Quantum Technologies and the UK Ecosystem

TYI

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TYI's expertise and services reflect our mission as a pro-growth, pro-abundance, research-focused political consultancy dedicated to creating a secure and prosperous United Kingdom.

Across our team, we work to develop and influence policy using research, data and expertise in planning, development, local government, quantum technologies, defence, energy, and advanced manufacturing.

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Where We Are Now

3rd

globally in quantum research quality (top-cited papers)

2nd

globally in VC funding attracted to quantum sector

64

pure-play quantum companies – 2nd highest globally

£1bn+

invested in NQTP since 2014

Research Infrastructure and Quality

The United Kingdom's quantum research base is its most important and least precarious asset. Built over more than a decade through the National Quantum Technologies Programme (NQTP) and its predecessor funding streams, it represents one of the few areas of sustained, systemic public investment in a frontier technology that has produced genuinely world-class output. The challenge is that research excellence is necessary but not sufficient: without the translational infrastructure to convert that output into deployed products and commercial value, the UK risks funding the R&D that others industrialise.

Academic Standing

Between 2012 and 2022, the UK attracted an estimated 12% of global private investment in quantum technologies, which is a disproportionate share for an economy of its size. The ECIPE 2025 Quantum Clusters Ranking placed Cambridge and Oxford among the global leaders in industry-involving academic collaborations relative to GDP, outperforming Silicon Valley and Helsinki on research intensity metrics. The US leads in quantum computing research quality at 34% of top-cited global papers whereas China leads in quantum communications at 34%. UK institutions are not disaggregated in these breakdowns, but the Nature Index ranks them among the global top performers in quantum physics output, and the ASPI Critical Technology Tracker consistently places the UK in the top five globally for quantum research quality.

The UK's strengths cluster around distinct institutional anchors:

- Oxford's trapped-ion programme (the origin of Oxford Ionics).
- Bristol's photonics and quantum communications work (origin of PsiQuantum).
- UCL's quantum biosciences and Q-BIOMED programme.
- University of Birmingham's quantum sensing and gravimetry.
- Heriot-Watt and Strathclyde's photonics cluster in Scotland.
- Sussex's trapped-ion hardware (origin of Universal Quantum).
- the National Physical Laboratory's world-leading quantum metrology and standards capabilities.

The NQTP's deliberate investment across multiple institutions and hardware modalities, rather than concentrating resources in one flagship centre, has produced a geographically distributed but intellectually coherent ecosystem. The NQTP is widely regarded as one of the most successful long-term public R&D programmes in deep tech globally.

The NQTP: A Decade of Structured Investment

Phase one (2014–2019) invested £270 million to establish the field. Phase two (2019–2024) shifted emphasis from academic research to industry-led projects with matched government co-investment, funding 139 projects and training more than 470 doctoral students through EPSRC Centres for Doctoral Training. In 2024, the programme formally concluded and five new Quantum Research Hubs were launched for the third phase, covering: quantum computing via integrated implementations (QCi3, 50+ investigators across 18 universities); integrated quantum networks (IQNET); biomedical quantum sensing (QBIOMED, anchored at UCL and co-funded by DHSC and NIHR); sensing, imaging and timing (QuSIT, nine universities); and navigation and positioning. The National Quantum Computing Centre at Harwell received renewed 10-year UKRI funding in 2025.

Where the research base is strong - and where it is not

The UK's research strengths are concentrated in: trapped-ion quantum computing; photonics and optical quantum systems; quantum sensing and magnetometry; quantum error correction software; and quantum metrology (such as the NPL's Quantum Metrology Institute). The UK also has a rich history in clocks and timekeeping, and is globally recognised for this. It is comparatively weaker in superconducting qubit hardware, where the dominant global platform led by Google, IBM, and the US national laboratories, and in the systems-integration engineering needed to build complete, scalable quantum computers from components. This distribution has direct bearing on the commercialisation challenges the UK faces, and on the strategic choices it must make about which hardware modalities to back with concentrated investment.

Quantum Technological Development

Quantum technology comprises three domains at substantially different stages of maturity. Quantum sensing is the most commercially ready, with early products deployed in hospitals, civil engineering, and defence—that is not to say it is ready to be commercialised, but it is the most advanced modality.. Quantum computing is the most capital-intensive and furthest from general commercial deployment, but hardware is advancing at pace, as with systems architecture and error correction routines. Quantum communications occupies a middle position: quantum key distribution is commercially available in specialist networks, while a full quantum internet remains a 2035+ target.

Quantum Sensing: Deployment Already Under Way

Quantum sensing uses quantum states to detect physical phenomena with unprecedented precision. It is the domain in which UK research output, spinout activity, and near-term commercial deployment converge most closely. Optically pumped magnetometer (OPM) systems developed from research at the University of Nottingham are entering clinical trials for brain imaging, providing a non-cryogenic alternative to conventional MEG scanners.

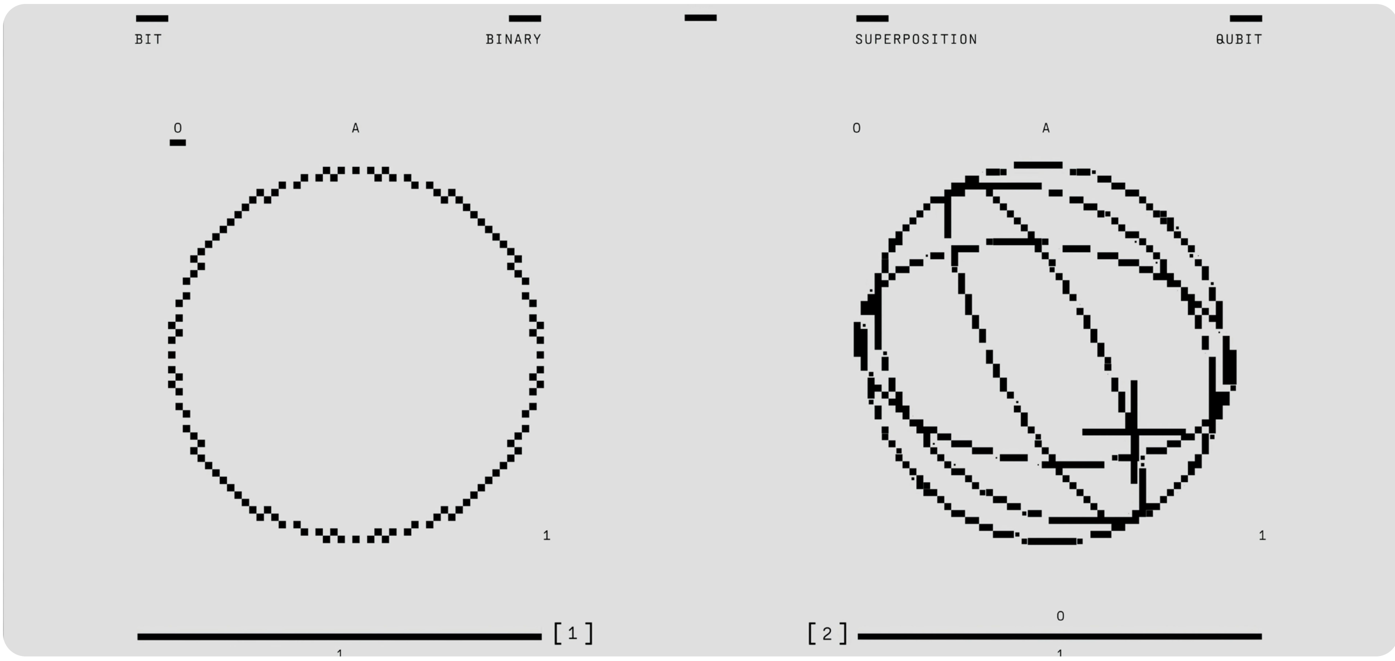
There are several funded product development programmes with defined commercial routes to market. The UK's modality-agnostic research strategy has produced a comparatively richer sensing spinout ecosystem than other major quantum nations.

Quantum Computing: Rapid Hardware Progress, Commercial Deployment Still Years Away

Quantum computing remains pre-commercial for most business applications. The critical distinction is between Noisy Intermediate-Scale Quantum (NISQ) devices, with today's machines, capable of running short algorithms but prone to errors, and fault-tolerant quantum computers (FTQC), where error correction enables reliable computation at scale. The transition to FTQC is the central engineering challenge of the decade. Current best estimates suggest fault-tolerant systems capable of tackling commercially valuable problems (drug discovery, financial optimisation, breaking encryption) are achievable in the early-to-mid 2030s, depending on progress in quantum error correction.

Quantum Communications: Early Deployment in Specific Applications

Quantum key distribution (QKD) is commercially available and being deployed in specialist networks. BT Group is building quantum-secure networking infrastructure under the March 2026 package (£125 million quantum networking allocation), targeting both a domestic quantum internet and post-quantum secure communications for critical national infrastructure. The National Physical Laboratory operates quantum communications testbeds.



Quantum Deployment in Britain

Deployment is where the UK's performance diverges most sharply from its research standing. Britain excels at producing spinouts and attracts disproportionate VC funding; it is structurally poor at scaling them to the point of domestic commercial dominance. The ECIPE 2025 Quantum Clusters Ranking found UK clusters dominate global rankings for ecosystem maturity and spinout efficiency but fall sharply in company scale and market capitalisation.

The Startup Ecosystem

The UK hosts 64 pure-play quantum companies—second only to the US (148). At least 160 companies are active in the broader sector and directly correlated to quantum activity in supply chains. In 2024, the UK attracted the second-highest quantum VC globally, and has made up over 18% of global quantum VC funding since 2020. The ecosystem skews toward SMEs: DSIT analysis found the typical UK quantum company in 2023 employed fewer than 50 people.

Where Value is Being Lost: The Brain Drain Pattern

There are three core examples of quantum start-ups and its IP, skills, and expertise exiting the UK as already familiar scale-up problems are encountered.

1. Oxford Ionics: University of Oxford spinout with world-leading trapped-ion hardware (99.99% gate fidelity), acquired by IonQ (US) for approximately £1 billion, June 2025.
2. Universal Quantum: University of Sussex spinout, relocated primary engineering operations to Hamburg after receiving a €70 million German government contract — more than five times the value of the largest comparable UK procurement award.
3. PsiQuantum: Bristol-origin photonic quantum computing company, now scaling primarily in the United States with over £1.3 billion in global backing.

The UK lacks a procurement culture that uses large, visible government contracts to anchor domestic champions before market consolidation forces exist. Without procurement pull, private investors rationally defer; without private scale-up capital, companies seek better-capitalised foreign acquirers. Despite the announcement of a new procurement programme focused on UK quantum computing deployment, details remain unclear and there is only limited funding available from UKRI in order to realise cross-sectoral scale-up.

Where Deployment is Genuinely Succeeding: Sensing and Defence

Quantum sensing is the domain in which UK companies are actually reaching commercial deployment. The Innovate UK Commercialising Quantum Challenge has funded approximately 140 projects since 2018. The 2025 Sensing Mission Primer awards represent a maturation: companies funded to demonstrate products against specific market requirements, not to conduct further research. The Quantum Centre for Nuclear Defence and Security at AWE (launched November 2025) is an early deployment-oriented initiative, embedding quantum sensing and computing in nuclear security applications alongside the Universities of Strathclyde, Oxford, and Birmingham. National Quantum Strategy Mission targets, which are quantum sensing in every NHS Trust by 2030; quantum navigation on aircraft by 2030, are to create institutional accountability for deployment outcomes, rather than just being research milestones. The Royal Navy has trialled quantum sensing in the Arctic circle, in order to circumvent the threat of GPS jamming in the UK.

Government Support for the Quantum Sector

The UK has one of the most developed government quantum support structures globally: a decade-long investment programme, a formal national strategy, five dedicated quantum missions, a standing cross-departmental governance structure, an active parliamentary inquiry track, and the first advanced procurement programme of its kind. The risk is not the absence of strategy but coherence and scale of execution, as multiple departments hold overlapping quantum interests, and the gap between strategy commitments and programme delivery has, in some cases, been significant.

Departmental Taxonomy

Responsibility for quantum is genuinely cross-departmental, but this can lead to policy silos and resource duplication. The table below maps the principal government departments and bodies with significant quantum remits, their primary quantum roles, and the key instruments through which they exercise them.

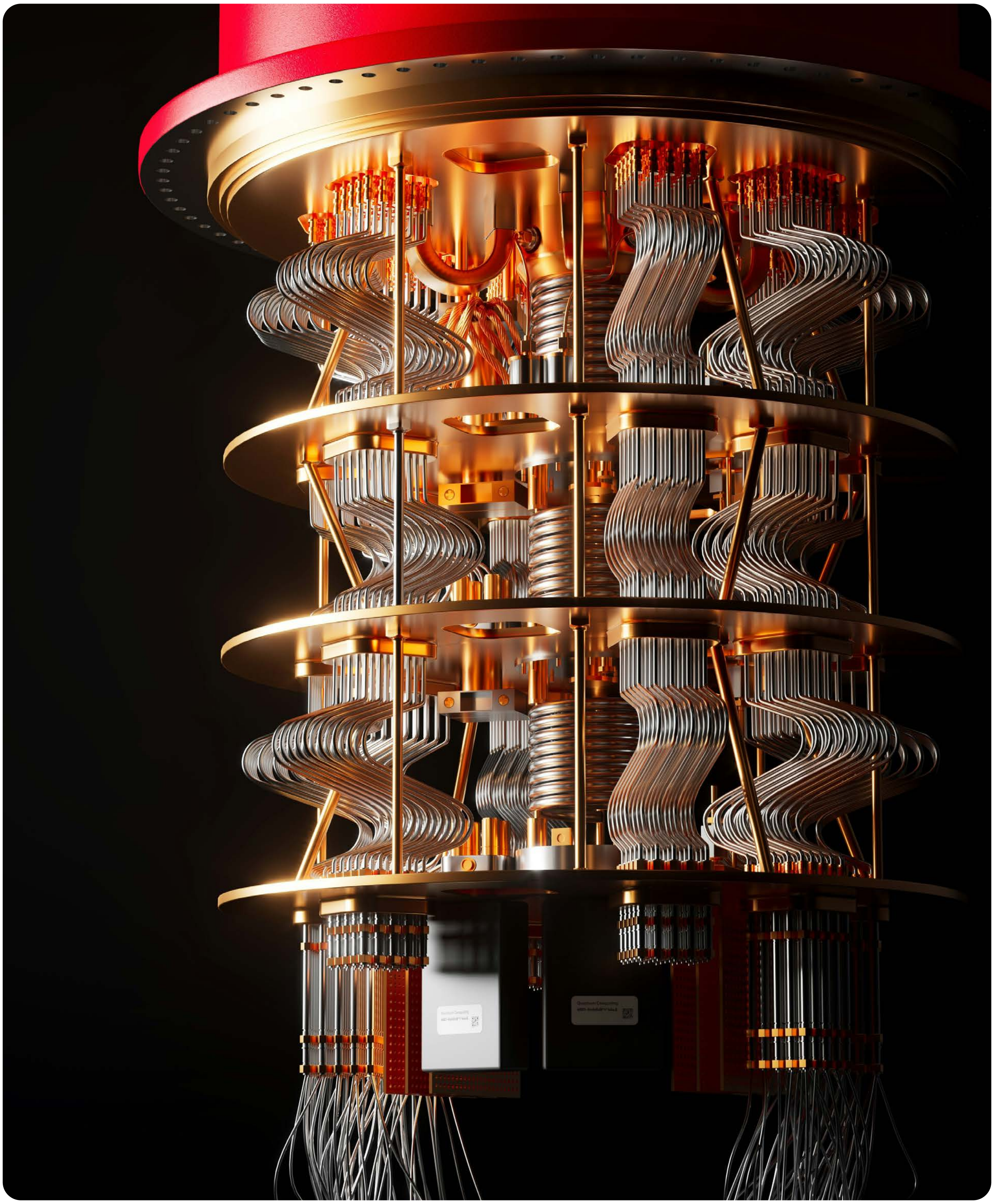
Department/Body	Primary Quantum Remit	Key Instruments
DSIT - Department for Science, Innovation and Technology	Lead department. Houses the Office for Quantum. Owns the National Quantum Strategy, ProQure programme, NQTP, and international quantum agreements.	National Quantum Strategy; ProQure; NQTP; Quantum SAB; Office for Quantum; bilateral agreements
HM Treasury	Capital provider via Spending Review settlements. Co-owner of the March 2026 £2bn announcement. Owns NWF levers.	Spending Review quantum envelope; NWF capital allocation; R&D tax relief framework
Ministry of Defence / DSTL / GCHQ	Security and defence applications: PNT resilience, quantum-safe communications, nuclear security. GCHQ is a NQTP Programme Board member.	AWE Quantum Centre for Nuclear Defence and Security; NQTP Programme Board; Dstl quantum R&D; PNT military applications
DHSC - Department of Health and Social Care	Co-funder of QuSIT Hub. Mission 3 delivery (quantum sensing in every NHS Trust by 2030) falls within its scope.	QuSIT Hub co-funding; Mission 3; NHS quantum adoption pathway; NIHR co-funding
DESNZ - Department for Energy Security and Net Zero	Quantum sensing for energy infrastructure, grid optimisation, and greenhouse gas monitoring.	Clean energy Industrial Strategy; quantum for grid and energy; greenhouse gas monitoring
DBT - Department for Business and Trade	International investment attraction; export promotion; international quantum bilateral agreements.	UK-US, UK-Canada, UK-Australia, UK-Netherlands bilateral quantum agreements; inward investment
DfE - Department for Education	Workforce pipeline: PhD studentships, CDTs, apprenticeship frameworks. Member of Quantum Skills Taskforce.	CDT funding; apprenticeship standards; Quantum Skills Taskforce membership
UKRI (EPSRC, Innovate UK, STFC)	Primary delivery vehicle. EPSRC funds research and CDTs; Innovate UK runs challenge funds; STFC hosts NQCC at Harwell.	NQTP delivery; NQCC at Harwell; Innovate UK Quantum Challenges; CDT programme; £1bn+ budget (Dec 2025)
NPL - National Physical Laboratory	National standards, metrology, and testing/evaluation. Hosts the Quantum Metrology Institute (QMI, est. 2015).	QMI; quantum standards and metrology; PQC algorithm testing; quantum standards network pilot
NCSC - National Cyber Security Centre	Post-quantum cryptography guidance, standards, and CNI threat assessment. Published PQC migration timelines.	PQC migration guidance; quantum threat assessment; NCSC standards adoption programme
NQCC - National Quantum Computing Centre	Runs UK National Quantum Technologies Programme. Coordinates between academia, industry, and government.	Education and PQC readiness: SparQ Access scheme, Quantum Software Lab, Funding Opportunities.

The Office for Quantum: coordination node

Established within DSIT under the 2023 National Quantum Strategy, the Office for Quantum (OfQ) is the primary government body responsible for coordinating quantum policy across departments. It reports to the National Science and Technology Council (chaired by the Prime Minister) and is advised by the Quantum Strategic Advisory Board (SAB), expanded and refreshed in February 2025.

The Quantum Skills Taskforce (November 2023), chaired by Professor Sheila Rowan FRS, brought together over 150 stakeholders from UKRI, IoP, RAEng, techUK, UKQuantum, DSIT, DfE, and DBT. Its June 2025 report is the most comprehensive cross-institutional assessment of UK quantum workforce needs to date.

The NQTP Programme Board has representatives from EPSRC, Innovate UK, STFC, NQCC, NPL, GCHQ, MoD, and DSIT, which is a cross-departmental governance structure that few other technology programmes in the UK can match.



Part 2
Where We Will Be in the 2030s

The 2030s will be the decade in which quantum technologies move from demonstration to deployment at scale. The transition is not uniform: some technologies will be commercially embedded well before 2030, others will spend the decade in the engineering phase, and at least one development (Q-Day, the point at which a quantum computer can break RSA encryption) may arrive earlier than most institutions are prepared for. For the UK, the 2030s are simultaneously the window of maximum opportunity and maximum risk.

Understanding where the UK will be requires separating three distinct trajectories: the global hardware technology roadmap, against which UK milestones must be benchmarked; the sector-by-sector deployment picture, where different industries will encounter quantum advantage at different speeds; and the geopolitical and security dimension, where Q-Day creates an asymmetric risk that no amount of economic optimism can offset.

The Global Hardware Trajectory

The architecture of quantum computing is being redesigned around a single objective: fault-tolerant quantum computing (FTQC), where error correction is sufficiently good that a quantum computer can run long, commercially valuable algorithms reliably. Every major hardware company has now committed to a specific FTQC roadmap, and the timelines have compressed dramatically over the past two years.

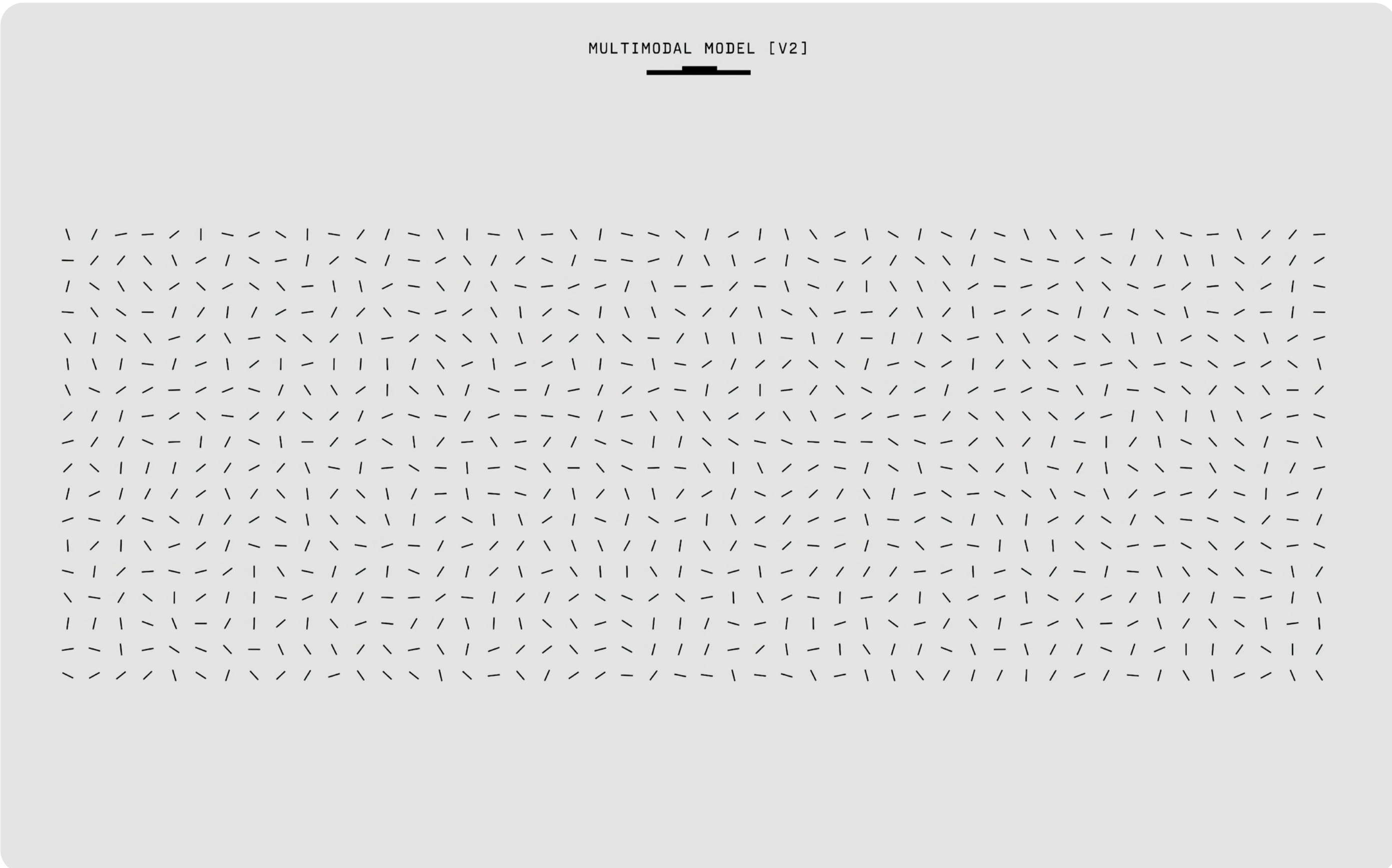
2026–27 Early FTQC	First fault-tolerant quantum computers demonstrated. IBM targets Starling system with 200 logical qubits by 2029. Quantinuum's Helios processor already achieving 48 logical qubits from 98 physical. Google completes PQC migration by 2029. Microsoft's Majorana-1 topological architecture shows 1,000-fold error rate reduction.
2028–30 Utility-Scale	Utility-scale quantum computing arrives for specific problem classes: drug simulation, materials science, financial optimisation. Forrester (2026): "Practical business uses for quantum computing are likely to emerge by 2030 — much earlier than anticipated in 2024." IBM commits to 1,000 logical qubits and quantum-centric supercomputers by early 2030s. Quantinuum targets Apollo system: fully fault-tolerant, millions of gate operations, commercial tipping point.
2031–33 First Advantage	First commercially significant quantum advantage demonstrated in real-world applications. Quantum World Congress expert consensus: utility-scale targets around 2032–2033. IBM roadmap extends to 100,000 qubits by 2033, targeting simulations that surpass classical HPC. Global Risk Institute Quantum Threat Timeline 2025: probability of a cryptographically relevant quantum computer within 10 years now 28–49% — the highest estimate in the survey's seven-year history.
2034–35 Q-Day Window	Most credible window for cryptographically relevant quantum computers capable of breaking RSA-2048. Three independent research papers in early 2026 reduced the qubit requirements for cracking RSA from 20 million to under 1 million. There are ongoing trials towards this larger window. Google has shifted its own PQC migration target from 2035 to 2029. NIST urges migration off RSA/ECC by 2030. UK government's full PQC mandate target: 2035. The 91% of UK businesses without a PQC roadmap are running out of time.

The UK's government mission target for large-scale quantum computers on UK shores by the early 2030s sits squarely within this global hardware window. The question is not whether capable machines will exist; they will. The question is whether they will be built in Britain or whether they will be American, German, or Finnish systems that the UK will access as a customer rather than a producer.

Part 3
How much the UK could gain economically

Headline Figures in Play

Projection	Source	Horizon
£200 billion added to the economy	DSIT/HM Treasury (March 2026)	By 2045
£212 total economic impact	Quantum Computing Report/DSIT	By 2045
£11 billion direct quantum GDP contribution	DSIT Industrial Strategy (November 2025)	By 2045
7% boost to national productivity	DSIT	Over 20 years
£100,000+ high-paid jobs created	DSIT	By 2045



Growth Scenarios

The government estimates that by 2045 quantum could be delivering an economic boost of £200 billion per year. It is important to convert this into its value today, especially in comparing it to the cost of the £2 billion the government has announced in March 2026 it will invest in quantum. To do this we convert all figures into Net Present Value (NPV) terms (i.e. apply the government discount rate of 3.5% per year to them to account for the greater value of having the money today than tomorrow). The £200 billion figure is likely the best potential outcome, where the UK is prepared for quantum at an early stage and the industry becomes commercially viable sooner. To account for alternative outcomes we construct three scenarios:

Three delivery scenarios for NPV modelling

- **Scenario A — Full delivery:** UK achieves large-scale quantum computing by early 2030s; leads in at least two key verticals (pharma, financial services). 100% of the £200 billion potential benefit is achieved.
- **Scenario B — Partial delivery:** UK retains research advantage but cedes commercialisation to the US and Germany. Brain drain continues. Value: 50% of the potential benefit is achieved by 2045.
- **Scenario C — Failure:** Continued brain drain; no domestic quantum stack; UK becomes a consumer, not a producer, of quantum technology. Value: 25% of the potential benefit is achieved by 2045.

Oxford Economics estimate that the Quantum industry in the UK currently delivers a total economic benefit of £435 million[1], we assume this is the starting total in our model. We use a function to simulate the S curve that characterises the economic benefits of innovation: new innovations tend to see initially slow growth in economic benefits delivered, before passing an inflection point where the rate grows significantly, before gradually plateauing.

Table X shows the results of converting the benefits and costs arising in the three scenarios into NPV terms over the 2026-2045 period. The differences between the three scenarios are stark, even when converted into NPV terms, the net benefits from the best outcome for quantum in the UK in Scenario A delivers cumulative economic benefits of £1.3 trillion over the 2026-2045 period. In the worst outcome, where the UK is late to quantum and the economy unprepared, scenario C, the cumulative benefits are just £227 billion over the same period.

	2026-2045 Cumulative	2026-2045 Average Annual
Scenario A	£1,311bn	£66bn
Scenario B	£448bn	£22bn
Scenario C	£227bn	£11bn

Sector-Specific Value

While Quantum will deliver broad economic benefits, certain sectors are likely to be most exposed. McKinsey estimates that by 2035 the quantum industry could be delivering benefits of between $900 - $2,100 billion globally, but that most of these benefits are concentrated in a few industries, such as Finance, Energy, Pharmaceuticals, and Aerospace and Defence.[2]

Quantum offers key advantages for these sectors including:

- **Financial services:** optimisation, risk modelling, and quantum-safe cryptography transition.
- **Energy:** grid optimisation, renewables balancing, materials simulation.
- **Pharmaceuticals:** accelerated drug discovery, diagnostic imaging, personalised treatments.
- **Defence and national security:** PNT resilience, secure communications, intelligence.

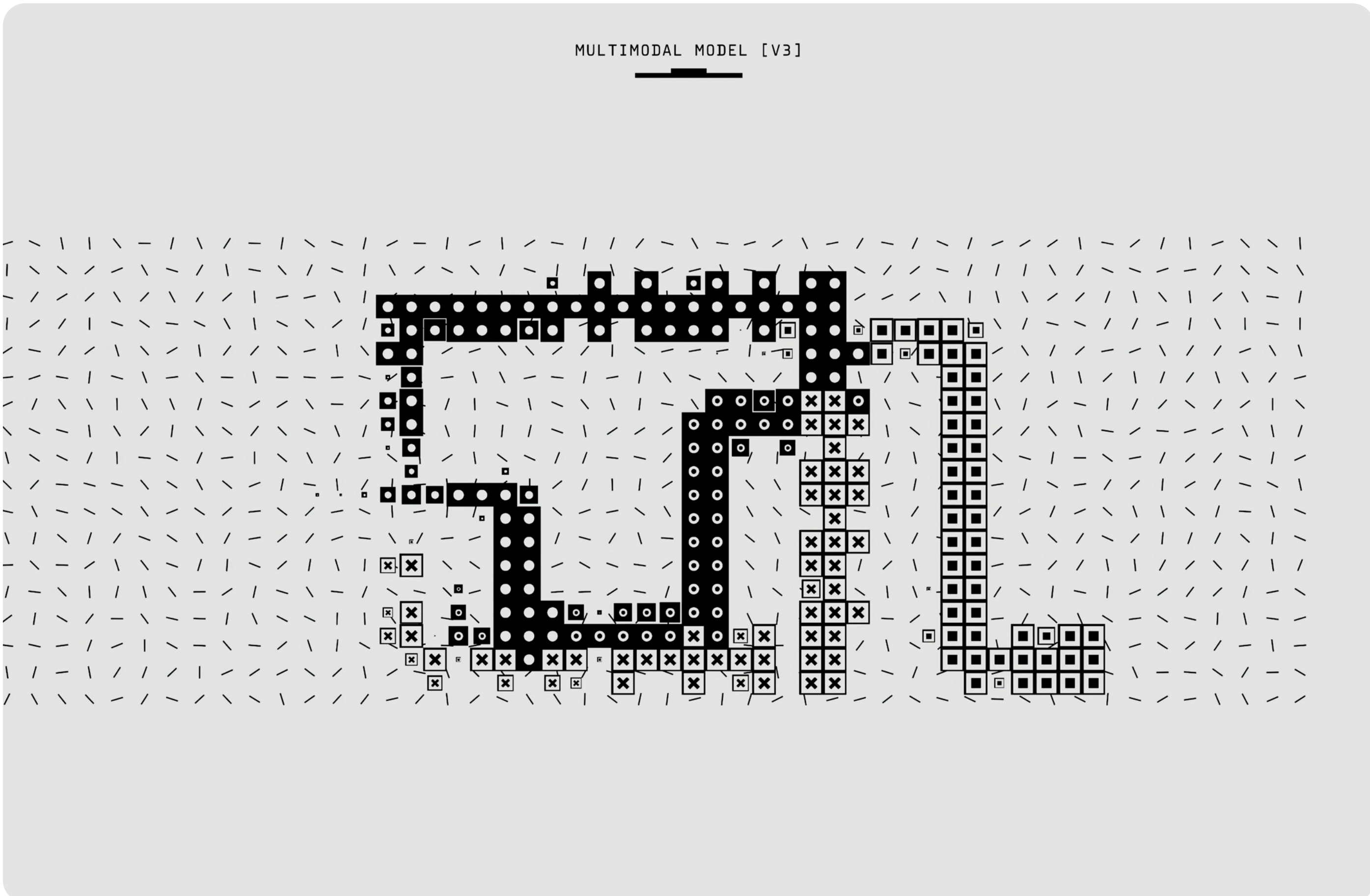
[1] https://www.oxfordeconomics.com/wp-content/uploads/2025/02/Quantum_Computing_Report_PAGES-1.pdf

[2] https://www.mckinsey.com/~/media/mckinsey/business%20functions/mckinsey%20digital/our%20insights/the%20year%20of%20quantum%20from%20concept%20to%20reality%20in%202025/quantum-monitor-2025.pdf

Table Y shows how these economic benefits are broken down by sector in a low and high scenario. We convert the global estimates from dollar into sterling terms, and then estimate what share of the global total for each sector the UK will get.[1] By far the largest beneficiary both at the global level and the UK is forecast to be the Finance industry, with estimated economic benefits of between £43 - £65 billion by 2035. The other sectors such as pharmaceuticals and Travel, Transport and Logistics are forecast to get smaller but still significant economic benefits.

Table Y: Estimated Economic Value from Quantum by 2035 by sector

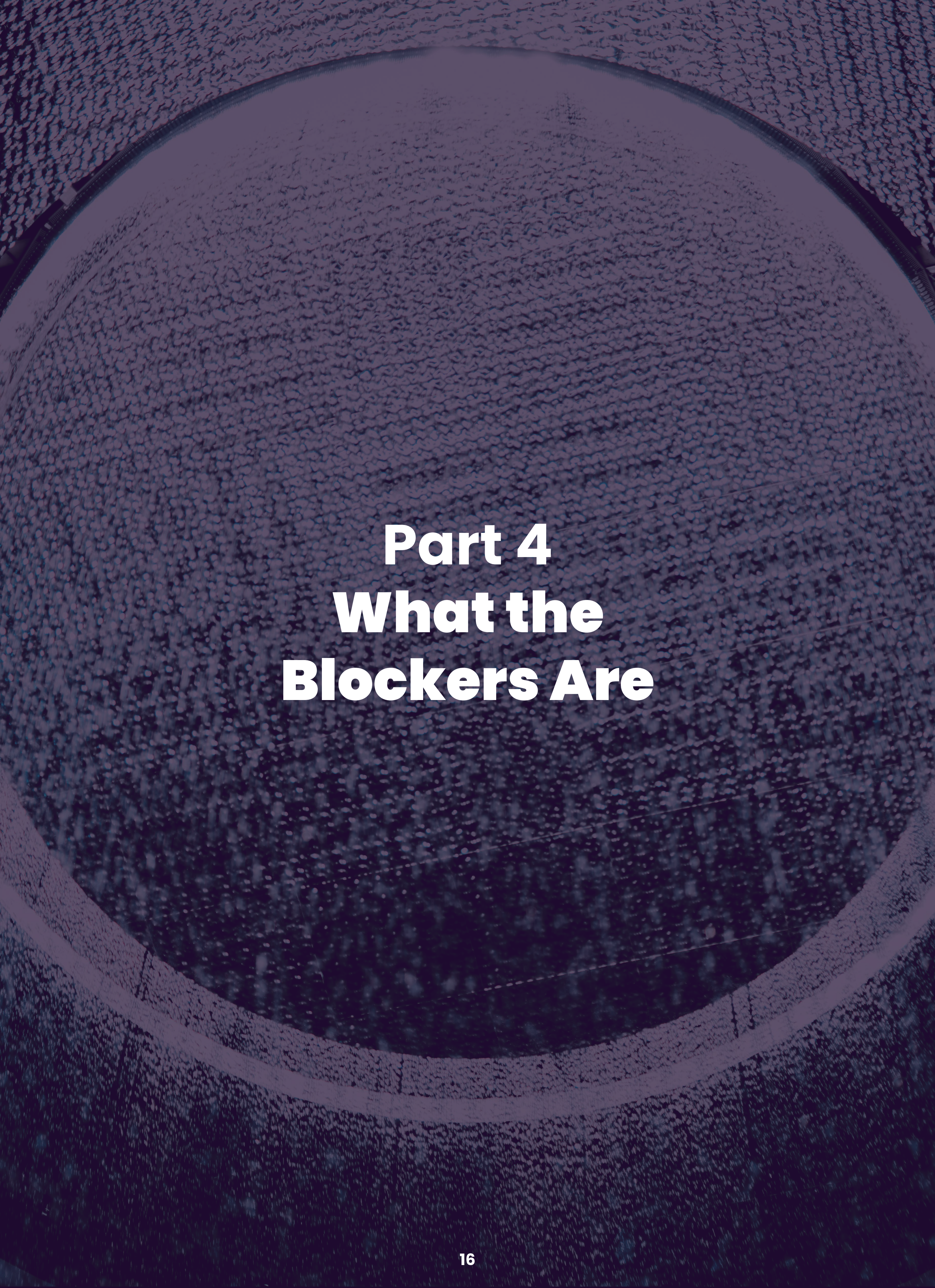
Sector	Global Economic Value (£bn)		UK Economic Value (£bn)	
	Low	High	Low	High
Financial Services	£297	£446	£43	£65
Energy and Materials[2]	£149	£372	£2	£6
Travel, Transport and Logistics	£149	£372	£4	£8
Pharmaceuticals	£52	£297	£2	£9
Advanced Industries[3]	£37	£74	£2	£4
Total	£684	£1,562	£53	£92



[1] We do this by using a range of data sources to estimate the current UK share of the global market for each sector. For example for Oil and Gas (a subset of the Energy and Materials sector) we use the UK's share of production of Oil and Gas as a proxy for its share of that industry.

[2] Energy and Materials includes: Oil & Gas, Sustainable Energy, Chemicals.

[3] Advanced Industries includes: Automotive, Aerospace and defence, advanced electronics, semiconductors, Insurance, Telecoms and media.



Part 4
What the Blockers Are

Engineering: Hardware Is Not Yet Ready to Scale

The fundamental bottlenecks to quantum commercialisation are engineering problems. The physics of quantum advantage is well established (although far from completed), and Britain is recognised as a global trailblazer for its research. The challenge is turning that physics into engineered, scalable, cost-effective systems through engineering and development, which is an area that the US and China have more advanced capacity in.

EVIDENCE BASE

Qubit fragility and error correction overhead

Current quantum computers rely on physical qubits that are inherently noisy (prone to error from exogenous factors, such as heat or electromagnetic interference). Quantum Error Correction (QEC) is essential but requires hundreds to thousands of physical qubits to protect a single logical qubit. Achieving fault-tolerant systems, which are non-negotiable for commercially valuable tasks such as drug discovery or financial optimisation requires machines with millions of physical qubits, far beyond the hundreds or low thousands available today.

Cryogenic Infrastructure

Most leading quantum platforms must operate at temperatures close to absolute zero, requiring dilution refrigerators that are expensive, bulky, sensitive to vibration, and extremely difficult to scale. Scaling to millions of qubits would require infrastructure comparable to a small data centre, devoted entirely to control systems, before a single computation is run. It is clear that without cheaper energy, financing costs, or capital inputs in the earliest stages of development, the engineering problem will continue to pervade commercial roll-out.

UK hardware position

Oxford Ionics achieved 99.99% fidelity for two-qubit gates in 2025, again proving Britain's excellence in the sector. However, the UK lacks the systems-integration and supply-chain depth (cryogenics, lasers, advanced packaging) that Germany, Finland, and the Netherlands have invested in building. British companies can design world-class components but cannot yet assemble them into scalable systems domestically.

Policy Recommendations

- **Fund a Quantum Engineering Institute:** A national-scale engineering laboratory, which would be distinct from the research hubs, dedicated to translational engineering: qubit error correction at scale, cryogenic integration, control systems architecture. Optimally, this would be modelled on Finland's VTT technical research institute.
- **Mission-focused ARIA grants for hardware:** ARIA should commission dedicated programmes on cryogenic systems engineering and materials integration, targeting the supply-chain gaps in the UK's quantum stack.
- **Establish a Quantum Manufacturing Centre:** A dedicated UK facility for quantum hardware fabrication, providing shared infrastructure that individual startups cannot afford alone — drawing on the UK's photonics cluster in Scotland and existing semiconductor expertise.
- **Domestic content in ProQure criteria:** ProQure should specify domestic manufacturing requirements for a proportion of shortlisted systems, creating demand signals that justify private investment in the UK supply chain.

The Valley of Death: Lab to Market

Britain's research commercialisation failure is not unique to quantum; it is a recurring pattern across our deep tech ecosystem. As highlighted in the Science and Technology Committee's report 'Bleeding to death: the science and technology growth emergency', there is an historic and noted failure within Britain to achieve true scale for these nascent industries. In quantum, this means that breakthroughs made in British universities travel abroad before they generate economic value. The immediate cause is the absence of translational infrastructure: the applied engineering teams, testbed facilities, industry partnerships, and patient capital that bridge the gap between a laboratory result and a deployable product.

EVIDENCE BASE

The brain drain in sharp relief

Oxford Ionics, developed from Oxford University research, was acquired by US firm IonQ for approximately $1 bn in June 2025. Universal Quantum, a Sussex spin-out, set up an additional base in Hamburg after receiving a €70 million German government contract, more than double any comparable UK commitment. PsiQuantum, originally a Bristol spinout, is scaling operations in the United States. In each case, the technology originated in British universities; the economic value accrued elsewhere.

The quantum stack gap

Scaling a quantum computer requires not just the processor but an entire ecosystem of components: cryogenic systems, lasers, photonic components, classical control hardware, advanced packaging, and software. Germany, Finland, Denmark, and the Netherlands have invested heavily in building these domestic supply chains. The UK has not. British quantum companies must source key components abroad, adding cost, lead time, and geopolitical exposure.

Structural roots: the last-mile problem

Academic incentives reward publication rather than deployment. Technology Transfer Offices at UK universities perform with similar expertise as to their US counterparts, however, the latter has access to considerably larger amounts of venture capital. Plus, there is no UK equivalent of the DARPA model of mission-driven engineering that pulls academic breakthroughs into fieldable systems. The five Quantum Research Hubs, excellent at fundamental research, therefore lack the embedded translational teams needed to convert results into products.

Policy Recommendations

- **Embed translation units in Quantum Hubs:** Small applied engineering teams (5–15 people) within each Research Hub, tasked with last-mile conversion of academic results to prototypes, funded via a ring-fenced UKRI translation budget.
- **Launch a Quantum Translational Research Organisation embedded within the National Physics Laboratory:** A time-limited, mission-focused body with 10–30 dedicated researchers tasked with moving UK quantum IP from Technology Readiness Level (TRL) 4–5 to TRL 7–8. Funded via government grant and industrial co-investment.
- **Reform TTO capacity:** DSIT should fund a Quantum Commercialisation Programme within UKRI to strengthen Technology Transfer Office capabilities specifically for quantum IP across all NQTP hub institutions.
- **Advanced Market Commitments:** Use government procurement commitments to create guaranteed demand for domestically developed quantum products. AMCs provide demand-signalling without upfront fiscal exposure.

Capital and Scale-Up

The UK's VC ecosystem is the strongest in Europe for early-stage deep tech, but structurally weak at the £50m–£500m growth-capital rounds needed to build expensive quantum hardware at scale. This gap forces British quantum companies to choose between accepting foreign acquisition or relocating to jurisdictions where large-scale funding is available. The Mansion House reforms are a step forward, but the capital mobilised to date is insufficient for the scale of the challenge.

EVIDENCE BASE

The numbers

Global quantum investment hit 3.77 billion in equity funding in the first three quarters of 2025 alone, according to SpinQ Technology, which is a 128% year-on-year increase. Yet the UK's share of late-stage rounds remains disproportionately small. The Royal Academy of Engineering's 2025 State of UK Deep Tech report found that late-stage funding accounted for only 20% of total UK VC investment, compared to 35% in the US, with over 60% of late-stage funding for UK companies coming from overseas. Closing this gap would require an additional £11 billion annually.

The pension capital opportunity

UK defined contribution pension funds hold trillions in assets but historically invest a tiny fraction in domestic ventures. The Venture Capital Compact has secured commitments from nine providers to allocate 5% of default funds to unlisted equities by 2030—this is directionally correct but too slow. IQM (Finland) demonstrated the alternative: its £320 million Series B included Finnish pension funds as anchor investors, providing patient capital unavailable through conventional VC channels.

Early positive signals

Quantum Exponential Group has launched a £300 million Quantum Technologies Fund in partnership with the Harwell Quantum Cluster. Quantinuum raised $600 million at a $10 billion valuation in September 2025. These are positive developments, but the quantum sector requires a deeper and more systematic pipeline of scale-up capital, not isolated rounds.

Policy Recommendations

- **Revive and modernise the Corporate Venturing Scheme:** The original CVS (2000–2010) channelled £132 million into 579 companies. A new CVS providing corporation tax relief for investment in early-stage UK quantum firms, co-invested by the British Business Bank and National Wealth Fund, could mobilise FTSE 100 balance sheets at speed.
- **NWF Quantum Scale-Up Fund:** The National Wealth Fund should establish a dedicated Quantum Scale-Up Fund targeting the £50m–£500m growth capital gap, structured to attract defined contribution pension fund co-investment under the Mansion House framework.
- **Ring-fence £200m for UK-only procurement competitions:** Portion a minimum of £200 million from the DSIT quantum envelope for procurement competitions open exclusively to UK-headquartered quantum companies.
- **Court sovereign and strategic investors:** DSIT and DBT should actively engage sovereign wealth funds, defence primes, and major financial services institutions (HSBC, Barclays, Lloyds) as strategic co-investors in the UK quantum ecosystem.

Skills

The UK quantum workforce problem has two dimensions. The first is a shortage of quantum specialists globally (such as physicists, QEC researchers, hardware engineers, etc) of whom there are fewer than 30,000 worldwide. The second, more acute dimension is a shortage of quantum engineers: professionals who can bridge the gap between theoretical physics and commercial deployment. Sustaining the pipeline of both strands will be critical to beginning, sustaining, and leading in the quantum space, as well as other areas of deep tech.

EVIDENCE BASE

Global and UK talent gap

McKinsey found one qualified quantum candidate for every three open positions globally. A 2026 QuEra Quantum Readiness Report found that 37% of UK organisations cited talent availability as their primary barrier. The UK Quantum Skills Taskforce (June 2025) confirmed an acute shortage of technicians across the sector, particularly in higher education. Global demand for quantum scientists and engineers is projected to exceed one million by 2030.

The quantum engineer: a new role that does not yet exist

Until recently, quantum companies recruited primarily from physics PhDs. Now, as the industry transitions from laboratory experimentation to engineering deployment, a distinct role has emerged: the quantum engineer, combining quantum mechanics with systems integration, software engineering, and product development. No university curriculum reliably produces this profile at scale. The NQCC's Quantum Computing Scalability Conference (Oxford, April 2025) identified this translational engineering gap as the primary near-term constraint on UK industry growth.

International talent exposure

The UK quantum sector is heavily dependent on international talent, although there are limitations on where new human capital can be sourced owing to national security regulations. Post-Brexit visa frictions create structural risk: the US, Singapore, and Germany are actively recruiting from the same global pool with fewer bureaucratic barriers. Any deterioration in the UK's attractiveness as a destination for global quantum talent would disproportionately damage the sector.

Policy Recommendations

- **Create a Quantum Engineering conversion MSc:** A fully funded, industry-embedded programme taking graduates from physics, electrical engineering, and software backgrounds and training them for quantum deployment roles. Partner with NQCC testbeds for hands-on training.
- **Establish a City and Guilds provided quantum apprenticeship:** DfE should work with City and Guilds to create an apprenticeship course for higher-level technical apprenticeships (Level 3, 4, and 5), to supplement engineers.
- **Scale the PhD pipeline:** Set an interim target of 500 quantum PhD studentships per year by 2028, with at least 40% in engineering-oriented programmes, not only theoretical physics.
- **Launch a Global Quantum Talent Visa:** A fast-track visa route for quantum specialists, with a dedicated quantum employer endorsement pathway and targeted outreach to the top 200 global quantum researchers.
- **Mandate industry-academia co-supervision:** ProQure contract winners should co-supervise at least two PhD students each. Innovate UK should offer a 50% salary subsidy for first quantum engineer hires at SMEs.
- **Establish a Quantum Skills Council:** A standing body co-chaired by DSIT and UKQuantum, maintaining a live skills census, accrediting curricula, and coordinating between universities, FE colleges, and employers.

Government Procurement Lag

Procurement is the most powerful lever the state has to shape emerging technology markets. By committing to buy a product at scale before it exists, governments create the demand signals that make private investment rational and allow companies to hire, build manufacturing capacity, and achieve cost reductions from scale. The UK has been too cautious in this previously, and it has a narrow window to pivot and rectify this area. The result is that British quantum companies look abroad for the large, visible contracts that justify scaling and often relocate to get them.

EVIDENCE BASE

The German contract comparison

Universal Quantum, founded at the University of Sussex, received a €70 million German government contract and subsequently relocated its primary engineering operations to Hamburg. Rather than any other factor, the contract's award size and conditions was the decisive factor in the company's decision to relocate. Germany used quantum procurement explicitly as industrial policy to anchor a national champion, whereas the UK has not done so. Indeed, there is wider industry concern that there is a blockage in realising the ambitions stated within the extant Industrial Strategy with regards to deep tech, as evidenced by OpenAI's recent halt on UK-facing inward investment. The National Quantum Strategy identifies procurement as a priority, but the execution has lagged strategy.

ProQure: a welcome but insufficient start

The ProQure programme, launched March 2026, is the most significant UK quantum procurement commitment to date, inviting bids of up to £14 million for phase one contracts. This is meaningful, but Germany's contract to Universal Quantum alone was five times larger than a ProQure phase one award. The programme also lacks explicit domestic content requirements: successful bidders need not build or operate in the UK.

Private sector adoption gap

Government procurement alone cannot create a quantum market. Research by Kyndryl found that only 4% of UK business leaders identify quantum as the most impactful near-term technology. A 2025 ISACA poll found that 41% of organisations do not plan to address quantum computing at this time and 37% have not discussed it internally. The gap between stated national quantum ambitions and enterprise investment remains enormous.

Policy Recommendations

- **Scale ProQure phase two awards:** Commit to at least two phase two contracts of £50 million or above, ring-fenced for UK-headquartered companies. The signal value of a large, visible domestic contract far exceeds the headline cost.
- **Introduce domestic content requirements:** A proportion of ProQure awards should require hardware designed and assembled in the UK, with key components sourced domestically where available, which is how Germany, France, and the US use procurement as industrial policy.
- **NHS and HMRC as early quantum adopters:** Identify two or three high-value public sector use cases, such as NHS drug discovery, HMRC fraud detection, and MoD logistics optimisation, where quantum systems can be piloted at scale. DSIT should establish Quantum Application Partnerships with NHSE and HMRC.

Cybersecurity Complacency

Within a decade, cryptographically relevant quantum computers are expected to break RSA and ECC encryption. The foundations of most online security, including banking, e-commerce, government communications, and critical national infrastructure, are based on these increasingly vulnerable protocols. Adversaries are already collecting encrypted UK data, in anticipation of decrypting it once quantum capability is achieved. The migration to post-quantum cryptography is a decade-long infrastructure programme. Most UK organisations have not started.

EVIDENCE BASE

Enterprise unpreparedness: the data

A December 2025 survey of 1,500 security professionals by the Trusted Computing Group found that 91% of businesses have no formal roadmap for migrating to quantum-safe algorithms. Eighty-one percent reported cryptographic libraries and hardware security modules unprepared for post-quantum integration. An ISACA 2025 poll found only 5% of organisations have a defined quantum computing strategy, yet 62% of technology professionals acknowledge the encryption risk. The gap between awareness and action is one of the starkest findings in the sector.

The harvest now, decrypt later threat is live

Any data encrypted today using classical methods that has a secrecy lifetime extending beyond approximately 2030 is at risk. This includes national security communications, intellectual property, financial transaction records, medical data, and diplomatic communications. The NCSC has issued guidance recommending organisations prioritise PQC migration and begin cryptographic asset inventories, but has not yet mandated action for most sectors. The US NSA mandates all new national security systems be quantum-safe by January 2027.

The migration timeline is already compressed

Upgrading cryptography across a large enterprise typically takes 5 to 10 years when accounting for budgeting, procurement, development, testing, and rollout across thousands of systems. NIST published its first PQC standards in August 2024. The EU requires all member states to begin transition by the end of 2026. The UK's full PQC mandate target is 2035. For organisations that have not started, the window to migrate before Q-Day is already compressing. Financial services and telecoms are beginning to move whilst most other sectors are not, creating a significant vulnerability window.

Policy Recommendations

- **Mandate PQC migration planning for critical national infrastructure:** The NCSC should issue a statutory directive requiring CNI operators to submit a PQC migration roadmap by the end of 2026, with interim progress reporting.
- **National Cryptographic Inventory Programme:** Fund the NCSC to provide free cryptographic asset inventorying tools and support to medium-sized enterprises and public sector bodies. Without visibility of cryptographic dependencies, organisations cannot plan migration.
- **Designate BT's quantum-secure network as critical national infrastructure:** Provide anchor procurement and create a clear pathway for quantum key distribution to be embedded in government communications.
- **Launch a Quantum Ready Business campaign:** A Cabinet Office-led public information and kite-mark scheme for organisations with credible PQC migration plans (analogous to Y2K preparation campaigns) to create boardroom urgency without additional regulation.

How TYI Quantum Can Help

TYI's Positioning

TYI Quantum combines leading cross-party public affairs experience, with the scientific know-how from scientists in the field. We are proud to be the Secretariat for the All Party Parliamentary Group for Quantum Technologies—education for policy makers on systems as nascent and complex as quantum technology is paramount, as they come online.

Policy Advocacy and Parliamentary Engagement

- We represent quantum sector clients before DSIT, DESNZ, and the Ministry of Defence.
- We support engagement between policy makers to the APPG for Quantum Technologies on quantum technologies (including opportunities and threats), quantum technological standards, and infrastructure.
- We campaign on educating Whitehall, and the wider arms of government around Q-Day security preparedness and the resulting economic opportunities.
- We engage Select Committees, including Science and Technology, Defence, and Treasury who all have active interest in quantum.

Research

- We curate rapid policy notes on discrete policy questions: procurement, capital, skills, cryptography reform, etc. These are put together by our experienced and award-winning research team in coordination with experts in quantum science and technology.
- We undertake economic modelling of the quantum opportunity—including the NPV analysis identified in Section 3.
- We prepare comparative analysis of international quantum strategies to sharpen the UK's policy debate and identify transferable models.

Stakeholder Mapping and Coalition-Building

- Our established relationships across Whitehall, Westminster, and FTSE-listed companies help our quantum clients build cross-sector coalitions for advocacy and education.
- We facilitate introductions between quantum hardware companies and financial services clients facing Q-Day exposure.

Quantum Technologies and the UK Ecosystem

TYI

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