Invest 2035: The UK's Modern Industrial Strategy

Consultation Response

Additional information

To drive productivity and economic growth, we need long-term investment in research and development (R&D), infrastructure, and skills development. Engineering is central to this vision, as it underpins all eight growth sectors, making it crucial for the UK's long-term development and global competitiveness. To grow and become more productive, we need both fresh ideas and a willingness to embrace new approaches across all sectors. While investing in R&D can help generate ideas, the 5.5 million businesses in the UK—the majority of which are SMEs—will need support to adopt and take advantage of new technologies. Economic growth cannot rely solely on those already investing in R&D. The government plays a vital role in creating an environment where businesses can thrive, including balanced tax and regulation, robust infrastructure, and strong trade relationships.

Furthermore, with the majority of the 2035 workforce already employed, targeted investment in upskilling the existing workforce, as well as preparing those entering the job market, will be essential to ensure they can adopt new technologies and drive productivity and national growth. An ageing population coupled with general border tightening underlines the need for 'quality over quantity' of jobs in the UK workforce. Prioritising investment in engineering talent is essential to raise productivity. Achieving this vision requires a National Engineering and Technology Workforce Strategy to develop a highly skilled workforce equipped to meet demands. With world-leading universities, modern infrastructure, and a commitment to high-quality innovation, this strategy would ensure the UK remains competitive in global markets, drives sustainable growth, and supports the rebalancing of the economy.

Headline message: Engineering underpins the goals of the Industrial Strategy, but the UK already needs 124,000 new engineers and technicians annually to meet current projected demand. To promote growth and boost productivity, the White Paper must therefore include a National Engineering and Technology Workforce Strategy to address this shortage, while taking a systems thinking approach to invest in engineering infrastructure and clusters.

Key takeaways:

1. **Engineering as a foundational sector**
   Engineering not only underpins each of the eight growth sectors but is essential to their development. Technology development, investment and productivity improvements are engineering-related topics that will be important to ensure growth is achieved.

2. **Need for a National Engineering and Technology Workforce Strategy**
   To address the demands of the Industrial Strategy, we strongly advocate for a comprehensive National Engineering and Technology Workforce Strategy. This is vital to ensuring that the UK has a robust pipeline of skilled engineers and technicians who are prepared to lead progress in the sustainable development and innovation needed to deliver the government's goals, including for growth sectors and missions.

3. **Incorporation of systems thinking**
   Integrating systems thinking within the Industrial Strategy is essential for effective

problem-solving and implementation. A systems approach would enable coordinated, scalable and sustainable solutions across industries, strengthening the UK's global competitiveness.

4. **Investing in infrastructure and clusters**
   Large-scale demonstration and test facilities have proven successful in advancing high-integrity engineering solutions, especially when co-located with industry clusters. These sites are places where innovative ideas and approaches can be introduced and showcased to validate and support scale up. This proximity enables faster, more efficient development by bringing together all players in the value chain; an approach that we believe should be prioritised.

5. **Commitment to a long-term strategic policy**

   To ensure sustainable growth and productivity increases, the UK government must prioritise long-term strategic policy decisions and leverage government tools to better align with the growth sectors. By using policy levers such as government procurement, financing mechanisms, education and skills development and regulatory frameworks, the government can create a supportive ecosystem that nurtures innovation and fosters investment. This alignment is essential for providing stability and direction to industry sectors, enabling businesses to plan confidently for the future, and ensuring that the UK remains competitive on a global stage.

A Modern Industrial Strategy

1. How should the UK government identify the most important subsectors for delivering our objectives?

The UK government should focus on subsectors that directly align with Net Zero goals, national security and energy security, whilst simultaneously delivering long-term sustainable growth, inclusive regional and local growth, high-quality employment, and a well-adapted, climate-resilient UK. As economic security is equally as important, this should focus on subsectors where the nation has existing and emerging strengths, is world leading, or has the potential to be world leading and the capability to do more.

Engineering sectors, for example, contribute £646 bn to the economy, showing high job growth and lower turnover rates in the future. [1,2] With a well-targeted industrial strategy, we feel there is great potential for this contribution to the economy to grow. High-value industries linked to strong investment in research and the building of relevant technical and engineering skills and capabilities in the UK should be prioritised.

Opportunities for collaboration between subsectors, across sectors, and internationally should be recognised and incentivised, particularly when they are interconnected and have overlapping needs for skills, competencies and capabilities. For example, in life sciences, life changing drugs require advanced manufacturing and a highly digitalised traceable supply chain, and must deliver outcomes efficiently and sustainably, while meeting clean energy and waste reduction requirements.

2. How should the UK government account for emerging sectors and technologies for which conventional data sources are less appropriate?

To future-proof its strategy, the UK government should form strategic partnerships with national academies and Professional Engineering Institutions (PEIs) with global footprints to convene stakeholders from both the domestic and global science and engineering community. Engaging with global PEIs, such as the Institution of Mechanical Engineers, offers access to sectoral expertise and continuous updates on industry shifts, enabling the government to forecast and support emerging fields more accurately. Additionally, PEIs have significant representation within universities and research institutions where emerging technologies and innovation can occur. PEIs are already advancing workforce skills in emerging technologies, which could provide valuable guidance on curriculum development, skills forecasting and reskilling programmes. Ensuring this goes beyond the engineering workforce to improve broader technological literacy is essential to boosting productivity in the long-term.

Prioritising technology requires a thorough, systematic approach to research and analysis. The UK government can learn from businesses that excel in detailed assessments, by collaborating with industry partners. Effective analysis must consider international competition and cooperation; evaluating how other nations position themselves in key technology areas. Conventional data sources should be complemented by insights from real-time industry reports, allowing the government to monitor developments as they arise. The government should improve its international intelligence analysis by working with academia, industry

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[1] Royal Academy of Engineering. (2023). *Engineering Economy and Place.* https://raeng.org.uk/eep

[2] World Economic Forum. (2023). *The Future of Jobs Report 2023.* https://www.weforum.org/publications/the-future-of-jobs-report-2023/

partners and tech incubators, and look to establish an 'emerging technologies observatory' as a core internal capability within government for agile policymaking.

This could support the government to benchmark other nations' approaches and leverage their learnings to prioritise potential high-growth investments. China's New Energy Vehicle (NEV) programme has helped them to dominate the electric vehicle transition globally by securing resources, building supply chains and creating jobs to ensure its delivery. [3] However, conventional data sources may not have indicated this at the outset.

3. How should the UK government incorporate foundational sectors and value chains into this analysis?

Foundational sectors will be varied, may overlap and be interdependent, and are likely critical to multiple growth sectors. Engineering underpins many aspects of the UK economy, from sectors like manufacturing and energy, to less obvious sectors like healthcare and the arts. This positions engineering as a foundational sector that will impact every growth sector in some way. Historically, the UK has been at the forefront of industrial revolutions due to its world-class engineering and manufacturing heritage—a reputation which persists today—as well as being a global leader in technological innovation and advanced manufacturing. Looking ahead to 2035, leveraging the engineering foundational sector to boost the economy will be critical, given it contributes £645 bn annually to the UK economy and accounts for 32% of the total economic output across 729,000 engineering businesses. [4] Investment in engineers has a strong multiplier effect, stimulating economic activity beyond the sector itself; EngineeringUK estimates that for every £1 invested in engineering, £1.45 is generated in output. [5]

Within their analysis, the government should consider the security of supply chains, including access to affordable raw materials and minerals. The UK relies heavily on materials mined abroad and on specialised technological components that are not produced domestically. [6] Recent supply chain disruptions have intensified concerns over the rising demand for 'critical' materials, as projections indicate that future needs may surpass available resources. The demand for these materials should be monitored and planned for when considering infrastructure and technology planning. There should be a promotion of circular economy principles to ensure materials can be recovered, reused or recycled. The UK has an opportunity to become a leader here, reducing our reliance on an increasingly challenging international market and ensuring we achieve sustainability goals. [7] With this, a cross-government materials strategy should be developed, covering materials beyond those deemed 'critical' in the government's current Critical Minerals Strategy and reducing siloes between government departments by connecting policies on recycling and waste, trade, national risk and the

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[3] Tian, J., Wang, P., & Zhu, D. (2024). Overview of Chinese new energy vehicle industry and policy development. *Green Energy and Resources, 2*(2). https://doi.org/10.1016/j.gerr.2024.100075

[4] Royal Academy of Engineering. (2022, November 4*). A hotbed of innovation: New research reveals engineering adds up to an estimated £645bn to the UKs economy.* https://raeng.org.uk/news/a-hotbed-of-innovation-new-research-reveals-engineering-adds-up-to-an-estimated-645bn-to-the-uk-s-economy-annually

[5] EngineeringUK. (2018). *EngineeringUK 2018: The state of engineering*.https://www.engineeringuk.com/media/156187/state-of-engineering-report-2018.pdf

[6] National Engineering Policy Centre. (2024). *Critical Materials: demand-side resource efficiency measures for sustainability and resilience.* https://nepc.raeng.org.uk/media/qutgamxj/nepc-critical-materials-report.pdf

[7] Institution of Mechanical Engineers. (2024). *Engineering Policy Priorities for the 2024-29 UK Parliament*. https://www.imeche.org/policy-and-press/reports/detail/engineering-policy-priorities-for-the-2024-2029-uk-parliament

Industrial Strategy.[8] Collation and publication of material flow data should be prioritised as part of this work.

An important consideration for the Industrial Strategy will be whether the market's response to domestic policies align with global development goals. For example, if the market is driven to offshore carbon-heavy activities, the overall effect could be increased global emissions. This will require analysis of government interventions in both the development and widespread adoption of technologies.

As part of the Budget, the Chancellor announced an investment of £20.4 bn in research and development for next year, which is welcomed.[9] However, there is an opportunity to align this funding with growth sectors, with a particular focus on those that require significant capital investment in the development and deployment stages, whilst maintaining 'blue skies research'. This should be coupled with policies that encourage cross-sector collaboration, skills development and the adoption of emerging technologies to ensure that the increased funding translates into tangible benefits for the UK's industrial landscape.

Our growth-driving sectors

4. What are the most important subsectors and technologies that the UK government should focus on and why?

Engineering is a foundational sector that underpins all eight growth sectors, meaning engineers are vital to the delivery of the Industrial Strategy. Engineers comprise 19% of jobs and the engineering economy contributes 32% of total economic output in the UK.[10,11] The Industrial Strategy should emphasise the role of engineers across growth sectors and boost the supply of engineers to meet current and future demand. The World Economic Forum reports technology, digitisation and sustainability as drivers of the fastest growing jobs, with net growth in jobs across virtually all engineering disciplines.[12] The UK is globally competitive in many subsectors that have roots in engineering (e.g. aerospace and automotive) and has the potential to be a global leader in others—AI, simulation, battery technology/recycling, low-carbon technologies, and carbon capture. Below are some examples of the impact of engineers and important subsectors within the growth sectors:

- **Advanced manufacturing** – Engineers are central to delivering and revolutionising the manufacturing sector, using automation and cutting-edge technologies to adapt processes and improve efficiencies. EngineeringUK reported around 36% of people working in engineering in the UK in 2021 worked in manufacturing.[13] The advanced manufacturing definition should emphasise the processes and technologies involved in creating products, rather than just the end product itself. It encompasses the integration

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[8] HM Government. (2022). *Resilience for the Future: The United Kingdom's Critical Minerals Strategy.* https://www.gov.uk/government/publications/uk-critical-mineral-strategy

[9] Department for Science, Innovation and Technology. (2024, October 31). *Government backs UK R&D with record £20.4 billion investment at Autumn Budget.* https://www.gov.uk/government/news/government-backs-uk-rd-with-record-204-billion-investment-at-autumn-budget

[10] EngineeringUK. (2023). *Engineering skills needs – now and into the future.* https://www.engineeringuk.com/media/318944/engineering-skills-needs-now-and-into-the-future_report_fv.pdf

[11] Royal Academy of Engineering. (2023). *Engineering Economy and Place.* https://raeng.org.uk/eep

[12] World Economic Forum. (2023). *The Future of Jobs Report 2023.* https://www.weforum.org/publications/the-future-of-jobs-report-2023/

[13] EngineeringUK. (2022). *Trends in the engineering workforces: Between 2010 and 2021*. https://www.engineeringuk.com/media/318305/trends-in-the-engineering-workforce_engineeringuk_2022.pdf

of modern technologies, processes, and business practices at all stages of production. The New Zealand definition provides a useful perspective: "This includes both primary and non-primary sector manufacturing. The term "advanced" refers to the use of modern technologies, processes and business practices in the manufacturing process rather than whether the final products are high-tech." [14] A critical subsector is transport, which in turn will be vital in unlocking regional growth. The government should look to incorporate systems thinking to map the interdependencies of subsectors with wider goals.

- **Clean energy industries** – The decarbonisation of the energy sector will rely on engineering solutions, both new and existing. Mechanical engineers are already playing a leading role in clean energy technologies, such as wind turbines, hydrogen fuel cells, and electric vehicle powertrains. Additionally, engineers are developing less widely deployed technologies that could prove vital to our Net Zero journey like hydrogen combustion and e-fuels. By 2050, the energy sector must fill 400,000 roles, 65% of which are new jobs. [15] Alongside transport, a critical subsector to consider is power production, storage, distribution and transmission to reach Net Zero. Skilled engineers and technicians are needed for future data, technologies, renewables, grid infrastructure, installation and maintenance.
- **Creative industries** – Engineering contributes to the creative industry through technological advances such as AI, design-led engineering and conservation, and bringing architecture to life. [16] Concerts and other events would not be possible without the venues they are held in, which engineers work closely with architects to create. [17] Research and development (R&D) in the creative industries represented 11.5% of all business R&D in 2018. [18] Specific areas that the UK has the potential to be globally competitive, like simulation and virtual reality, should be targeted.
- **Defence** – Engineers help the UK maintain its technological and operational edge in the defence sector through innovation. As defence encompasses land, sea, air, space and cyberspace capabilities, several subsectors dominated by engineers will be of importance; particularly those that are key to national security. For example, the aerospace and automotive subsector is vital for integrated transport and power networks in the defence sector. Additionally, the UK is globally competitive in autonomy and cyber technologies that have become a differentiator in modern defence scenarios. In 2022, 43% of the UK defence sector's workforce was in STEM-related roles (engineer, scientist, researcher, technician and technologist). [19] A 2023 survey revealed

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[14] Ministry of Business, Innovation and Employment. (n.d.). *Advanced Manufacturing*. https://www.mbie.govt.nz/business-and-employment/economic-development/industry-transformation-plans/advanced-manufacturing

[15] EngineeringUK. (2024). *Net zero workforce: An analysis of existing research*. https://www.engineeringuk.com/media/ukob05gg/net-zero-workforce-engineeringuk-may-24.pdf

[16] Council for Science and Technology. (2023, October 5). *Harnessing Research and Development in the UK Creative Industries*. https://assets.publishing.service.gov.uk/media/652fc7ac92895c0010dcb980/Harnessing_Research_and_Development_in_the_UK_Creative_Industries.pdf

[17] Institution of Mechanical Engineers. (2024). *Engineering Better Sports Venues.* https://www.imeche.org/policy-and-press/reports/detail/engineering-better-sports-venues

[18] Creative Industries Policy and Evidence Centre. (2022, June 28). *National Statistics on the Creative Industries.* https://pec.ac.uk/news_entries/national-statistics-on-the-creative-industries/

[19] Joint Economic Data Hub. (2024). *2024 Annual Economic Report*. https://jedhub.org/docs/2024/20242904_JEDHub_Annual_Economic_Report_2024_v1.0.pdf

engineering skills as the leading shortage reported by almost half of the 80 defence sector organisations that participated. [20]

- **Digital and technology** – Engineers are leaders in technological advancements and digitalisation, which cut across growth sectors. EngineeringUK reported 12.9% of the UK workforce were in engineering and technology roles within the engineering industry and another 6.2% worked in these roles in other industries. [21]
- **Financial services** – Financial services are enabled by digital information and technologies like AI, data and software to support financial modelling and forecasting, management and planning. Many engineering graduates also end up working in the finance sector as they have both the technical and problem-solving skills required—6.22% of engineering graduates going into business, banking and finance in 2018. [22]
- **Life sciences** – Engineers, working in the field of biomedical engineering, will be essential to delivering a Net Zero NHS that is fit for the future as they help to develop and maintain the machines, materials and more that are crucial for the sector. There are currently not enough engineers working in the NHS to maintain technologies and achieve sustainability goals, with the research showing the workforce must grow by 44%. [23] Engineers are also needed to develop and mass produce new drugs or vaccines, improve surgical procedures and advance prosthetics innovation. For example, Alice Kan at Kan Do Ventures developed the manufacturing process for the Oxford-AZ COVID-19 vaccine at an unprecedented pace to deliver all 100 million doses for the UK.
- **Professional and business services (PBS)** – This sector includes a range of knowledge intensive industries like legal, audit, accountancy, human resource, architecture and engineering services, as well as support functions such as call centres and other business support services. The third highest proportion of jobs in Great Britain's PBS sector are from architectural and engineering activities, even excluding scientific R&D. [24] Innovation in the PBS sector, like new data or management systems, automation and the use of AI, relies on engineers.

Infrastructure more broadly underpins all growth sectors and engineering contributes to this in various ways, including construction, data or control centres, and heating/cooling infrastructure. For example, 21.8% of the UK's engineering industry worked in construction in 2021. [25] In utilities such as water, engineers are essential for the sector to overcome current and future challenges, including a changing climate and increasing population. Solutions that

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[20] Defence Online. (2024). *Delivering the Defence Workforce of the Future*. https://www.defenceonline.co.uk/2024/01/24/employment-trends-in-defence-new-research-launched/
[21] EngineeringUK. (2024). *The engineering and technology workforce*. https://www.engineeringuk.com/media/eqnhrz1l/the-engineering-and-technology-workforce-update-engineeringuk-october-2024.pdf
[22] Engineering Construction Industry Training Board. (2018). *Engineering today: The supply and demand for engineers in the UK*. https://www.ecitb.org.uk/wp-content/uploads/2018/12/EC03-ECITB-ET-Report-FINAL-23.01.18-1.pdf
[23] Institution of Mechanical Engineers. (2024). *Transforming healthcare: The role of engineering in delivering a Net Zero health service*. https://www.imeche.org/docs/default-source/1-oscar/reports-policy-statements-and-documents/transforming_healthcare_2024_report_digital-dpg.pdf
[24] Department for Business, Energy and Industrial Strategy. (2020). *Professional & Business Services sector Creating further demand and growth outside London*.https://assets.publishing.service.gov.uk/media/5e4aa8e5e5274a6d2f754f09/professional-business-services-sector-growth-outside-london.pdf
[25] EngineeringUK. (2022). *Trends in the engineering workforces: Between 2010 and 2021*. https://www.engineeringuk.com/media/318305/trends-in-the-engineering-workforce_engineeringuk_2022.pdf

integrate cutting-edge technologies with legacy infrastructure to produce robust and safe water supplies and waste treatment will not be realised without engineers.

5. What are the UK's strengths and capabilities in these subsectors?

The UK's world-leading engineering heritage from the Industrial Revolution through to cutting-edge developments in aerospace, automotive and energy sectors highlight engineering's many strengths. Over time, this has fostered the UK's world-class engineering and manufacturing capabilities and has driven the establishment of industrial clusters that are hubs for engineering innovation. These engineering hotspots should be targeted to compound regional growth. For example, areas in the UK like Aberdeenshire and the Midlands where between 1 in 3 and 1 in 2 adults are employed in the engineering economy, may overlap with high potential regions identified by the Industrial Strategy (e.g. West Midlands) so investment in these intersecting regions could compound growth. [26] Leveraging the significant export potential for engineering services and products will be important. Manufacturing contributes £217 bn to economic output in the UK and on average provides better paid jobs than the whole economy. [27] Automotive and aerospace and other transport showed the highest growth in 2023. Whilst remaining in the top 15 largest manufacturing economies, the UK has slipped from 9th in 2011 to 12th in 2022, falling behind Germany, South Korea, Mexico, France and Italy. This must be rectified through targeted investment for advanced manufacturing and leveraging our position outside of the EU to benefit the economy.

The UK is also home to many of the world's leading universities, research hubs and professional bodies, which produce highly skilled engineers, offering a strong foundation for cutting-edge sustainable technology development. Graduates with engineering and technology backgrounds tend to report better employment outcomes than those from other subjects; 72.5% reported being in work following graduation compared to 69.7% of graduates from all other subjects. [28] Research and development (R&D) is strong in the UK with output increasing annually but innovation scale-up is poor. [29] This infrastructure within UK universities attracts £21.7 bn of national and international public funds to invest into research done collaboratively with businesses and non-academic organisations. [30]

The combination of our world-class engineering and educational institutions has nurtured strengths in innovation in the UK, despite financial systems not providing the ideal environment for long term investment and value. Ongoing government investments in R&D, innovation (e.g. UK Research and Innovation grants, scale-up and demonstration facilities like the UK Battery Industrialisation Centre, and Connected and Automated Mobility testbeds), and sustainability (e.g. Net Zero goals) is needed. Alongside greater private investment with an improved

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[26] Royal Academy of Engineering. (2022, November 4*). A hotbed of innovation: New research reveals engineering adds up to an estimated £645bn to the UKs economy.* https://raeng.org.uk/news/a-hotbed-of-innovation-new-research-reveals-engineering-adds-up-to-an-estimated-645bn-to-the-uk-s-economy-annually

[27] Make UK. (2024). *UK Manufacturing: The Facts 2024.* https://www.makeuk.org/insights/publications/uk-manufacturing-the-facts-2024

[28] EngineeringUK. (2024). *Graduate outcomes – engineering and technology.* https://www.engineeringuk.com/media/vrgfi2yo/hesa-graduate-outcomes-engineering-and-technology-fv-engineeringuk-march-24.pdf

[29] Atherton, G., Lewis, J., & Bolton, P. (2024). Higher education around the world: Comparing international approaches and performance with the UK. *House of Commons Library.* https://commonslibrary.parliament.uk/research-briefings/cbp-9840/

[30] Atherton, G., Lewis, J., & Bolton, P. (2024). Higher education in the UK: Systems, policy approaches, and challenges. *House of Commons Library.* https://commonslibrary.parliament.uk/research-briefings/cbp-9640/

understanding of the innovation cycle, this will support the mechanical engineering profession's ability to drive forward technologies across the growth sectors but particularly within manufacturing, energy and infrastructure.

6. What are the key enablers and barriers to growth in these subsectors and how could the UK government address them?

Enablers:

- **Consistent long-term strategic direction:** It takes time to harness growth through science and technology; return on investments must wait for new discoveries to be commercialised, new industries to grow, and existing industries to adopt new innovations. The UK government can enable growth by providing a consistent long-term strategic direction with stable budget commitment to provide certainty for growth sectors to flourish. This should align strategies and objectives, and build on successful existing initiatives, institutions and infrastructure. Cross-party support is essential to reduce the impact of political cycles on prioritisation and funding of initiatives, as well as coherent and sustained policies that align levers including regulation, skills, finance and innovation. UK government organisations currently lack coherence, which results in frustrating and fragmented engagement for engineers and engineering companies. Addressing this will require extensive engagement and alignment across government organisations and with industry, championed by capable leaders.
- **Agility:** Within a long-term strategy, the UK needs to be able to act at pace and shift priorities when needed, without compromising the long-term goal. This agility will require expertise to assess when changes are needed to make the most of newly emerging opportunities, address new threats, deploy resources well, operate at timescales that work for business, fail fast, and compete globally.
- **Strong research and development (R&D) infrastructure:** Continued investment in R&D (public and private) is critical. This includes via UK Research and Innovation, quality-related research funding, additional funding from government departments or agencies (e.g. Advanced Research and Invention Agency), as well as from other sources like charities or industry.
- **Collaboration between academia, industry, and government:** Partnership is key to the UK's success to date. Academia, industry and government networks help to identify the needs of different stakeholders and practical opportunities to progress shared goals, as well as provide access to extensive expertise to inform decision-making. Therefore, initiatives to optimise existing networks (like public sector research organisations and the Catapult Network) and foster more public-to-private partnerships and collaborations between universities and industry would accelerate the commercialisation of new technologies. Previous success can be seen where governments and industry have collaborated via formal growth partnerships, e.g. the Aerospace Growth Partnership. A 'connect-and-convene' approach is preferable to foster reciprocal relationships where all parties have a sense of ownership and commitment.
- **National Engineering and Technology Workforce Strategy**: Success of an industrial strategy across the growth sectors is dependent on having enough adequately trained engineers, but the UK is experiencing an engineering skills shortage that is expected to worsen over time (discussed as a barrier further below). To maintain leadership in

emerging and foundational sectors and develop, attract, and retain adequate engineering talent, the UK needs a coherent, long-term workforce strategy. This could include promoting STEM careers in schools, ensuring employers have access to and providing incentives for high quality funded engineering apprenticeships and degrees, and creating clearer pathways for engineers into high-growth industries. Other initiatives could look to expand engineering education and training, enhance visa schemes for international talent, and encourage diversity in the engineering workforce. UK trained engineers are highly employable internationally; over a third of the UK's STEM graduates in 2015/16 were employed abroad six months after graduating. [31] By ensuring our curriculum incorporates systems thinking approaches to address global sustainability challenges, there is the potential to shape international practice for global benefit.

- **International talent:** International students contribute over £40 bn to the UK economy annually. [32] Additionally, international students in UK universities are a vital part of our domestic skills strategy for engineering and broader STEM courses. Over a quarter of entrants studying mechanical engineering in higher education in the 2021-2022 academic year were international students. [33] This indicates international students contribute significantly to mechanical engineering course costs for universities, particularly as their fees are higher than domestic students—some universities even looking to international students to plug budget deficits. [34] For context, in 2019, engineering and technology subjects cost universities an estimated £11,394 per student per year on average to run. [35] Attracting international talent also enables industry to plug skills gaps in the short-to-medium term. As of 2021, 18.5% of total employees working in engineering occupations were born outside of the UK (figure derived). [36] International R&D collaboration and investment is also key to enabling growth as one quarter (£15.5 bn in 2023) of the UK's R&D expenditure by businesses comes from those with overseas ownership. [37]

Barriers:

- **Shortage of skilled engineers and technicians:** There is an urgent need to address the shortage of engineers and technicians in the UK, which will only be exacerbated by increased demand in emerging fields and global economic and geopolitical pressures. Immediate action should include development of a National Engineering and

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[31] Higher Education Statistics Agency. (2017, August 29). *Recent UK Graduates Now Working in 173 Countries*. https://www.hesa.ac.uk/insight/29-08-2017/uk-graduates-in-173-countries#DLHE_info

[32] Hillman, N. (2024, June 20). New constituency-level data prove the value of international students to the UK. *Higher Education Policy Institute*. https://www.hepi.ac.uk/2024/06/20/new-constituency-level-data-prove-the-value-of-international-students-to-the-uk/

[33] EngineeringUK. (2023). *Engineering in higher education*. https://www.engineeringuk.com/research-policy/educational-pathways-into-engineering/higher-education/

[34] UK Parliament. (2024, April 26). *MPs to investigate universities' funding reliance on international students*. https://committees.parliament.uk/committee/203/education-committee/news/201068/mps-to-investigate-universities-funding-reliance-on-international-students/

[35] Department for Education. (2019). *Understanding costs of undergraduate provision in Higher Education: Costing study report*. https://assets.publishing.service.gov.uk/media/5f356650e90e0732e4bd8c79/Understanding_costs_of_undergraduate_provision_in_higher_education.pdf

[36] EngineeringUK. (2022). *Trends in the engineering workforces: Between 2010 and 2021*. https://www.engineeringuk.com/media/318305/trends-in-the-engineering-workforce_engineeringuk_2022.pdf

[37] National Centre for Universities and Business. (2023). *Attracting international investment in Research & Development (R&D)*. https://www.ncub.co.uk/wp-content/uploads/2021/07/Attracting-international-investment-in-Research-Development.pdf

Technology Workforce Strategy as well as analysis of factors contributing to a lack of training within industry.

- The UK needs 124,000 new engineers and technicians annually to meet demand, but projected shortfalls are between 37,000 and 59,000. [38] According to the Institution for Engineering and Technology, the low-carbon energy sector will need 400,000 new workers by 2050 to achieve Net Zero targets, the majority of whom will require engineering qualifications. In the buildings sector, 45,000 technicians each year must be trained to meet retrofitting demand. [39]
- Only 9.3% of tertiary graduates in the UK gain qualifications in the field of engineering, manufacturing and construction – seventh lowest in the OECD. [40] The greatest skills gap and shortages are for level 4 and 5 qualifications, which include foundation degrees and higher apprenticeships; despite high employer demand, only 4% of people in the UK gain these qualifications by age 25. [41]
- 63% of UK engineering employers surveyed in 2023 thought the education system did not prepare graduates for the industry. [42] Yet there is a lack of investment in upskilling and reskilling in critical areas, with the UK reportedly the least likely to offer training in new technologies and manufacturing sectors compared to international counterparts.

- **Lack of sustained patient capital:** Many engineering-driven innovations that will support growth sectors require sustained, patient capital, which the UK currently lacks. Emerging technologies often require significant upfront investment and long development timelines. The UK's business investment consistently ranks lower than every other G7 country and has so for 24 of the last 30 years. [43] The last time the UK was 'average' in G7 total investment was in 1990. The Industrial Strategy should look to understand the extent to which this is caused by lack of cash, short-termism, tax treatment, poor understanding by investors, weighted average cost of capital, or investment criteria.
    - The most effective government initiatives to commercialise innovation should be continued (e.g. Catapults). Underperforming schemes should be reviewed and more effective initiatives created to ensure the full commercial potential of UK innovation is realised. For example, innovation hubs enable evaluation of technology start-ups and facilitate their growth through private sector investment and fostering relationships with industry partners. While effective, existing or new networks that are supported by government could be more targeted to deliver on the Industrial Strategy.

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[38] EngineeringUK. (2022). *EngineeringUK response: The Net Zero Review.* https://www.engineeringuk.com/media/318645/net-zero-review-october-2022-enguk-final.pdf
[39] EngineeringUK. (2024). *Net zero workforce: An analysis of existing research.* https://www.engineeringuk.com/media/ukob05gg/net-zero-workforce-engineeringuk-may-24.pdf
[40] Organisation for Economic Co-operation and Development. (2024). *United Kingdom: Overview of the education system.* https://gpseducation.oecd.org/CountryProfile?primaryCountry=GBR&treshold=10&topic=EO
[41] Department for Education. (2024). *Skills England: Driving growth and widening opportunities.* https://assets.publishing.service.gov.uk/media/66ffd4fce84ae1fd8592ee37/Skills_England_Report.pdf
[42] The Institution of Engineering and Technology. (2023). *IET sustainability skills survey: 2023 summary.* https://www.theiet.org/media/zeoid452/sustainability-skills-survey-2023-summary.pdf
[43] Institute for Public Policy Research. (2024). *Rock bottom: Low investment in the UK economy.* https://ippr-org.files.svdcdn.com/production/Downloads/Rock_bottom_June24_2024-06-18-081624_arsv.pdf

    - Initiatives to reduce the overlap between similar projects funded in parallel could increase the return on investment as new projects can better leverage learnings from similar ones that have been done before.
- **Poor leadership and capability:** The variable leadership capability across the UK has resulted in low productivity and slow progress in adopting new technologies. UK businesses have lower management quality than the USA, Germany and Sweden, which is linked to lower productivity. [44] Substantial improvement in basic performance is needed before they can take on transformational technology. The Manufacturer MX Awards demonstrate that this can be done across all sectors with the right backing. [45] Trusted and capable leadership from government is needed, supported by expert non-political leaders. Each must have a good understanding of their respective sector and be empowered to make decisions, deploy resources, and accept and learn from failures. Building the science, engineering and technology capability within the UK's civil service and greater partnership between the government and Professional Engineering Institutions with global expertise will help to improve leadership and capability.

Creating a Pro-Business Environment

7. What are the most significant barriers to investment? Do they vary across the growth-driving sectors? What evidence can you share to illustrate this?

Investment in the UK's key growth sectors faces several barriers, including challenges in talent acquisition, access to finance, research infrastructure and regional disparities. It is welcomed that the Green Paper acknowledges some of these. Inconsistent policy and a lack of strategic focus in recent years have limited investment—underscoring the need for a long-term industrial strategy. A well-defined strategy with clear priorities will not only signal demand but also set a strategic direction, enabling the UK to make informed choices about the outcomes and competitive advantages it aims to achieve. [46]

A shortage of skilled talent remains a persistent barrier, significantly impacting the growth sectors. Engineering skills and talent are crucial for bringing innovation to life and creating operational efficiencies. Nearly half (49%) of engineering businesses are experiencing difficulties in the skills available to them when trying to recruit. In clean energy alone, it is estimated that the UK will need to fill 400,000 roles by 2050, 260,000 of which will be new roles. [47] In the buildings sector, retrofitting will require the training of 45,000 technicians each year. This talent deficit discourages investment and growth, as firms require a skilled workforce to justify large-scale capital commitments.

Access to finance, particularly for the commercialisation of innovation and large engineering projects is another barrier. Engineers play a pivotal role in the commercialisation of research, serving as the bridge between innovative ideas and real-world applications. Their expertise in the development and deployment of new technologies ensures that research can be transformed into viable products and services that drive economic growth. Engineers bring

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[44] Department for Education. (2024). *Skills England: Driving growth and widening opportunities*. https://assets.publishing.service.gov.uk/media/66ffd4fce84ae1fd8592ee37/Skills_England_Report.pdf

[45] Institution of Mechanical Engineers. (n.d.). *The Manufacturer Mx Awards.* https://www.imeche.org/events/tmmx-awards

[46] National Engineering Policy Centre (2024) *Engineering a resilient and prosperous future: Policy priorities for the next UK parliament*. https://nepc.raeng.org.uk/media/3xodtwpq/engineering-a-resilient-and-prosperous-future.pdf

[47] EngineeringUK. (2024). *Net zero workforce: An analysis of existing research*. https://www.engineeringuk.com/media/ukob05gg/net-zero-workforce-engineeringuk-may-24.pdf

technical know-how, problem-solving skills, and practical implementation strategies that are essential for scaling innovations from the lab to the marketplace. However, they often struggle to secure sufficient financing due to perceived risks and longer timeframes for return on investment. This will be a particular barrier to the advanced manufacturing and clean energy growth sectors but will be present across all eight.

The lack of support for late-stage research and development limits the ability to test and validate new technologies at scale. In particular, large-scale demonstration sites and industrial testing facilities where innovative ideas and approaches can be introduced, showcased, verified and validated to support the scale-up process. Without these facilities, investors face heightened risks related to technology reliability and performance, which can dampen willingness to invest in innovative engineering projects. The National Engineering Policy Centre and the Institution of Mechanical Engineers have called for increased investment in demonstration facilities to enable faster commercialisation and mitigate investment risk by providing performance data for investors. This needs to be supported by viable domestic or export market opportunities for the technology being scaled. A good example is the UK Battery Industrialisation Centre, set up with government funding to pilot manufacturing technologies that are key to the gigafactories needed for electric vehicle (EV) batteries. [48] There then needs to be demand from a viable EV manufacturing market for the innovation to be successful.

The UK's heavy reliance on imported raw materials and specialised technological components leaves it vulnerable to supply chain disruptions, which have grown increasingly concerning as global demand for critical materials rises. Many of these essential resources, from rare minerals to advanced components, are sourced from abroad with limited domestic production capacity. Recent disruptions have highlighted the need for strategic planning to ensure the secure and sustainable supply of these materials. To address this, the UK must deliver on its Critical Minerals Strategy to support the Industrial Strategy. [49] Promotion of circular economy principles forms part of the solution, emphasising recovery, reuse, and recycling of materials, to reduce dependency on volatile international markets. By developing a cross-government materials strategy, covering materials beyond those deemed 'critical' in the current strategy, the UK can position itself as a leader in sustainable resource management, ensuring long-term resilience and advancing toward its sustainability goals.

Venture capital and private equity investors may be reluctant to invest in technologies that are more costly to bring to market due to higher risk and longer investment timeframes. [50] Government intervention may be needed alongside initiatives to close the knowledge gap between investors and innovators. There are pronounced regional disparities in access to venture capital, public funding and skilled engineering labour. These inequalities create barriers for companies seeking to invest in specific regions, often driving investment to London and the South East while leaving other regions under-resourced. [51]

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[48] UK Battery Industrialisation Centre. (n.d.). *Enabling battery technologies & developing skills*. https://www.ukbic.co.uk/

[49] HM Government. (2022). *Resilience for the Future: The United Kingdom's Critical Minerals Strategy.* https://www.gov.uk/government/publications/uk-critical-mineral-strategy

[50] European Investment Bank. (2018). *Financing the Deep Tech Revolution: How investors assess risks in Key Enabling Technologies (KETs)*. https://www.eib.org/attachments/pj/study_on_financing_the_deep_tech_revolution_en.pdf

[51] British Business Bank. (2024). *Small business equity tracker 2024.* https://www.british-business-bank.co.uk/about/research-and-publications/small-business-equity-tracker-2024

People and Skills

8. Where you identified barriers in response to Question 7 which relate to people and skills (including issues such as delivery of employment support, careers, and skills provision), what UK government policy solutions could best address these?

As we look towards 2035, it is important to recognise that most of that future workforce is already present in today's labour market. This reality highlights an urgent need for strategic investment in reskilling alongside support for those entering the workforce, equipping both current employees and new entrants to adapt to transformative technologies. This will empower individuals to drive performance at the company level while fostering economic growth on a national scale and is a powerful opportunity to secure a competitive and sustainable future.

A coherent skills programme across the UK is essential to streamline workforce development for industry, particularly regarding apprenticeships. By developing flexible, modular qualifications, workers will be able to continuously upskill as technologies advance, addressing the evolving needs of foundational sectors and to take advantage of emerging technologies.

Addressing the skills shortages in engineering to support all the growth sectors, but particularly advanced manufacturing and clean energy industries, will require targeted and proactive interventions. The urgency of this becomes evident from analysis indicating that over a third of UK vacancies in 2022 were due to skills shortages; a significant increase from 2013-2017 when skills shortage vacancies remained stable at around 22%. [52]

A National Engineering and Technology Workforce Strategy, developed in collaboration with industry in the growth sectors, is essential. This should take a strategic and joined up approach, working collaboratively with the devolved administrations to address UK-wide skills shortages, with influence nationally and regionally and at all stages of education. It should also address the gap in quality career provision, particularly in science, technology, engineering and mathematics (STEM) fields. Furthermore, the government must address the critical shortage of STEM teachers.

The strategy should also seek to improve diversity by encouraging participation from women, ethnic minorities and underrepresented groups to foster a more inclusive profession. As of 2023, women represented just 14% of the core engineering workforce in the UK, compared to 52% of the rest of the workforce. [53]

The greatest skills gap and shortages are for level 4 and 5 qualifications, which include foundation degrees and higher apprenticeships; despite high employer demand, only 4% of people in the UK gain these qualifications by age 25. [54] Strengthening apprenticeship and training programmes could help attract more qualified engineers into these critical fields. Skills England should ensure that the development of programmes are aligned with industry requirements, with employers working with delivery partners to provide the training required. A good example of this is the MIRA Technology Institute.

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[52] Department for Education. (2024). *Skills England: Driving growth and widening opportunities*. https://assets.publishing.service.gov.uk/media/66ffd4fce84ae1fd8592ee37/Skills_England_Report.pdf

[53] EngineeringUK. (2022). *Women in Engineering: Trends in women in the engineering workforce between 2010 and 2021*. https://www.engineeringuk.com/media/318036/women-in-engineering-report-extended-analysis-engineeringuk-march-2022.pdf

[54] Department for Education. (2024). *Skills England: Driving growth and widening opportunities*. https://assets.publishing.service.gov.uk/media/66ffd4fce84ae1fd8592ee37/Skills_England_Report.pdf

The strategy must emphasise lifelong learning and continuous professional development for engineers. Policies are required that encourage and incentivise ongoing training to ensure that the workforce remains at the forefront of technological advancements. This could be particularly important in the Net Zero transition as sectors like offshore oil and gas decline in the UK and offshore wind expands significantly. Furthermore, the lifelong learning entitlement represents a positive step forward in which eligible learners can access up to £37,000 in tuition fee loans, equivalent to 4 years of study at current fee rates. [55] Additional financial incentives may be beneficial to get people into further and higher education for careers that have been identified as vital to delivering the Industrial Strategy, like engineering. This has to be integrated into a broad and holistic skills system.

To align research and innovation with industrial needs, it is essential to strengthen collaboration between industry and academia. Expanding initiatives like the Catapult Network can drive projects that bridge foundational sectors and high-growth industries, fostering a mutually beneficial exchange of knowledge and resources. Emphasising interdisciplinary education by combining insights from various engineering fields will help develop engineers with the broad expertise required to optimise complex industrial processes.

Building strong partnerships with academia should not only involve large corporations but also engage smaller businesses, including solo enterprises, to ensure a diverse and inclusive approach. Additionally, while T Levels highlight the value of practical work placements, their low adoption rate among companies is concerning, as these experiences are essential to engineering training.

The UK has a relatively high proportion of STEM graduates. During the academic year 2021/22, 42% of all graduates in the UK completed STEM disciplines. However, the UK is producing fewer graduates in engineering, manufacturing and construction compared to other countries. In 2021, only 9.1% of UK graduates were in these fields, significantly lower than countries like Germany (22.1%), Korea (20.1%), and Japan (16.8%). [56] Recognising the role of international students in our domestic skills pipeline is crucial, as they are needed to support domestic degrees and the wider economy. International students contribute over £40 bn annually to the UK economy. [57] Over a quarter of entrants studying mechanical engineering in higher education in the 2021-2022 academic year were international students. [58] This indicates international students contribute significantly to mechanical engineering course costs for universities, particularly as their fees are higher than domestic students—some universities even looking to international students to plug budget deficits. [59] For context, in 2019, engineering and

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[55] Department for Education. (2024). *Lifelong Learning Entitlement overview.* https://www.gov.uk/government/publications/lifelong-learning-entitlement-lle-overview/lifelong-learning-entitlement-overview

[56] Cambridge Industrial Innovation Policy. (2024). *UK Innovation Report 2024.* https://www.ciip.group.cam.ac.uk/innovation/the-uk-innovation-report-2024/

[57] Universities UK. (2023, May 16). *International students boost UK economy by £41.9 billion.* https://www.universitiesuk.ac.uk/latest/news/international-students-boost-uk-economy

[58] EngineeringUK. (2023). *Engineering in higher education.* https://www.engineeringuk.com/research-policy/educational-pathways-into-engineering/higher-education/

[59] UK Parliament. (2024, April 26). *MPs to investigate universities' funding reliance on international students.* https://committees.parliament.uk/committee/203/education-committee/news/201068/mps-to-investigate-universities-funding-reliance-on-international-students/

technology subjects cost universities an estimated £11,394 per student per year on average to run. [60]

However, recent data indicates a negative trend in international students studying in the UK. Student visa applications from January to September 2024 were 16% lower than in the same period in 2023. [61] This decline could be attributed to the changes to student visas introduced in January this year. [62] Sustained reductions could mean a 0.5% fall in GDP, while threatening institutional stability, regional economies, and increasing unemployment rates. [63]

By implementing a holistic approach to education and skills development through a National Engineering and Technology Workforce Strategy, the UK can build a resilient workforce capable of driving innovation across both foundational and growth sectors, ultimately contributing to long-term economic growth and competitiveness.

9. What more could be done to achieve a step change in employer investment in training in the growth-driving sectors?

To drive transformative growth in the growth sectors, a substantial increase in employer investment in workforce training is essential. Achieving this shift requires targeted actions that both incentivise businesses and align training with market demands. First, introducing tax incentives for companies that invest in employee education and training would make skills development a strategic priority and significantly boost employer engagement.

Additionally, policies should engage businesses and sector-specific institutions to develop a comprehensive list of 'employable skills' in demand. This collaboration would ensure that training efforts align with actual industry needs. Using these skills, the national curriculum should be revised to incorporate practical problems for students to work on, including the provision of materials and equipment that reflect what is used in the workplace. This approach will familiarise students with real-world scenarios.

Furthermore, improving the availability and advertising of reskilling training for the entire working population can enhance the pipeline of individuals equipped with necessary skills. Strengthening collaboration between industry and academia is essential.

There are pockets of excellence where industry and local skills providers are working together to develop solutions to local skills shortages. For example, The Energy Transition Skills Hub founded by ETZ Ltd, Shell UK and North East Scotland College (with support from the Scottish Government's Just Transition Fund for the North East and Moray) is due to open in September 2025. The Hub aims to significantly increase the capacity of the existing training facilities for fabrication skills on the existing campus at North East Scotland College and provide a flexible space able to adapt to the skills requirements of the future, while making a positive social

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[60] Department for Education. (2019). *Understanding costs of undergraduate provision in Higher Education: Costing study report*. https://assets.publishing.service.gov.uk/media/5f356650e90e0732e4bd8c79/Understanding_costs_of_undergraduate_provision_in_higher_education.pdf

[61] Home Office. (2024, November 14). *Official Statistics: Monthly monitoring of entry clearance visa applications*. https://www.gov.uk/government/statistics/monthly-entry-clearance-visa-applications/monthly-monitoring-of-entry-clearance-visa-applications

[62] Home Office. (2024, January 2). *Tough government action on student visas comes into effect*. https://www.gov.uk/government/news/tough-government-action-on-student-visas-comes-into-effect

[63] Blake, G. (2024, September 3). Reduced international student numbers are a much bigger problem than you think. *Higher Education Policy Institute*. https://www.hepi.ac.uk/2024/09/03/reduced-international-student-numbers-are-a-much-bigger-problem-than-you-think/

impact on communities. The Hub will be built on the site of a disused industrial site next to the college as an extension to the existing campus. It will create flexible training pathways, removing barriers to access to allow for upskilling and reskilling courses, with an outreach programme to get schools involved and inspire the next generation. A mobile classroom staffed with an outreach worker and equipped with interactive technology will visit local schools aiming to inspire the next generation about the energy transition. Another good example of partnering to deliver industry-focused training and education is the MIRA Technology Institute.

It is also crucial to develop specific initiatives that support small and medium-sized enterprises in growth sectors, as they often face significant barriers to investment in training. Addressing regional disparities by developing targeted interventions will ensure that growth sectors can thrive across all areas of the UK. One significant barrier is the struggle to balance the long-term benefits of apprenticeships with the immediate costs and resource commitments required. This is especially challenging for smaller businesses with limited financial flexibility. Additionally, fmany SMEs have less access to information about apprenticeship programmes and may lack the internal resources to navigate the complexities of implementation. This becomes relevant as apprenticeship starts in small employers have had only a 2% increase since 2018/19 (pre-pandemic), whilst medium and large-sized employer starts are still 12% and 10% lower, respectively. [64]

The Apprenticeship Levy, introduced in 2017, has also had negative consequences. Rather than boosting apprenticeship numbers, it has led to a decline, particularly affecting small and medium-sized enterprises (SMEs) that struggle to invest in training. [65] Additionally, the focus has shifted towards higher-level apprenticeships for more experienced staff, leaving fewer entry-level opportunities for young people. [66]

We welcome the reform to the apprenticeship levy to the growth and skills levy, which better encompasses upskilling and reskilling as part of the remit. However, we urge the government to encourage companies to ensure the upskilling of current staff does not come at the detriment of the recruitment of young people into entry level apprenticeships.

By implementing these measures, among a national industrial strategy, the UK can create a more dynamic and responsive skills ecosystem that better supports the needs of growth-driving sectors, contributing to increased productivity and economic growth.

Research, Development and Innovation

10. Where you identified barriers in response to Question 7 which relate to RDI and technology adoption and diffusion, what UK government policy solutions could best address these?

Investing in research and development (R&D) will help to generate ideas, and innovation. However, support is needed for all 5.5 million businesses to be able to take advantage of new developments and technologies, driving productivity and growth. Economic growth in the UK cannot rely solely on those with the capacity to invest in R&D. Programmes such as ‘Made

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[64] Department for Education. (2024, July 25). *Apprenticeships in England by industry characteristics.* https://explore-education-statistics.service.gov.uk/find-statistics/apprenticeships-in-england-by-industry-characteristics
[65] Department for Education. (2024, July 25). *Apprenticeships in England by industry characteristics.* https://explore-education-statistics.service.gov.uk/find-statistics/apprenticeships-in-england-by-industry-characteristics
[66] Policy Exchange. (2023). *Reforming the Apprenticeship Levy.* https://policyexchange.org.uk/wp-content/uploads/Reforming-the-Apprenticeship-Levy.pdf

Smarter' which focus on enabling manufacturing to grow through the adoption of digital technologies, innovation and skills can enable targeted support. To support technology adoption and diffusion, there needs to be a need a combination of a supportive regulatory framework, increased risk appetite, reduced bureaucracy and for the government to make clear technology choices in appropriate timescales.

A supportive regulatory framework encourages innovation by reducing barriers to technology adoption, such as streamlined approval processes, standards for new technologies, and tax incentives. These regulations lower the entry costs for emerging technologies, which is crucial in high-capital sectors. Advanced technology adoption often involves substantial risks, including high initial costs and uncertain returns. For this reason, a culture of risk-taking in both private enterprises and government-backed initiatives is crucial. Countries like Germany and the USA have historically achieved higher technology diffusion rates, partly due to a strong ecosystem of public-private partnerships and robust funding mechanisms that spread the financial risk. The government's role in choosing and timing technology investments, such as AI, robotics and advanced manufacturing systems, is pivotal. Clear strategic choices reduce market uncertainty and encourage coordinated industry uptake.

The UK government should also consider increased support for late-stage R&D, where funding often falls short. Focusing on the development and deployment phases, especially in sectors like clean energy industries and advanced manufacturing, would allow engineers to scale up innovations and bring them closer to commercialisation, enabling growth. Without investment in this stage, the UK risks losing companies to other countries, where they are better able to take more risks and develop technologies. Existing initiatives, institutions and infrastructures, such as the Catapult Network and other Research and Technology Organisations, should be strengthened and scaled. A particular focus should be on supporting small and medium-sized companies that have potential for transformational developments on a global scale. This should be via long term patient capital. Innovate UK and the British Business Bank should work together to develop financial mechanisms to fill this gap.

Government and industry should co-design new industry-led partnerships aligned to the growth sectors. There has been previous success when governments and industry have cooperated and planned via formal growth partnerships to accelerate industrial growth, e.g. the Aerospace Growth Partnership and the Advanced Propulsion Centre.

Additionally, investing in workforce upskilling initiatives tailored for technology adoption—such as programmes in AI and automation—would empower businesses to integrate these innovations smoothly. These combined policies would foster a supportive ecosystem for technology adoption, particularly by bridging the critical gaps in funding, knowledge transfer and workforce readiness.

11. What are the barriers to R&D commercialisation that the UK government should be considering?

As a country we are excellent at science and one-offs, but a renewed focus will be required for commercialisation to support growth sectors. However, inadequate funding for the development, demonstration and deployment stage of research and development (R&D) and large-scale demonstration sites, limited patient long-term capital, and a lack of coordinated initiatives between R&D and finance sectors all hinder R&D commercialisation. Engineers are

crucial to this stage, and investment in their skills and capabilities will also support commercialisation efforts across all eight growth sectors.

A renewed focus of the R&D budget on the 'development' stage will be critical. To make significant strides, the government will need to invest in commercial-scale demonstration projects across the UK. [67] These will help to identify what works in real world environments, what does not, and what can meet cost targets, whilst supporting a rigorous testing and measurement programme to meet performance, safety and reliability standards. Rapid deployment and testing—often referred to as 'fail fast' approaches—are essential, particularly for the sectors that are harder to decarbonise or electrify in the coming decades. The specific infrastructure to achieve this can be prohibitively expensive for a company to invest in alone. Increasing the provision of high-quality, open-access infrastructure for scale-up and commercialisation in priority subsectors should be considered. In the absence of large-scale demonstration sites, simulations and digital twins could be used in some cases but this would require open-access data and investment.

Facilities like the Catapult Network and the National Measurement Laboratories illustrate the impact of sites where technologies can be validated but there is a need for more widespread access to demonstration sites. Such infrastructure is essential for high-potential sectors like renewable energy where investors require evidence of reliability and performance.

Engineering commercialisation often requires long-term patient capital, which is essential to support the development, scaling and sustained growth of engineering innovations. This support is particularly vital during the transition between Technology Readiness Levels 4 and 6, where advancements need both funding and time to mature into viable, market-ready solutions.

Additionally, bringing R&D and finance professionals together through targeted initiatives can help bridge the gap between technology developers and investors, fostering mutual understanding of technological advancements and investment expectations. These steps would facilitate R&D commercialisation, providing the support needed to move innovations smoothly from lab to market and securing more substantial private investment. Precedence for this has been set in the work run by the Department for Energy Security and Net Zero in their hydrogen Net Zero investment roadmap. [68]

Data in the Industrial Strategy

12. How can the UK government best use data to support the delivery of the Industrial Strategy?

To support the Industrial Strategy, the UK government could develop a robust AI-compatible data infrastructure by enhancing accessibility to high-quality, standardised datasets across sectors such as healthcare, transportation and energy. Standardising these datasets would allow AI developers to focus more on innovation rather than data preparation. Fostering collaborations between public institutions and private AI developers could also drive innovation, utilising government data in a secure, ethical manner. Such initiatives could include

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[67] Institution of Mechanical Engineers. (2024). *Engineering Policy Priorities for the 2024-29 UK Parliament*. https://www.imeche.org/policy-and-press/reports/detail/engineering-policy-priorities-for-the-2024-2029-uk-parliament

[68] Department for Energy Security and Net Zero. (2023). *Hydrogen net zero investment roadmap*. *https://www.gov.uk/government/publications/hydrogen-net-zero-investment-roadmap#full-publication-update-history*

public-private partnership grants or shared research hubs. The creation of a National Data Library, as set out in the Labour Party manifesto could provide an opportunity to deliver standardised data sets, driving efficiencies across all sectors and reducing the cost of government. [69]

Establishing a robust database of key performance indicators and other key data focused on industrial output and investment opportunities will provide valuable insights to drive strategic decision-making. This centralised resource can help identify trends, optimise resource allocation, and support increased productivity in the growth sectors identified.

The government could also incentivise private companies to share data by offering tax breaks or funding opportunities, fostering a more effective data ecosystem. Encouraging data sharing between the public and private sectors, while maintaining safeguards, would help address systemic challenges. Upskilling workers in AI and data analytics is also essential for maximizing the impact of these datasets on the UK economy.

13. What challenges or barriers to sharing or accessing data could the UK government remove to help improve business operations and decision making?

Regarding barriers to data sharing, standardisation and interoperability between systems are key. The government could encourage the use of interoperable data standards to overcome data silos and facilitate seamless information exchange. Clear privacy guidelines, particularly for small and medium-size enterprises, would help businesses share data responsibly. Secure data collaboration mechanisms, such as data trusts, could unlock the potential of shared data while ensuring privacy and compliance.

Integrating data literacy throughout the curriculum is essential to equip students for increasingly digitalised careers, fostering the skills needed to navigate and interpret complex data in various fields.

A national data strategy prioritising transparency, fairness, and inclusivity would further support data sharing and accessibility. Input from diverse stakeholders would create an inclusive framework, fostering widespread adoption. Public awareness campaigns could also help shift cultural attitudes towards more openness and collaboration.

Given the Industrial Strategy's goal of fostering long-term economic growth and certainty for business investment, these approaches can help create a stable, innovative economic landscape. By enhancing data accessibility and removing barriers, the government can stimulate growth sectors and ensure the UK remains a relevant leader in AI advancement.

Infrastructure

14. Where you identified barriers in response to Question 7 which relate to planning, infrastructure, and transport, what UK government policy solutions could best address these in addition to existing reforms? How can this best support regional growth?

The government has recognised the importance of infrastructure investment to enable growth through the 2024 Autumn Budget. [70]

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[69] Labour. (2024). *Labour Party Manifesto 2024*. https://labour.org.uk/change/kickstart-economic-growth/
[70] HM Treasury. (2024). *Autumn Budget 2024*. https://www.gov.uk/government/publications/autumn-budget-2024/autumn-budget-2024-html

Addressing infrastructure and transport barriers requires streamlined planning, targeted investment, and a focus on climate-resilient growth. Expediting the approval process for critical infrastructure projects by simplifying planning regulations would reduce delays in growth-aligned projects such as new transport links and energy grid upgrades. The Institution of Mechanical Engineers contributed to and supports the parallel submission to this consultation by the National Engineering Policy Centre, which highlights five areas of opportunities for significant improvement to the planning system for energy infrastructure:

- The introduction of spatial planning
- Providing consistency for decision makers
- Improving public engagement
- A strategic approach to environmental assessment
- Sufficient resourcing of the planning system

Developing tailored regional investment plans that prioritise local infrastructure based on economic needs would support regional growth, enabling high-potential sectors—such as advanced manufacturing and clean energy—to flourish. The Energy Systems Catapult has highlighted that there will be no 'one-size-fits-all' for the energy transition and that Local Area Energy Planning is required to exploit opportunities and deliver Net Zero in different regions of the country. [71]

Investment in enabling infrastructure is essential to deliver rapid decarbonisation of the electricity grid, as recently laid out by the National Energy System Operator. [72] This includes faster grid connections, expanding energy storage capacity and advancing smart-grid technology. As industrial clusters emerge, low-carbon hubs for technologies like carbon capture, small modular reactors and floating offshore wind will play a crucial role, particularly in rural or industrial regions suited for these developments.

Sustainable, effective and efficient transport has a critical role in driving a sustainable and growing economy. We believe that the ineffectiveness of significant elements of the UK's transport networks, and their relative saturation, is an important factor in the lack of vibrance and robustness in the UK economy. Deploying sustainable, resilient and fully accessible integrated transport networks is not just a critical element of a UK response to the challenges of a rapidly changing climate, it should be a first step in broadening the UK economy so that cities and regions outside of London can play a fully proportionate role in the country's economic growth. As a subsector of the advanced manufacturing growth sector—manufacturing of motor vehicles showing the largest value increase of £9.6 bn in 2023—improving transport infrastructure has compounding effects. [73] To enhance low-carbon transport, policy measures that make electric vehicles and rail travel more affordable would support this transition and contribute to the government's regional growth ambitions by creating accessible, sustainable infrastructure.

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[71] Energy Systems Catapult. (n.d.). *Local area energy planning*. https://es.catapult.org.uk/tools-and-labs/local-area-energy-plans/

[72] National Energy System Operator. (2024). *Clean Power 2030*. https://www.neso.energy/publications/clean-power-2030

[73] Office for National Statistics. (2024, September 19). UK manufacturers' sales by product: 2023. *ONS, statistical bulletin*. https://www.ons.gov.uk/businessindustryandtrade/manufacturingandproductionindustry/bulletins/ukmanufacturerssalesbyproductprodcom/2023

15. How can investment into infrastructure support the Industrial Strategy? What can the UK government do to better support this and facilitate co-investment? How does this differ across infrastructure classes?

Infrastructure investment is foundational to the Industrial Strategy's objectives, particularly in fostering productivity and connectivity. Establishing an overarching body, like a National Infrastructure and Service Transformation Authority, would enable coordinated efforts, enhance co-investment opportunities, and ensure alignment with industrial priorities. The government have committed to a 10-year national infrastructure strategy on a similar timescale to the Industrial Strategy and these should be aligned. This strategy should not only focus on new projects but also in the maintenance of existing infrastructure to prevent disruptions.

Transport is one of the main enabling infrastructures and strategic investments that improve transport links and reduce travel times could elevate business efficiency and encourage the development of high-tech clusters around key growth sectors

Other types of infrastructure (energy, digital) will require tailored approaches, with energy infrastructure investments particularly vital in supporting the decarbonisation of high-energy industries and achieving Net Zero targets. Through these initiatives, the UK government can foster an ecosystem that not only supports the Industrial Strategy but also attracts private investment in line with the nation's long-term growth agenda.

Energy

16. What are the barriers to competitive industrial activity and increased electrification, beyond those set out in response to the UK government's recent Call for Evidence on industrial electrification?

Barriers to expanding industrial electrification in the UK extend to high capital costs, grid capacity limitations, workforce constraints and protracted planning times. The initial costs associated with electrification technology are substantial. Given the need for new equipment, retrofitting and infrastructure upgrades, companies often struggle with high upfront expenses that limit adoption, especially compared to nations with established subsidies. Additionally, the UK's electrical grid may face capacity issues, especially as demand spikes with widespread electrification efforts in high-energy sectors. Without increased grid resilience and capacity expansion, there's a risk of stalling progress on industrial electrification. Various mechanisms to reduce industrial electricity costs and increase investment confidence have been explored by University College London in 2021. [74]

A shortage of skilled workers also poses a barrier; sectors competing for similar skills could lead to wage inflation, reducing the feasibility for some companies to adopt new electrification technologies. Long planning times further hinder the speed at which electrification projects can be implemented, delaying progress in transitioning to more sustainable practices. Lastly, the competitive gap widens when compared to countries offering substantial subsidies or tax exemptions for electrification projects, highlighting the need for government intervention to lower these barriers and accelerate UK electrification initiatives. [75]

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[74] University College London Institute for Sustainable Resources. (2021). *Delivering competitive industrial electricity prices in an era of transition.* https://www.ucl.ac.uk/bartlett/sustainable/news/2021/sep/delivering-competitive-industrial-electricity-prices-era-transition

[75] Bundesministerium für Wirtschaft und Klimaschutz. (2024, February 12). *Electricity price package.* https://www.bmwk-energiewende.de/EWD/Redaktion/EN/Newsletter/2024/01/Meldung/news5.html

17. What examples of international best practice to support businesses on energy, for example Purchase Power Agreements, would you recommend to increase investment and growth?

To encourage investment in new low-carbon energy technologies, several international best practices could be adopted or expanded in the UK, including in the areas of carbon pricing and government financing of energy projects.

Putting a (technology neutral) price on carbon emissions, in a manner that is stable and predictable for business, but rises over time, is one policy mechanism that incentivises companies to switch investment to low-carbon technology. Emissions trading schemes (ETS) create a market incentive for companies to reduce emissions by assigning a cost to carbon output, motivating energy-efficient practices and investments. Alternative pricing, such as the carbon taxes implemented in Sweden, are another option to incentivise industries to invest in cleaner technologies by making high-carbon energy sources more costly.

The UK's independent ETS, created after leaving the EU scheme, will need to evolve, in particular as it expands to cover more sectors. The ultimate aim should be to have a single pricing scheme that covers the whole economy, and there are lessons that can be learned by other countries going through the same process. [76]

Similarly, more countries and regions are beginning to implement carbon border adjustment mechanisms (CBAMs). This is a method by which the embedded carbon emissions of imported products can be priced at the same level as those manufactured domestically. Their implementation in the UK will be a necessary, but not sufficient, step in ensuring that large parts of heavy industry are not offshored to countries with laxer environmental regulations. The UK has committed to begin the implementation of CBAMs in 2027, but various countries have forged ahead and could be learned from.

Carbon pricing and CBAMs are powerful policy leavers to promote domestic low-carbon technologies, but must be accompanied by a healthy environment for business that de-risks investment in capital intensive projects.

Government can help through financing programmes, particularly those reducing the cost of capital for large-scale energy projects. In countries like Germany, public financing and loan guarantees for renewable energy projects lower investment risks and encourage rapid growth. Together, these practices offer a robust framework for supporting industrial growth through sustainable energy investments, driving both competitiveness and sustainability in the UK.

Regulatory environment

18. Where you identified barriers in response to Question 7 which relate to competition, what evidence can you share to illustrate their impact and what solutions could best address them?

No response.

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[76] Grantham Research Institute on Climate Change and the Environment. (2022). *The future of UK carbon policy: how could the UK Emissions Trading Scheme evolve to help achieve net-zero?* https://www.lse.ac.uk/granthaminstitute/publication/the-future-of-uk-carbon-policy-how-could-the-uk-emissions-trading-scheme-evolve-to-help-achieve-net-zero/

19. How can regulatory and competition institutions best drive market dynamism to boost economic activity and growth?

Regulatory and competition institutions should focus on providing certainty, encouraging and unlocking investment, increasing market access, and incentivising solutions that align with Net Zero goals. For the clean energy sector this will involve long-term policies to boost businesses' confidence, streamlining regulatory processes, incentives for efficient, flexible, low-carbon solutions that are responsive to demand, encouraging diverse players into the market, and supporting infrastructure changes.

Regulatory bodies should adopt a technology-neutral approach that encourages competition. The current system is a complicated mix of different subsidies, incentives and penalties, which can result in unearned windfalls and increased cost to consumers. A simplified system that rewards operators fairly for value they bring to the system (and charges accurately for negative externalities) would incentivise innovation and reduce overall costs.

Additionally, implementing carbon border adjustments could help internalise negative externalities and level the playing field, creating new onshoring opportunities.

By building on and expanding the existing Critical Mineral Strategy to cover materials beyond those deemed 'critical' in this report, the UK government can position itself as a leader in sustainable resource management, ensuring long-term resilience and advancing toward its sustainability goals.[77] The UK's heavy reliance on imported raw materials and specialized technological components leaves it vulnerable to supply chain disruptions, which have grown increasingly concerning as global demand for critical materials rises. Many of these essential resources, from rare minerals to advanced components, are sourced from abroad with limited domestic production capacity. Recent disruptions have highlighted the need for strategic planning to ensure the secure and sustainable supply of these materials. To address this, the UK should promote circular economy principles, emphasising recovery, reuse, and recycling of materials, to reduce dependency on volatile international markets. By setting the rules and standards for material recycling, the government can unleash innovation in the private sector.

20. Do you have suggestions on where regulation can be reformed or introduced to encourage growth and innovation, including addressing any barriers you identified in Question 7?

Consistency and predictability in regulation are critical for businesses. Smaller companies are often overwhelmed by excessive and complex regulation, due to limited administrative capacity to interpret and comply with it, leading to certain sectors being dominated by large firms, creating barriers to entry and risks creating a pseudo monopolistic environment.

New regulations should lower the regulatory burden while maintaining world-leading safety standards, protecting both people and the planet, which will be particularly beneficial to SMEs. The UK has an opportunity to develop an innovative, outcomes-based regulatory system, and regulatory bodies should work with industry-led organisations to guide this development. International alignment of standards will be important to increase market access for companies and reduce the regulatory burden. An effort should be made to have consistent language across

[77] HM Government. (2022). *Resilience for the Future: The United Kingdom's Critical Minerals Strategy.* https://www.gov.uk/government/publications/uk-critical-mineral-strategy

regulations and standards to make it easier for innovators to effectively understand and interpret between standards and regulations produced by different bodies.

Regulatory reform can drive growth and innovation by simplifying processes and removing outdated restrictions. For example, in healthcare and the life sciences growth sector, the government could create a supportive funding and regulatory environment to empower engineers, small and medium-sized enterprises and industry to tackle sustainability challenges within healthcare, with a streamlined regulatory process and support for companies to navigate. [78] The current review of medical device regulations should address barriers and reduce time to market for innovations, leveraging lessons from the COVID-19 response.

In the energy sector, introducing carbon border adjustment mechanisms would incentivise cleaner domestic production and prevent 'carbon leakage', where companies might otherwise outsource production to regions with weaker environmental standards. Finally, working to continuously evolve and improve the regulatory framework for offshore carbon dioxide storage, in-line with the EU and other international partners, would encourage investment in carbon capture and storage technologies. This would support the UK's climate goals and foster growth in sustainable energy sectors by reducing barriers and stimulating both innovation and competitiveness in key growth sectors.

Crowding in investment and scale up finance

21. What are the main factors that influence businesses' investment decisions? Do these differ for the growth-driving sectors and based on the nature of the investment (e.g. buildings, machinery & equipment, vehicles, software, RDI, workforce skills) and types of firms (large, small, domestic, international, across different regions)?

The return on investment, uncertainty, cost and availability of finance are all relevant to businesses when making investment decisions. [79] The regulatory environment also plays a key role in promoting growth. [80]

Micro – Costs and benefits to the business:

Return on investment in both the short and long term is directly impacted by the costs a business incurs, for example cost of capital, which KPMG reports higher weighted averages for the automotive and manufacturing sectors.[81] Analysis by the Bank of England following 2021 Budget measures that reduced the cost of capital by 2.5% between 2021 and 2023 were an important driver of investment for businesses.[82] Greater investment by businesses in technology that will boost productivity and maximise benefits, like AI and robotics, is needed to

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[78] Institution of Mechanical Engineers. (2024). *Transforming healthcare: The role of engineering in delivering a Net Zero health service.* https://www.imeche.org/docs/default-source/1-oscar/reports-policy-statements-and-documents/transforming_healthcare_2024_report_digital-dpg.pdf

[79] Bank of England. (2021, June 25). *Influences on investment by UK businesses: evidence from the Decision Maker Panel.* https://www.bankofengland.co.uk/quarterly-bulletin/2021/2021-q2/influences-on-investment-by-uk-businesses-evidence-from-the-decision-maker-panel

[80] Regulatory Delivery. (2012). *Regulation and growth.* https://www.gov.uk/government/publications/regulation-and-growth

[81] KPMG. (2024). *KPMG Cost of Capital Study 2024.* https://kpmg.com/de/en/home/insights/overview/cost-of-capital.study.html

[82] Bank of England. (2021, June 25). *Influences on investment by UK businesses: evidence from the Decision Maker Panel.* https://www.bankofengland.co.uk/quarterly-bulletin/2021/2021-q2/influences-on-investment-by-uk-businesses-evidence-from-the-decision-maker-panel

increase return on investment supported by clear signalling and encouragement from government.

Capital maturity varies significantly across sectors, with heavy engineering and manufacturing characterised by slow-moving markets, dominated by a few large global firms with lengthy procurement and development cycles. Unlike the life sciences sector, which has evolved financing models to support its high potential returns, heavy engineering faces greater challenges in attracting venture capital due to limited IPO opportunities and reliance on corporate acquisition for exits. There are exceptions; the life science funding landscape has seen large improvements over recent years but there are still areas to improve, and the semiconductor sector has benefited from recent AI demand increases. Patient capital is needed as traditional 10-year capital funds are often insufficient, and there is a need for 15–20-year funds to support long-term innovation. The UK government could play a key role in bridging market inefficiencies by supporting extended finance cycles through initiatives like the British Business Bank and by co-investing with permanent capital investors.

Risk sharing between government and industry is crucial, especially for capital-intensive sectors and emerging technologies like in the clean energy industries, advance manufacturing, defence and life sciences growth sectors. Support for these businesses will encourage investment and boost capability.

Business infrastructure may impact decisions as small-and-medium enterprises may be more sensitive to cash flow. 50% of UK investment is undertaken by 0.5% of large multinationals. [83] Existing localised supply chains that are resilient or the opportunity to grow this may also be factored in.

The availability of skilled labour is vital to investment decisions as having the right people in the job can be a determinant of success. There are engineering skills shortages globally; the UK specifically needs 124,000 new engineers and technicians annually to meet current demand. [84] Engineers, as innovators, are also often entrepreneurs themselves. The characteristics of entrepreneurs are suggested to influence venture capital investment, ahead of financial considerations. [85] This implies investing into the engineers' skills and capability could help boost investment.

Macro – An innovation-friendly environment:

Consistency of government policies, fiscal stability, and a supportive regulatory environment are essential for fostering innovation. Fragmented engagement across government departments currently frustrates industry, reducing the UK's attractiveness compared to countries offering tailored support. For instance, the Industrial Strategy Challenge Fund took 72 weeks to select

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[83] Bank of England. (2024). *Cost of Capital and UK Business Investment: Measurement Challenges and Research Opportunities.* https://www.bankofengland.co.uk/-/media/boe/files/speech/2024/may/cost-of-capital-and-uk-business-investment-slides-by-catherine-l-mann.pdf

[84] EngineeringUK. (2022). *EngineeringUK response: The Net Zero Review.* https://www.engineeringuk.com/media/318645/net-zero-review-october-2022-enguk-final.pdf

[85] Dhochak, M. and Sharma, A.K. (2016), Identification and prioritization of factors affecting venture capitalists' investment decision-making process: An analytical hierarchal process (AHP) approach, *Journal of Small Business and Enterprise Development*, *23*(4):964-983. https://doi.org/10.1108/JSBED-12-2015-0166

and approve funding challenges in 2019-20, with an additional 31 weeks for project assessments, slowing progress. [86]

People, finance, infrastructure and demand management are four key areas to enable innovation recommended by the Council for Science and Technology in 2021. [87] This included improving the quality of education and training in relation to innovation, new partnerships and mechanisms for funding late-stage research and development (R&D) and scale-ups, mapping and reviewing innovation infrastructure, and departmental plans for procurement on innovation. Support for public procurement and the quality of R&D infrastructure can also influence businesses investment decisions. Global evidence of factors influencing extensive (whether to invest) and intensive (how much to invest) margins of foreign direct investment should be analysed and may be different for each margin. Evidence suggests that technology capital is a key driver and distance has a negative impact on both margins. [88]

22. What are the main barriers faced by companies who are seeking finance to scale up in the UK or by investors who are seeking to deploy capital, and do those barriers vary for the growth-driving sectors? How can addressing these barriers enable more global players in the UK?

Return on investment drive business decisions, but high risk and policy uncertainty act as a barrier to this. An inconsistent policy landscape (including regulation and tax policy), driven by political cycles, policy reversals and uncoordinated public bodies, contributes to uncertainty for companies and investors in the UK. The government's role here is to reduce the risks faced by companies and investors so that the long-term value of innovations can be realised. The Council for Science and Technology makes some suggestions for this including reviewing the risk profile and availability of capital for innovative companies, mobilising pension funds, and supporting and educating investors. [89]

A shortage of patient capital in the UK leads to the loss of high potential companies across the growth sectors, particularly those with engineering roots. Compared to the USA, the UK's weaknesses are primarily in ability to scale-up. Deep tech, a cutting-edge area with innovative science and engineering roots, commonly presents scaling issues that need to be addressed. One barrier here is the lack of UK investors with specialist knowledge in less established sectors. The British Business Bank and British Patient Capital could support deep tech companies with specialist investors.

There are specific barriers within funding mechanisms that if removed could enable growth. For example, Innovate UK's Contracts for Innovation (formerly, Small Business Research Initiative (SBRI)) is a funding opportunity for new solutions and technologies to solve problems in the public sector. Currently, this mechanism limits solutions by being overclassified in the early stage and could be utilised better for dual-use programmes. A review of funding mechanisms could be beneficial alongside a roadmap of support for scaling up that identifies gaps in existing support and distinct challenges in certain growth sectors and subsectors. Through

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[86] House of Commons Committee of Public Accounts (2021). *Industrial Strategy Challenge Fund*. https://committees.parliament.uk/publications/5687/documents/65817/default/

[87] Council for Science and Technology. (2021, June 14). *Scaling the impact of innovation in the United Kingdom*. https://assets.publishing.service.gov.uk/media/60f05748e90e0764d0ab7d3c/CST_Letter_Innovation.pdf

[88] Nguyen, A. T. N. (2019). A global analysis of factors impacting the intensive and extensive margins of bilateral foreign direct investment. *The World Economy, 42*(9), 2649–2667. https://doi.org/10.1111/twec.12827

[89] Council for Science and Technology. (2021, June 14). *Scaling the impact of innovation in the United Kingdom*. https://assets.publishing.service.gov.uk/media/60f05748e90e0764d0ab7d3c/CST_Letter_Innovation.pdf

collaboration by Innovate UK, British Business Bank and British Patient Capital, work should aim to remove cliff edges, plug gaps, and make the system more joined up. This roadmap should be used as an opportunity to signal to investors UK ambitions and help to make the navigation of the UKs support system easier.

23. The UK government currently seeks to support growth through a range of financial instruments including grants, loans, guarantees and equity. Are there additional instruments of which you have experience in other jurisdictions, which could encourage strategic investment?

An unclear and inconsistent policy landscape to date has led to a lack of strategic investment, therefore the Industrial Strategy is a welcome action, which the engineering community has long called for. [90]

Funding and spending priorities:

We welcome the National Wealth Fund announced earlier this year to unlock private investment, with at least £5.8bn earmarked for engineering-heavy sectors like green hydrogen, carbon capture, gigafactories and green steel. [91] Long-term patient capital will be vital for engineering as a foundation for all eight growth sectors, particularly clean energy and advanced manufacturing.

The government should further promote a joined-up approach to investment through encouraging cross-departmental spending priorities, recognising the cross-cutting nature of society's greatest challenges. For example, HM Treasury reported only 28 joint bids in the last spending review, despite their efforts to encourage joint bids. [92]

Public procurement:

Public procurement of innovative goods and services can foster the uptake of innovation and act as leverage for start-ups. The impact on growth is two-fold: modernising public services and boosting innovative companies. Lessons can be drawn from initiatives like the *New European Innovation Agenda* (2022), which supports innovation through regulatory sandboxes, test beds, and living labs. [93]

The UK is underutilising the potential of public procurement. The Council for Science and Technology (CST) states that "if just 5% of the £300bn that government already spends on procurement was targeted towards innovative products and services, £16bn of revenue (the equivalent of twenty ARIA institutions) would be available to companies that prioritise research and innovation". This is showcased by Innovate UK's SBRI scheme's participating companies experiencing over 30% growth in annual revenue on average. [94] The CST offer recommendations

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[90] National Engineering Policy Centre (2024) *Engineering a resilient and prosperous future: Policy priorities for the next UK parliament*. https://nepc.raeng.org.uk/media/3xodtwpq/engineering-a-resilient-and-prosperous-future.pdf
[91] HM Treasury. (2024). *National Wealth Fund: Mobilising Private Investment*. https://www.gov.uk/government/publications/national-wealth-fund-mobilising-private-investment
[92] House of Commons Committee of Public Accounts. (2024). *Cross-government Working*. https://committees.parliament.uk/publications/43286/documents/215470/default/
[93] European Commission. (2023). *The New European Innovation Agenda*. https://research-and-innovation.ec.europa.eu/strategy/support-policy-making/shaping-eu-research-and-innovation-policy/new-european-innovation-agenda_en
[94] Council for Science and Technology. (2022, October 7). *Delivering national priorities through public procurement*. https://assets.publishing.service.gov.uk/media/638796ddd3bf7f7380c57910/20221007_CST_Procurement_-_Final__2_.pdf

for public procurement improvement relating to signalling, governance and accountability, and delivery, with examples to support. For example, demand signalling has helped NASA to accelerate growth of private companies to produce new technologies and reduce costs.

Pension fund investments:

UK pension funds should increase investment into private equity—currently, the UK lags behind counterparts like Australia and Canada. [95] A good example is the Ontario Teachers' Pension Plan, which invests $59 bn in private capital. The previous UK government's efforts to boost pension fund investment into innovative companies, through the Mansion House Reforms, has seen some success. [96] For example, Aviva Investors recently announced new venture capital capabilities with reference to the government's initiative. [97] The current government's plans to take this further, through the Pension Investment Review to support start-ups, scale-ups and infrastructure, is a welcome announcement.[98]

Investor knowledge:

Enhancing investor expertise is essential to unlock the potential of innovative engineering. Two key approaches include:

- Facilitate domestic investors to provide fellowships for people with deep engineering knowledge to develop knowledgeable science and engineering specialist investors aligned with the growth sectors
- Include investors in growth plans so they understand the roadmap, already being tested by the Hydrogen Net Zero Investment Roadmap published earlier this year. [99]

International partnerships

24. How can international partnerships (government-to-government or government-to-business) support the Industrial Strategy?

Government-to-government:

International partnerships, particularly government-to-government, can support the Industrial Strategy to implement solutions to issues that are not unique to the UK. There is a shortage of

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[95] Wright, W., & Thornhill, J. (2024, September). Comparing the asset allocation of global pension systems. *New Financial*. https://www.newfinancial.org/reports/comparing-the-asset-allocation-of-global-pension-systems

[96] HM Treasury. (2023, November 21). *£320 million plan to usher innovation and deliver Mansion House Reforms*. https://www.gov.uk/government/news/320-million-plan-to-usher-innovation-and-deliver-mansion-house-reforms

[97] Mills, L. (2024, September 2). Aviva adplac capability to rebranded private markets business. *Investment and Pensions Europe*. https://www.ipe.com/news/aviva-adds-venture-capital-capability-to-rebranded-private-markets-business/10075424.article

[98] HM Treasury. (2024, November 14). *Mansion House 2024 speech*. https://www.gov.uk/government/speeches/mansion-house-2024-speech

[99] HM Government. (2024). *Hydrogen Net Zero Investment Roadmap: Leading the way to net zero*. https://assets.publishing.service.gov.uk/media/65ddc51dcf7eb10015f57f9b/hydrogen-net-zero-investment-roadmap.pdf

skilled engineers globally: the USA needs roughly 400,000 new engineers each year; predictions for the shortage in Australia are estimated at 200,000 engineers by 2040. [100,101]

Vital to boosting our domestic engineering skills pipeline are international students, who contribute over £40 bn to the UK economy annually. [102] Attracting international talent also enables industry to plug skills gaps in the short-to-medium term. As of 2021, 18.5% of total employees working in engineering occupations were born outside of the UK (derived). [103]

The UK should partner with international counterparts to investigate successful policies to increase engineering education and skills and maximise benefits from innovation across growth sectors. Australia's 2024 Federal Budget included $22.7 bn for the government's Future Made in Australia package that provides significant investment for science and innovation and related skills. [104] The efficacy of policies should be investigated and learned from international through partnerships. The Future Made in Australia package includes (but is not limited to):

- $134.2 m to improve approvals for renewable projects and support faster decisions
- encouraging foreign investment with refunds for unsuccessful competitive bids of 75% of application fees.
- $65 bn of investment in renewable capacity through the Capacity Investment Scheme by 2030.
- $17.3 m to mobilise private sector investment in sustainable activities.
- $1.1 bn over five years (+ another $2.7 bn from 2028/29 to 2034/35) to reform tertiary education and provide skills and training in priority industries.
- $30 m for the VET teaching workforce for clean energy courses and $50 m to upgrade and expand clean energy training facilities.

In the USA, the Revolutionizing Engineering Departments programme supports fundamental changes to the training of undergraduate engineering students that equip them with the technical and professional skills needed to solve complex societal problems. [105] While in Canada they have launched the Advanced Manufacturing Engineers Upskilling Program in October 2024, to support workers into new careers through skills training and job placement in some of the fastest-growing industries in Canada using an industry-oriented approach. [106]

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[100] Kodey, A., Bedard, J., Nipper, J., Post, N., Lovett, S., & Negreros, A. (2023). The US Needs More Engineers. What's the Solution? *Boston Consulting Group.* https://www.bcg.com/publications/2023/addressing-the-engineering-talent-shortage

[101] Institution of Engineers Australia. (2023). *The Engineering Profession: A statistical overview.* https://www.engineersaustralia.org.au/sites/default/files/2023-11/engineering-profession-statistical-overview-fifteenth-edition.pdf

[102] Hillman, N. (2024, June 20). New constituency-level data prove the value of international students to the UK. *Higher Education Policy Institute.* https://www.hepi.ac.uk/2024/06/20/new-constituency-level-data-prove-the-value-of-international-students-to-the-uk/

[103] EngineeringUK. (2022). *Trends in the engineering workforces: Between 2010 and 2021*. https://www.engineeringuk.com/media/318305/trends-in-the-engineering-workforce_engineeringuk_2022.pdf

[104] Budget 2024-25. (2024). *Investing in a Future Made in Australia*. https://budget.gov.au/content/03-future-made.htm

[105] U.S. National Science Foundation. (2024). *IUSE/Professional Formation of Engineers: Revolutionizing Engineering Departments.* https://new.nsf.gov/funding/opportunities/iusepfe-red-iuseprofessional-formation-engineers-revolutionizing

[106] Foresight Canada. (n.d.). *Unlock the Future of Your Clean Technology with Skilled Talent*. https://foresightcac.com/ame-up

Government-to-government relationships can also promote regulatory alignment between the UK and its international partners, which supports growth for sectors operating across borders.

International partnerships between Professional Engineering Institutions (for example between Verein Deutscher Ingenieure and the Institution of Mechanical Engineers) can support government-to-government partnerships by providing further channels to share global engineering expertise and industry perspectives to inform policy.

Government-to-business:

Government-to-business partnerships will be essential in advancing the Industrial Strategy. British officials posted abroad should actively promote strategic industrial sites, clusters and British expertise to international markets at international trade events and through marketing campaigns. The UK's GREAT campaign, with its objective to drive economic growth across the entire nation by encouraging an international audience to visit, study, trade, invest, live and work in the UK, shows the impact effective international communications can have. [107] GREAT's 'Study UK' campaign was set to generate £407m of investment right across the UK, from international students registered in 2021/22. [108]

Additionally, an OECD 2023 report into investing in sustainable development suggests that increasing synergies between investment related institutions can foster alignment between institutions. [109] This would involve better articulating and operationalising the synergies among international development actors such as multilateral development banks, international financial institutions and public actors supporting commercial endeavours, including export credit agencies, trade entities and investment promotion agencies (IPAs). IPAs promote the country's advantages, business opportunities and incentives via marketing efforts and collaboration with relevant government departments, fostering an investor-friendly environment.

Shaping policy to support small-and-medium sized companies (SMEs) will be essential as they make up 99.9% of the business population in the UK.[110] The German Mittelstand similarly represents 99% of Germany's business population and are drivers of innovation and technology, with both national and international strengths.[111] The German government strives to enable the Mittelstand to thrive through policy designed to foster a positive start-up and business environment and strengthen competitiveness, innovation, and job creation.

25. Which international markets do you see as the greatest opportunity for the growth-driving sectors and how does it differ by sector?

India has a growing digital economy and is an appealing market for innovation, ranking first globally in domestic market scale and ICT services, sixth in venture capital received and eighth

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[107] GREAT Britain & Northern Ireland. (n.d.). *The GREAT Campaign*. https://greatcampaign.com/
[108] Cabinet Office. (2022, September 30). *GREAT campaign drives growth across the four corners of the UK*. https://www.gov.uk/government/news/great-campaign-drives-growth-across-the-four-corners-of-the-uk
[109] Organisation for Economic Co-operation and Development. (2023). *Latin American Economic Outlook 2023: Investing in Sustainable Development*. https://www.oecd-ilibrary.org/development/latin-american-economic-outlook-2023_4903d546-en
[110] Federation of Small Businesses. (2023). *UK Small Business Statistics*. https://www.fsb.org.uk/uk-small-business-statistics.html
[111] Bundesministerium für Wirtschaft und Klimaschutz. (n.d.). *The German Mittelstand as a model for success*. https://www.bmwk.de/Redaktion/EN/Dossier/sme-policy.html

in finance for startups and scaleups on the Global Innovation Index (GII).[112] Existing UK-India engineering ties, such as those through Jaguar Land Rover, should be strengthened, particularly in AI and digital sectors, to unlock growth potential.

Looking at overall rankings for the GII, the UK trails Switzerland (1), Sweden (2), USA (3), and Singapore (4). These nations excel across multiple indicators, with Switzerland leading in intellectual property payments and receipts, and university-industry R&D collaboration. Singapore ranks highly in policy stability, regulatory quality, high-tech manufacturing and exports, and cultural and creative services exports.[113,114]

Place

26. Do you agree with this characterisation of clusters? Are there any additional characteristics of dimensions of cluster definition and strength we should consider, such as the difference between services clusters and manufacturing clusters?

Engineering underpins all eight growth sectors and is a driver of local growth, providing high skill job opportunities.[115] The characterisation of clusters, especially as locally owned growth plans, is positive as it allows for tailored strategies that reflect local strengths and resources.[116] Including universities in this framework, not only as sources of innovation but as integral to local skills development, would further reinforce this approach. Many universities recruit from their surrounding regions, so incorporating them helps retain local talent and aligns educational output with industry needs. Proximity also strengthens clusters particularly with a strong engineering base, such as Sheffield's advanced manufacturing cluster.

27. What public and private sector interventions are needed to make strategic industrial sites 'investment-ready'? How should we determine which sites across the UK are most critical for unlocking this investment?

Making strategic industrial sites investment-ready requires a coordinated approach encompassing infrastructure upgrades, skills development, financial support, and community engagement. Long-term investment through locally owned growth plans is essential to ensure benefits are distributed across the UK, not just in already prosperous regions with existing absorptive capacity.

Infrastructure improvements should focus on core utilities such as transport connectivity and telecommunications, which can support community and industrial demands and enable these sites to operate at full capacity. This includes investments in high-speed internet, reliable energy grids, and efficient public transport links, which make these sites accessible and functional for industries of all sizes. Investment decisions on late-stage R&D infrastructure to

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[112] World Intellectual Property Organization. (2024). *Global Innovation Index 2024: Innovation strengths and weaknesses in India*. https://www.wipo.int/gii-ranking/en/india/section/strengths-weaknesses
[113] World Intellectual Property Organization. (2024). *Global Innovation Index 2024: Innovation strengths and weaknesses in Switzerland*. https://www.wipo.int/gii-ranking/en/switzerland/section/strengths-weaknesses
[114] World Intellectual Property Organization. (2024). *Global Innovation Index 2024: Innovation strengths and weaknesses in Singapore*. https://www.wipo.int/gii-ranking/en/singapore/section/strengths-weaknesses
[115] Royal Academy of Engineering. (2022, November 4*). A hotbed of innovation: New research reveals engineering adds up to an estimated £645bn to the UKs economy.* https://raeng.org.uk/news/a-hotbed-of-innovation-new-research-reveals-engineering-adds-up-to-an-estimated-645bn-to-the-uk-s-economy-annually
[116] Royal Society. (2020). *Research and innovation clusters*. https://royalsociety.org/-/media/policy/Publications/2020/2020-07-research-and-innovation-clusters-report.pdf

support the scale up and development of the growth sectors and innovation have long lead-in times but an 'enduring legacy'. [117] These facilities provide the means to validate and demonstrate technologies, helping companies overcome the "valley of death" and leaving an enduring legacy for innovation.

Financial tools should be structured to reduce the risks for investors and accelerate the development of critical infrastructure, from construction to operational capacity. Marketing these sites through trade events and campaigns would boost their visibility, attracting domestic and international investor interest.

For clusters to benefit entire regions rather than just city centres, ensuring connectivity across urban and rural communities is crucial. The transport sector will be a key sector of the advanced manufacturing growth sector whilst also being a strong component in the delivery of clusters and local and national growth.

Developing a skilled workforce is equally important. Regional training hubs would allow for tailored training programmes developed and aligned with specific industrial needs. Working alongside the framework of Local Skills Improvement Plans, these hubs could foster effective and strategic employer relationships to ensure that the local workforce has the skills to meet industry demands, creating a pipeline of qualified talent that attracts businesses and investors.

Partnerships between schools, businesses, and research institutions can boost local employment aspirations and build a skilled pipeline for future industry needs. Additionally, government and Innovate UK should look to encourage collaboration amongst small and medium sized enterprises to encourage innovation and to support these companies to grow.

Case Study: Sellafield Ltd is responsible for decommissioning the UK's largest and most complex nuclear site in West Cumbria, relying on having a fully engaged workforce made up of people with the right skills for the roles, that are ready at the right time. Carrying out this nationally important work requires carefully managed, world first engineering projects, and most importantly the development of a workforce, as well as the education of future workers, crucial to the success of Sellafield Ltd. To ensure they have a pipeline of the required skills in an area that has already been identified as a priority, Sellafield Ltd are investing heavily in projects that benefit not just industry but also support the local community and local economic priorities. In West Cumbria they have created a Project Academy and helped to facilitate a University Technical College (UTC) and the National College for Nuclear Northern Hub. [118,119] In Warrington they have focused on engineering through support to the Warrington UTC. [120] Sellafield Ltd are committed to place-based education initiatives and want to be visible and accessible to their local communities.

Finally, fostering community support and local engagement can facilitate smooth site development and long-term sustainability. Community-oriented programmes, like site-specific

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[117] Council for Science and Technology. (2020, September 24). *Levelling up: the role of science and technology in addressing disparities and promoting equality of opportunity.* https://assets.publishing.service.gov.uk/media/601c0675d3bf7f70bc2e1f1d/CST_levelling_up_letter.pdf

[118] University of Cumbria. (n.d.). *A Project Academy for Sellafield.* https://www.cumbria.ac.uk/business/project-management/a-project-academy-for-sellafield/

[119] Northern Powerhouse Partnership. (2024). *Investing in education and skills at Sellafield.* https://www.northernpowerhousepartnership.co.uk/investing-in-education-and-skills-at-sellafield/

[120] UTC Warrington. (n.d.). *Sellafield.* https://utcw.co.uk/tag/sellafield/

skills training courses, encourage local employment, helping to build a skilled workforce from within the community. This not only provides a sustainable labour source but also strengthens local economic ties, making strategic industrial sites an integral part of the region's economic ecosystem. Identifying the most critical sites should involve assessing regional economic needs, infrastructure readiness, and alignment with national growth sectors, ensuring investments are directed toward areas with the highest potential for immediate and long-term economic impact.

28. How should the Industrial Strategy accelerate growth in city regions and clusters of growth sectors across the UK through Local Growth Plans and other policy mechanisms?

The Industrial Strategy can drive growth by simplifying access to business support services, especially for funding and regulatory guidance, to help new and scaling companies. Ensuring consistent long-term funding for research and development and innovation programmes would also build a stable foundation for clusters to flourish. Innovation hubs and business incubators can provide resources and support for SMEs in high-potential sectors, driving regional growth.

Including local stakeholders in planning processes would ensure that growth aligns with community priorities, creating a stronger foundation for sustainable development. Encouraging collaboration between public agencies and private investors would bring necessary resources and expertise to the table. Tracking metrics on the effectiveness of Local Growth Plans would help guide necessary adjustments and ensure they meet evolving needs.

29. How should the Industrial Strategy align with devolved government economic strategies and support the sectoral strengths of Scotland, Wales, and Northern Ireland?

For the Industrial Strategy to succeed across the entire UK, it is essential to collaborate with devolved governments. This ensures that regional needs are reflected while aligning policies towards a shared national goal.

Tailoring skills development with the specific needs of local industries will enhance workforce readiness and support regional sectoral strengths. This could mean targeted training in sectors like renewable energy in Scotland, advanced manufacturing in Wales, and life sciences in Northern Ireland.

Simplifying frameworks for businesses to operate skills programmes, like apprenticeships, across borders will enable smoother workforce development and address skills gaps consistently. Collaborative work should be done to address this which will allow businesses to access talent across the UK and support continuous professional growth. This could be the provision of forums for ministers and officials to discuss and consult on policy development and share information.

Partnerships and Institutions

30. How can the Industrial Strategy Council best support the UK government to deliver and monitor the Industrial Strategy?

The Industrial Strategy Council will play a crucial role in providing evidence-based recommendations to adapt and refine strategies in response to changing economic conditions, providing the government with the agility needed to address emerging challenges and

opportunities. The success of the strategy will rely on the adoption of a systems approach to mitigate risks effectively and ensure the various components of the strategy work cohesively. [121] The Council should ensure this systems approach is taken and ensure overlaps and interdependencies are understood across the growth-driving sectors, emerging sectors and the foundational sectors.

Given the central role of engineering across all eight growth sectors and systems thinking a core engineering skill, it is essential for the engineering community to be represented on the council.

The Council should also support the UK government to ensure there is a clear strategic framework whereby which central government, devolved governments and regional and local institutions can collaborate and cooperate.

To enhance transparency and support data-driven decision-making, the Industrial Strategy Council could regularly publish reports on Industrial Strategy outcomes. This reporting can include updates on sector-specific targets, skills development, regional growth, and innovation funding, providing stakeholders with consistent information and helping to build public confidence in the strategy's effectiveness. This should include information for the finance sector to bring them along with the shared vision and promote investment.

31. How should the Industrial Strategy Council interact with key non-government institutions and organisations?

The Industrial Strategy Council's interactions with non-government institutions should involve close collaboration with industry bodies, academic institutions, and Professional Engineering Institutions, such as the Institution of Mechanical Engineers and the National Engineering Policy Centre. These organisations bring valuable sector-specific expertise and can help test and refine policy incentives, ensuring they align with industry needs and are viable in practice. By actively engaging with professional engineering and policy communities, the council can strengthen the relevance and applicability of the Industrial Strategy across growth sectors, such as advanced manufacturing and clean energy.

32. How can the UK government improve the interface between the Industrial Strategy Council and government, business, local leaders and trade unions?

The University of Cambridge, Bennett Institute for Public Policy, The Productivity Institute and the UKRI's Economic and Social Research Council jointly write that "a systematic mechanism of continuous learning—one of deliberative, rigorous, evidence-based evaluation and analysis, followed by mechanisms to incorporate learning outcomes into the policy decision-making structures—is missing in the British industrial policymaking practice." [122]

The government could strengthen the Industrial Strategy Council's interface with various stakeholders by establishing formal channels for consistent and structured engagement to promote continuous learning. For example, regular roundtables or advisory panels with representatives from business, local leadership, trade unions, and Professional Engineering Institutions (PEIs) would facilitate open communication and allow for coordinated planning. PEIs such as the Institution of Mechanical Engineers, as independent entities, can bridge gaps

[121] National Engineering Policy Centre. (n.d.). *Net Zero: A systems perspective on the climate challenge.* https://raeng.org.uk/media/b4jpdttw/net-zero-a-systems-perspective-on-the-climate-challenge-final-nepc.pdf
[122] Coyle, D., & Muhtar, A. (2021). *UK's Industrial Policy: Learning from the past?* https://www.bennettinstitute.cam.ac.uk/wp-content/uploads/2020/12/Industrial_Policy_-_Learning_from_the_past.pdf

between sectors, acting as a neutral party to convene discussions among communities and stakeholders with diverse interests.

The National Engineering Policy Centre (NEPC) brings engineering thinking to the heart of policymaking, creating positive impacts for society. We are a partnership of 42 professional engineering organisations that cover the breadth and depth of our profession, led by the Royal Academy of Engineering. Together we provide insights, advice, and practical policy recommendations on complex national and global challenges. The National Engineering Policy Centre is pleased to offer its services to the Industrial Strategy Council, both as a source for insights and collaborative policymaking, but also as a route to the 42 partners of the Policy Centre to connect with their specific and extensive expertise, many of whom have international footprints.

The National Engineering Policy Centre has expertise in systems thinking. Engineers and policymakers working together have the opportunity to employ systems approaches to better understand and intervene to solve challenging policy problems, through collaboration and knowledge sharing across sectors. Engineers tackle complex challenges, including through examining whole systems and how their elements interact with one another in order to optimise outcomes that take into account a diversity of stakeholder approaches. When these principles are applied outside the world of engineering to tackle the societal challenges, they can have transformational effects, as already recognised in the health and care sector.[123] Further embedding systems expertise and engineering insights into the policy process is essential. We encourage the next government to increase access to external engineering expertise, including through the NEPC and its partners.

[123] Royal Academy of Engineering, The Academy of Medical Sciences, & Royal College of Physicians. (2017). *Engineering better care*. https://reports.raeng.org.uk/engineering-better-care/section-3-defining-a-systems-approach