

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<sup>24</sup> [The link between GCSE grades and A-level participation and attainment](#), The Institute of Physics, 2016

<sup>25</sup> [The link between GCSE grades and A-level participation and attainment](#), The Institute of Physics, 2016

<sup>26</sup> [Report of Professor Sir Adrian Smith's review of post-16 mathematics](#), 2017

### *Apprenticeship Levy*

33. The engineering profession is concerned that it is not clear how the funding will be distributed around the UK, with the levy being UK-wide, but the voucher scheme being England only, and levies raised from English payroll having to be spent in England. Additionally, we believe that large companies should be able to use their underspent levy to train more apprentices than they need for their own business for the benefit of their supply chain.
34. The timing of levy funding, and how long companies are allowed to stockpile their contribution is key – some sub-sectors of engineering and construction, such as aerospace, infrastructure building, and energy, have very long time horizons (up to five years). For those companies, the ability to 'stock up' their levy funding to meet known future need would enable them to plan and bid for work more effectively.
35. The 'redirection of unused funding' should focus on supporting those sub-sectors that contribute directly and most effectively to UK productivity:
- big data and energy-efficient computing
  - satellites and commercial applications of space
  - robotics and autonomous systems
  - synthetic biology and the wider life sciences
  - regenerative medicine
  - agri-science and agricultural technology
  - advanced materials and nanotechnology
  - energy and its storage, including nuclear, offshore wind, oil and gas
  - aerospace
  - automotive
  - construction
  - information economy
  - international education
  - professional and business services.
36. Only apprenticeships that meet the Engineering Council's criteria and have 'approved apprenticeship' status should be funded by the levy. Also, only apprenticeships that lead to employment (in the 'host company, in the supply chain, or quickly into the occupation) should attract funding. The levy should also be available to employers who want to upskills adults with substantive, professionally approved training.

### *Institutes of Technology*

37. The engineering profession is concerned that funding for the Institutes of Technology should not be spent on additional physical infrastructure. Instead, the £170 million should be used to enable current centres of excellence such as the AMRC in Rotherham, TWI in Middlesbrough and the Bristol Composites Centre to develop networks of FE colleges, close gaps in local provision and provide 'improver pathways' to enable those institutes to provide specialist training within a coordinated national programme, to ensure national accessibility.

### **Higher education**

38. A key concern of the engineering profession is the ability of the UK HE system to cope with any significant increase of interest in engineering courses from students.

Much of the provision is already at capacity and some universities are working with facilities which are not at the cutting edge of 21st century advanced technology.

39. The demand of industry is for graduates who have extensive practical and design experience as well as sound understanding of engineering principles. Courses are therefore necessarily expensive to run and many universities are consequently wary of expanding places or of establishing new provision. There is therefore a real need to incentivise universities to invest both in staff and in facilities and ensure that the Strategically Important and Vulnerable Subjects funding and the high-cost subject funding are meeting the requirements of engineering higher education.

*High-cost subject funding*

40. Engineering is expensive to teach for numerous reasons, most notably the cost of specialist facilities and equipment and the cost to maintain them. Fieldwork for students involved in disciplines such as chemical engineering can also be costly due to travel, student supervision, equipment and insurance. Furthermore, small group teaching required for training students to operate specialist equipment makes staff costs higher and regulatory costs associated with working with hazardous equipment can be very high.
41. Over the last few years there has been increasing recognition of the importance of practical, hands-on learning for students in engineering at degree level. The active learning pedagogical approach enables a deeper understanding of theory and principles. However, the approach requires a change of focus from lecture based teaching to more active learning environments. These environments tend to be open spaces that allow students to create, build and test designs, structures and prototypes.
42. HEFCE assigns subjects to 'price groups' and uses this to allocate funding to high-cost subjects. Currently, laboratory-based science, engineering and technology subjects are seriously disadvantaged in HEFCE's 'price groups' considering the scope and breadth that they are required to cover. Medicine, dentistry and veterinary science are in price group A and receive £10,000 per student per year. Science and engineering by comparison receive only £1,500 per student per year<sup>27</sup>. While this additional funding is welcome, it is insufficient to ensure that universities have up-to-date technology used in industry to give students education and training on the type of equipment/ software they will experience in the workplace.
43. despite being equally, if not more, expensive in terms of resources for equipment and laboratory staff and the cost of industrial projects and design. The 'price groups' used in the current funding model do not reflect this adequately. Sufficient resources should be made available to ensure that engineering is adequately funded and can continue making substantial contributions to the economy.
44. A report by the Science and Technology Select Committee<sup>28</sup> highlighted that the cost of educating HEFCE fundable taught students in some engineering subjects in 2009/10 was £15,700 per annum. Therefore, despite increases in undergraduate tuition fees, many institutions will still face a deficit on much of their taught engineering provision. With variable fees, there is also concern that STEM courses may end up being more expensive than other courses which could subsequently impact on the number of students choosing to pursue STEM courses. There is also a

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<sup>27</sup> [Guide to funding 2017-18: How HEFCE allocates its funds](#), Higher Education Funding Council, 2017

<sup>28</sup> [Higher Education in Science, Technology, Engineering and Mathematics \(STEM\) subjects](#), Authority of the House of Lords, 2017

danger that cheaper humanities courses may end up cross-subsidising the more expensive STEM courses.

*Strategically Important and Vulnerable Subjects funding*

45. In 2005, the Higher Education Funding Council for England (HEFCE) identified a number of STEM subjects as 'strategically important and vulnerable subjects' (SIVS) with concern that HE institutions would cut back on provision because of falling demand<sup>29</sup>. There was also concern that SIVS would be under threat because of the inherent cost of provision (in terms of capital and other costs associated with laboratories, consumables and technician support) in their subject delivery.
46. Departments are feeling keenly the loss of the financial incentive per student in engineering which gave universities a strong base for planning and sustaining engineering to ensure that courses and facilities reflect latest advancements in engineering industry.
47. The Engineering profession would welcome reconsideration of support for this strategically important subject in higher education to ensure that courses and facilities reflect latest advancements in engineering industry.

**Lifelong learning**

48. The engineering profession has always been strongly supportive of Continuing Professional Development. The speed of technological change, as well as the growth in global competition, make this an ongoing imperative for UK engineering in order to maintain a leading position internationally. Upskilling and professional development of the existing engineering workforce should be through effective existing mechanisms and such bodies as those involved in professional registration, which should in turn be encouraged through government procurement policies.
49. Professional engineering institutions have a key role to play in supporting individuals and companies to keep up-to-date with technological change and global competition. They can inspire, inform, motivate, and help manage careers across engineering disciplines and sectors. This must include reskilling those sections of the workforce carrying out low-added value repetitive tasks that can be carried out by machines as well as ensuring there are more opportunities for non-engineers to enter STEM careers later in life with targeted support such as bursaries, scholarships for foundation programmes and/or degree 'conversion' courses.
50. As part of a survey of the engineering profession, we asked engineers about the main barriers to their organisation training and educating its workforce<sup>30</sup>. The majority of obstacles were categorised as financial (lack of money to spend on development versus the cost of training) and time-related (constraints in giving individuals time to train or the lack of flexibility in when training is available) though the risk of investing in training employees only to have them 'poached' by another organisation that would then reap the benefits of the first company's investment was also noted.
51. We need to put in place high quality systems to support lifelong learning, particularly for SMEs. Investment is required in a comprehensive programme of upskilling

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<sup>29</sup> HEFCE 2005,

<http://www.hefce.ac.uk/data/year/2008/Strategically,important,and,vulnerable,subjects,an,interim,evaluation,of,HEFCEs,programme,of,work/>

<sup>30</sup> [Engineering an economy that works for all: Industrial Strategy Green Paper response](#), Royal Academy of Engineering, 2017

developed in partnership with industry and training providers to ensure that the UK workforce at all levels, in the public and private sector and in all parts of the UK, has the skills needed to shape and participate in the industries of tomorrow.

#### *Sector deals*

52. A key aim of the sector deals should be to address the UK's lagging productivity levels. Respondents to an Academy survey identified four priority actions that organisations could take to improve their productivity<sup>31</sup>. The most frequently cited action was the recruitment, training and retention of staff.
53. Therefore, sector deals provide a crucial opportunity to drive improvements in productivity through, for example, upskilling of staff and expansion of talent pools. Employers need the confidence to invest in training and upskilling and education and training providers need confidence to invest in facilities and staff by bringing policy stability, and sector deals should ensure that this is addressed at the sectoral level.

#### *Local skills*

54. Major infrastructure projects have been shown to be effective incubators for both innovation and upskilling the workforce, and the government should consider how this can be further encouraged. For example, Crossrail has implemented a shared innovation scheme, I3P-1768 with supply-chain partners, which created an incentive to innovate and the potential for shared gains. Successes in publicly funded projects can demonstrate the benefits of innovation investment, educate decision-makers and create a skills and evidence base to support future decisions<sup>32</sup>.
55. Examples of this approach include the Tunnelling and Underground Construction Academy (TUCA)<sup>33</sup>, which is a purpose-built facility providing training in the key skills required to work in tunnel excavation and underground construction. TUCA is training the engineers required to deliver Crossrail 2, the Thames Tideway Tunnel and High Speed 2.

### **Primary and secondary schools**

56. Primary and secondary education needs to be considered by the inquiry to ensure that the right incentives, inspection regimes and funding models for schools are in place to nurture and develop interest, engagement and attainment in key subjects that will support the nation's skills needs from a young age through to post education.

#### *Teacher shortages and professional development*

57. In particular, specialist teacher shortages in STEM subjects in schools should be addressed as a matter of urgency. There should be an even greater investment in subject-specific continuing professional development for teachers, to ensure that all teachers undertake it alongside general professional development, making annual training compulsory and monitored through OFSTED inspections. Additionally, there needs to be greater adoption of proven technology capable of supporting learning.

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<sup>31</sup> [Engineering an economy that works for all: Industrial Strategy Green Paper response](#), Royal Academy of Engineering, 2017

<sup>32</sup> ['State of the Nation: Digital Transformation', ICE, 2017](#)

<sup>33</sup> [TUCA](#)

*A broader curriculum to age 18*

58. A key issue that the engineering community believes is preventing more young people from accessing engineering careers is the requirement for specialisation at too early an age. The education system in England, Wales and Northern Ireland sets individuals on an arts/science divide at the age of 16 and often even earlier when choosing GCSE subjects at age 14, while many have not made up their mind about future careers.
59. We support the Royal Society's recommendation, in its report *Vision for science and mathematics education*, for all students to study a broader curriculum that includes mathematics and science to age 18<sup>34</sup>. A broader curriculum would provide more opportunities for the development of creativity, critical thinking and communication skills. This would enable those wishing to explore STEM subjects further to make career decisions later on in their education, rather than committing to one side or the other of the arts/science divide at age 16, hence increasing the potential flow into engineering.
60. This would require the development of a new baccalaureate-style post-16 framework that spans academic and technical/professional progression pathways across a broad range of subjects to the age of 18.

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<sup>34</sup> [Vision for science and mathematics education](#). The Royal Society, 2014.