

The Quantum Era: Global trends and the UK's path to leadership

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Brief Introduction

- **Current Role:** Quantum Cluster Manager, Harwell Campus, NQCC
- **Expertise:** Quantum technologies, innovation strategy, photonics and semiconductor
- **Key achievements:** Mapping the UK's quantum landscape and contributed to national strategy reviews
- **Academic background:** PhD in Ultrafast Photonics, Heriot-Watt University

Talk overview

- The International Year of Quantum
- Quantum initiatives around the world
- The UK quantum landscape
- Harwell Campus: A hub for quantum innovation
- Challenges and opportunities for quantum in the UK

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The international Year of Quantum 2025



The international Year of Quantum 2025



INTERNATIONAL YEAR OF
Quantum Science
and Technology

<https://quantum2025.org/>

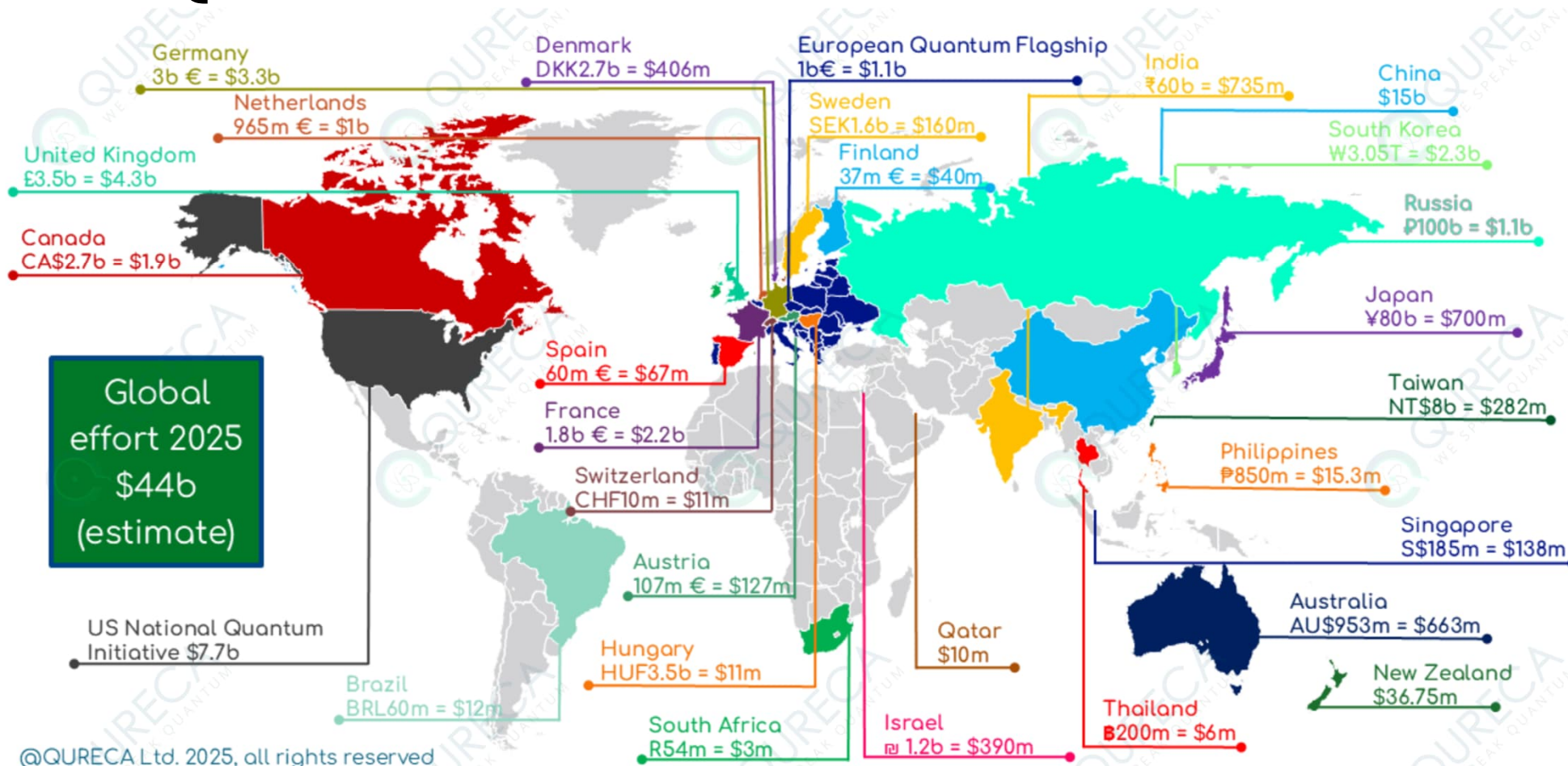


Anne L'Huillier, who won the 2023 Nobel Prize for her work in attosecond physics, presented an overview of the early development of quantum mechanics.

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- Collaboration

Innovation Clusters

Quantum initiatives around the world



Global market dynamics

The quantum technology ecosystem in 2023

Summary of Quantum Technology Monitor findings



Source: Quantum Technology Monitor, Mckinsey and Company, 2023

¹ The potential 2040 market size is a sum of the upper ranges across quantum computing, quantum communications, and quantum sensing.
² Total includes 32 companies that do two or more quantum technologies simultaneously.
³ Economic value is defined as the additional revenue and saved costs that the application of quantum computing can unlock. These four industries are the most likely to realize this value earlier than other industries; therefore, they are examined in more depth.

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The UK quantum landscape

National Centres



A U.K. Hub for Quantum Enabled Position, Navigation and Timing (QEPNT) Led by <i>University of Glasgow</i>	Integrated Quantum Networks (IQN) Quantum Technology Research Hub Led by <i>Heriot-Watt University</i>	UK National Quantum Technology Hub in Sensing and Timing Led by <i>University of Birmingham</i>	National Quantum Computing Centre (NQCC) Led by <i>UK Research and Innovation</i>	The Quantum Computing and Simulation Hub Led by <i>University of Oxford</i>
QC13: Hub for Quantum Computing via Integrated and Interconnected Implementations Led by <i>University of Oxford</i>		QuantIC - The UK Quantum Technology Hub in Quantum Imaging Led by <i>University of Glasgow</i>		
UK Quantum Technology Hub in Sensing, Imaging and Timing (QuSIT) Led by <i>University of Birmingham</i>	Quantum Biomedical Sensing Research Hub Led by <i>University College London</i>	Quantum Metrology Institute-NPL Led by <i>National Physical Laboratory</i>	The Quantum Communication Hub Led by <i>University of York</i>	

Academic partners

- Aalto University
- Argonne National Laboratory
- Aston University
- Australian National University
- Australian Research Council
- Bar-Ilan University
- Bates College
- Ben-Gurion University of the Negev
- Boston University
- Cardiff University

[Search Applications](#) All
 [Search Capabilities](#) All
 [Research Topics](#) All
 [Industrial Partners](#)
 [Academic Partners](#) All

Applications

- 3D Imaging
- Atomic Scale Mass Sensing
- Automotive Applications
- Autonomous Vehicles
- Autonomous vehicles
- Biomedical Imaging
- Collision Avoidance
- Contamination Control
- Defense and Security
- Detection of Cancer Biomarkers

Capabilities

- Atomic clocks
- Bayesian methods
- Chip Scale QKD
- Cold Atoms
- Compact Atomic Clocks
- Compact sources
- Component prototyping
- Computational Modelling
- Computational Stereo Imaging
- Covert imaging

Research topics

- Algorithms
- Applications
- Architectures
- Atoms
- Clocks
- Cold Atoms
- Computational Methods
- Control & Emulation
- Detector Development
- Fundamentals
- Gaussian Boson

Industrial partners

- 1QBit
- 3DMD
- AAC Clyde Space
- ADVA AG Optical Networking
- ARM Holdings
- AWE
- AegiQ
- Agency for Science, Technology and Research (A*..
- Airbus Defence and Space
- Allpectra GmbH

<https://iuk-business-connect.org.uk/programme/quantum-landscape/>



Innovation Clusters



The National Quantum Technologies Programme



Ministry
of Defence



Innovation Clusters

The National Quantum Technologies Programme

 Quantum Technology Hubs

 Building national capabilities

 Research

 Driving commercialisation and industrialisation

 National Quantum Strategy Missions

 Skills

The UK National Quantum Strategy(2023)

- By 2033 we will maintain our top 3 position in the quality of our quantum science publications, whilst increasing the volume of our research publications.
- By 2033, we will have funded an additional 1000 postgraduate research students in quantum relevant disciplines
- By 2033 we will have bilateral arrangements with 5 further leading quantum nations, based on substantive collaborative work programmes
- By 2033, the UK will have a 15% share of global private equity investment into quantum technology companies.
- By 2033, the UK will have a 15% share of the global quantum technologies market.
- By 2033, all businesses within key relevant sectors of the UK will be aware of the potential of quantum technologies and 75% of relevant businesses will have taken steps to 12 prepare for the arrival of quantum computing.
- The UK will be a global leader in establishing global standards for quantum.

The National Quantum missions

Mission 1: By 2035, there will be accessible, UK-based quantum computers capable of running 1 trillion operations and supporting applications that provide benefits well in excess of classical supercomputers across key sectors of the economy.

Mission 2: By 2035, the UK will have deployed the world's most advanced quantum network at scale, pioneering the future quantum internet.

Mission 3: By 2030, every NHS Trust will benefit from quantum sensing-enabled solutions, helping those with chronic illness live healthier, longer lives through early diagnosis and treatment.

Mission 4: By 2030, quantum navigation systems, including clocks, will be deployed on aircraft, providing next-generation accuracy for resilience that is independent of satellite signals.

Mission 5: By 2030, mobile, networked quantum sensors will have unlocked new situational awareness capabilities, exploited across critical infrastructure in the transport, telecoms, energy, and defence sectors.

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Harwell Innovation Clusters



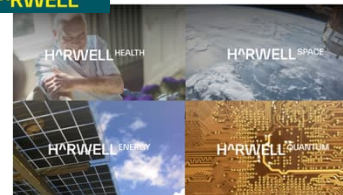
Innovation Clusters



North West **Health Tech** Cluster hosted at Sci-Tech Daresbury

Digital Tech Cluster hosted at Sci-Tech Daresbury

North West **Space** Cluster hosted at Sci-Tech Daresbury



- Harwell **Space** Cluster
- Harwell **Health** Cluster
- Harwell **Energy** Cluster
- Harwell **Quantum** Cluster

>305

Organisations in total participating in Clusters

>5150

Jobs supported across the Clusters

£1.4B

Private investment attracted by Cluster organisations



The Quantum Cluster



Innovation Clusters

National Quantum Computing Centre:

QC readiness, training, applications and sector engagement

RAL Space: Quantum communication, satellite QKD, cold atom sensors, gravimeters

ESA: Satellite QKD, Quantum sensing and quantum computing

SAT Catapult: Quantum communication, Satellite QKD

Quantum startups: Element6, Redwave Labs, Nu Quantum, Infleqtion, Finchetto, Applied Quantum Computing, Open Quantum, TreQ, Quantopticon, QuERA



Testbeds delivery partners

The Quantum Cluster: mission and goals

Mission: Advance the development and adoption of quantum technologies for socio-economic growth

Goals:

- Convening stakeholders and building meaningful collaborations around quantum technologies
- Developing useful applications of quantum technologies
- Supporting businesses and technology scale up.

The National Quantum Computing Centre

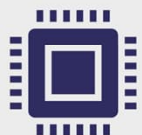


- Collaborative programme between EPSRC and STFC:
 - £93m initial 5-year investment(2020)**
 - £41m programme acceleration(2023)**
- Addressing the challenges of scaling quantum computing
- Driving user adoption and economic value through the SPARQ programme

Science minister unveiling the NQCC Plaque in October 2024

SPARQ Programme

Access



Access to
quantum
computing
resources

Expertise



Technical
expertise and
applications
support

Networking



Networking,
workshops
and
hackathons

Skills



Skills
development
and learning
resources

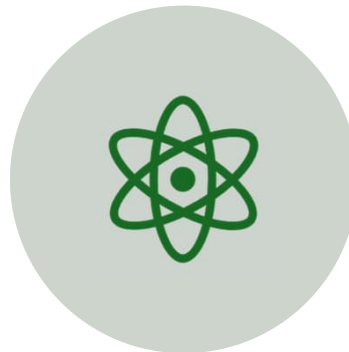
- Support the discovery and development of use cases and applications for quantum computing
- Enhance quantum computing literacy and programming skills
- Build a UK quantum computing user community through knowledge exchange and networking

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Scaling quantum technology



WHY DOES IT MATTER



THE KEY CHALLENGES IN
SCALING QUANTUM



COLLABORATION
OPPORTUNITIES: THE QUANTUM
CLUSTER

Scaling quantum technology: why does it matter?

- Enabling complex quantum science for real-world applications.
- Bridging the gap between theoretical potential and practical utility.
- Supporting advancements in industries like healthcare, energy, and space



Photo credit NQCC

Scaling quantum technology: the key challenges



Addressing hardware limitations



End user engagement and ecosystem building



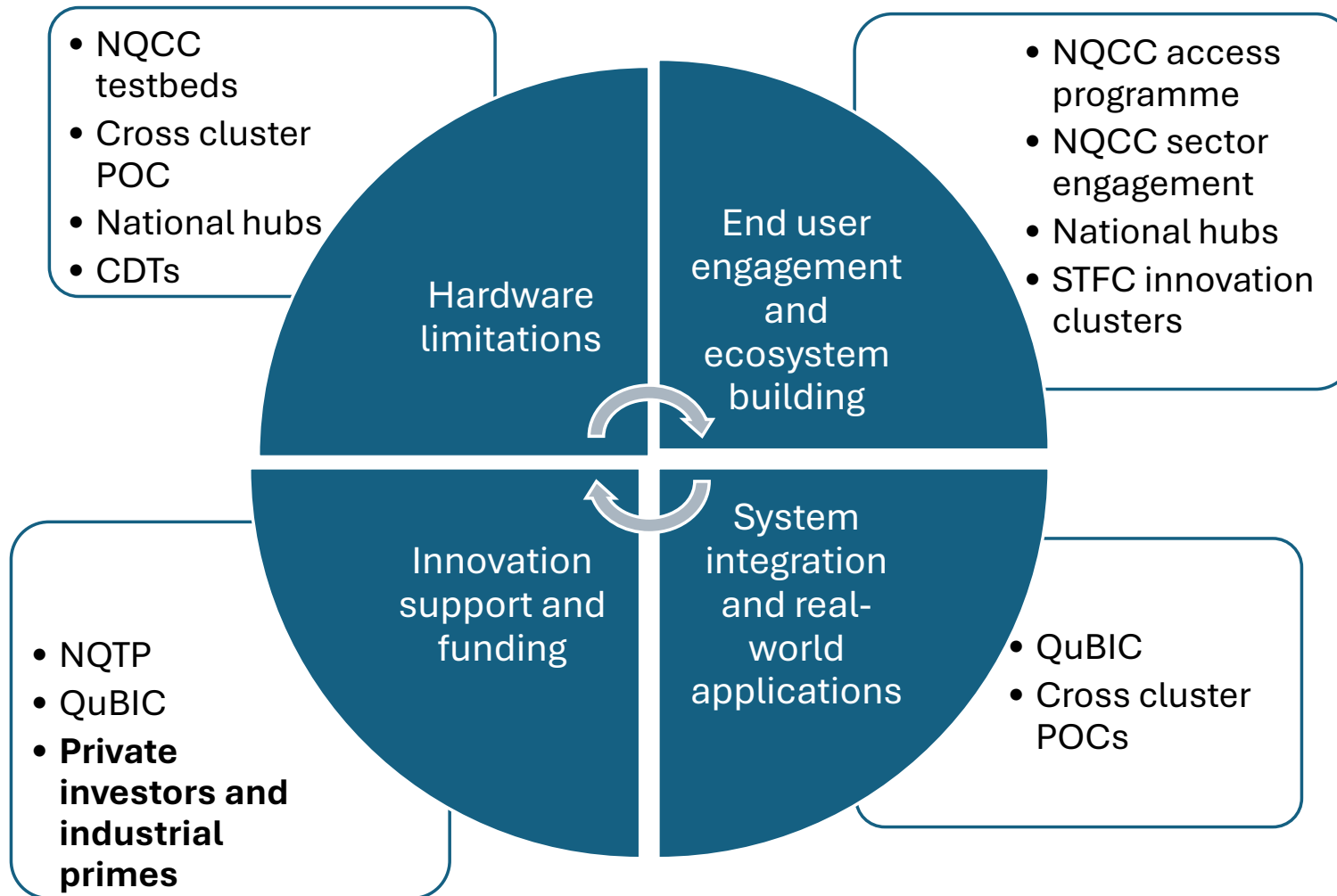
Innovation support and funding



Bridging the gap between system development and integration in real world applications



Scaling quantum technology: The quantum cluster



Opportunities for quantum in the UK: What's next?

- The national missions in computing, sensing and computing
- Addressing key challenges to tech scalability
- Exploring cross-sector opportunities
- Training schemes to build hand on skills for quantum technologies



Science and
Technology
Facilities Council

Innovation Clusters

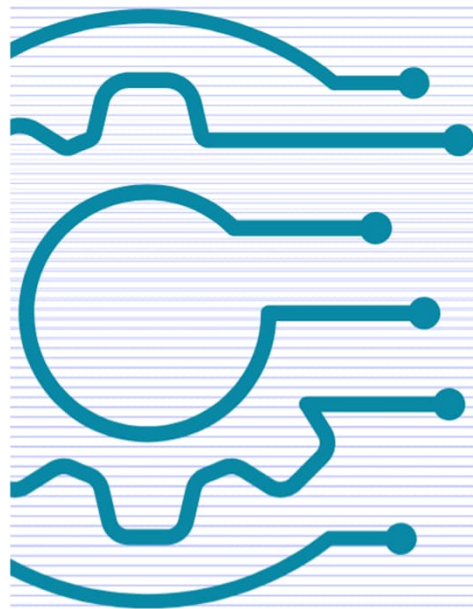


National Quantum
Computing Centre



QUANTUM
TECHNOLOGY
INITIATIVE

CERN Main Auditorium



QUANTUM TECHNOLOGY CONFERENCE

QT4HEP 20-24 January 2025