NATIONAL
ENGINEERING
POLICY CENTRE

Engineering priorities for our future economy and society

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The UK faces a number of defining challenges to its prosperity, security and wellbeing. Navigating these challenges will require making trade-offs and dealing with uncertainties in the face of these escalating pressures with limited resources.

Engineers have the skills, insights and ingenuity to help tackle many of these challenges in ways that optimise efficiency, economy, safety and reliability. As engineers, we are problem-solvers and innovators, with a unique perspective on the world. From increasing productivity and renewing our infrastructure, to the skills gap and the threat of climate change, these challenges rightly lie at the heart of the UK's Industrial Strategy.

Most of these big challenges are long term in nature and require cross-government action. Engineering is central to delivering on them.

Here, we set out our priorities for upcoming policy and spending decisions in the UK. The actions we propose will enable the UK to make investment decisions that will create more jobs and prosperity, and meet the future needs of our society in a way that is faster, more efficient and sustainable. The engineering profession stands ready to support delivering on these goals and bring about the best outcome for the UK.

The National Engineering Policy Centre is an ambitious partnership, led by the Royal Academy of Engineering, between 39 different UK engineering organisations. Together, we represent[1]:

450,000 engineers

25% of the UK GVA, with **£420.5 billion** generated

19% of the UK workforce, with **5.8 million** jobs

27% of registered companies, with **721,940** companies

ROYAL ACADEMY OF ENGINEERING

IHE INSTITUTE OF HIGHWAY ENGINEERS

Skills

Implement the recommendations of the Perkins Review to secure the engineering skills necessary for the UK's future.[2]

Ensure the funding for further education colleges reflects the higher cost of providing engineering programmes, especially with the forthcoming T levels in engineering and manufacturing, as well as delivery of higher level technical skills.

Why? Further education is critical to the skills pipeline and its funding in 2019/20 is set to fall by 13% in real terms since 2010.[6]

Introduce a requirement for 40 hours of subject-specific continuing professional development (CPD) every year for teachers of mathematics, science, design and technology, and computing, with ringfenced funding.

Why? Subject-specific CPD keeps teachers updated in developments in their subjects and career options, yet one in three STEM teachers in secondary schools say they knew 'a little' or 'almost nothing' about engineering or nearly two in five lacked confidence in giving advice about engineering careers.[7]

Give employers greater flexibility on spending in the Apprenticeship Levy to include funds to support other forms of high-quality training provision.

Why? While the engineering community is supportive of the levy and recent softening of rules, a survey of business leaders revealed that 4 in 10 employers believe that apprentices are not the most appropriate use of their training budget[8], with evidence that only 8% of first-year levy contributions spent.[9]

Invest in understanding what works in interventions that promote the uptake of engineering education by students of all backgrounds through commissioning a longitudinal cohort study of young people, tracking their outcomes.

Why? Just 33% of young people aged 11 to 14 reported taking part in a STEM careers activity in the last year[10], although over 600 organisations operate in engineering engagement.[11] Evidence-based insight into effective outreach is needed to enable schools and the profession to use their resources most efficiently.

WHY?

The UK has a long-standing skills gap and a chronic failure to encourage enough young people to become engineers and skilled technicians.

124,000
engineers and technicians with core engineering skills are required per year in the UK.[3]

59,000
annual shortfall of engineering graduates and technicians to fill core engineering roles at level 3 and above.[4]

50%
of roles in the Shortage Occupation List are in engineering, with this pressure likely to increase following potential restrictions on EU citizens coming to the UK.[5]

Innovation

Increase Innovate UK's budget to boost support for business innovation and the 'D' of R&D to increase productivity.

Increase Innovate UK's budget to help address the UK's historic under-investment in innovation and the 'D' of R&D.

Why? Recent investment through the Industrial Strategy Challenge Fund (ISCF) is an important step in readdressing the balance but only 6% of Innovate UK's 2017/18 budget is allocated to Open programmes, limiting their ability to rapidly respond to business needs in any area of the economy.[15]

Increase and diversify Official Development Assistance (ODA) allocation to engineering and technology to capitalise on its potential to address all Sustainable Development Goals in the UK and globally.

Why? Most ODA investment in engineering and technology has focused on infrastructure delivery and, more recently, research. These must be complemented by support in education, skills and locally driven innovation to realise the potential benefit.

Publish a roadmap to 2.4%, including public spending up to 2027, demonstrating the government's commitment to its target and providing certainty to businesses.

Why? Current R&D investment in the UK is approximately 1.7% of GDP, below the OECD average of 2.4%.

Deliver measures that encourage investment in R&D by businesses in the UK and from abroad to help companies take their innovation to market such as:

- Boost support for late-stage R&D and demonstration for companies to develop their products in real-world environments and to attract further R&D and supply chains.
- Make innovation a key component of the public procurement process to bring best value for money to the public purse.
- Maintain the UK's competitive package of tax incentives for companies to innovate such as R&D tax credits, EIS and SEIS.

Why? Companies make global decisions about where to invest in R&D. Businesses find UK tax incentives for R&D internationally competitive, but support for late-stage R&D is poor compared to competitor countries.[16]

WHY?

Innovation is a pillar of the UK's economy but we face stiff international competition in the global market. Long-term commitment to innovation is essential to encourage businesses to invest here and help create new markets, supply chains and jobs.

Firms that consistently invest in R&D are **13% more productive** than firms that don't.[12]

For every £1 invested, Innovate UK's schemes **return an average of £7.30 GVA** to the economy.[13]

For every £1 spent by the government on R&D, private sector R&D **output rises by 20p per year** in perpetuity, by raising the level of the UK knowledge base.[14]

Digital

Deliver fast and resilient digital infrastructure, a thriving business environment, excellent digital skills and a diverse pipeline of workers to create a world-leading digital economy.

Drive the establishment of world-class digital connectivity and infrastructure that is fast, secure and resilient across both urban and rural areas of the UK, through investments such as the National Productivity Investment Fund.

Why? Connectivity is an essential prerequisite for an advanced digital economy and ensuring UK competitiveness, since the fast, resilient and secure transfer of data is required for many data-driven systems. Conversely, broadband outages are estimated to cost business over £12 billion per year.[20]

Ensure that funding for new digital technologies and processes includes requirements to address cybersecurity to enable safety, resilience and trust in their adoption.

Why? 28% of manufacturers across 13 countries reported revenue losses due to cyberattacks in 2017.[21]

Provide targeted support for the development, commercialisation and adoption of digital technologies where the value can be clearly demonstrated and there is potential to develop a strong and vibrant market.

Why? Organisations in many sectors are unclear about the benefits of digital technologies for their businesses and how to adopt them.[22] Digital sectors are estimated to create jobs two times faster than the rest of the economy.[23]

Make computing courses appealing to a wider range of young people in school to attract a more diverse cohort of workers.

Why? Women only make up 15% of the technology workforce.[24]

WHY?

The UK has many of the key assets required to become one of the world's top digitally driven and data-enabled economies, from our excellence in cybersecurity and pioneering artificial intelligence (AI) to the potential transformations to be achieved through Industry 4.0, automation and Internet of Things. But the potential growth and productivity benefits will not be realised without measures to drive the effective and safe adoption of these technologies.

The UK could forgo **£141 billion** of growth in the next decade if steps are not taken to address the digital skills gap.[17]

£630 billion
estimated increase to the UK economy by AI by 2035, increasing the annual growth rate of GVA from 2.5 to 3.9%.[18]

Up to 14%
estimated increase in value of UK manufacturing by 2027 through the uptake of industrial digital technologies such as Industry 4.0.[19]

Infrastructure

Deliver on the recommendations of the National Infrastructure Assessment or set out alternative plans to meet the UK's long-term infrastructure needs.

Maintain, as a minimum, the current level of funding for economic infrastructure and ringfence funding packages for rail (CP6) and roads (RIS2).

Why? A sustained investment in infrastructure of 0.5% of GDP is estimated to lead to long-term growth of 0.5% to 2.0% of GDP in large advanced economies.[27]

Demand all public bodies publish forecast costs and benefits of their major infrastructure projects at each appraisal stage and at a suitable point after completion.

Why? Highways England routinely publishes project evaluations of major investments, leading to more accurate estimates of future projects, reducing the average error in forecast costs by 20% between 2000 and 2009.[28]

Include airport capacity in future National Infrastructure Assessments and devolve powers and funding to cities to pursue ambitious, integrated strategies for transport, employment and housing and to create thriving areas and communities.

Why? To promote growth that is felt in all parts of the country, these strategies must be delivered by local areas and integrated across air, road and rail to ensure efficient investment. However, airport capacity needs to be included in the NIC's remit for this to be achieved.

Incentivise the uptake of offsite manufacturing for construction to deliver better infrastructure and drive productivity through procurement, regulation and R&D funding, building on the Construction Sector Deal.

Why? 20% reduction in delivery schedule in the construction of the Royal Victoria Building, Western General Hospital in Edinburgh, through the offsite production of 55% of building components.[29]

WHY?

Decisions we make about our infrastructure now will sustain us for decades to come. High-performing infrastructure is a central pillar of any world-class economy, and investing in infrastructure improves productivity, collective wellbeing, social inclusivity, healthy lifestyle choices, and national safety and resilience.

The National Infrastructure Commission (NIC) was established in 2015 to provide **independent strategic thinking**, **analysis** and **advice** to address the UK's long-term infrastructure needs.

11th

UK ranking in the overall quality of infrastructure in 2017.[25]

Every £1 spent on infrastructure in the UK is worth **£2.84 in economic output**.[26]

Energy and climate change

Deliver on the UK's ambitious climate change goals by investing in demonstration and deployment of new low-carbon heat, charging of electric vehicles and carbon capture and storage technologies.

- **Invest in large-scale demonstration for heat technologies** such as district heat networks, heat pumps and heat recovery to support their scale up.

  Why? 85% of UK households and 65% of non-domestic buildings currently use fossil-fuel based natural gas.[33]

- **Roll out of charging infrastructure for electric vehicles** in urban and rural areas to encourage their uptake and meet consumer demand, subsidising where the private sector is less likely to deliver.

  Why? Only a 2% reduction in UK carbon emissions in transport between 1990 and 2017, compared to 60% in electricity supply.[34]

- **Support the large-scale demonstration of carbon capture, usage and storage (CCUS)**, particularly in energy-intensive industries and the development of shared infrastructure, market frameworks and regulation.[35]

  Why? CCUS is crucial for achieving net-zero emissions and limiting global average temperature increases to 1.5°C, yet there are currently no large-scale UK CCUS pilots compared to 43 projects currently around the world.[36]

- **Increase investment in whole-system, large-scale integrated multi-technology pilots** of low-carbon technologies to establish how technologies, consumer behaviour, and financial mechanisms can be integrated in real-world situations, through programmes similar to the ISCF's *Prospering from the energy revolution* programme.[37]

  Why? The interconnectedness of the energy system means that failure to take a system-wide view risks creating undesirable knock-on effects in other sectors and excluding important and more efficient solutions.[38]

WHY?

The UK is not on track to meet its 2050 greenhouse gas emissions target. While excellent progress continues to be made in electricity generation, bold action is needed in heat and transport.

42%
– reduction in annual UK greenhouse emissions since 1990, with a target of 57% by 2030 and net-zero by 2050.[30]

75%
of emissions reductions since 2012 have come from electricity supply.[31]

Many of the technologies needed to decarbonise energy already exist but urgently require investment to bring about their large-scale testing and deployment.[32]

References

1 State of Engineering 2018, Engineering UK, 2018. Data from 2019 Excel resource.
2 Engineering skills for the future: the 2013 Perkins Review revisited, Education for Engineering and Royal Academy of Engineering, 2019.
3 State of Engineering 2018, Engineering UK, 2018.
4 *Ibid.*
5 Shortage Occupation List, Home Office.
6 Long-run comparisons of spending per pupil across different stages of education, IFS, 2018.
7 Engineering Brand Monitor, EngineeringUK, 2019 (forthcoming).
8 Business leaders finally getting to grips with apprenticeship levy, Institute of Directors, 5 December 2018.
9 The Apprenticeship Levy: one year on, the Open University, April 2018.
10 State of Engineering 2018, Engineering UK, 2018.
11 The UK STEM Education landscape, Royal Academy of Engineering, 2015.
12 Innovation Report 2014: Innovation, Research and Growth, Department for Business Innovation and Skills, 2014.
13 10 years shaping the future, Innovate UK, 2017.
14 The Economic Significance of the UK Science Base: a report for the Campaign for Science and Engineering, Haskel J, Hughes A, Bascavusoglu-Moreau E, 2014.
15 Delivery Plan 2017-18: shaping the future, Innovate UK, 2017 (p.32). Notes: budget allocation exclusively to Open programmes, excluding Eurostars, KTPs.
16 Increasing R&D investment: business perspectives, Royal Academy of Engineering, 2018.
17 It's Learning, Just Not as We Know it, Accenture, 2018.
18 Growing the artificial intelligence industry in the UK, Professor Dame Wendy Hall and Jérôme Pesenti Review, 2017.
19 Made Smarter Review 2017, Professor Juergen Maier, 2017.
20 £12 billion: the cost of internet downtime to UK businesses, Beaming, 2018
21 *Ibid.*
22 The changing nature of R&D, CBI and University of Leeds, 2019.
23 Tech Nation 2017, Tech City, 2017.
24 Women in Technology, PWC, 2018
25 The Global Competitiveness Report 2017-2018, Klaus Schwab and World Economic Forum, 2017.
26 National Infrastructure Plan, HM Treasury, 2014.
27 The effect of the size and the mix of public spending on growth and inequality, OECD, 2016.
28 Post Opening Project Evaluation (POPE) of Major Schemes, Highways England, 2015.
29 Offsite manufacture for construction: building for change, House of Lords Science and Technology Select Committee, July 2018, HL 169 2017-19.
30 Final UK greenhouse gas emissions national statistics: 1990-2017, Office for National Statistics, 2019.
31 Reducing UK emissions - 2018 Progress report to Parliament, Committee on Climate Change, 2018.
32 Written evidence submitted by the Royal Academy of Engineering (cross-engineering sector response) to inquiry on technologies for meeting Clean Growth emissions reduction targets, House of Commons Science and Technology Select Committee, December 2018.
33 Clean Growth: Transforming Heating, Department for Business, Energy and Industrial Strategy, 2018.
34 2017 UK Greenhouse Gas Emissions, Department for Business, Energy and Industrial Strategy, 2019.
35 Transitioning to hydrogen: assessing the engineering risks and uncertainties, The IET in partnership with IChemE, IGEM, IMechE and HSL, 2019.
36 Net Zero - The UK's contribution to stopping global warming, Committee on Climate Change, 2019.
37 Prospering from the energy revolution, Innovate UK, 14 May 2018.
38 Net Zero - The UK's contribution to stopping global warming, Committee on Climate Change, 2019.

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The **National Engineering Policy Centre** connects policymakers with critical engineering expertise to inform and respond to policy issues of national importance, giving policymakers a route to advice from across the whole profession, and the profession a unified voice on shared challenges.

The Centre is an ambitious partnership, led by the Royal Academy of Engineering, between 39 different UK engineering organisations representing 450,000 engineers. Our ambition is that the National Engineering Policy Centre will be a trusted partner for policymakers, enabling them to access excellent engineering expertise, for social and economic benefit.

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