



Department for  
Business, Energy  
& Industrial Strategy

# UK Quantum Strategy

Call for Evidence

Closing date: 10 March 2022

February 2022



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# Introduction

Improvements in our understanding and ability to control quantum properties mean we can achieve a step change in technological performance. As a result, quantum technologies are anticipated to have significant impacts across multiple sectors; including finance and healthcare, and within defence and security.

These impacts range from: unprecedented computing power to solve certain problems which will lead to substantial productivity gains across the economy; timing and communications advances that will provide resilience and new functionality within future networks for the benefit of wider society; and new sensing and imaging to improve the measurement of changes in a range of environments, leading to applications within autonomous systems, medical diagnostics, earth observation or defence and security. The anticipated impacts of these technologies on economies globally amount to hundreds of billions of dollars in the next few decades.

Quantum technologies have been recognised within the government's Integrated Review (IR) of Science, Defence, Development and Foreign Policy as transformative technologies because of their critical role in underpinning the next wave of technological innovation. They are also one of the seven priority technology areas within the government's Innovation Strategy, our long-term plan for delivering innovation-led growth. Because of their advantages, they also pose potential risks if adversaries gain a technological advantage over the UK, given the ability to use these technologies for defence and security purposes.

## Current state of play

Recognising the importance of these technologies, government established the National Quantum Technologies Programme (NQTP) in 2014 to work with industry and academia to commercialise quantum technologies for economic and societal benefit, build a strong quantum industry, and a trusted supply chain and capabilities. This ten-year programme, representing over £1bn of public and private investment into the field (2014-2024) and decades of previous investments, have built world leading strengths in quantum science and technology development.

The NQTP has nurtured considerable developments and the UK now has a thriving ecosystem of spin-outs, SMEs, and large businesses that are poised to take advantage of the opportunities these technologies represent, with more investment in UK quantum firms than in any other European country. There have been many early successes from companies participating in the programme, including world firsts in ion trap platforms (an important step towards useful quantum computing machines and sensors), a commercially available gas sensor to track methane emissions in real time from energy infrastructure, and the use of quantum magnetic imaging to guide epilepsy surgery, which is now in clinical trials.

But, as with many deep tech sectors, there is still much to do to move these technological advances from the research lab to real-world applications able to compete in existing markets and create new ones. As the Innovation Strategy stresses, the journey of tech-based innovation to market can be long, complex, and often non-linear. Quantum technologies are cross-cutting in terms of their applications and span a range of readiness levels. This requires an interdisciplinary approach across the technology families (computing, sensing, timing,

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communications, and imaging) as well as application areas. Making further progress in quantum will require taking a broad approach across these technologies, and working with industry to identify the most promising near-term applications and ensure that the UK economy is ready to implement them.

## Call for evidence

To inform the development of the Quantum Strategy we are seeking views from the quantum community and wider interested parties on the following questions. **You can either submit a response to the call for evidence electronically or in hard copy by 10 March.** Please submit evidence to support any assertions where possible.

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# General information

## Why we are consulting

To inform the development of the Quantum Strategy we are seeking views from the quantum community and wider interested parties on the following areas: strategy vision and objectives, the knowledge pipeline, the innovation ecosystem, skills, adoption and the regulatory environment.

## Consultation details

**Issued:** 14 February 2022

**Respond by:** 10 March 2022

**Enquiries to:**  
Technology Strategy & Security Team  
Department for Business, Energy and Industrial Strategy

6th Floor, Area ORC1A  
1 Victoria Street  
London  
SW1H 0ET  
Email: [future.sectors@beis.gov.uk](mailto:future.sectors@beis.gov.uk)

**Consultation reference:** UK quantum strategy: call for evidence

### **Audiences:**

Researchers, businesses, research organisations, industry bodies, students, users, and wider interested parties in quantum technologies.

### **Territorial extent:**

United Kingdom

## How to respond

**Respond online at:** [beisgovuk.citizenspace.com/strategy/quantum-strategy-call-for-evidence](https://beisgovuk.citizenspace.com/strategy/quantum-strategy-call-for-evidence)

or

**Email to:** [future.sectors@beis.gov.uk](mailto:future.sectors@beis.gov.uk)

**Write to:**

Technology Strategy & Security Team  
Department for Business, Energy and Industrial Strategy  
6th Floor, Area ORC1A  
1 Victoria Street  
London  
SW1H 0ET

Email: [future.sectors@beis.gov.uk](mailto:future.sectors@beis.gov.uk)

When responding, please state whether you are responding as an individual or representing the views of an organisation.

Your response will be most useful if it is framed in direct response to the questions posed, though further comments and evidence are also welcome.

Please indicate whether any of the information in your response is commercially sensitive.

## Confidentiality and data protection

Information you provide in response to this consultation, including personal information, may be disclosed in accordance with UK legislation (the Freedom of Information Act 2000, the Data Protection Act 2018 and the Environmental Information Regulations 2004).

If you want the information that you provide to be treated as confidential please tell us, but be aware that we cannot guarantee confidentiality in all circumstances. An automatic confidentiality disclaimer generated by your IT system will not be regarded by us as a confidentiality request.

We will process your personal data in accordance with all applicable data protection laws. See our [privacy policy](#).

We will summarise all responses and publish this summary on [GOV.UK](https://www.gov.uk).

## Quality assurance

This consultation has been carried out in accordance with the government's [consultation principles](#).

If you have any complaints about the way this consultation has been conducted, please email: [beis.bru@beis.gov.uk](mailto:beis.bru@beis.gov.uk).

# The proposals

The Integrated Review highlighted the importance of technology for our prosperity, security, and resilience, setting out how the UK government would “take a more active approach to building and sustaining strategic advantage through Science and Technology”.

Due to the anticipated transformative potential of quantum technologies, global competition has significantly increased in the past few years. It is therefore essential that we continue to build on existing strengths and work with the community of research organisations, academics, and businesses, to ensure that the UK is best-placed to develop and take advantage of quantum technologies.

With the second phase of the NQTP coming to an end in 2024, it is the right time to develop a national Quantum Strategy setting out how we will support commercialisation and industrialisation, attract investment and further develop the sector and supply chains, evolve the research landscape and increase efforts to collaborate with our international partners. We must take action to retain talent, capability and know-how in the UK, and protect our knowledge and intellectual property. As these technologies near the market, there will be an increasing need for the UK to be a leading force in the development of regulatory frameworks, standards and benchmarks governing their use and to enable UK companies to compete internationally, as well as to encourage businesses to locate in the UK.

In 2020 the NQTP programme partners worked with the UK quantum community to refresh the NQTP’s Strategic Intent (SI), setting out a vision to create a quantum-enabled economy in which quantum technologies unlock innovation and growth across key sectors, helping to build a thriving, resilient and secure economy and society. The National Quantum Strategy will build on this work.

## Strategy remit

The strategy will cover all quantum technologies and their enablers, including sensing, timing, imaging, communications and computing. All quantum technologies have important applications and value for government and society but will mature and find applications at different rates and times. Technologies realised earliest will be important stepping-stones to help accelerate the path to scalable quantum computing machines and a future quantum-enabled internet.



# Consultation questions

## Strategy vision and objectives

The NQTP's strategic intent document, published in November 2020, set out a vision for a future world in which quantum technologies become an integral part of a range of innovative technology platforms delivering technological advances and new applications:

“Create a ‘quantum enabled economy’, in which quantum technologies are an integral part of the UK’s digital backbone and advanced manufacturing base; unlocking innovation across sectors to drive growth and help build a thriving and resilient economy and society.”

Building on this, we propose three objectives for the Quantum Strategy:

- To grow and maintain a sustainable quantum sector, delivering societal and economic benefits to the UK.
- To grow and maintain the UK’s capabilities and leading global position – to help the UK to have strategic advantage in and through quantum technologies (where the UK has strengths and a competitive edge).
- To enable the wider economy and society to take advantage of the opportunities associated with the use of quantum technologies and mitigate the risks.

**1. A. Are the above vision and objectives right for the Quantum Strategy over the next 5+ years?**

**B. What activities or interventions are critical to realising these key objectives over the next 5+ years? Please list the top five.**

**C. What are the key barriers to realising these objectives?**

## The knowledge pipeline

2. **A. What big research questions or themes should the quantum programme be looking to answer in its next phase? Please specify how it would advance the development of quantum technologies.**
- B. What research mechanisms (for example, centres, programmes or partnerships) work well within the current research landscape?**
- C. How should the existing mechanisms evolve to continue to advance the science and help pull through technologies to commercialisation?**
- D. What research mechanisms are missing from the current research landscape? Are there examples from other countries we can learn from?**
- E. What research infrastructure will be required to facilitate technology development both now and in the future? Are there any gaps in provision?**

**Please note:** a more detailed review of the infrastructure requirements for the programme is being conducted by the Strategic Advisory Board of the NQTP. Please use the [survey link](#). **The infrastructure survey will close at midnight on 28 February 2022.**

Please indicate whether any of your responses to the above questions are commercially sensitive.

## Innovation ecosystem

3. **A. What works well within the existing innovation ecosystem? (Examples might include: mission-oriented programmes, industry-led collaborative research and development projects (such as the ISCF quantum challenge), investment accelerators, entrepreneurship schemes, the National Security Strategic Investment Fund, government procurement, demonstration programmes, guidance on IP protection.)**
- B. What barriers exist or what is missing from the existing innovation ecosystem? Are there examples from other countries we can learn from?**
- C. At what stage and investment size (from pre-seed to IPO) have companies found it challenging to raise finance? What were the barriers faced?**
- D. Do you envisage having difficulties in the future? At what stage and why? How do you intend to overcome these difficulties?**
- E. What should government's role be in helping companies secure investment from VCs and others through their growth journey?**
- F. What critical infrastructure, facilities, or equipment will be required by companies in the future? And what should government's role be in facilitating access to them?**

Please indicate whether any of your responses to the above questions are commercially sensitive.

## Skills

4. **A. What are the biggest skills and training challenges over the next 2-5 years that a national strategy should seek to address?**
- B. What would be the most impactful things that government could do to ensure there is the necessary talent and skills base in the UK in the years to come?**
- C. What skills and knowledge are required by businesses to successfully explore useful applications from quantum technologies?**
- D. Please indicate what is working within the existing skills and training landscape. (Examples might include: fellowships, centres to train doctoral students, measures to increase broader skills (non-doctoral training), industry placements for students, apprenticeships, technician programmes, entrepreneurship training.)**
- E. What is missing from or not working in the current landscape? What can we learn from approaches in other technology sectors or countries?**

Please indicate whether any of your responses to the above questions are commercially sensitive.

## Adoption

5. **A. What are likely to be the most impactful applications of quantum technologies in terms of commercial or societal benefit? When will these benefits materialise?**
- B. How can we ensure that potential users are aware of the opportunities that quantum technologies present?**
- C. How can we facilitate use case exploration and technology adoption? Or accelerate the discovery of useful applications?**
- D. How can we facilitate the technological convergence of quantum technologies with other technologies to create societal or economic benefit?**

Please indicate whether any of your responses to the above questions are commercially sensitive.

## Regulatory environment

6. **A. What regulatory changes will be required in the coming years to enable societal and economic benefits to be realised and ensure any potential harms are mitigated?**
- B. How should government look to influence the development of international regulations, standards, and norms to inform the development or transfer of these technologies globally to help grow the UK sector, and protect the UK's capabilities?**
- C. What role can government play in helping academics and industry to protect and grow their IP?**

Please indicate whether any of your responses to the above questions are commercially sensitive.

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This consultation is available from: [www.gov.uk/government/consultations/uk-quantum-strategy-call-for-evidence](https://www.gov.uk/government/consultations/uk-quantum-strategy-call-for-evidence)

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