

Under the Microscope: response to the House of Commons Science, Innovation and Technology Committee's call for input

About the Institution of Engineering and Technology (IET)

The IET is a trusted adviser of independent, impartial, evidence-based engineering and technology expertise. We are a registered charity and one of the world's leading professional societies for the engineering and technology community with over 155,000 members worldwide in 148 countries. Our strength is in working collaboratively with government, industry and academia to engineer solutions for our greatest societal challenges. We believe that professional guidance, especially in highly technological areas, is critical to good policy making. For further details on the evidence submitted, please contact <u>policy@theiet.org</u>.

Executive Summary

The IET welcomes the opportunity to comment on what topics the Science, Innovation and Technology Committee should explore further.

Given the current pace of change in technological advancement, particularly to support the industrial strategy and government missions, the IET recommends the committee exploring three topics in greater depth:

- 1. **Quantum** sovereignty and security
- 2. **Entrepreneurship** and how the UK can build and shape its entrepreneurial ecosystem to respond its ever-changing need.
- 3. Al and sustainability

1. Quantum

This year marks 100 years since the initial development of quantum mechanics and is internationally known as the 'year of quantum'. The world is currently experiencing the second quantum revolution which has huge potential across a diverse range of applications, including environmental monitoring, health care, defence, navigation, and in the financial and security sectors. However, quantum also has the potential to be very disruptive, with possible security challenges to those who do not capitalise effectively on the quantum revolution.

For quantum technologies to be realised in practice, they must be integrated into wider systems. Although quantum is beginning to move from laboratories to tangible application, it faces specific challenges from a systems engineering perspective to ensure it can integrate with other systems safely and effectively. The IET, together with DSTL and QinetiQ has recently authored <u>a report outlining these challenges</u>. As part of the launch of this report in parliament, it raised wider questions about the need for the UK to rapidly develop strategic capabilities in quantum technology to ensure it has a competitive advantage more importantly is not put at a disadvantage in future.

Quantum sovereignty

Quantum is a disruptive technology that has not yet reached its full potential, but has capacity to revolutionise industry and the global technological landscape. As quantum technology gains pace, there are certain benefits for countries like the UK to ensure it stays

ahead of the curve, particularly in terms of security and quantum computing. We refer to this as quantum sovereignty.

Quantum security

The UK will be at a disadvantage if it does not prioritise quantum technologies, not least as it has potential to pose a risk to digital security, particularly in areas like the financial sector, which the UK is historically strong. This threat will exacerbate if the UK does not develop its own capabilities.

There are trends in several engineering areas (particularly in security engineering) to rely more strongly on ongoing evidence rather than 'done and dusted' approaches to verification and validation because this contributes to improved agility and responsiveness. Unless suitably robust methods for the assurance of quantum technologies can be developed, this could become a sticking point in the adoption of such technologies. (Source: IET, <u>Quantum</u> technologies: a new frontier for systems engineering?, 2025)

Quantum Literacy

For the UK to gain a competitive advantage, it is pivotal that quantum literacy is improved. Most employers think that senior management doesn't understand other emerging technologies such as quantum engineering (Source: <u>IET Skills for a digital future skills</u> <u>survey</u>, 2023). Quantum literacy is not only about making sure there is greater understanding amongst the general population but also ensuring that experts can explain quantum clearly and concisely. Examples of its use may help increase awareness around how quantum can impact everyday lives, this can be coupled with publicity around success stories to maintain interest. Incorporating aspects, whether it be examples or a basic teaching, of quantum in the STEM curriculum would help to ensure it was seen as another technology for adoption, and not something to be afraid of, but rather embraced.

Greater investment in quantum technologies is needed in the UK through the industrial strategy and the national quantum strategy. This will provide a strong basis for the necessary skills to support the application of quantum. Transferable skills that are required can often be found in a range of backgrounds and reskilling and upskilling are integral to addressing these issues. Apprenticeships will support the necessary skills pipeline for quantum technology.

Further investigation

Quantum is a highly beneficial technology, that has the potential to be very advantageous for those who capitalise on it, but also very disruptive to those who don't. It is therefore particularly timely for the committee to consider this subject in advance of the industrial strategy.

Exploring quantum sovereignty / security further will help the UK become more resilient against future developments. Quantum technologies, when implemented effectively and sensibly, can improve key infrastructures and sectors, such as: transport, telecommunications, energy, and the security, financial and defence sectors.

An inquiry expanding on the issues highlighted here would not only allow for a cross departmental look into how the UK could gain a competitive advantage in the application of quantum technologies, but also into level of quantum literacy in this field. The review would support both the national quantum strategy and industrial strategy.

2. Entrepreneurship

The UK has a strong opportunity to build and shape an entrepreneurial ecosystem that will support the foundations of an industrial strategy. The UK's innovation and entrepreneurship landscape is complex, with a decreasing number of companies seeking investment for growth. By investing into entrepreneurship, it will help keep the UK on the technological trajectory the world is taking.

Entrepreneurial ecosystem

The UK is doing well in the early stage of entrepreneurship, but we are not successfully initiating, scaling and developing people to embrace risk, this is partly because entrepreneurial ambition is not taught in the same way that it is in other countries.

Previous work conducted by the YPC & IET Staff (Source: <u>IET Young Professionals</u> <u>Committee (YPC) Innovation & Entrepreneurship (I&E) Working Group</u>, 2024) have shown that innovators and entrepreneurs face the challenges of navigating multiple stakeholders, over-engineering solutions, complying with standards, creating products with limited commercial value, prolonged development times and a poor understanding of the market.

Unclear pathways and a lack of multi-sector support also exacerbate financial and communicational disconnects, further hindering growth. To develop the ecosystem surrounding innovation and entrepreneurship, key areas of focus include: facilitating knowledge sharing, mentorship programs, networking, educating in appropriate design practices, showcasing success, and connecting with commercial opportunities.

We need to have entrepreneurial ecosystem as a focal point for our organisational / educational institutions. There is currently a fragmentation of interventions, a lot of 'reinventing the wheel' despite there being projects that are already fit for purpose (Scale Up Institute), ultimately causing more fragmentation. Government should explore the pipeline journey of a tech start-up is and what the challenges / barriers they face are, as well as assessing the challenge around how academia commercialises research, and what Technology Transfer Offices (TTOs) offer.

While incubators, accelerators, government schemes, and regional initiatives can also provide crucial support, more is needed to streamline the process of bringing innovative ideas to market.

Further investigation

Investigating barriers to entrepreneurship will be key to establishing the UK as a strong international competitor and boost innovation and growth. The UK's current innovation and entrepreneurship landscape is complex, with a decreasing number of companies seeking investment for growth.

Whilst the UK is doing well in the early stage of entrepreneurship, it is not initiating, scaling and developing entrepreneurship, this is partly because entrepreneurial ambition is not taught in the same way that it is in other countries. The committee in its unique position within parliament can explore the pipeline journey of a start-up and acknowledge the challenges they face and investigate having an entrepreneurial ecosystem as a focal point for our organisational / educational institutions. This presents an excellent opportunity to build and shape an entrepreneurial ecosystem that will support the industrial strategy and technology adoption review.

3. Al and sustainability

Al is influencing how businesses, industries and technologies operate now and in the future. However, the use of Al has an environmental impact. This is due to the data centres and network infrastructures that are needed to operate the AI models consuming large amounts of energy and water. Currently AI's energy use only represents around 2-3% of total global emissions. (Source: <u>World Economic Forum, AI and Energy</u>, 2024) However, this is likely to increase as adoption of AI increases to drive efficiency and productivity.

Sustainability and investment

There is a unique juxtaposition between AI and sustainability, as AI is high consumer of energy, but also possesses huge potential to tackle climate change, but greater scrutiny is needed. Reports predict that the use of AI could help to mitigate 5-10% of global greenhouse gases (GHG) by 2030 (Source: <u>Boston Consulting Group</u>, <u>How AI Can Speed Climate Action</u>, 2023).

The IET proposes a 'bronze, silver, gold' standard for data centres: bronze for excessive energy consumption which is harmful to the environment, silver for less harmful, and gold for environmentally sustainable operations. This would emphasise the moral responsibility surrounding data centre energy consumption. Government should subsequently encourage the removal of "bronze" data centres (those not using green energy) in the UK. Similar to the country's shift away from coal energy, this could support the push for sustainable technological progress. It would also be appropriate to tangibly recognise instances where developers have acted sustainably by adapting an existing product, for example Large Language Models (LLMs), rather than retraining or starting from the beginning, which has led to a lower carbon footprint.

There are also ethical considerations of pursuing technology that is not net-productive. By focusing on carbon efficient AI and technologies the UK has the potential to become a leader in the global AI economy. It should be clarified that the costs of running hardware in data centres are significantly higher in both energy consumption and financial terms than solely storing data for AI processes. To limit harm, the environmental impact of data centres needs greater recognition across industry without being overlooked in favour of cost efficiency. There also needs to be a consideration on what type of AI to use, whether it is LLMs, traditional compute optimisation or search techniques as there is a considerable cost of training and re-training models to achieve this.

The growing financial cost of LLMs is unsustainable, this is in part due to the extensive cost of the energy required to run them, making LLMs unprofitable. The UK must be cautious about investment in technologies that may or may not have reached their peak. There should be consideration surrounding whether the UK should invest in current technologies that are excelling so the technology's security and durability is enhanced, invest in next generation technologies in an effort the lead in the field, or target and lead in niche topics such as: smaller machine learning or narrower AI approaches.

A clean, modern and decarbonised grid will be vital to move towards net zero. Companies like Microsoft and Google are already exploring alternative power options such as nuclear technologies to power LLMs. Government should invest in other clean energy technologies such as offshore wind, which has a proven track record in the UK. The drive to decarbonise our energy system by 2050 offers the nation an opportunity to move from fuel-based solutions and become more energy independent.

Further investigation

Al is a huge consumer of energy, but if used correctly, it can be a huge asset in reaching netzero. This can be driven through the assessment of LLM's and datacentres. Looking further into LLM's will allow the UK to measure their environmental impact and incorporate our recommended bronze, silver and gold sustainability rating. Government should subsequently encourage the removal of "bronze" data centres (those not using green energy) in the UK. Similar to the country's shift away from coal energy, this could support the push for sustainable technological progress.

As the Government seeks to pursue AI for efficiencies in public services and for growth in the UK. It is timely to consider the impact it will have on sustainability and energy consumption. The committee would be able to review this level of impact throughout governmental departments, building on existing work of the <u>IET</u> and <u>National Engineering Policy Centre</u> in this area. It can also use the opportunities to make recommendations for best practice in Government.