QUANTUM INSIDER
powered by RESONANCE

NZIAT NZ Quantum Tech Ecosystem Study

July, 2026

RESONANCE

About Us

- Resonance **transforms complex information** on **rapidly evolving industries** into **actionable insights.**
- Powered by a global team of >60 professionals, we unite analysts, engineers, and industry experts to **provide foundational intelligence and strategic advisory services to our customers.**
- We focus on technologies that **will define the next century of innovation**: quantum, space, and AI/ML.
- The Resonance Intelligence Platform combines **advanced AI capabilities** with **human industry expertise**, delivering real-time, data-driven insights through a subscription model that powers informed decision-making.
- Resonance enriches this foundational intelligence to provide **strategic advisory services, having defined regional and national strategies** and **supported the world's leading tech companies.**
- Our comprehensive service ecosystem has empowered over **200 clients**, including top-tier corporations, national governments, and leading academic institutions.

Empowering 200+ Organizations from Fortune 500 to Government Agencies
Across Emerging Technology Markets



Disclaimer

- These materials have been prepared by Resonance for general informational purposes only, and they are not intended to be, and should not be construed as, financial, legal, or other advice.
- In preparing these materials, Resonance has assumed and relied upon the accuracy and completeness of any publicly available information and of any other information made available to Resonance by any third parties, and Resonance has not assumed any responsibility for any independent verification of any of such information. These materials are based upon economic, monetary, market, and other conditions as in effect on, and the information available to Resonance as of, the date hereof, unless indicated otherwise. Subsequent developments may affect the information set out in this document, and Resonance assumes no responsibility for updating or revising these materials.
- These materials may include certain statements regarding future conditions and events. These statements and the conditions and events they describe are inherently subject to uncertainty, and there can be no assurance that any of the future conditions or events described in these materials will be realized. In fact, actual future conditions and events may differ materially from what is described in these materials. Resonance assumes no responsibility for the realization (or lack of realization) of any future conditions or events described in these materials.
- Nothing herein shall constitute a commitment or undertaking on the part of Resonance to provide any service. Resonance shall have no duties or obligations to you in respect of these materials or other advice provided to you, except to the extent specifically set forth in an engagement or other written agreement, if any, that is entered into by Resonance and you.

Executive Summary (1/5)

1 Quantum technologies are scaling rapidly across computing, sensing, and communications, with commercialisation momentum accelerating globally

- Quantum Computing by far attracts the most investment and ecosystem activity, though other quantum technologies are more mature and show earlier deployment pathways (e.g., Quantum Sensing, Quantum Comms)
- Beyond Quantum Computing, Quantum Sensing enables ultra-precise navigation, imaging, and measurement, while Quantum Communications focus on secure networking and encryption
- Use cases are emerging across defence, healthcare, energy, finance, telecom, logistics, and advanced manufacturing

2 Current quantum ecosystems remain concentrated in upstream infrastructure and hardware, though application and deployment layers are beginning to emerge

- The quantum value chain spans enabling infrastructure, hardware, cloud platforms, software, and end-user applications
- Leading players including IonQ, D-Wave, Quantinuum, Bluefors, SandboxAQ, and ID Quantique specialize across different layers of the stack; players that are attracting funding are either (1) highly ambitious, long-term plays (such as millions of qubit quantum computers), or (2) critical “picks-and-shovels” infrastructure plays (such as dilution refrigerators)
- Preliminary analysis suggests New Zealand is better positioned in upstream niches such as photonics, cryogenics, lasers, sensing vs. large-scale operational Quantum Computing
- Additional opportunities may also exist in the application/deployment layer, particularly in software applications, dataset benchmarking, and workforce education

Executive Summary (2/5)

3 **Investment, technical, and research signals indicate accelerating momentum toward large-scale quantum commercialisation, with a particular focus on 2030 as a “make or break” year for Quantum Computing**

- **Global public quantum investment exceeds $50B, while quantum tech funding surpassed $9B in 2025, led primarily by Quantum Computing**
- **Major roadmaps increasingly converge around ~2030 as the expected breakthrough period for commercially meaningful fault-tolerant quantum systems**
- **Global patenting and research activity continue accelerating rapidly, led by the U.S. and China but increasingly distributed across international ecosystems**

Executive Summary (3/5)

4 New Zealand aligns most closely with Norway, Portugal, and Czechia as a pre-commercial ecosystem with strong research foundations and limited commercial activity

- **Countries successfully transitioning to commercialisation combine government-led coordination, focused investment programmes in the hundreds of millions, and specialization in a limited number of quantum niches**
- **Denmark, Ireland, and Singapore represent aspirational peers - each built their commercial layers through a single breakout company or flagship institution anchoring the ecosystem**
- **New Zealand's ecosystem is entirely research-led, with no pure-play quantum companies, no dedicated quantum VC, and no national quantum strategy yet in place**
- **The NZIAT discovery phase (2025-2026) is the critical inflection point - its outcome will determine whether NZ formalises a national quantum platform or remains fragmented**

Executive Summary (4/5)

5 **New Zealand's quantum ecosystem is distributed across four cities, anchored by photonics and quantum optics research and a small but growing set of quantum-adjacent commercial players**

- Academic and research strength is concentrated in Dunedin (Otago/Dodd-Walls), Wellington (VUW/Paihau-Robinson/MSL), and Auckland (University of Auckland), with Dodd-Walls appearing in the majority of NZ's top-cited quantum papers across photonics and quantum optics
- Public funding includes ~NZD 13.35M in identified quantum-specific commitments (primarily QTA, 2025-2029, and the NZ-Korea collaboration programme, 2025-2027). Broader science funding channels such as the Dodd-Walls Centre and Marsden Fund additionally support quantum-related research, but are not exclusively dedicated to quantum technologies
- New Zealand has no pure-play quantum companies, but a growing set of quantum-adjacent commercial players spanning photonics, cryogenics, superconducting technologies, frequency control, and fusion. Quantifi Photonics, Fabrum, Rakon, HTS-110, and OpenStar demonstrate emerging commercialisation pathways across the ecosystem
- End-sector demand is real and substantial: New Zealand's largest industries, including agriculture, transport & logistics, healthcare, manufacturing, and telecommunications, represent over 40% of GDP (2025 estimates) and have clear quantum use cases across computing, sensing, and communications, but currently lack domestic supply-side capability to address them

Executive Summary (5/5)

6 **New Zealand's strong academic foundations provide a solid starting point, but global leaders demonstrate that quantum success requires coordinated development across the full ecosystem**

- Leading ecosystems translate research excellence into economic outcomes through targeted investments in infrastructure, industry engagement, talent, and commercialisation support
- New Zealand is well positioned to build on its strengths in photonics, sensing, cryogenics, and advanced materials, areas where smaller ecosystems can establish internationally competitive niches
- The proposed initiatives address key ecosystem gaps in commercialisation, industry adoption, infrastructure, and talent, while prioritising photonics, sensing, cryogenics, and advanced materials, areas where New Zealand already possesses research excellence and the greatest potential to establish globally competitive positions
- Priority interventions focus on strengthening talent pipelines, accelerating TRL 4-6 commercialisation, and increasing access to global quantum infrastructure and expertise
- Industry-facing programmes in telecommunications, cybersecurity, critical infrastructure, and advanced manufacturing can help stimulate demand and create pathways for commercial adoption

New Zealand combines distributed research clusters with strong academic and end sector capabilities

Non-exhaustive



+12 Academic and research

- 6 Universities
- +6 Research centres

+7 Financing

- 2 Public funding
- +5 Private capital

+7 Quantum companies

- +7 Adjacent technologies

+20 End sectors

- +5 Agriculture, Energy & Environmental Resilience
- +5 Maritime, Transportation & Industrial Systems
- +5 Healthcare, Life Sciences & Advanced Materials
- +5 Space, Defence, & Telecommunications

Source: The Quantum Insider

Note: Organisations were selected based on their relevance to New Zealand's quantum ecosystem, including research activity, funding participation, commercialisation activity, technology development, and potential as future quantum end users. The Otago Quantum Optics Group is a leading university-based quantum research group and is included within the University of Otago rather than shown as a standalone research centre

New Zealand has solid academic foundations but lags leading ecosystems in commercialisation, adoption, and infrastructure

				Early-stage	Developing		Advanced
Success factors	**New Zealand**	**Portugal**	**Norway**	**Czech Republic**	**Ireland**	**Denmark**	**Singapore**
National strategy	No dedicated national quantum strategy (NZIAT discovery phase underway)	Portuguese Quantum Initiative (PQI)	National Quantum Initiative Technology (NQTI)	Czech National Quantum Communication Infrastructure	National Quantum Strategy (2023)	National Strategy for Quantum Technology + NQCP (2023)	National Quantum Strategy (2024)
Funding scale	~NZD $13.35 M quantum-specific funding	€50M+	€100M+ programmes	€50M+	€100M+ National Quantum Strategy	DKK 2.7B (~€360M)	S$300M+ National Quantum Strategy
Academic excellence	Dodd-Walls Centre, Victoria University, University of Auckland	Instituto Superior Técnico, University of Porto	NTNU, University of Oslo	Czech Technical University, Charles University	Trinity College Dublin, Tyndall Institute	Niels Bohr Institute, DTU	CQT, NUS, NTU
Industry adoption	Limited pilots, few end-user programmes. Early stage PQC awareness	Some engagement in telecom and photonics. Limited PQC	Energy and maritime use cases. Early assessment of PQC	Research-led ecosystem with early stage PQC	Enterprise pilots in pharma, finance, semiconductors. Private sector PQC	Novo Nordisk, Maersk, Microsoft collaborations. Private sector PQC	DBS, Singtel, ST Engineering, GovTech pilots. Public and private sector PQC
Talent pipeline	Strong PhD production but limited industrial absorption	Quantum education programmes through PQI	Dedicated quantum courses at NTNU	Strong physics and engineering graduates	Quantum 2030 workforce programmes	MSc/PhD pipeline through NQCP and Quantum DTU	National Quantum-Safe Network Plus workforce initiatives
International Partnerships	Australia, UK, US, Korea collaborations; Dodd-Walls highly international	Quantum Flagship participation	Quantum Flagship participation; Nordic collaborations	Quantum Flagship participation	IBM, Microsoft, Horizon Europe, US partnerships	Microsoft, NVIDIA, Atom Computing, EU Quantum Flagship	MIT, Oxford, NUS, National Quantum Office partnerships
Infrastructure and testbeds	Limited dedicated facilities	Emerging photonics facilities	National quantum labs emerging	National quantum research infrastructure	Tyndall facilities and national testbeds	NQCP quantum campus, fabrication and test facilities	National Quantum Computing Hub, telecom testbeds
Ecosystem connectivity	Weak links between academia, startups and industry	Growing but fragmented ecosystem	Strong collaboration in energy and maritime	Improving collaboration networks through EU programmes	Strong linkages via Tyndall and research centers	Strong collaboration through NQCP and Quantum Denmark	Highly connected ecosystem coordinated by NQO
Supply chain advantage	Limited domestic quantum supply chain; geographically isolated	Access to EU photonics ecosystems	Strength in advanced materials, cryogenics, and energy	Central European manufacturing base and engineering talent	Access to EU market and semiconductor ecosystem	Strong position in advanced materials, and photonics	Strategic position within Asian electronics
Corporate champions & VC ecosystem	Limited quantum-focused VC activity; no quantum champion	Small but growing deep-tech investment ecosystem	Limited VC depth; few quantum champions	Emerging startup ecosystem; limited specialist capital	Equal1, Horizon Quantum, strong multinational presence	Novo Nordisk Foundation, active VC/PE ecosystem	Active corporate champions and venture funding

Source: The Quantum Insider, press release, Resonance analysis
Note: New Zealand funding includes QTA (NZD $12M) and NZ-Korea quantum funding (NZD $1.35M); excludes broader science funding not exclusively dedicated to quantum; New Zealand academic excellence institutions selection based on concentration of quantum publications, research activity, and participation in national quantum initiatives; New Zealand's limited domestic supply chain also encourages specialization in globally competitive niches and international partnerships

New Zealand can accelerate quantum ecosystem development through a coordinated supply-and-demand strategy

Detailed next

1 Supply creation

"Without supply, innovation stalls"

A Expand Research Excellence

Increase support for leading quantum research programmes and strengthen New Zealand's capabilities in photonics, sensing, and quantum-adjacent technologies

B Accelerate Commercialisation

Improve the conversion of research into startups, IP, and commercial products through dedicated commercialisation support and funding

C Develop Quantum Workforce

Build a pipeline of researchers, engineers, and industry professionals with quantum-relevant skills across academia and industry

D Establish Infrastructure & Testbeds

Develop shared facilities, test environments, and demonstration platforms to support technology development and validation

2 Demand generation

"Without demand, talent leaves"

A Launch Infrastructure Challenge Program

Deploy Quantum Sensing pilots across critical infrastructure sectors such as transport, utilities, water, and environmental monitoring

B Build Telecom & Quantum Communications Readiness

Partner with Spark and other telecom stakeholders to pilot quantum-safe communications, precision timing, PQC migration, and future quantum networking capabilities

C Accelerate Quantum Computing Adoption

Facilitate industry access to Quantum Computing through cloud access, leasing models, strategic partnerships, and pilot programmes with global quantum providers

D Build Encryption & Quantum Security Readiness

Prepare government and industry for Q-Day through quantum-safe cryptography adoption, security assessments, standards compliance, and workforce training

1B. Targeted interventions can help New Zealand bridge the TRL 4-6 commercialization gap

TRL 1-3
Proof of concept

TRL 4-6
Prototype development

TRL 7-9
Commercial track

Challenges

- **Expertise gap:** Researchers require engineering and product-development support
- **Infrastructure gap:** Access to fabrication, testing, and commercial platforms is limited
- **Funding gap:** Grants fall short at TRL 4–6, before technologies are ready for VC capital

	Potential mechanisms	Illustrative partners	Expected impact
International Translation Partnerships	• Researcher exchanges and visiting experts • Joint commercialization programs • Access to engineering, fabrication, and product-development expertise	Australia, UK, US, Canada, Singapore, South Korea	• Faster TRL progression • Access to specialist expertise • Stronger international networks
Access to Commercial Infrastructure & Industry Networks	• Access to quantum computing platforms • Shared testing and prototyping facilities • Industry pilot programs and technical support	IBM, D-Wave, IonQ, Quantinuum, Rigetti	• Faster prototype development • Reduced infrastructure barriers • Earlier industry engagement
Translation & Commercialization Fund	• Competition-based funding • Industry participation requirements • Support for engineering, testing, and prototype development	Innovate UK, NQIT	• More spin-outs and startups • Increased commercial readiness • Improved attractiveness for private investment

1C. Building a quantum workforce requires interventions across multiple talent levels and career stages

	Quantum Awareness & Industry Training	Quantum Technician & Engineering Pathway	Advanced Research & Commercialization Fellows
Target audience	Industry professionals, engineers, government agencies, corporates	Technicians, engineers, photonics specialists, electronics graduates	MSc, PhD and postdoctoral researchers
Programs	• Short courses on quantum fundamentals • Executive education for industry leaders • PQC and quantum cybersecurity certifications • Industry workshops with end users	• One-year quantum technician certificate • Cryogenics and photonics training • Quantum hardware apprenticeships • Industry placements at Quantifi Photonics, QTA, and research labs	• Industry-funded PhDs • Commercialization fellowships • International exchange programs • Startup residency programs
Examples	• Florida's Palm Beach State College Quantum Innovation Center • IBM Quantum Educators Program • MIT xPRO quantum courses	• Palm Beach State College quantum systems certification • Quantum Technology Training Program (Germany) • Quantum Computing Inc. workforce partnerships	• Mitacs (Canada) • Quantum Delta NL talent programs • UK National Quantum Technologies Programme CDT network
Timeline	6-12 months	1-3 years	3-5 years
Expected outcomes	• Increased awareness of quantum technologies across industry and government • Improved readiness for quantum-safe cybersecurity and future technology deployment	• Stronger links between academia, vocational education, and industry • Reduced dependence on overseas talent • Improved startup scaling capability	• Higher researcher retention • Increased startup formation • Stronger university-industry collaboration

1D. A testbed program should bridge academic R&D and sector-led commercialization, under a dedicated coordinating entity

1. Dedicated leadership body

- **NZIAT likely acts as funder, not operator**
- **A central entity should coordinate** themes, grants, industry engagement and reviews
- **Likely candidate: Dodd-Walls Centre**, to be confirmed
- **Role: "connective tissue"** between government, academia and end users

2. Two funding tracks

Academic R&D track

- **Supports research aligned with existing NZ strengths** and QTA themes
- **Focus areas could include sensing, maritime,** agriculture, rare earths, environment, health or defence
- **Objective:** accelerate research with commercialization potential

Applied innovation track

- **Supports prototypes, pilots and de-risking** with sector users
- **Companies may participate as partners,** not necessarily direct grant recipients
- **Objective:** translate quantum into real-world use cases

3. Thematic allocation and governance

- **Funding should be allocated against priority themes,** not open-ended equipment wish lists (energy, energy resilience, sustainability, national security, disaster preparedness)
- **Themes should align with NZ national priorities a**nd existing research strengths
- **Infrastructure spend should be selective,** as hardware-heavy projects can quickly absorb the budget

4. Staged reviews and spending curve

Typical structure: 5-year program

- **Year 1:** light-touch review
- **Year 2.5:** mid-term review
- **Year 5:** final review / renewal decision
- **Spending likely front-loaded,** then tapering over time

Testbeds may take different forms depending on the selected priority area, ranging from software platforms and shared datasets to specialised hardware and sector-specific demonstrators

2B. Leading telecom operators and enterprises are already piloting quantum communication technologies

Use case & example	Partners	What was done	Outcome
Quantum-safe banking communications	IBM HSBC	• **Assessed exposure of banking systems** to future quantum threats • **Tested post-quantum cryptography across payments**, digital banking, and sensitive communications • **Evaluated migration pathways** for critical financial infrastructure	• **Established a roadmap for quantum-safe migration** • **Improved resilience of banking communications** and transactions • **Increased preparedness for future cybersecurity** and regulatory requirements
Quantum-secure government communications	SK telecom ICHNP	• **Deployed quantum-safe security technologies** across government communications networks • **Tested secure mobile communications** for public-sector users • **Integrated quantum security solutions** into existing telecom infrastructure	• **Enhanced protection of sensitive government communications** • **Demonstrated operational deployment** of quantum-safe technologies • **Accelerated adoption of quantum security** across public institutions
Quantum-safe telecom infrastructure	Telefónica LUXQUANTA POLITÉCNICA UNIVERSIDAD POLITÉCNICA DE MADRID	• **Piloted QKD and quantum-safe networking** over operational fiber networks • **Tested secure key distribution** and encrypted communications • **Validated interoperability** with existing telecom and enterprise infrastructure	• **Demonstrated feasibility of quantum-secure communications** on existing networks • **Developed technical expertise in quantum networking technologies** • **Established foundations for future quantum communication services**

2C. Cloud-based access models provide the most practical pathway for New Zealand to develop quantum computing capabilities

Strategic recommendations for NZ

Model family	What it provides	Operating model	Best suited to
QCaaS	**Remote job submission on shared systems**, with no hardware ownership	**The provider handles calibration**, maintenance, uptime, upgrades and scheduling	**Learning, benchmarking, early R&D** and trying multiple modalities
Reserved capacity	**A specific machine or block of time**, held exclusively	**Vendor-operated cloud**, with the customer reserving the window	**Queue-sensitive work, demos, workshops** and time-sensitive runs
Premium / co-design	**Cloud access** plus vendor scientists and application support	**Vendor-operated,** with onboarding and workflow assistance	**Teams needing expert help** to build and deploy applications
Lease	**A temporary right to use hardware** or capacity	**An on-prem physical lease**, or a multi-year capacity agreement	**Fixed-term access** without an outright purchase
On-prem managed	**A system sited close to the customer** and vendor-serviced	**Between lease or purchase and QCaaS**; the vendor remains heavily involved	**Proximity and control without the full ownership** burden
Colocation / sovereign	**Direct, secure or region-specific access**, without owning the machine	**Vendor hardware hosted** in a neutral or in-region data centre	**Latency, security or data-residency requirements**
Purchase	**Hands-on access**, local security and deep stack control	**Customer owns and operates**; requires facilities, integration and staff	**Workforce development and strategic ownership** of the stack

Leasing may become attractive once demand is established and priority technology pathways emerge, but is likely premature given the current scale and maturity of New Zealand's ecosystem

Investment in quantum should prioritize differentiated capabilities and near-term value creation

Why invest now?

Build on existing strengths
- **Focus on areas** where NZ already has research and industrial capabilities
- **Specialize in selected niches** rather than competing across the full quantum value chain

Capture first-mover advantages
- **Establish NZ as a recognised hub for selected capabilities** (e.g., sensing, photonics, testbeds)
- **Attract international partners, talent and investment**

Preserve future strategic optionality
- **Early investment creates the capability to participate in future quantum value chains** as markets mature
- **Waiting reduces NZ's ability to influence future ecosystems** and capture emerging opportunities

Key caveats

Limited funding (~NZ$70m)
- **Insufficient to compete** across multiple technology areas
- **Hardware-heavy infrastructure could rapidly consume available funding**

Risk of moving too early
- **Some applications remain immature**
- **Returns may take years** to materialize

Execution risk
- **Requires strong coordination,** leadership and industry participation
- **Funding dispersed across too many initiatives** is unlikely to achieve critical mass

What success looks like

Focus on one or two strategic niches
- **Align investments with NZ strengths** and national priorities

Prioritize low-capital, high-impact initiatives
- **Cloud-based quantum computing access**
- **International partnerships**
- **Shared testbeds**
- **Innovation and commercialization programmes**

Measure outcomes
- **Industry pilots** launched
- **International partnerships** established
- **Commercial prototypes** demonstrated
- **New companies and investment** attracted
- **Research translated** into real-world deployment

TQI experts considered the main issue for New Zealand is "how to invest" rather than "whether to invest". With a constrained budget, success depends on focused specialization, selective investment and translating research into commercial applications

Glossary

- **AQ** Algorithmic Qubits
- **CQT** Centre for Quantum Technologies (Singapore)
- **DARPA** Defence Advanced Research Projects Agency (USA)
- **DLR** German Aerospace Centre
- **DOE** U.S. Department of Energy
- **FCT** Portuguese Foundation for Science and Technology
- **FTQC** Fault-Tolerant Quantum Computing
- **HPC** High-Performance Computing
- **HTS** High-Temperature Superconductor
- **INL** International Iberian Nanotechnology Laboratory (Spain)
- **KAIST** Korea Advanced Institute of Science and Technology
- **LIDAR** Light Detection and Ranging
- **MBIE** Ministry of Business, Innovation and Employment (NZ)
- **MEG** Magnetoencephalography
- **MRI** Magnetic Resonance Imaging
- **MSL** Measurement Standards Laboratory of New Zealand
- **NBI** Niels Bohr Institute (Denmark)
- **NIST** National Institute of Standards and Technology (USA)
- **NMR** Nuclear Magnetic Resonance
- **NPL** National Physical Laboratory (UK)
- **NQCP** National Quantum Computing Programme (Denmark)
- **NQO** National Quantum Office (Singapore)
- **NQPI** National Quantum Processor Initiative (Singapore)
- **NQS** National Quantum Strategy (Singapore)
- **NTU** Nanyang Technological University (Singapore)
- **NUS** National University of Singapore
- **NV** Nitrogen-Vacancy (centre in diamond)
- **NZIAT** New Zealand Institute for Advanced Technologies
- **PNT** Positioning, Navigation, and Timing
- **PQC** Post-Quantum Cryptography
- **QC** Quantum Computing
- **QKD** Quantum Key Distribution
- **QPU** Quantum Processing Unit
- **QRNG** Quantum Random Number Generator
- **QSA** Quantum Secure Authentication
- **QTA** Quantum Technologies Aotearoa (NZ)
- **SFI** Science Foundation Ireland
- **SQUID** Superconducting Quantum Interference Device
- **TRL** Technology Readiness Level
- **VLQ** Very Large Quantum computer (Czech Republic)
- **VUW** Victoria University of Wellington (NZ)

QUANTUM INSIDER
powered by RESONANCE

1. What is Quantum

Quantum technology is an umbrella term with three core pillars, enabling many different cross-sector applications

Non-exhaustive

Pillars	Description
Quantum Computing	Exponential processing for optimization, simulation, cryptography
Quantum Sensing	Ultra-precise measurement for navigation, imaging, materials
Quantum Communications	Unhackable encryption via quantum key distribution

Sectors & Applications – *non-exhaustive*

Defence & Security	Energy & Materials	Pharma & Life Sciences	Finance
Cryptography, threat detection, Quantum Sensing for navigation	Battery optimization, catalyst design, grid management	Drug discovery, protein folding, personalized medicine	Portfolio optimization, risk modeling, fraud detection

Different Quantum Computing modalities present distinct trade-offs across performance, scalability, and commercialisation

Quantum Computing

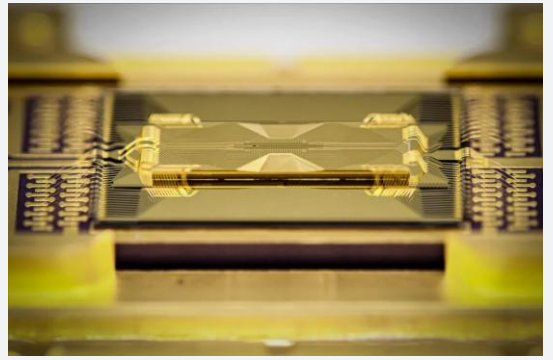
Qubit Technology	What to Know	TRL
Trapped Ion	Uses individual atoms controlled by electric fields. Highly precise, stable, and operates in standard commercial environments.	**8-9**
Superconducting	Based on electrical circuits cooled to near absolute zero. Offers fast processing speeds but depends on highly specialised cryogenic systems.	**8-9**
Neutral Atom	Uses laser-controlled atoms. Scalable architecture, but still in early commercial stages.	**5-7**
Photonic	Uses particles of light (photons) to carry and process quantum information. Large-scale computing performance is limited due to technical challenges.	**6-8**
Diamond (Nitrogen-Vacancy Centers)	Uses defects in diamond to store and control quantum states. Very long coherence at room temperature, but difficult to scale into large processors.	**3-5**
Semiconductor Spins	Uses electron or hole spins in semiconductor quantum dots. Compact and compatible with existing chip manufacturing but maintaining coherence and control is challenging.	**4-6**

Not all qubit types are equally advanced.

Trapped Ion and **Superconducting** qubits are currently the most mature, with commercial systems available for purchase or for use on cloud platforms.



IonQ's Tempo system delivers higher gate speeds and mid-circuit measurement-crucial for unlocking larger problem sets and reducing time-to-solution.



IonQ's AQ64 system delivers 64 algorithmic qubits, leveraging trapped-ion technology in a compact, scalable architecture.

Quantum computers are chip-based with different architectures and fabrication methods.

1 Early Quantum Computing adoption is concentrated across pharma, materials science, finance, and automotive leaders

Quantum Computing

Non-exhaustive

Life Science	Material Science	Finance	Automotive	Others
MERCK, BAYER, inCerebro, astex pharmaceuticals, BIOX-VISION, CHUGAI, novonesis, MAYO CLINIC, Cleveland Clinic, Daiichi-Sankyo	MITSUBISHI CHEMICAL GROUP, BASF We create chemistry, Hitachi Metals, Ltd., STRATUM AI, OTI, CORNING, DIC, DAICEL Sustainable Value Together	JPMorganChase, BBVA, Moody's, Morgan Stanley, citi, WELLS FARGO, HSBC, Goldman Sachs, MUFG, Fidelity, Allianz	VOLKSWAGEN GROUP, BMW GROUP, STELLANTIS, gm, DAIMLER, TOYOTA, HYUNDAI MOTOR GROUP, Ford, NISSAN MOTOR COMPANY, VOLVO, DENSO, NOVONIX, AISIN	AIRBUS, Capgemini, aramco, CISCO, Deutsche Telekom, EQUINIX, FOXCONN, BEYOND LIMITS, Avast
Drug discovery and molecular simulation, accelerating the design of new therapeutics.	Materials and chemical discovery, breakthroughs in areas like advanced alloys, superconductors, batteries.	Optimization and financial modelling: portfolio optimization, risk analysis, and fraud detection.	Fleet routing of autonomous vehicles, battery material simulation, supply chain optimization.	Network security, infrastructure optimization, industry-specific simulations.

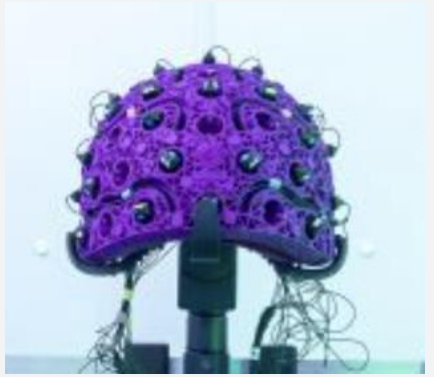
2 Quantum Sensing is emerging as a near-term commercial opportunity across timing, imaging, navigation, and monitoring applications

Quantum Sensing

Quantum Sensor Type	Use Cases and Industry Relevance	Underlying Technology	TRL
Atomic Clocks	Precision timing for telecommunications, finance, navigation, and GPS synchronisation. Critical for resilient networks and emerging quantum communication timing.	Cold atom optical clocks, trapped ion clocks, commercial microwave atomic clocks	**8-9**
Quantum Magnetometers	Medical imaging (MEG), geophysical surveys, infrastructure monitoring, non-destructive testing, submarine detection and surveillance. Strong commercial pathway.	NV centres, optically pumped magnetometers, SQUIDs	**7-9**
Photon Detectors	Enabling components for quantum communication, astronomy, remote sensing and LIDAR in autonomous systems and satellites. Already deployed.	Superconducting nanowire detectors, avalanche photodiodes	**8-9**
Quantum Gravimeters	Underground resource exploration, construction, civil engineering and environmental monitoring. Commercial cold atom gravimeters exist today.	Cold atom interferometry	**6-8**
Quantum Inertial Sensors	GPS-denied navigation for aviation, submarines, spacecraft and autonomous vehicles. Strong defence pull; commercial systems emerging.	Cold atom interferometry, matter wave gyroscopes	**4-7**
Quantum Electrometers	RF signal detection, EM field sensing and cybersecurity monitoring in congested or noisy environments. Fast-moving research, early prototypes.	Rydberg atom sensors, NV centres	**3-5**
Quantum Thermometers	Thermal monitoring for cryogenics, semiconductor fabrication, biomedical systems and quantum hardware development. Primarily research and specialist use today.	NV centres, superconducting circuits, trapped ions	**3-5**



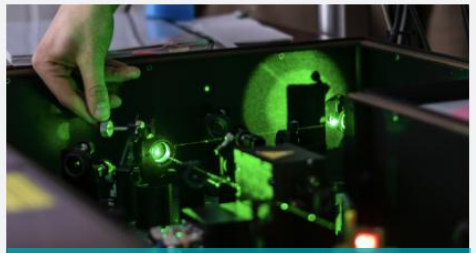
Atomic gravimeter from Vector Atomics - for maritime navigation

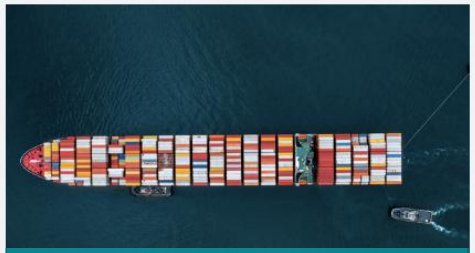


Optically-pumped Magnetometer headset by Cerca for brain prognostics and diagnostics

2 Quantum Sensing serves diverse end markets, though adoption maturity varies across verticals

Quantum Sensing

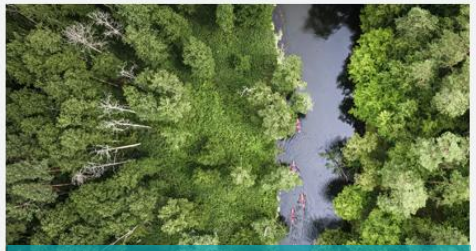

Sensing & Detection (Generalist)


Navigation


Communication


Aerospace


Energy


Environmental Monitoring


Mining / Geology


Material Science


Industrial / Manufacturing


Healthcare / Biomedical

2 Quantum Sensing end-use markets | Key Vertical Applications (1/2)

Quantum Sensing

	Sensing & Detection	Navigation	Communication	Aerospace	Energy
Need	**Detect signals too weak or small for conventional sensors.**	**Navigate reliably when GPS is unavailable, e.g. underwater, underground, or in contested airspace.**	**Secure, interference-resistant transmission for next-generation networks.**	**Precise sensing in space and high-altitude environments where conventional instruments degrade.**	**Pinpoint where energy is lost inside power systems to improve efficiency and prevent failures.**
Key Applications	• Mapping material defects and anomalies at nanoscale resolution • Measuring EM fields, temperature, and pressure in extreme environments • Identifying trace chemicals for security and quality assurance	• Drift-free positioning for submarines and aircraft using quantum inertial sensors • Satellite-independent location via Earth's natural magnetic field variations • Precise geomagnetic mapping to keep global navigation infrastructure accurate	• Quantum-secured signals distributed over standard commercial telecom fiber • Ultra-sensitive detection and localization of signal interference or jamming • Long-distance quantum encryption via single-photon detection	• Mapping Earth's magnetic field from orbit with greater accuracy than current satellites • Spacecraft orientation and anomaly detection using quantum-grade magnetic sensing • Environmental and inertial monitoring for defence platforms under strict size and weight constraints	• Imaging energy losses in power electronics components at microscopic resolution • High-precision battery current monitoring across wide ranges in EVs and grid storage • Early detection of degradation in advanced power semiconductors before failures occur

2 Quantum Sensing end-use markets | Key Vertical Applications (2/2)

Quantum Sensing

	Environmental Monitoring	Mining / Geology	Material Science	Industrial / Manufacturing	Healthcare / Biomedical
Need	**Detect pollutants and environmental changes at levels conventional instruments cannot reach.**	**Find subsurface minerals and structures without disruptive or costly drilling.**	**Characterize advanced materials, e.g. 2D materials, superconductors, beyond what classical instruments can resolve.**	**Find defects in manufactured components invisible to conventional inspection tools.**	**Detect faint biological signals for clinical diagnosis, without cryogenic lab infrastructure.**
Key Applications	• Trace chemical detection in water at sensitivity far beyond standard field instruments • Non-invasive mapping of groundwater movement, soil composition, and buried contaminants • Monitoring geophysical signals linked to volcanic activity or seismic risk	• Drone-based magnetic surveys to map ore bodies with greater resolution than conventional airborne methods • Combined gravity and magnetic sensing to build 3D images of underground geology • High-resolution rock analysis for geological dating and formation mapping	• Imaging magnetic domain structures and spin dynamics in next-generation 2D and spintronic materials • Probing how materials respond to heat, stress, and EM fields during development • Non-destructive testing of semiconductor and magnetic device layers to accelerate R&D	• Non-destructive imaging of electrical faults inside multi-layer chips without cutting them • Detecting microscopic cracks in metals and electronics during production • Quality control for advanced semiconductor packaging where optical inspection falls short	• Room-temperature brain and heart imaging using quantum sensors, removing the need for large cooling systems • Tracking magnetic nanoparticles inside the body for cancer detection and drug delivery monitoring • Cellular-level measurement of temperature and pH for early-stage disease research

3 Quantum communication is evolving through layered technologies spanning PQC, QKD, and future quantum networking

Quantum Communication

Technology	Use Cases and Industry Relevance	Underlying Technology	TRL
Post Quantum Cryptography (PQC)	Quantum resistant encryption for government, finance, telecom and cloud services. Supports large-scale migration of existing digital systems.	Classical cryptography upgraded with lattice, hash or multivariate algorithms.	**9**
Quantum Key Distribution (QKD) - Fibre	Ultra secure point-to-point communication for defence, banking, data centres and telecom networks. Deployed in Europe, China and Japan.	Photonic encoding using phase, polarisation or time bin states transmitted over optical fibre.	**9**
Quantum Random Number Generators (QRNGs)	High-entropy randomness for key generation in security modules, financial systems and telecom equipment. Commercial products widely available.	Vacuum fluctuation sources, single photon detection and photonic noise processes.	**8**
Satellite QKD (Free Space)	Long distance secure links for strategic communication, inter city backbones and remote regions. Demonstrated via space to ground links.	Free space photonics using weak coherent pulses or entangled photon sources.	**7**
Entanglement Distribution / Quantum Repeaters	Extends QKD range and enables future quantum networking. Needed for scalable quantum communication but early in deployment.	Atomic ensembles, trapped ions, NV centres and quantum memory platforms.	**5**
Quantum Secure Authentication (QSA)	Uses unclonable quantum states for authentication of devices, critical infrastructure and supply chains. Research with targeted pilots.	Photonic physical unclonability, quantum fingerprinting techniques.	**4**
Quantum Internet Protocols	Long horizon technologies for distributed Quantum Computing, networked sensing and secure multi party computation.	Entanglement swapping, quantum memories and distributed quantum processors.	**3**



Rack-mounted Clavis XG QKD system by IDQ for long-range (up to 150km)



Quantum Random Number Generator chip for a wide range of applications

QUANTUM INSIDER
powered by RESONANCE

2. Company and Supply Chain Profiling

Quantum ecosystems span a highly fragmented value chain from hardware infrastructure to enterprise applications

Non-exhaustive

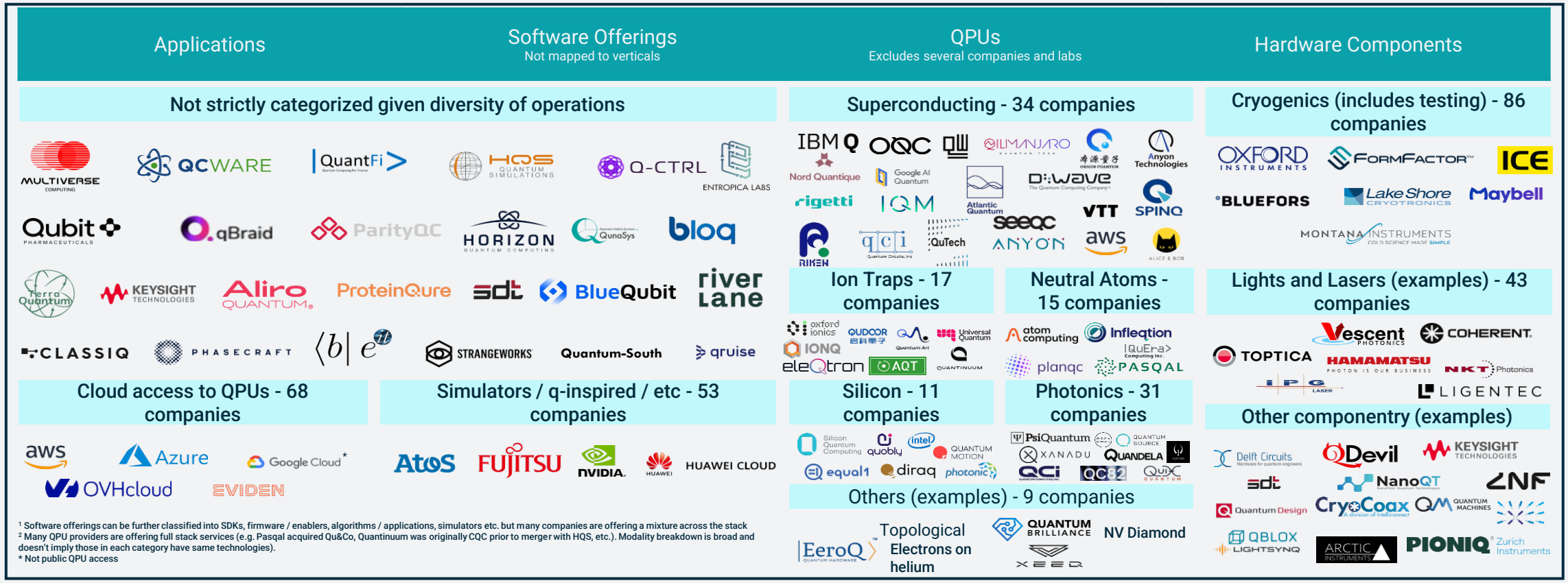
Materials & components	Cryogenics / photonics / control electronics	Semiconductor & fabrication infrastructure	Quantum devices & subsystems	Systems integration	Cloud / networking / infrastructure	End customers
• Quantum-grade materials & photonic components • Lasers, optics & RF/microwave components elementSIX DE BEERS GROUP HAMAMATSU COHERENT	• Cryogenic systems & dilution refrigerators • Quantum control electronics & RF signal chains BLUEFORS QBLOX Zurich Instruments	• Chip fabrication & foundry services • Packaging, photonics & semiconductor processes skywater Infineon GlobalFoundries	• QPUs, atomic clocks & quantum sensors • QKD systems, quantum memories & photonic devices IONQ IBM D-Wave The Quantum Computing Company	• Hybrid quantum systems & HPC integration • Enterprise deployment & orchestration layers CISCO DELL Technologies EQUINIX	• Quantum cloud access & data center infrastructure • Telecom, networking & secure communications infrastructure NOKIA Azure aws	Enterprise, government & research end users Applications across telecom, defence, healthcare & finance AstraZeneca AIRBUS Goldman Sachs

Revenue generation today remains concentrated in upstream layers such as materials, photonics, cryogenics, and semiconductor infrastructure, where commercial demand and established customer bases already exist

Source: Quantum Insider Intelligence platform.

Hundreds of companies operate across the quantum ecosystem, from hardware to applications

Non-exhaustive



[1] Software offerings can be further classified into SDKs, firmware / enablers, algorithms / applications, simulators etc. but many companies are offering a mixture across the stack
[2] Many QPU providers are offering full stack services (e.g. Pasqal acquired Qu&Co, Quantinuum was originally CQC prior to merger with HQS, etc.). Modality breakdown is broad and doesn't imply those in each category have same technologies).
* Not public QPU access

The following slides provide detailed profiles of leading quantum companies selected as commercial benchmarks, showcasing strong technical progress, credible commercialisation roadmaps, and broad validation through strategic partnerships and customer adoption

IonQ is rapidly emerging as a leading full-stack trapped-ion quantum platform



Quantum Computing

Strategic partnerships

- **AWS, Azure, and Google Cloud distribution partnerships**
- **U.S. Air Force, DARPA, and DOE quantum programmes**
- **QuantumBasel and KISTI national quantum deployments**

Full-stack trapped-ion quantum platform

Key market developments

- **~$3.5B raised and publicly traded**
- **Q1 2026 revenue reached $64.7M**; FY2026 guidance increased to $270M
- **Aggressive M&A strategy** across networking, sensing, and security
- **Expanded internationally** across Europe and Asia with 12+ global offices

Key quantum milestones

- 2023: Forte trapped-ion platform commercial launch
- 2025: AQ64 milestone achieved ahead of schedule
- 2025: 99.99% two-qubit gate fidelity world record
- 2026+: 256-qubit roadmap and fault-tolerant architecture published

Company summary

Founded in 2015, IonQ is the leading publicly traded pure-play quantum company focused on trapped-ion computing. The company is expanding beyond quantum hardware into networking, sensing, and security through aggressive acquisitions, hyperscaler partnerships, and international deployments across Europe and Asia

Lessons for New Zealand

Demonstrates that trapped-ion Quantum Computing is progressing beyond R&D, with meaningful revenues, global customers, and commercial deployment through hyperscaler and government partnerships

D-Wave has emerged as the leading commercial quantum annealing company with growing enterprise traction

D-Wave The Quantum Computing Company™



Quantum Computing

Strategic partnerships

- **Mastercard, NTT DOCOMO, and BASF enterprise collaborations**
- **AWS Braket distribution partnership**
- **SkyWater manufacturing partnership**

Dual-platform annealing and gate-model quantum platform

Key market developments

- **Public listing on NYSE** through SPAC merger in 2022
- **Acquired Quantum Circuits** to expand into gate-model Quantum Computing
- **~$588M cash and securities balance as of Q1 2026 and record Q1 2026 bookings of $33.4M (+1,994% YoY)**

Key quantum milestones

- 2010: First commercial quantum computer launched
- 2020: Advantage platform released (5,000+ qubits)
- 2025: Quantum supremacy claim in materials simulation
- 2026+: Gate-model roadmap launched after Quantum Circuits acquisition

Company summary

Founded in 1999, D-Wave is the leading commercial quantum annealing company and one of the few quantum players actively selling on-prem quantum systems. The company focuses on optimization workloads across enterprise and government markets while expanding into gate-model Quantum Computing through the acquisition of Quantum Circuits

Lessons for New Zealand

Demonstrates that superconducting/annealing Quantum Computing can already support commercial enterprise applications, generating customer demand and recurring revenues today

Quantinuum is positioning itself as a leading fault-tolerant trapped-ion quantum platform

QUANTINUUM



Quantum Computing

Strategic partnerships

- **JPMorgan, Airbus, and BMW enterprise collaborations**
- **NVIDIA and Microsoft Azure Quantum partnerships**
- **DARPA, DOE, and UK government programmes**

Full-stack trapped-ion Quantum Computing and quantum cybersecurity platform

Key market developments

- **Formed through Honeywell Quantum Solutions and Cambridge Quantum merger**
- **Expanded into quantum cybersecurity** through Quantum Origin
- **Secured major government and enterprise contracts**
- **International deployments** across the U.S., Europe, and Japan

Key quantum milestones

- 2020: H1 trapped-ion platform launched
- 2023: Logical qubit and error-correction breakthroughs demonstrated
- 2024: H2 system achieved industry-leading fidelity benchmarks
- 2025+: Fault-tolerant trapped-ion roadmap expanded

Company summary

Formed in 2021 through the merger of Honeywell Quantum Solutions and Cambridge Quantum, Quantinuum is a leading trapped-ion quantum company combining high-fidelity hardware with software and cybersecurity capabilities. The company focuses on fault-tolerant Quantum Computing, enterprise applications, and quantum-safe security solutions

Lessons for New Zealand

Demonstrates that quantum-safe cybersecurity represent one of the most mature and deployable quantum market opportunities today

SandboxAQ combines Quantum Sensing and AI to target near-term enterprise and defence applications

SANDBOXAQ

Quantum Sensing

Strategic partnerships

- **Google Cloud, NVIDIA, and AWS collaborations**
- **Partnerships with Mayo Clinic and major pharma companies**
- **U.S. government and national security engagements**

AI and Quantum Sensing enterprise platform

Key market developments

- **Spun out of Alphabet in 2022**
- **Raised $1B+ funding** from investors including Google, NVIDIA
- **Expanded across cybersecurity, sensing, navigation, and biopharma markets**
- **Commercial deployments** across enterprise and government customers

Key quantum milestones

- 2022: SandboxAQ launched as independent company
- 2023: Expanded AQNav Quantum Sensing platform
- 2024: Scaled quantum simulation and sensing applications
- 2025+: Expanded AI + Quantum Sensing product suite

Company summary

SandboxAQ is an AI and quantum company spun out of Alphabet in 2022, focused on enterprise and government applications across sensing, navigation, cybersecurity, and life sciences. The company combines AI with Quantum Sensing and quantum-inspired technologies to commercialize near-term applications without developing Quantum Computing hardware

Lessons for New Zealand

Demonstrates that alternative Quantum Computing modalities can achieve commercial traction well before fault-tolerant Quantum Computing is reached

AOSense is positioning itself as a leading Quantum Sensing and atomic instrumentation provider

Quantum Sensing

Strategic partnerships

- U.S. Department of Defence and DARPA programmes
- Collaborations with aerospace and national security agencies
- Partnerships across navigation, timing, and sensing applications

Quantum Sensing and atomic instrumentation platform

Key market developments

- Expanded into defence and aerospace Quantum Sensing applications
- Secured government-backed navigation and timing programmes
- Commercialized atomic clocks and inertial sensing systems

Key quantum milestones

- 2010s: Expanded Quantum Sensing and atomic clock platforms
- 2020s: Advanced inertial and navigation sensing systems
- 2025+: Scaling quantum positioning and timing applications

Company summary

Founded in 2004, AOSense is a Quantum Sensing company focused on atomic clocks, inertial sensing, and precision navigation technologies for defence, aerospace, and scientific applications. The company leverages atom interferometry and quantum measurement systems to develop next-generation positioning, navigation, and timing capabilities

Lessons for New Zealand

Demonstrates the commercial potential of quantum sensing technologies in navigation, timing, aerospace, and defence applications

Source: The Quantum Insider

ID Quantique specializes in quantum-secure communications and quantum cryptography infrastructure

Quantum Communications

Strategic partnerships

- **Partnerships with telecom operators, governments, and financial institutions**
- **Collaborations with SK Telecom and global cybersecurity players**

Quantum Communications and quantum-safe cybersecurity platform

Key market developments

- **Expanded globally** across telecom and critical infrastructure markets
- **Acquired controlling stake by IonQ** in 2025
- **Commercial deployments of quantum-safe communication systems**

Key quantum milestones

- 2000s: Commercialized quantum key distribution systems
- 2010s: Expanded quantum-secure networking platforms
- 2025+: Integrated into IonQ's quantum networking roadmap

Company summary

Founded in 2001 in Switzerland, ID Quantique is a leading Quantum Communications company focused on quantum key distribution, quantum-safe encryption, and secure networking infrastructure. The company provides quantum-secure communications technologies for telecom operators, governments, and critical infrastructure customers worldwide

Lessons for New Zealand

Demonstrates that quantum communications and quantum-safe cybersecurity represent one of the most mature and commercially deployable quantum market opportunities today

Bluefors has become the leading cryogenic infrastructure provider enabling the scaling of Quantum Computing systems

Enabling Technology

Strategic partnerships

- **IBM, Google, and Rigetti superconducting quantum collaborations**
- **Quantum Computing deployments** across national labs and research institutions

Quantum cryogenic infrastructure and dilution refrigeration leader

Key market developments

- **Expanded globally** across Europe, North America, and Asia
- **Established as a leading supplier of dilution** refrigerators for Quantum Computing
- **Rapid scaling** driven by growth in superconducting quantum deployments

Key quantum milestones

- 2011: First quantum-focused dilution refrigerator deployments
- 2019: Expanded into large-scale quantum systems
- 2022: Released next-generation LD/XLD platforms
- 2024+: Supporting fault-tolerant quantum scaling

Company summary

Founded in Finland as a spinout from the Low Temperature Lab of Aalto University, Bluefors is the leading supplier of dilution refrigerators and cryogenic infrastructure for Quantum Computing applications. The company provides critical cooling systems enabling superconducting and other low-temperature quantum architectures, supporting many of the world's leading quantum hardware developers and research institutions

Lessons for New Zealand

Demonstrates that enabling technologies such as cryogenics can become globally competitive businesses by supplying critical infrastructure to the broader quantum ecosystem

Source: The Quantum Insider

New Zealand should focus on selective positions within the global quantum value chain

New Zealand should focus on advantaged niches rather than the full quantum stack

Preliminary

Materials & components	Cryogenics, photonics and control electronics	Semiconductor and fabrication	Quantum devices and subsystems	Systems integration and deployment	Cloud, networking and secure infrastructure	End users and applications
●●●○ Medium to high	●●●○ Medium to high	●○○○ Low to medium	●●○○ Medium	●●○○ Medium	●●○○ Medium	●●●● High
Strong position in photonics, specialist materials, and precision components supporting quantum value chains	Strong fit with lasers, optics, photonics, instrumentation and quantum research capability.	Large scale foundry capability is unlikely, but niche prototyping, packaging or photonic fabrication may be relevant.	Relevant for sensing, timing, photonics and selected device development.	Potential fit in applied deployments, field trials, and sector-specific integration rather than large-scale systems leadership.	More likely as a user, integrator and secure communications partner than as a full infrastructure provider.	Strong alignment with agriculture, environment, space, infrastructure, health and maritime needs.

Why these ratings

High-rated segments align with New Zealand's strengths in photonics, cryogenics, sensing, and end-user industries, while lower-rated segments typically require large-scale fabrication capacity, hyperscale infrastructure, or capital investment beyond New Zealand's current ecosystem

Implications for New Zealand

New Zealand’s quantum strategy should prioritize enabling technologies, systems integration, and application-led commercialisation, while leveraging international partnerships for large-scale computing, fabrication, and networking infrastructure

QUANTUM INSIDER
powered by RESONANCE

3. Global market and Technology Signals

Quantum market signals point toward accelerating commercialisation and ecosystem scaling

Market

- **Global public quantum investment exceeds ~$50B**
- **Private Quantum Tech (computing, sensing, communications, security, software) funding surpassed ~$9B in 2025,** with Quantum Computing representing ~85%
- Major players including IBM, IonQ, Quantinuum, PsiQuantum, and D-Wave have secured **$1B+ in funding across multiple QC modalities**

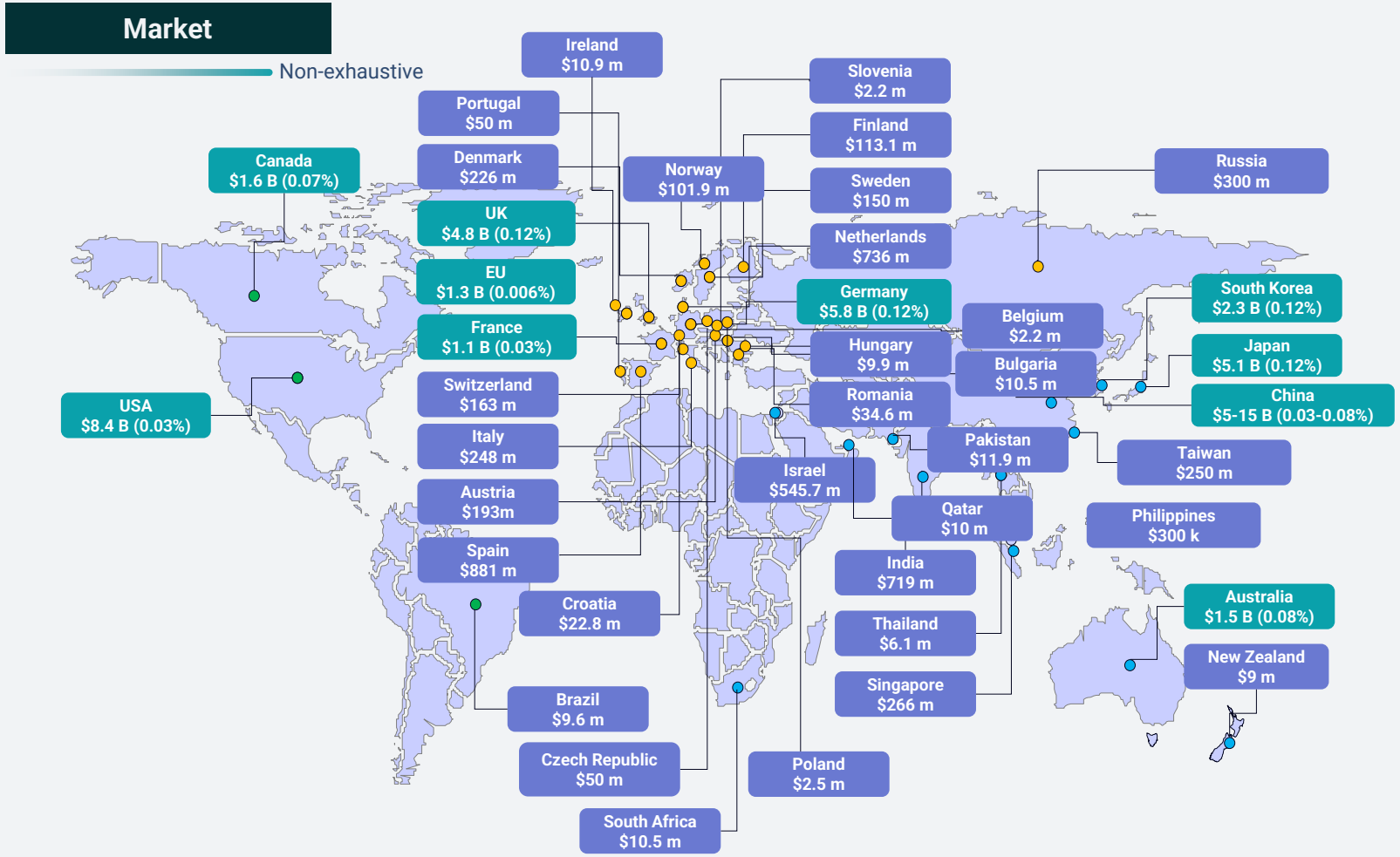
Technology

- Recent breakthroughs include Google's Willow chip, IBM's FTQC roadmap, IonQ's **99.99% gate fidelity**, and Alice & Bob's FTQC progress
- **Most major roadmaps converge around ~2030** as the expected commercialisation breakthrough period
- **Physical qubit counts continue increasing rapidly** alongside advances in error correction and logical qubits
- **Big Tech players** including Google, Microsoft, AWS, and NVIDIA **continue accelerating quantum investment** and infrastructure development

Research & Patents

- **Global quantum patenting surpassed ~73k cumulative filings** between 2021-2025
- **China and the U.S. dominate** global patent activity and research output
- **Patent filings roughly doubled over the last five years**, with the strongest increase in 2025
- **Cross-border patenting through WIPO and EPO** highlights growing international commercialisation ambitions

Global public investment in quantum technologies exceeds $50 billion, led by the U.S., China, and Europe



- ✓ Global interest in quantum technology has surged, with regional leaders beginning to emerge.
- ✓ Of 33 governments with significant quantum initiatives, over 20 have established formal, coordinated policies.
- ✓ Public funding commitments exceed $50 billion

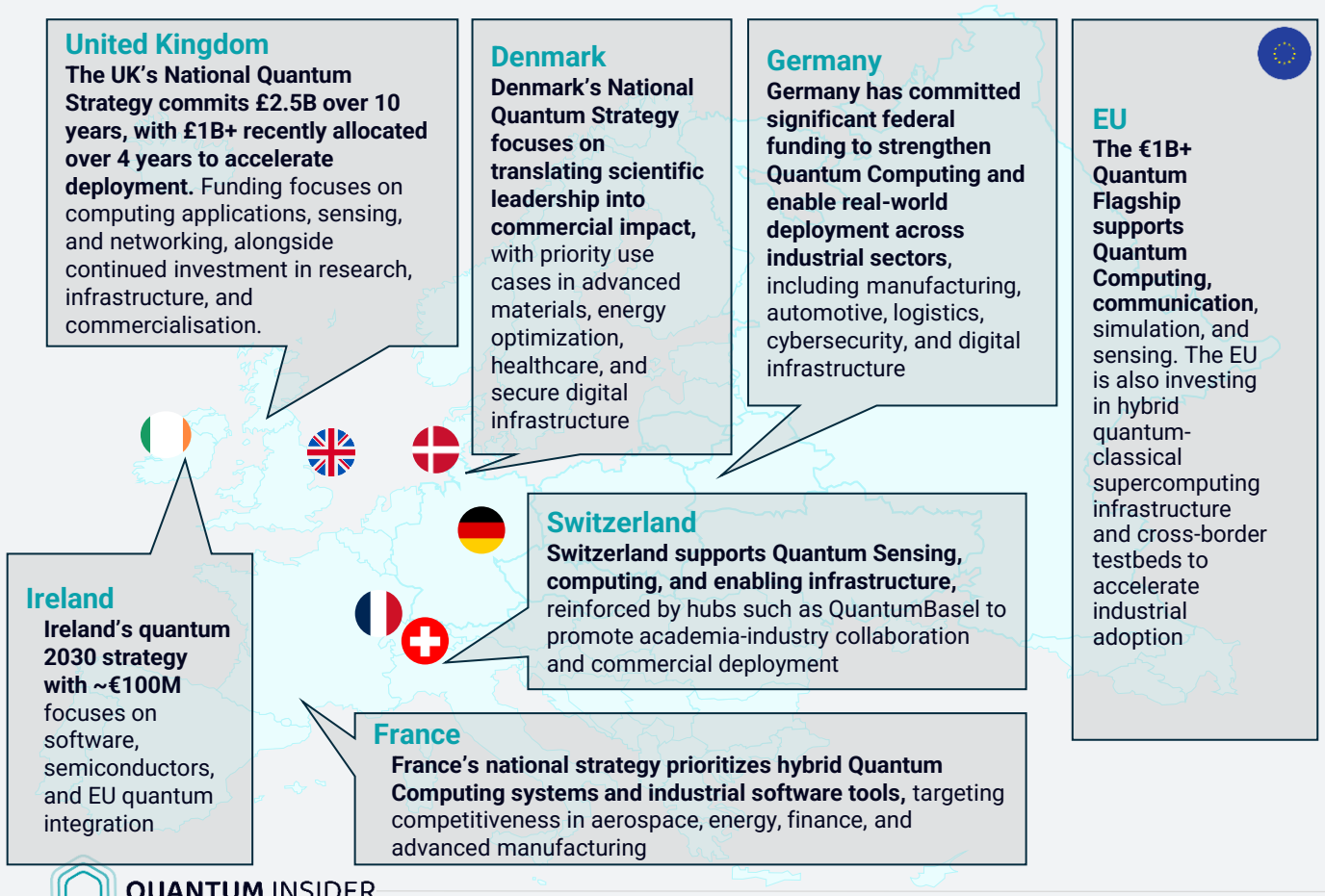
* Estimates are based on our analysis of data from Resonance's Quantum Insider Intelligence platform. **USA provides limited forward-looking visibility however its annual commitments have typically been around $1B since NQI founding.

European and RoW regional quantum ecosystems and national initiatives are gaining momentum

Market

Non-exhaustive

EU & European National Governments



United Kingdom

The UK's National Quantum Strategy commits £2.5B over 10 years, with £1B+ recently allocated over 4 years to accelerate deployment. Funding focuses on computing applications, sensing, and networking, alongside continued investment in research, infrastructure, and commercialisation.

Denmark

Denmark's National Quantum Strategy focuses on translating scientific leadership into commercial impact, with priority use cases in advanced materials, energy optimization, healthcare, and secure digital infrastructure

Germany

Germany has committed significant federal funding to strengthen Quantum Computing and enable real-world deployment across industrial sectors, including manufacturing, automotive, logistics, cybersecurity, and digital infrastructure

EU

The €1B+ Quantum Flagship supports Quantum Computing, communication, simulation, and sensing. The EU is also investing in hybrid quantum-classical supercomputing infrastructure and cross-border testbeds to accelerate industrial adoption

Switzerland

Switzerland supports Quantum Sensing, computing, and enabling infrastructure, reinforced by hubs such as QuantumBasel to promote academia-industry collaboration and commercial deployment

Ireland

Ireland's quantum 2030 strategy with ~€100M focuses on software, semiconductors, and EU quantum integration

France

France's national strategy prioritizes hybrid Quantum Computing systems and industrial software tools, targeting competitiveness in aerospace, energy, finance, and advanced manufacturing

Rest of World - National Governments

Since the 2018 National Quantum Initiative Act, the U.S. has **invested over $1.8 billion in foundational funding, with current annual spending at around $800 million to $1 billion** across several departments. Intent for additional **$2 billion QC** incentives announced May 2026

South Korea is investing ~$2.3 billion to scale domestic Quantum Computing to ~1,000 qubits by 2031 and develop quantum sensors for strategic sectors like batteries, semiconductors, and medical technologies

Australia's National Quantum Strategy commits ~AUD 1B+ in anchor investments and ecosystem funding, including large-scale computing initiatives and applied quantum infrastructure

China is making large-scale state-backed investments in Quantum Computing and Quantum Communications, aligned with national priorities in secure infrastructure, advanced technology leadership, and strategic autonomy

India's National Quantum Mission supports long-term quantum capability development, with emphasis on computing hardware, secure communications, and domestic ecosystem scaling

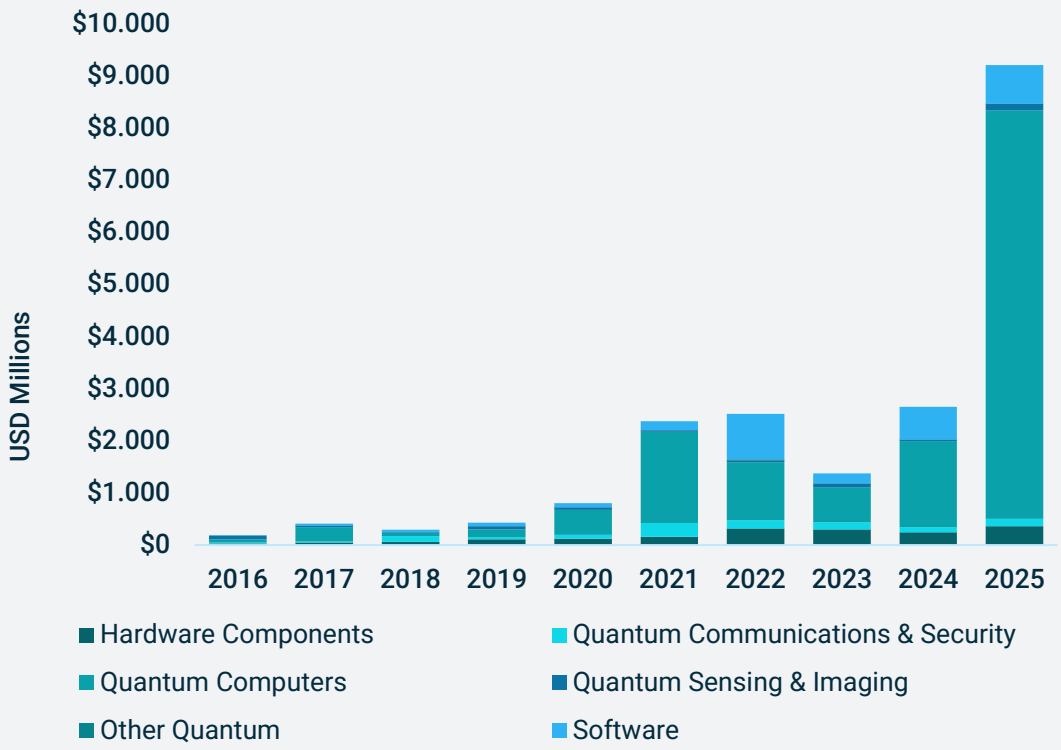
Singapore's National Quantum Strategy with ~SGD300M focuses on computing, communications, sensing, and commercialisation

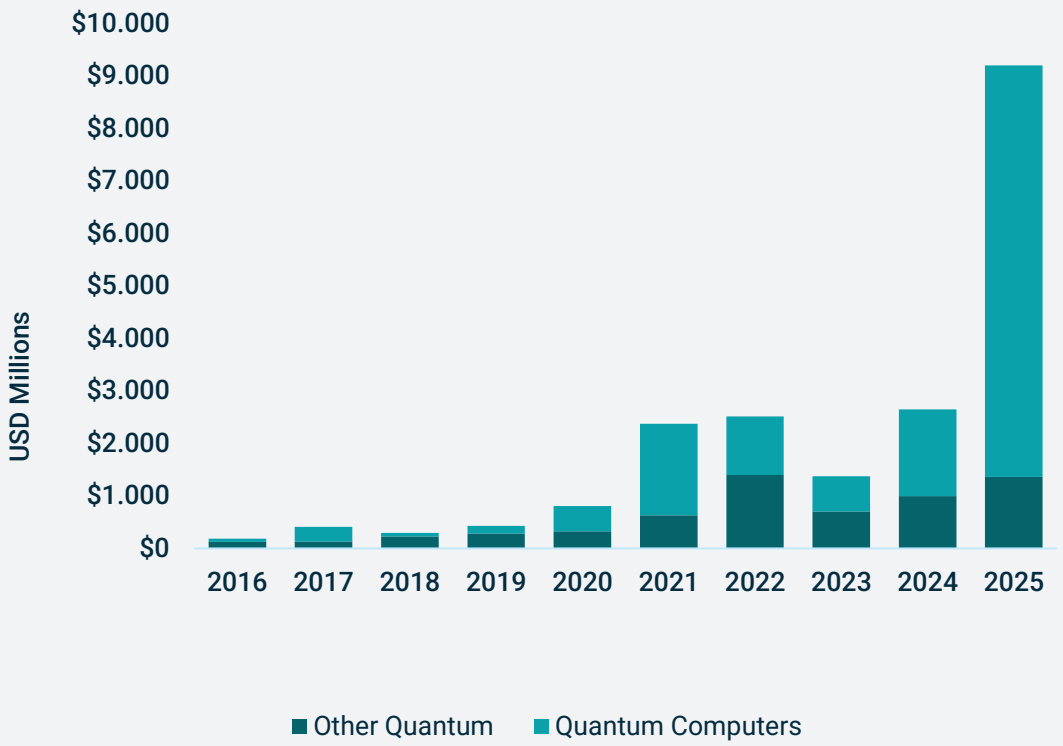
Source: Quantum Insider Intelligence platform

Quantum Tech funding has already passed $9B in 2025, with Quantum Computing representing ~85%

Market

Capital Raised per year



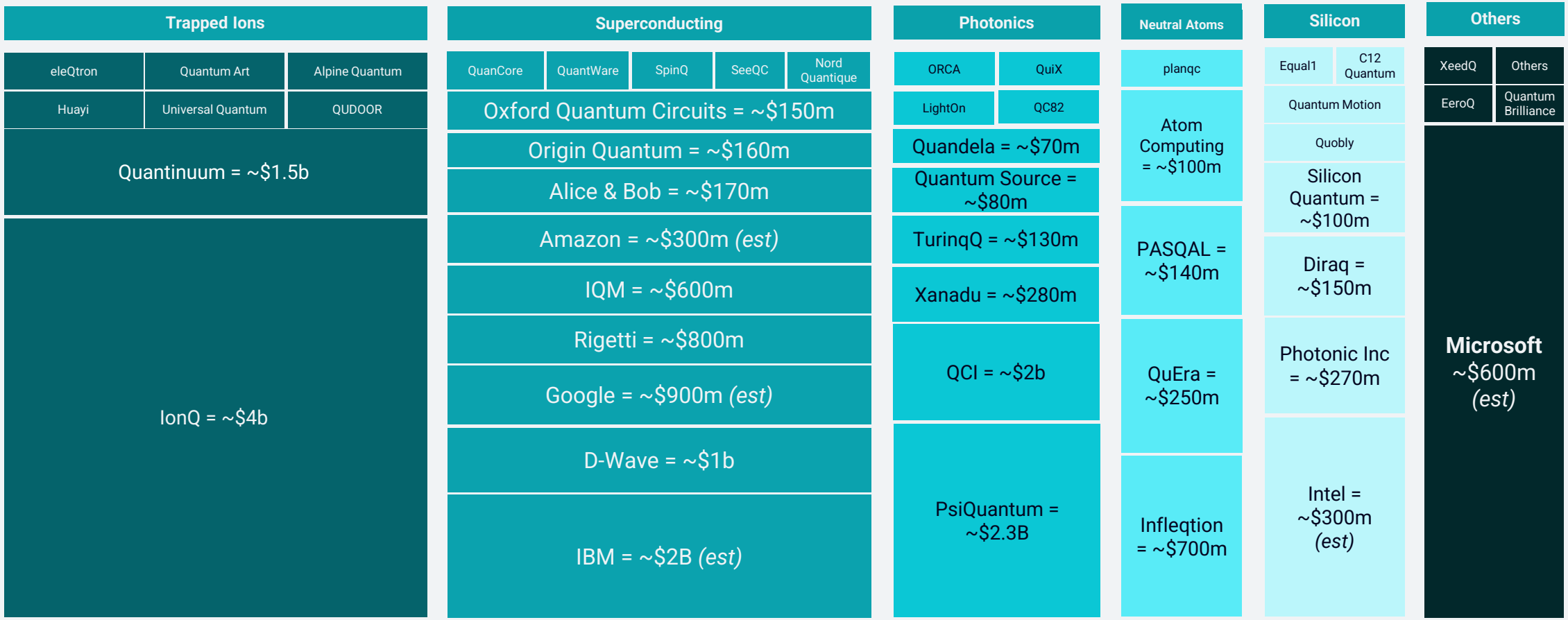


Notes: Includes post IPO funding

Along with the international investment momentum, major Quantum Computing firms are securing billion-dollar investments

Market

Non-exhaustive



Source: The Quantum Insider.

Notes: Total Funding raised; Tile size not to scale; Larger company fundings (e.g., IBM, Microsoft) are estimates

Past year breakthroughs typically involve progress on promised roadmaps or new entrants to the quantum race

Technology



Google

December 2024

Google introduced its 105-qubit Quantum Computing chip, Willow, achieving below-threshold quantum error correction.



IONQ *

September 2025

IonQ Achieves 99.99% Two-Qubit Gate Performance



IBM *

June 2025

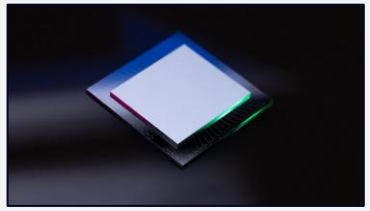
IBM Offers Roadmap Toward Large-Scale, Fault-Tolerant Quantum Computer at New IBM Quantum Data Center



ALICE & BOB *

October 2025

Alice & Bob Shortens Timeline to Quantum Computing Applications in Healthcare and Agriculture



aws

February 2025

AWS Unveils Ocelot, its first Quantum Computing Chip.



QUANTINUM *

November 2025

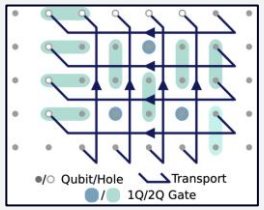
Quantinuum launches Helios, described as the world's most accurate general-purpose commercial quantum computer



Pasqal

June 2025

Pasqal Releases 2025 Roadmap Showcasing Upgradable Platform from Today's Quantum Solutions to Tomorrow's Fault-Tolerant Systems



Infleqtion

September 2025

Infleqtion Unveils New Architecture to Accelerate Its Quantum Computing Roadmap To Achieve 1000 Logical Qubits by 2030

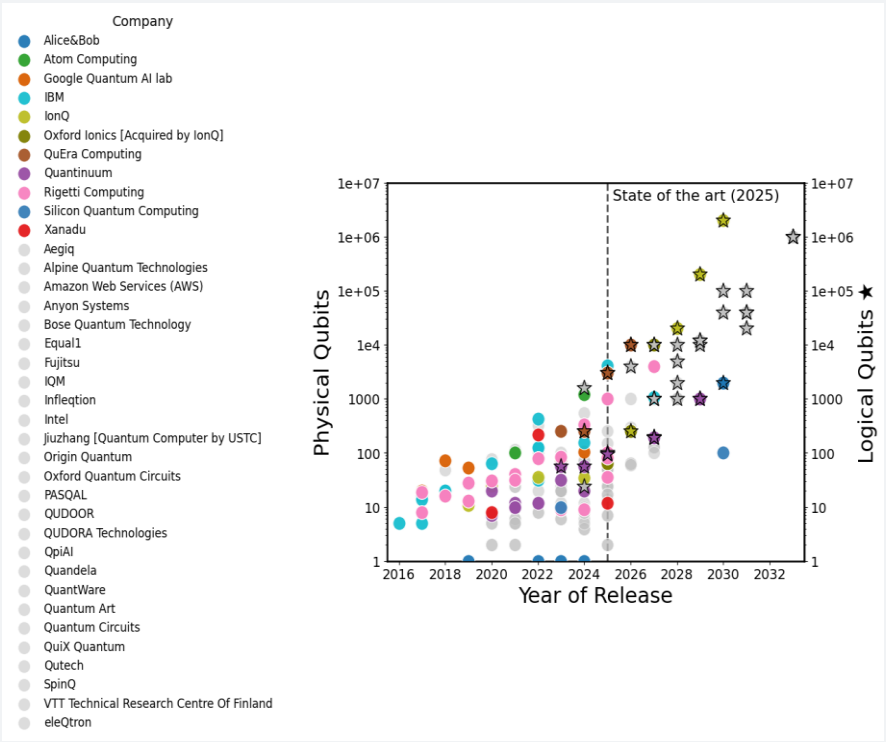
Notes: * Detailed roadmaps provided on next slide

Quantum Computing companies differ in their definitions of “useful”, but they typically agree on ~2030 as a crucial breakthrough year

Technology

Non-exhaustive

Company	2026	2027	2028	2029	2030	2030+
IBM	Demonstrate first example of scientific quantum advantage and a fault-tolerant module.	Diversify quantum advantage and entangle fault-tolerant modules.	-	**Deliver the first fault-tolerant quantum computer.**	-	Unlock the full power of Quantum Computing at scale.
Quantinuum	-	SOL system with 100+ logical qubits	-	-	**Universal, fully fault-tolerant target / commercial tipping point**	Commercially meaningful fault-tolerant machines
IonQ	-	Large-scale single-chip target (10k physical qubits)	**Offer a commercially available, interconnected system**	-	**Unlock applications that require massive logical qubit counts**	-
Alice & Bob	-	Fault-tolerant Quantum Computing	-	Universal Quantum Computing	**Useful Quantum Computing**	Comfortably stepping beyond classical simulation results



The number of qubits continues to grow, and roadmaps are becoming increasingly explicit about the technological stages and the supporting subcomponents and infrastructure required to reach them.

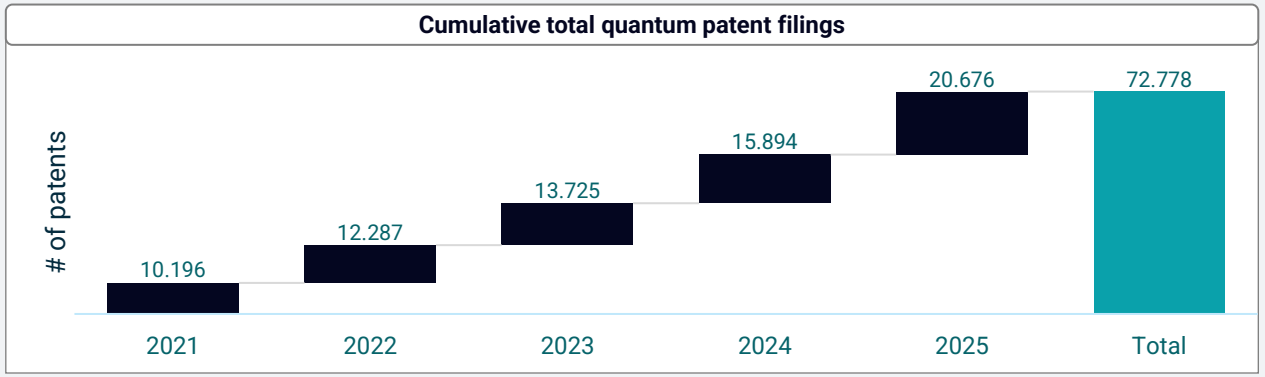
Recent roadmaps also feature error-corrected systems and logical-qubit targets, marking a clear shift from earlier generations of “proof-of-concept” devices, where scalability challenges were not well articulated.

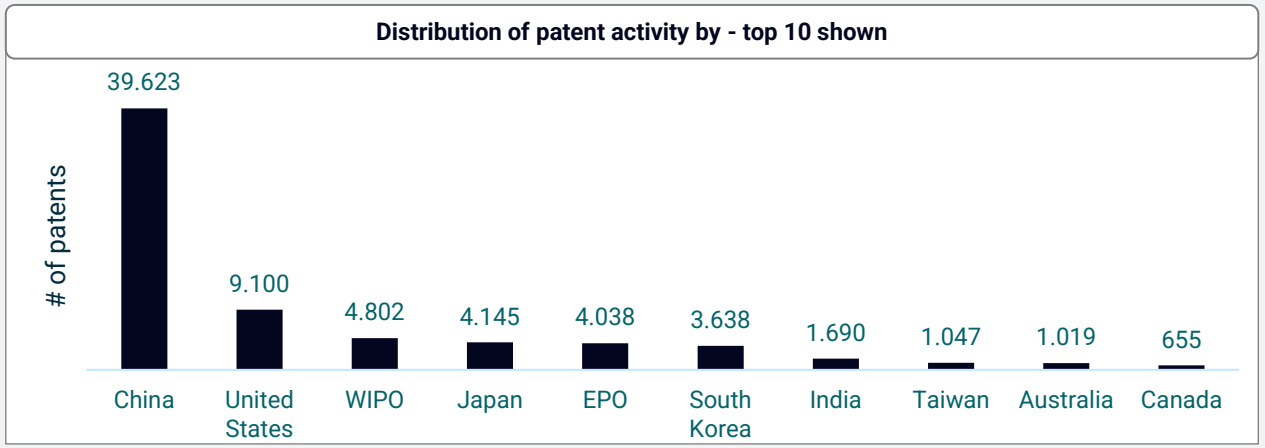
Notes: Samples of company roadmaps, non-exhaustive

Global quantum patenting is accelerating, led by China and the United States

Research & Patents

Global patent activity for quantum technologies
(2021 - 2025)





Key considerations

Global patent activity shows accelerating growth

- Between 2021 and 2025, cumulative patent filings in quantum technologies (computing, sensing, communications, hardware components and software) reached ~73,000 globally.
- Annual filings roughly doubled over five years, with the largest year-on-year increase in 2025.
- Trajectory suggests growing strategic emphasis on intellectual property protection as quantum technologies mature.
- The rapid increase in patent filings suggests that companies and countries are actively securing quantum intellectual property before commercialisation, positioning IP as a strategic entry barrier for new players.

Patent volume is highly concentrated and strategically routed

- China leads with ~4x US filings (though volume doesn't necessarily reflect quality or commercial viability).
- Cross-border patenting via WIPO and EPO together matches US filing volumes; 73% of WIPO filings already expired, indicating focus on specific market applications over long-term IP hold.

Source: Resonance Analysis, Minesoft Origin, World Business Chicago Research Center
Note: Data from 1 Jan 2021 to 31 Dec 2025

QUANTUM INSIDER
powered by RESONANCE

4. Ecosystem Mapping

New Zealand aligns more closely with Norway, Portugal, and the Czech Republic's pre-commercial quantum ecosystems

Non-exhaustive

Country	Commercialization stage	Quantum focus	National programmes	Coordination model	Talent / Workforce
Norway	Pre-commercialisation	**Sensing** (defence & maritime); early computing and comms R&D	**NOK 1.1B national initiative** (Aug 2025); Gemini Centre SINTEF/NTNU/UiO (2024-2028)	**Industry-anchored via Kongsberg;** Norwegian Quantum Cluster (Aug 2025); Oslo-Trondheim dual hubs	**Solid physics base**; no quantum PhD programme; brain drain risk
Portugal		**Software & algorithms** (pharma, materials); QKD & quantum-safe comms; early sensing	**€50M via PRR** (2024-2029); Portugal QCI QKD network; FCT/INL PhD scholarships (2nd call 2025)	**EU-anchored; no standalone strategy**; PQI as de facto coordinator; Lisbon dominant, Porto emerging	**Fewer than 200 researchers**; FCT PhD pipeline growing; broad Lisbon tech talent adjacent
Czech Republic		**QKD & quantum comms** (most advanced); quantum-HPC integration; optics & materials	**VLQ 24-qubit computer at IT4Innovations** (Sept 2025); CZQCI QKD backbone (Apr 2026); QIC IBM university consortium	**EU-infrastructure-led**; strategy in development; Prague-Brno-Ostrava triangle; 8-university QIC consortium	**Strong engineering and optics base**; live hardware access mitigates brain drain
Denmark	Early commercialisation	**Photonics** (dominant); QKD & comms; hardware R&D; sensing; software & algorithms	**National Strategy €161M (2024-2027);** NQCP €200M (2022-2034); QuNorth €80M; NATO DIANA Lab	**Government-led; Copenhagen cluster**; grants→philanthropy→VC→pension capital stack; 70+ partner community	**World-class research; 70+ PhD students** (19 nationalities); MSc programmes expanding commercial pipeline
Ireland		**Silicon Quantum Computing** (Equal1); photonics & semiconductors (Tyndall); QKD	**Quantum 2030 (Oct 2023); IrelandQCI €10M**; Trinity Quantum Alliance (IBM, Microsoft); IPIC / CONNECT SFI centers	**Government-led; multinational anchor model** (Intel, Google, IBM); Dublin-Cork dual hubs	**#1 EU STEM graduates per capita**; MNC presence boosts commercial quantum talent
Singapore		**QKD & comms** (dominant); Quantum Computing & processors (NQPI); sensing	**NQS S$300M (2024-2029)**; QEP 3.0 S$96.6M; NQPI processor initiative; NQSN+ QKD testbed	**Government-led via NQO at A*STAR**; CQT elevated to national flagship (2025); public funding dominant	**350+ researchers over 15 years**; NQSS scholarships active; commercial talent gap remains key bottleneck
USA	Advanced commercialization	**Full-stack leadership** (QC hardware, software, sensing, QKD, enabling tech); strong defence & enterprise applications	**National Quantum Initiative (2018);** CHIPS & Science Act quantum support; DOE Quantum Centers; DARPA programmes; NSF QLCI institutes	**Market-driven; Big Tech + government anchored**; clusters across Silicon Valley, Boston, Chicago, Colorado; strong VC + corporate ecosystem	**World-leading talent base; top universities** (MIT, Harvard, Stanford, Caltech); strong PhD pipeline; attracts global quantum talent
Germany		**Quantum hardware & enabling tech** (superconducting, ions, photonics); strong sensing, industrial applications & engineering	**Federal Quantum Computing Initiative**; DLR Quantum Computing Initiative; Quantum Flagship participation; Munich Quantum Valley	**Government-industry-academia model**; Fraunhofer, Max Planck, DLR + industrial champions (Bosch, Siemens, SAP)	**Deep engineering & physics talent base**; strong applied research institutes; industrial workforce supports commercialization

Countries progressing from research to commercialisation typically combine government-led coordination, focused investment programmes in the hundreds of millions, and specialization in a limited number of quantum niches rather than pursuing the full value chain

Norway's ecosystem is compact, industry-led, and centered on sensing and applied engineering

Non-exhaustive

Quantum Companies / Start ups

KONGSBERG SINTEF

Pre-commercialisation

Research Institutions / Universities

UiO : University of Oslo · NTNU · SINTEF · OSLOMET · UNIVERSITY OF BERGEN · simula

6 research institutions

Financial Institutions

The Research Council of Norway · NORWEGIAN MINISTRY OF TRADE, INDUSTRY AND FISHERIES · Innovation Norway · KONGSBERG

+NOK1.1B in committed capital



6 patents filed between 2021 and 2026

359 research papers published between 2021 and 2026

NATIONAL PROGRAMS

- **National Quantum Initiative**: NOK 1.1B (~$100M) over five years (announced Aug 2025)
- **Gemini Centre for Quantum Technology:** SINTEF, NTNU, UiO collaboration (2020, renewed 2024-2028); expanded to sensors, materials, and comms
- **Norwegian Quantum Cluster:** Launched Aug 2025; UiO, NTNU, SINTEF, Kongsberg, NHO, OsloMet, Simula

QUANTUM FOCUS

- **Clearest commercial niche in Quantum Sensing,** driven by Kongsberg's defence and maritime applications - navigation, underwater detection, pressure sensing
- **Foundational strength in Quantum Computing & algorithms** at UiO and NTNU, but no commercial computing product yet
- **Early-stage work in quantum-secure communications**

COORDINATION MODEL

- **Industry-anchored effort, uniquely,** Kongsberg is the primary commercial driver and cluster convener
- **Norwegian Quantum Cluster as the coordination body (Aug 2025);** Oslo and Trondheim as dual hubs with UiO/OsloMet and NTNU/SINTEF respectively
- **Predominantly public funding;** NOK 1.1B initiative still being designed; private VC essentially absent outside Kongsberg's internal investment

TALENT / WORKFORCE

- **Solid physics and engineering base** across UiO, NTNU, and SINTEF; sensor and materials expertise particularly strong
- **Nascent quantum-specific training;** Gemini Centre and OsloMet building curricula; no dedicated quantum doctoral programme
- **Significant brain drain risk;** no indigenous quantum employers beyond Kongsberg

Portugal is still in a pre-commercial quantum phase, driven primarily by academia, telecoms, and EU funding

Non-exhaustive

Quantum Companies / Start ups

Quantum Minds | QUANTUMLEAP | adyta | 3 companies

Research Institutions / Universities

altice labs | instituto de telecomunicações | inesc id lisboa | INL International Iberian Nanotechnology Laboratory | U.PORTO Faculdade de Ciências Universidade do Porto | 1290 Universidade de Coimbra | 6 research institutions

Financial Institutions

FCT Fundação para a Ciência e a Tecnologia | PRR Plano de Recuperação e Resiliência | Portugal Ventures | +€50M in committed capital



17 patents filed between 2021 and 2026

420 research papers published between 2021 and 2026

NATIONAL PROGRAMS

- **Government Quantum Commitment:** €50M (2024-2029) via PRR targeting research centres, private partnerships, and infrastructure
- **Portugal QCI Network:** EU-co-funded QKD deployment across national infrastructure; 14-org consortium led by PQI, IT, and INESC-ID
- **Quantum Portugal Initiative (FCT/INL):** PhD scholarship programme; second call open 2025; builds national research pipeline

QUANTUM FOCUS

- **Strategic bet on quantum software & algorithms,** avoiding hardware to compete in niches without large infrastructure costs
- **Applied strength in Quantum Communications & QKD** via national QCI network and strong telecoms industry participation
- **Early-stage Quantum Sensing** via PQI-led gravimetry trials in Lisbon

COORDINATION MODEL

- **EU-anchored model;** no standalone national strategy - roadmap and funding flow through EU Flagship and PRR instruments
- **Lisbon as dominant hub,** with PQI acting as de facto national coordinator; Porto emerging as secondary node
- **Telecoms industry as the primary commercial entry point;** private VC absent from quantum specifically

TALENT / WORKFORCE

- **Thin quantum workforce of fewer than 200;** significantly below comparable EU peers
- **Growing PhD pipeline via FCT/INL scholarships;** second call launched 2025
- **Broad tech talent base in Lisbon** provides adjacent software recruitment pool

The Czech Republic combines EU-driven coordination with emerging strengths in Quantum Communications and HPC

Non-exhaustive

Quantum Companies / Start ups

CyberSecurityHub cz · cesnet

3 companies

Research Institutions / Universities

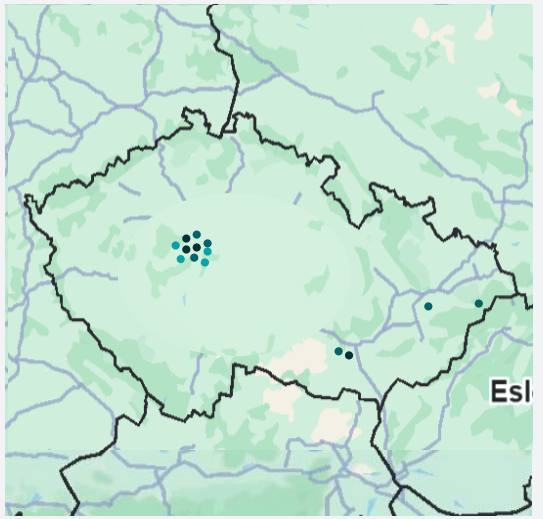
Czech Technical University in Prague · Masaryk University · Univerzita Palackého v Olomouci · The Czech Academy of Sciences · VŠB Technická Univerzita Ostrava · IT4Innovations Národní Superpočítačové Centrum · Charles University

6 research institutions

Financial Institutions

Ministerstvo obrany České republiky · TAČR · PRESTO Tech Horizons

+€50M in committed capital



22 patents filed between 2021 and 2026

523 research papers published between 2021 and 2026

NATIONAL PROGRAMS

- **NIKT:** national quantum ecosystem initiative coordinating research, commercialisation, and policy development
- **CZQCI:** flagship Quantum Communications programme establishing a nationwide quantum network
- **QCILUMI-Q (VLQ):** €5M quantum computer and HPC integration programme strengthening domestic Quantum Computing capabilities

QUANTUM FOCUS

- **Most advanced layer in Quantum Communications & QKD;** CZQCI backbone operational April 2026 across three cities
- **Growing strength in quantum-HPC integration** via VLQ linked to Karolina supercomputer
- **Core academic niche in quantum optics & materials** at Palacký and Czech Academy of Sciences

COORDINATION MODEL

- **EU-infrastructure-led model;** no national strategy yet - coordination flows through EuroHPC, EuroQCI, and Digital Europe
- **Prague-Brno-Ostrava triangle as geographic spine;** CTU anchors computing, IT4Innovations anchors HPC-quantum hardware
- **University consortium model via QIC** unusually well-coordinated for a pre-strategy ecosystem

TALENT / WORKFORCE

- **Strong engineering and optics base** across CTU, Masaryk, Palacký, and Czech Academy
- **Structured quantum training** via QIC and new CTU post-quantum cryptography courses
- **Brain drain partially mitigated by live hardware access** (VLQ, CZQCI) – having domestic options means researchers aren't forced to seek other opportunities in the region

Denmark combines strong research foundations with growing commercialisation

Non-exhaustive

Quantum Companies / Start ups

Sparrow Quantum · kvantify · QuNorth · Quantum Foundry Copenhagen · QDevil · QuantrolOx · QuantumSong · + 75 companies

Research Institutions / Universities

Niels Bohr Institute · DTU · DTU Nanolab National Centre for Nano Fabrication and Characterization · Aarhus University · SDU Quantum Hub · Copenhagen Center for Biomedical Quantum Sensing · Copenhagen Center for Biomedical Quantum Sensing · 7 research institutions

Financial Institutions

55North · EIFO · novo nordisk foundation · PensionDanmark · Innovation Fund Denmark · +€2.7B in committed capital



90 patents filed between 2021 and 2026

1164 research papers published between 2021 and 2026

NATIONAL PROGRAMS

- **National Quantum Strategy**: €161M from 2024-2027 focused on R&D, commercialisation, security, and international partnerships.
- **NQCP**: €200M over 12 years at NBI (2022-2034) building fault-tolerant hardware across four qubit pilot lines.
- **QuNorth / Magne**: €80M EIFO + NNF joint initiative acquiring a Level 2 quantum computer for sovereign Nordic access, operational 2026/27

QUANTUM FOCUS

- **Dominant commercial strength in photonics**, anchored by single-photon hardware and a deep NBI research legacy
- **Fast-growing applied layer in Quantum Communications & sensing**; national QKD network under deployment
- **Emerging vertical in software & algorithms with a life-sciences** focus, led by Kvantify and NQCP

COORDINATION MODEL

- **Government-led effort** with whole-of-government alignment across ministries and a two-part national quantum plan
- **Full-stack capital structure** layering public grants, philanthropy, government VC, dedicated quantum VC, and pension capital
- **Copenhagen cluster as the dominant hub**, co-locating NBI, NQCP, Quantum Denmark, and the NATO DIANA lab

TALENT / WORKFORCE

- **World-class base of research talent, internationally mobile**, with NBI's legacy driving strong inbound from EU, US, and Japan
- **Rapidly expanding PhD pipeline**, with 70+ students from 19 nationalities in the 2024 Niels Bohr Summer School
- **Persistent commercial talent gap being addressed through startup formation** and new MSc programmes

Singapore shares Denmark's coordinated ecosystem structure, but with stronger state-backed industrialization efforts

Non-exhaustive

Quantum Companies / Start ups

horizon quantum · SPEQTRAL · Entropica Labs · ATOMIONICS · AQSolotl · pQCee · **+ 15 companies**

Research Institutions / Universities

CQT Centre for Quantum Technologies, National University of Singapore · NUS National University of Singapore · Nanyang Technological University Singapore · A*STAR Agency for Science, Technology and Research Singapore · Singapore University of Technology and Design · **5 research institutions**

Financial Institutions

NRF Singapore · SGInnovate · XORA · Enterprise Singapore · **+S$700M in committed capital**



114 patents filed between 2021 and 2026

1981 research papers published between 2021 and 2026

NATIONAL PROGRAMS

- **National Quantum Strategy (NQS):** S$300M from 2024-2029 covering CQT elevation, processors, sensing, and talent
- **Quantum Engineering Programme 3.0:** S$96.6M (2020-2025) bridging research and industry across sensing and computing
- **National Quantum Processor Initiative (NQPI):** NQS-funded domestic processor development led by CQT and A*STAR

QUANTUM FOCUS

- **Dominant strength in quantum comms & QKD,** with national trials live and SpeQtral leading satellite commercialisation
- **Strategic push into Quantum Computing** via NQPI for domestic processors and Horizon's first commercial deployment
- **Emerging layer in Quantum Sensing** targeting navigation, biomedical, and environmental applications

COORDINATION MODEL

- **Government-led effort** centralised through the National Quantum Office (NQO) at A*STAR
- **CQT as national anchor,** elevated in 2025 with nodes across NUS, NTU, SUTD, and A*STAR
- **Predominantly public funding;** private VC nascent but growing via SGInnovate and Temasek

TALENT / WORKFORCE

- **Established base of 350+ researchers** built over 15 years of CQT investment across NUS, NTU, and A*STAR
- **Structured talent pipeline via NQSS;** 20+ active research groups across universities
- **Persistent commercial talent gap** flagged as primary NQS bottleneck; addressed via accelerators and international hiring

Ireland combines Denmark-style coordination with strong semiconductor expertise

Non-exhaustive

Quantum Companies / Start ups

equal1 · horizon quantum · CeADAR Ireland's Centre for Applied AI · SETU · Walton Institute for Information and Communication Systems Science

+ 20 companies

Research Institutions / Universities

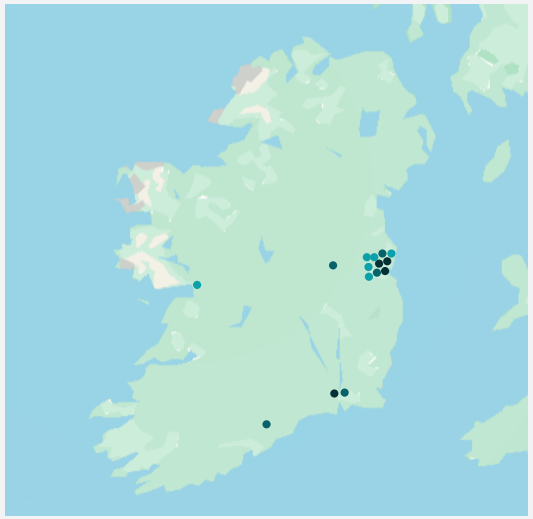
Tyndall National Institute · Trinity College Dublin, The University of Dublin · UCD Dublin University College Dublin · Maynooth University National University of Ireland Maynooth · Ollscoil na Gaillimhe University of Galway · Walton Institute for Information and Communication Systems Science

6 research institutions

Financial Institutions

Ciste Infheistíochta Straitéisí d'Éirinn Ireland Strategic Investment Fund — Gníomhaireacht Bainistíochta an Chisteáin Náisiúnta National Treasury Management Agency · Enterprise Ireland · Science Foundation Ireland Sfi For what's next · Atlantic Bridge · Elkstone

+€100M in committed capital



196 patents filed between 2021 and 2026

342 research papers published between 2021 and 2026

NATIONAL PROGRAMS

- **Quantum 2030:** National quantum strategy (Oct 2023) targeting competitive hub status across research, talent, and commercialisation by 2030
- **IrelandQCI:** €10M EU-co-funded project deploying QKD across Irish national networks; TCD and Walton Institute led

QUANTUM FOCUS

- **Defining commercial bet on silicon-based Quantum Computing,** with Equal1 the flagship and only indigenous hardware player
- **Strong academic base in photonics & semiconductors,** leveraging Tyndall's fabrication and IPIC infrastructure
- **Growing applied layer in quantum comms & QKD,** driven by IrelandQCI and EU quantum network participation

COORDINATION MODEL

- **Government-led effort via Quantum 2030 strategy,** with SFI and Enterprise Ireland as primary funding levers
- **Multinational anchor model -** Big Tech presence (Intel, Google, IBM, Microsoft) drives R&D co-investment alongside indigenous startups
- **Dublin and Cork as dual hubs;** TCD/UCD cluster in Dublin and Tyndall/UCC anchoring Cork's hardware base

TALENT / WORKFORCE

- **Strongest STEM graduate pipeline in the EU** at 40.1 per 1,000 capita, providing a deep pool for quantum recruitment
- **Research-heavy profile** with quantum groups at nearly every university; C-QuEST and Tyndall lead specialised training
- **Commercial talent boosted by multinational presence;** quantum workforce benefits from Ireland's broader tech talent ecosystem

The United States leads global quantum investment, anchored by world-class research and a dominant commercial ecosystem

Non-exhaustive

Quantum Companies / Start ups

D-Wave The Quantum Computing Company™ · IONQ · Google AI Quantum · IBM Quantum · SANDBOXAQ™ · + 100 companies

Research Institutions / Universities

Caltech · MIT · Stanford · BERKELEY LAB · THE UNIVERSITY OF CHICAGO · +50 research institutions

Financial Institutions

andreessen horowitz · iqt IN-Q-TEL™ · khosla ventures · BESSEMER VENTURE PARTNERS · +$8.4B in committed capital



9,100 patents filed between 2021 and 2026

+10K research papers published between 2021 and 2026

NATIONAL PROGRAMS

- **NQI:** Enacted 2018; reauthorised 2026 with increased funding across NSF, DOE, NIST, and DARPA
- **DOE National QIS Research Centers:** $625M for five centres (2025–2030) at Argonne, Brookhaven, Fermilab, Oak Ridge, and Lawrence Berkeley
- **DOE Quantum Leadership Act (proposed):** $2.5B across FY2026–2030 covering QIS research, foundry, networking, and user access

QUANTUM FOCUS

- **Global Quantum Computing leader:** IBM, Google, Microsoft, IonQ, and Quantinuum across all modalities; fault-tolerant roadmaps converging on 2030
- **Quantum Sensing commercialising:** IonQ, SandboxAQ, and defence primes deploying across navigation, timing, and ISR
- **PQC and Quantum Comms leader:** NIST standards finalised 2024; DARPA and AFRL funding quantum networking

COORDINATION MODEL

- **Multi-agency via NQCO:** 10+ federal departments including DOE, DOD, NSF, NIST, and intelligence community
- **Dual civilian–defence model:** NSF/DOE/NIST fund open science; DARPA, AFRL, and NSA fund dual-use in parallel
- **Deep private sector integration:** Cloud access via IBM, Google, Microsoft, Amazon; IonQ and D-Wave publicly traded

TALENT / WORKFORCE

- **World's deepest talent pool:** MIT, Caltech, Stanford, UMD, and 30+ NSF-funded quantum training programmes
- **Leading global talent attractor:** Strong net brain-gain from Europe and Asia
- **Workforce gap emerging:** Demand outpacing supply; NQI reauthorisation includes workforce development provisions

Germany combines research excellence with strong industrial adoption

Non-exhaustive

Quantum Companies / Start ups

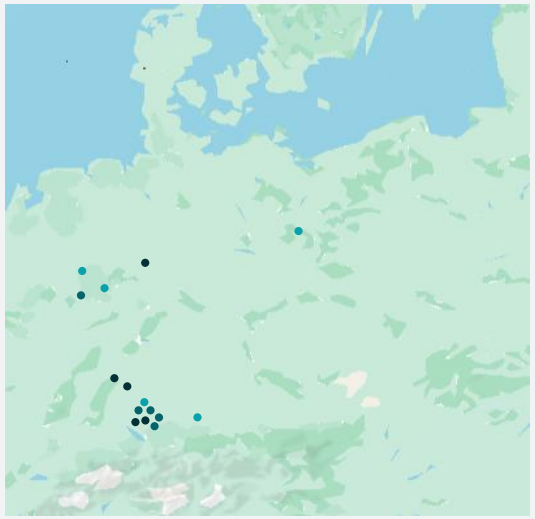
IQM · planqc · eleQtron · Quantum Brilliance · HQS Quantum Simulations · + 40 companies

Research Institutions / Universities

Technische Universität München · LMU Ludwig-Maximilians-Universität München · Max-Planck-Institut für Kolloid- und Grenzflächenforschung · Jülich Forschungszentrum · Fraunhofer · +25 research institutions

Financial Institutions

KfW · High-Tech Gründerfonds · Bayern Kapital Venture Capital für Bayern · Earlybird · UVC Partners · +€5B in committed capital



877 patents filed between 2021 and 2026

8,243 research papers published between 2021 and 2026

NATIONAL PROGRAMS

- **Federal Quantum Computing Initiative:** €2B+ via BMBF targeting domestic QPU development, quantum software, and workforce
- **Fujitsu–Jülich Partnership:** 10,000+ qubit superconducting computer under development at Forschungszentrum Jülich; targeted 2030
- **EU Quantum Flagship & EuroHPC:** Germany's largest contributor; hosts Jülich and LRZ Munich as quantum-HPC integration sites

QUANTUM FOCUS

- **Leading European hardware player:** IQM (€600M raised) building superconducting QPUs for national labs and HPC centres across Europe
- **Deep industrial quantum adoption:** BMW, BASF, Bosch, and Siemens among Europe's most active enterprise quantum users
- **Strong sensing and comms base:** PTB and DLR leading precision sensing and quantum clock R&D; active EuroQCI participant

COORDINATION MODEL

- **Federal-led with Länder co-investment:** BMBF coordinates nationally; Bavaria, Baden-Württemberg, and NRW run parallel state programmes
- **Academic-industrial bridge:** Fraunhofer and Max Planck Institutes connect fundamental research directly to industrial application
- **Munich and Berlin as dual hubs:** Munich Quantum Valley anchors computing and sensing; Berlin cluster strong in photonics and software

TALENT / WORKFORCE

- **Europe's largest research base:** 20+ quantum groups across TU Munich, LMU, Heidelberg, FU Berlin, and Max Planck network
- **Structured industrial pipeline:** Fraunhofer placements and BMBF doctoral programmes feed directly into corporate quantum teams
- **Lower brain drain risk:** Large domestic employers (IQM, BMW, Bosch, BASF) retain European talent that smaller ecosystems cannot

QUANTUM INSIDER
powered by RESONANCE

5. New Zealand Regional Mapping

New Zealand combines distributed research clusters with strong academic and end sector capabilities

Non-exhaustive



+12 Academic and research

- 6 Universities
- +6 Research centres

+7 Financing

- 2 Public funding
- +5 Private capital

+7 Quantum companies

- +7 Adjacent technologies

+20 End sectors

- +5 Agriculture, Energy & Environmental Resilience
- +5 Maritime, Transportation & Industrial Systems
- +5 Healthcare, Life Sciences & Advanced Materials
- +5 Space, Defence, & Telecommunications

Source: The Quantum Insider

Note: Organisations were selected based on their relevance to New Zealand's quantum ecosystem, including research activity, funding participation, commercialisation activity, technology development, and potential as future quantum end users. The Otago Quantum Optics Group is a leading university-based quantum research group and is included within the University of Otago rather than shown as a standalone research centre

New Zealand's universities demonstrate strongest capabilities in photonics, sensing, and quantum-adjacent materials research

Academic and research

University	Involvement in Quantum	Notable Achievements
Waipapa Taumata Rau University of Auckland	Quantum photonics; optical solitons; Raman spectroscopy; Quantum Sensing; AI and Quantum Computing applications; quantum biology	Quantifi Photonics spinout (acq. Teradyne); 7 top-cited papers including Nature Physics and Nature Photonics publications; MoU with Tech Mahindra on Quantum Computing (2024)
University of Otago Ōtākou Whakaihu Waka	Quantum optics; rare-earth-ion doped solids; quantum memory; ultracold atoms; Bose-Einstein condensates; photonic technologies; atomic physics	Hosts NZ's premier quantum CoRE (Dodd-Walls Centre); 5 top-cited papers including Nature Reviews Physics (199 citations); world-class rare-earth-ion quantum memory research
Victoria University of Wellington Te Herenga Waka	Superconducting memory devices; rare-earth nitride quantum materials; advanced materials science; quantum-adjacent materials chemistry	2 top-cited papers including Nature Nanotechnology (44 citations); home to the Paihau-Robinson Research Institute, New Zealand's leading centre for rare-earth nitride quantum materials research
UC University of Canterbury	Quantum Computing algorithms; quantum information theory; ring laser interferometry; Quantum Sensing applications	Nature Photonics paper on Earth's rotation via ring laser interferometer (39 citations); only NZ university with applied Quantum Sensing in top cited papers
Te Kunenga ki Pūrehuroa Massey University	Quantum Sensing; atomic physics; ultracold atom experiments	QTA contributor; ultracold atom experiments ongoing; no published top-cited papers or spinouts to date
AUT	Photonics, sensing technologies, advanced materials, optical engineering, and advanced computing research	Strong applied research and industry collaboration capabilities across engineering, advanced manufacturing, materials, and technology development

Source: The Quantum Insider, press release, Resonance analysis
Note: QTA: Quantum Technologies Aotearoa

Dodd-Walls Centre anchors New Zealand's highly collaborative quantum research ecosystem

Academic and research

Name	Parent / Host Institution	Quantum Research Area	Partner Programmes	Notable Achievements
Te Whai Ao Dodd-Walls Centre for Photonic and Quantum Technologies	University of Otago	Quantum optics, photonics, ultracold atoms, quantum memory, precision atomic physics	Quantum Technologies Aotearoa; Joint Quantum Institute USA; CQT Singapore; UK Quantum Hub; KAIST Korea	NZ's premier quantum CoRE; 8 of 10 top cited NZ quantum papers involve Dodd-Walls
Otago Quantum Optics Group		Rare-earth-ion doped solids, quantum memory, entangled light, Quantum Sensing	Dodd-Walls Centre; Quantum Technologies Aotearoa	Multiple Nature-family publications in quantum optics and memory
Paihau—Robinson Research Institute, Victoria University of Wellington Te Herenga Waka	Victoria University of Wellington	Superconducting devices, spintronics, scalable quantum hardware, magnetic materials	Quantum Technologies Aotearoa; Dodd-Walls Centre	Scalable quantum hardware research; π-Josephson junction development
MacDiarmid Institute		Advanced materials, nanotechnology, quantum dots, photonic materials, nanocrystals	Dodd-Walls Centre	2 top-cited papers including Nature Nanotechnology (44 citations)
Measurement Standards Laboratory of New Zealand	Earth Sciences New Zealand	Quantum metrology, atomic clocks, precision measurement, quantum standards for SI units	Quantum Technologies Aotearoa	Maintains NZ's national quantum measurement standards; full Quantum Technologies Aotearoa partner institution
Earth Sciences New Zealand		Quantum sensing applications for geophysics, gravimetry, environmental monitoring, subsurface imaging, and natural hazard assessment	Quantum Technologies Aotearoa; Earth Sciences New Zealand quantum sensing discovery activities	National leader in geoscience and environmental monitoring

Source: The Quantum Insider, press release, Resonance analysis
Note: QTA: Quantum Technologies Aotearoa. Earth Sciences New Zealand is expected to be established through the merger of GNS Science and NIWA; transition remains ongoing as of June 2026

Photonics and optics emerge as New Zealand's strongest quantum-adjacent research differentiators

Academic and research

Top 10 research papers by number of citations

Title	*# of citations*	*Authors*	*Topic*	*Journal*
Physical insights into non-fullerene organic photovoltaics	199	Victoria University of Wellington, University of Otago, Dodd-Walls Centre, MacDiarmid Institute	Organic solar cell, Fullerene, Photovoltaics	Nature Reviews Physics
Cascaded Deep Convolutional Neural Networks as Improved Methods of Preprocessing Raman Spectroscopy Data	69	University of Auckland, Dodd-Walls Centre	Raman spectroscopy, Artificial intelligence	Analytical Chemistry
Bloch oscillations of coherently driven dissipative solitons in a synthetic dimension	46	University of Auckland, Dodd-Walls Centre	Dissipative system, Physics, Bloch oscillations	Nature Physics
Optical gain and lasing from bulk cadmium sulfide nanocrystals through bandgap renormalization	44	Victoria University of Wellington, University of Otago, Dodd-Walls Centre, MacDiarmid Institute	Lasing threshold, Materials science, Nanocrystal	Nature Nanotechnology
Optical methods for bacterial detection and characterization	43	University of Auckland, Dodd-Walls Centre	Biochemical engineering, Characterization	APL Photonics
A novel SERS sensor for the ultrasensitive detection of kanamycin	43	University of Auckland	Surface plasmon resonance, Detection limit	Food Chemistry
Ultrashort dissipative Raman solitons in Kerr resonators	42	University of Auckland, Dodd-Walls Centre	Resonator, Laser, Optics	Nature Photonics
Bragg scattering of an ultracold dipolar gas across the Bose-Einstein condensate to supersolid transition	40	University of Otago	Supersolid, Physics, Phase transition	Physical Review A
Variations in the Earth's rotation rate measured with a ring laser interferometer	39	University of Canterbury, Dodd-Walls Centre	Interferometry, Rotation, Optics	Nature Photonics
Breathing dynamics of symmetry-broken temporal cavity solitons in Kerr ring resonators	37	University of Auckland, Dodd-Walls Centre	Resonator, Physics, Polarization	Optics Letters

Key considerations

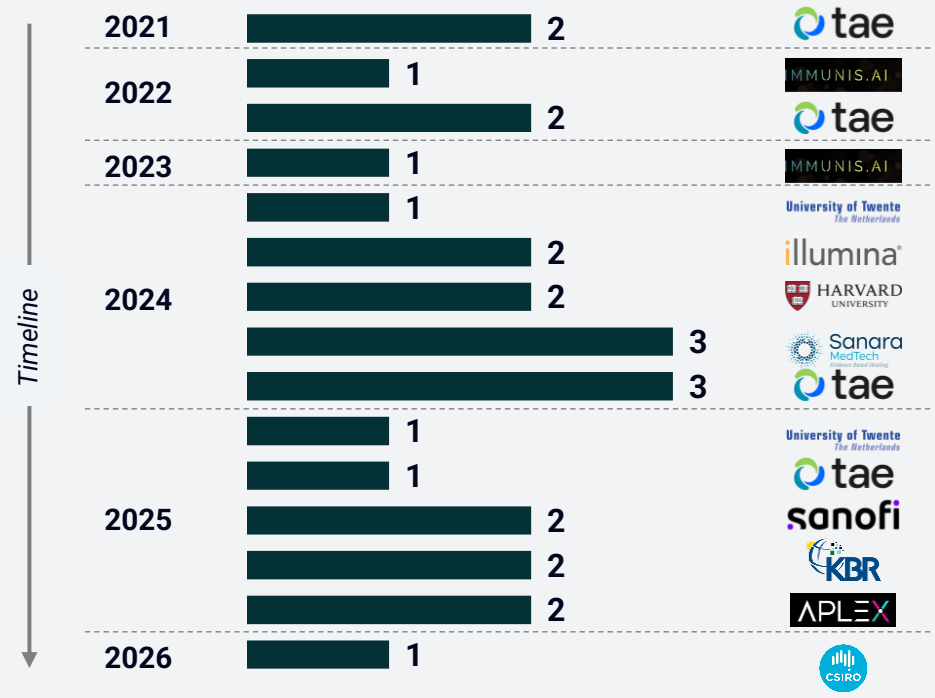
- **Research is concentrated in photonics,** optics, lasers, and advanced materials, highlighting New Zealand's strongest quantum-adjacent niche
- **Dodd-Walls Centre appears across a significant share of the highest-cited papers,** reinforcing its role as the country's primary quantum research coordination hub. Many Dodd-Walls researchers come from the University of Auckland and include double affiliations.
- **Research output is highly collaborative** across universities and national research centres
- **Most highly cited publications remain quantum-adjacent, particularly in photonics and optical physics,** rather than pure-play Quantum Computing hardware or communications systems

Source: The Quantum Insider, press release, Resonance analysis

International firms dominate NZ patent activity across photonics, sensing, superconducting systems, and diagnostics

Academic and research

New Zealand patent activity
(2021 - 2026)



Key considerations

Patent ownership is largely external to New Zealand:

- **Patent ownership is dominated by foreign entities**, including Harvard University, TAE Technologies, Illumina, CSIRO, and European healthcare and biotech institutions
- **Patent activity spans Quantum Computing, superconducting devices, photonics, diagnostics, and fusion-related systems**, though much of the activity reflects international protection strategies rather than domestic commercialisation

Patenting is routed through broader international strategies:

- **New Zealand appears to be included primarily within broader global patent filing strategies**, particularly across healthcare, photonics, quantum hardware, and advanced sensing technologies
- **Several filings relate to quantum-adjacent domains** such as superconducting interference devices, optical diagnostics, and photonic detection systems
- The distinction between patent protection and ecosystem presence remains important: **patent filings do not necessarily imply local R&D, manufacturing, or commercial activity in New Zealand**

See next slide for examples of patent activities of New Zealand firms

Source: Resonance Analysis, Minesoft Origin
Note: Analysis extended from 1 Jan 2020 to 11 Jun 2026, to emphasize the absence of patenting activity during the period 2021-2022

New Zealand’s quantum IP is concentrated in enabling technologies rather than end-user quantum devices

Academic and research Non-exhaustive

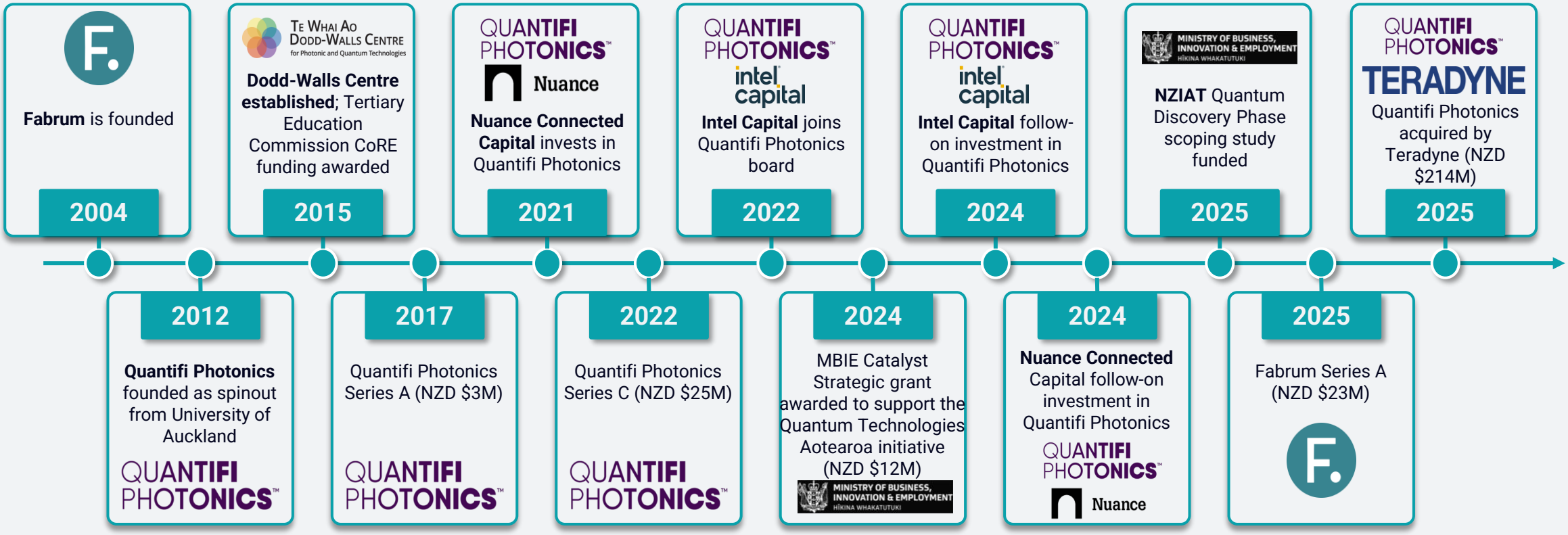
Category	Organizations	Patents	Technology focus
Pure Quantum	**University of Otago** **Otago Innovation Ltd**	1	Rare-earth quantum memory (optical coherence)
	HTS-110 Ltd	1	Atomic magnetometer / Quantum Sensing hardware
	Tuatara QRNG **US company; NZ co-inventor: C. Calude (Univ. of Auckland)**	3	Quantum random number generation
Enabling Tech	**Victoria Link / Victoria University of Wellington**	9	HTS magnets, flux pumps, superconducting switches, cryostats
	Fabrum	5	Cryocoolers, liquefaction, heat exchangers
	HTS-110 Ltd	2	HTS magnet field-control & shimming systems
	OpenStar Technologies	2	Dipole field magnet, cryogenic temperature maintenance
	Callaghan Innovation	1	Pressure-wave cryocooler

Source: Resonance analysis, Minesoft Origin, Google Patents. Counts = genuine quantum families (pure quantum) and live directly-enabling families (enabling, total 19). HTS-110 appears in both. Jurisdictions = filing footprint, not inventor location.

Commercialization activity has been concentrated around a small number of companies and public initiatives

Academic and research | Financing | Quantum companies

Non-exhaustive



Source: The Quantum Insider, press release, Resonance analysis

New Zealand's quantum funding remains highly research-driven, centered on QTA, Dodd-Walls Centre, and MBIE-backed initiatives

Financing

Detailed next

Program	Purpose	Quantum field of study	Amount	Years	Sponsor	Collaborating partners
QTA - Main Tranche	• Advanced seafloor cable-based sensing in the South Pacific • Magnetic field sensing with individual dysprosium atoms • Quantum-enabled Rydberg atomic polarimetry of radio-frequency fields • Quantum Enhanced Probabilistic Computing in Symmetry-Broken Resonators • Rare-earth nitride π-Josephson junctions as superconducting quantum logic elements • Building the quantum internet - microwave to optical transduction • Magnetic thin film materials for rare earth dopant-based quantum technologies	Quantum Sensing; Quantum Computing; Quantum Communications; Quantum Hardware	NZD $12M	2024-2028	MBIE	Dodd-Walls Centre; Joint Quantum Institute USA; Centre for Quantum Technologies Singapore; German Aerospace Centre; UK Quantum Technology Hub; Paihau-Robinson Research Institute
QTA - Start-up Tranche	• Developing Energy Efficient Fast Memory for Quantum Computers • Devices for Quantum Computing Applications • Early-Stage Quantum Networking • Entangling Atoms to Measure Magnetic Fields • Exploring the Quantum Optics of Chip Scale Lasers • Microwave - Optical Transduction: a Practical Electro-Optic Implementation • Seafloor Cable-Based Sensing Revolutionizing Ocean Monitoring	Quantum Computing; Quantum Sensing; Quantum Communications				Dodd-Walls Centre; Massey University; Centre for Quantum Technologies Singapore; University of Otago; University of Auckland
NZ-Korea Joint Research	• Chip-integrated high-fidelity squeezed light source for secure quantum communication • Rare earth quantum memories embedded in photonic integrated circuits • Transduction of electrically driven single photons: Surface acoustic waves meet whispering gallery mode resonators	Quantum Communications / QKD	NZD $1.35M	2026-2028	MBIE (Catalyst Strategic Fund)	University of Auckland; Dodd-Walls Centre; KAIST Korea
Dodd-Walls Beacons	• The One: quantum phases of matter, optical microresonators, quantum metrology, rare-earth ion quantum information • The Many: dynamics of light-matter interaction, quantum fluids, novel coherent Ising machines • The All: photonic sensing for disease detection, advanced materials testing, food production photonics	Quantum Optics; Quantum Sensing; Quantum Computing; Photonics; Quantum Materials	Part of NZD $36.75M (not quantum specific)	Multi-year rolling	Tertiary Education Commission	NZ universities; Dodd-Walls Centre nodes; international collaborators
Marsden Fund	• Contestable grants for investigator-led fundamental research across all sciences • Quantum physics groups at University of Otago and University of Auckland have received grants • Refocused in 2025 toward economic, environmental, and health benefit research	Quantum Optics; Quantum Materials; Quantum Computing	NZD $55.8M total(not quantum specific)	Annual rounds	Royal Society Te Apārangi / MBIE	NZ universities; Crown Research Institutes

Source: The Quantum Insider, press release, Resonance analysis
Note: NZ-Korea Joint Research: NZ contribution only; Korean NRF funding additional

Quantum Technologies Aotearoa

A research-led national program building quantum capability across sensing, communications, and computing

Non-exhaustive

NZ$12M Funding

MBIE Catalyst Strategic grant, 2024 to 2028, hosted by Te Whai Ao - Dodd-Walls Centre

17 Projects

across two tranches and three technology pillars, plus 3 NZ-Korea joint projects

20+ International Partners

across 8 countries, including the NIST and NPL metrology institutes

Communications & Networking (7 projects)

Microwave-to-optical transduction, on-chip QKD light sources, and rare-earth quantum memories for repeaters.

Sensing (5 projects)

Seafloor cable earthquake and tsunami detection, atomic magnetometry, and Rydberg antenna characterization.

Computing (4 projects)

π-Josephson junction logic elements, photonic Ising machines and P-bits, and energy-efficient quantum memory.

8 countries

- **USA** JQI, NIST
- **UK** NPL, Birmingham, Manchester
- **Singapore** CQT, NUS, A*STAR
- **Germany** DLR, Ulm, Mainz, Fraunhofer
- **Australia** ANU
- **Japan** NTT, Nagoya, Yokohama
- **Korea** KAIST
- **Italy** Parma

Microwave-to-Optical Transduction

The program's most mature direction has been validated by an external commercial proof point.

Why this is the program's most mature direction

1. **Targets a specific device** A bidirectional microwave-to-optical transducer module operating below 100 mK, not a component study or open-ended exploration.

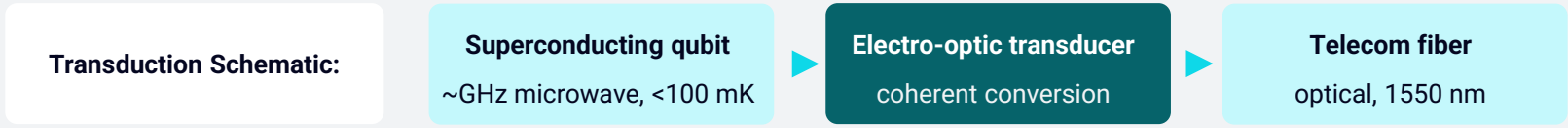
2. **Builds on proven groundwork** Advances a completed startup-tranche, room-temperature proof-of-principle into a cryogenically deployable device.

3. **Designed with international validation in mind** NIST (Colorado) for qubit-to-qubit state transfer, and the UK's NPL for integration into its Quantum Local Area Network.

External Validation: A peer has already gone commercial

QphoX (Netherlands) is pursuing the same mission: microwave-to-optical quantum transduction, moving from the lab to a commercial product.

- Spun out of TU Delft Quantum Nanoscience (founded 2021)
- ~US$14M raised across 3 rounds, including the EIC Fund, QDNL, Quantonation and TU Delft
- Optical qubit readout demonstrated with **Rigetti** and **Qblox**, published in Nature Physics (2025)



QTA projects: rare-earth materials for quantum devices

Academic and research

Magnetic thin-film hosts

Optical memory & transduction materials

Magnetic crystal thin films, such as Gd_2O_3 and YIG, can host rare-earth ions. These materials support long coherence times and enable fast microwave-to-optical signal conversion.

RESEARCH LEAD
A/Prof Jevon Longdell (QTA Science Lead), Prof Mike Reid, Dr Luke Trainor.

BASED AT
University of Otago, Dunedin.

COLLABORATORS
NTT Research (Japan), ANU, Manchester, NUS, A*STAR.

KEY PUBLICATION
“Long optical coherence times in a rare-earth-doped antiferromagnet,” Nature Physics (2025) - acknowledges QTA.

Rare-earth nitride π-junctions

Superconducting logic elements

Tunable rare-earth nitride semiconductors can form π-Josephson junctions, reducing bias currents for faster, more energy-efficient superconducting logic.

RESEARCH LEAD
Dr Simon Granville, Prof Ben Ruck.

BASED AT
Victoria Univ. Wellington (Robinson Institute); MacDiarmid Institute.

COLLABORATORS
Nagoya & Yokohama National Universities (Japan); Univ. Naples Federico II (Italy).

KEY PUBLICATION
Holmes-Hewett et al., “Rare-earth nitrides: fundamental advances and applications in cryogenic electronics,” J. Phys. D (2025).

QTA projects: seafloor cable-based sensing for hazard monitoring

Academic and research

What it is. Ultra-stable laser interferometry is a technique derived from quantum metrology that turns existing subsea telecom cables into arrays of sensors for earthquakes, tsunamis and ocean currents. A laser is sent along a spare fibre and reflected by the cable's repeaters. Each span acts as an independent sensor.

Why it matters. It senses offshore zones that land-based seismographs cannot reach, in one of Earth's most seismically active regions. Detecting quakes closer to the source means earlier, more reliable tsunami warning for coastal populations.

The opportunity. Only a handful of permanent seafloor sensors exist worldwide, because installing them is costly. Repurposing cables already on the seabed could create thousands of real-time sensors.

CONSIDERATIONS

Most immediate public benefit in the portfolio
Uses existing cables reducing project costs
Coordinate data pathways with Earth Sciences NZ and emergency management early.

RESEARCH LEAD
Dr Johan Grand (DWC Associate Investigator, MSL) with Dr Giuseppe Marra & Max Tamussino (UK NPL). MSL Chief Metrologist: Dr Annette Koo.

BASED AT
Measurement Standards Laboratory of NZ, Lower Hutt; partnered with UK NPL. Domestic partner: GNS Science (RCET)

TIMELINE
First deployment 2024 (proof-of-concept achieved); data through Dec 2025. Continuation adds sensitivity, real-time monitoring & data dissemination.

INTERNATIONAL COLLABORATORS
UK National Physical Laboratory - originator of the technique (first demonstrated 2021, UK-Canada Atlantic link).

KEY PUBLICATION (METHOD)
Marra et al., "Optical interferometry-based array of seafloor environmental sensors," Science (2022).

END GOAL
Integrate cable detections into national / regional seismic networks.

New Zealand's commercial ecosystem comprises a small number of quantum and quantum-adjacent companies

Quantum companies *Non-exhaustive*

Company	Business	Clients & Sectors	Capital Raised	Notable Events
Fabrum	• Designs and manufactures **cryogenic cooling systems** • **Patented dual-diaphragm pressure wave generator** and large-scale linear pulse tube technology	• **Quantum Computing infrastructure** • **Medical, space & defence, and industrial** gas	• **Series A:** NZD $23M (2025)	• **Founded 2004, Christchurch** • **Callaghan Innovation R&D grant** recipient
QUANTIFI PHOTONICS	• **Develops benchtop and modular photonic test** instruments • **Specialises in coherent optical communications** and optical transceiver testing	• **Semiconductor and cloud AI / data** center operators • Multinational technology companies	• **Series A:** NZD $3M (2017) • **Series C:** NZD $25M (2022)	• **Founded 2012 as University of Auckland spinout** • **Acquired by Teradyne** (US$16.7B market cap) March 2025 - NZ's largest deep tech exit
rakon	• Designs and manufactures **frequency control products** • **Crystal oscillators** for GPS, telecom, space & defence	• **Satellite and GPS manufacturers worldwide** • **Space & defence contractors**; telecoms operators	• **2006 IPO:** NZD 66 million raised	• **Founded 1967, Auckland** • **Supplies 90%+ of global GPS chip oscillator market** • **Acquired by Bourns Inc. May 2026**
BUCKLEY SYSTEMS	• **Precision electromagnets, ion beam physics hardware** • **Components for semiconductor fabs**, medical and particle accelerators	• **Semiconductor chip manufacturers (90%+ of global chip output)** • Medical imaging, particle accelerator labs, defence	• N/A	• **Founded 1986, Auckland**
HTS-110 a BOOTT company	• **Cryogen-free magnets for NMR**, beamlines, sensing and research	• **Universities, national labs, industrial R&D globally** • Metrology, MRI, and synchrotron beamlines	• N/A	• **Founded 2004, IRL spinout** • **Supplied magnets to Brookhaven National Lab (USA)** • **2026: launched 3Tracer 2.0 benchtop NMR** with Stelar (Italy)
OPENSTAR TECHNOLOGIES LTD	• **Levitated dipole fusion reactor** using HTS superconducting magnets • **"Inside-out" design** modelled on planetary magnetic fields	• **Pre-revenue**; government and clean energy focus • **NZ clean energy strategy alignment**; future utility sector	• **NZD $10M seed (2022)** • **NZD $35M government loan** (Reg. Infrastructure Fund, 2026) • **Targeting US$120-150M raise**	• **Founded 2021, Wellington** • **Nov 2024: achieved First Plasma in "Junior" prototype** • **Feb 2026: world-first levitated magnet** demonstration before PM Luxon

Source: The Quantum Insider, press release, Resonance analysis

New Zealand's largest industries offer multiple pathways for quantum adoption

End sectors

Detailed in Appendix

Industry	Est. Size & % of GDP (2025)	Quantum Computing Use Cases	Quantum Sensing Use Cases	Quantum Communications Use Cases	Adjacent / Hardware Use Cases	Companies
Agriculture, Energy & Environmental Resilience	• **Agriculture, forestry & fishing**: NZD $21.8B (5.1%) • **Electricity, gas, water & waste:** NZD $10.8B (2.5%)	Supply chain and logistics optimization; energy grid optimization; crop yield and soil molecular modelling	Gravity sensing for groundwater and geophysical surveying; quantum-enhanced environmental and emissions monitoring; precision agriculture sensing	Quantum-secure data transmission for critical energy infrastructure	Cryogenic sensing components; quantum gravimeters for land surveying	Fonterra, Zespri, genesis, Meridian, Land Information New Zealand
Maritime, Transportation & Industrial Systems	• **Manufacturing**: NZD $34.2B (7.9%) • **Transport, postal & warehousing**: NZD $18B (4.2%) • **Construction**: NZD $27.8B (6.4%)	Rail network and fleet scheduling optimisation; port logistics and route optimisation; air traffic and fleet management	Quantum inertial navigation for maritime and aviation; Quantum Sensing for infrastructure inspection and materials testing; underwater and coastal monitoring	Quantum-secure communications for port and maritime operations	Quantum gyroscopes for navigation; cryogenic cooling for industrial systems	Ports of Auckland, KiwiRail, Air New Zealand, Fulton Hogan, lpc Lyttelton Port of Christchurch
Healthcare, Life Sciences & Advanced Materials	• **Health care & social assistance**: NZD $29.5B (6.8%)	Quantum simulation for drug and biomarker discovery; genomics and personalised medicine; molecular modelling for crop and food science	Quantum Sensing for medical imaging and diagnostics; biosensing for disease detection and characterisation	Quantum-safe encryption for national health data infrastructure; secure patient data transmission	Quantum dot and nanocrystal materials for diagnostics; photonic sensing instruments	Te Whatu Ora Health New Zealand, douglas, Fisher & Paykel Healthcare, Auckland, Pacific Edge
Space, Defence & Telecommunications	• **Information media & telecoms**: NZD $17.8B (4.1%) • **Public administration & safety**: NZD $20.8B (4.8%)	Quantum Computing for signals intelligence and data processing; satellite data optimization	Quantum Sensing for defence navigation and positioning; quantum radar and RF field sensing	Post-quantum cryptography migration for national telecoms; Five Eyes quantum-secure communications; space-based QKD payloads	Space quantum experiment platforms; quantum-safe hardware for critical national infrastructure; photonic test equipment for satellite comms	Spark nz, New Zealand Defence Force, Te Tira Tiaki Government Communications Security Bureau, Rocket Lab, Dawn Aerospace

Source: The Quantum Insider, press release, Infometrics, Resonance analysis

QUANTUM INSIDER
powered by RESONANCE

6. Strategic Directions

Success in quantum requires coordinated development across strategy, talent, infrastructure, and commercialisation

Success factors	Why it matters / How it helps New Zealand compete
National strategy	Aligns government, academia, and industry around common priorities, preventing fragmented investments and signalling long-term commitment to investors and partners
Funding scale	Provides the resources needed to build research capabilities, infrastructure, talent pipelines, and commercialisation programmes at a scale that can compete internationally
Academic excellence	Generates intellectual property, talent, and scientific breakthroughs that form the foundation of future companies, applications, and investment opportunities
Industry adoption	Creates early demand for quantum solutions, validates use cases, attracts suppliers, and accelerates the transition from research to commercial deployment
Talent pipeline	Ensures a sustainable supply of researchers, engineers, technicians, and entrepreneurs required to build and scale a domestic quantum ecosystem
International Partnerships	Provides access to expertise, infrastructure, funding, and markets that would be difficult for New Zealand to develop independently
Infrastructure and testbeds	Enables companies and researchers to develop, test, and demonstrate technologies locally, reducing barriers to commercialisation and attracting foreign partners
Ecosystem connectivity	Strengthens collaboration between universities, startups, corporates, investors, and government, improving knowledge transfer and commercialisation outcomes
Supply chain advantage	Builds capabilities in enabling technologies (e.g., photonics, cryogenics, advanced materials) where smaller countries can establish globally competitive niches
Corporate champions & VC ecosystem	Provides capital, customers, commercialisation pathways, and success stories that help scale startups and attract further investment into the ecosystem

Source: The Quantum Insider, press release, Resonance analysis

New Zealand has solid academic foundations but lags leading ecosystems in commercialisation, adoption, and infrastructure

				Early-stage	Developing	Advanced	
Success factors	**New Zealand**	**Portugal**	**Norway**	**Czech Republic**	**Ireland**	**Denmark**	**Singapore**
National strategy	No dedicated national quantum strategy (NZIAT discovery phase underway)	Portuguese Quantum Initiative (PQI)	National Quantum Initiative Technology (NQTI)	Czech National Quantum Communication Infrastructure	National Quantum Strategy (2023)	National Strategy for Quantum Technology + NQCP (2023)	National Quantum Strategy (2024)
Funding scale	~NZD $13.35 M quantum-specific funding	€50M+	€100M+ programmes	€50M+	€100M+ National Quantum Strategy	DKK 2.7B (~€360M)	S$300M+ National Quantum Strategy
Academic excellence	Dodd-Walls Centre, Victoria University, University of Auckland	Instituto Superior Técnico, University of Porto	NTNU, University of Oslo	Czech Technical University, Charles University	Trinity College Dublin, Tyndall Institute	Niels Bohr Institute, DTU	CQT, NUS, NTU
Industry adoption	Limited pilots, few end-user programmes. Early stage PQC awareness	Some engagement in telecom and photonics. Limited PQC	Energy and maritime use cases. Early assessment of PQC	Research-led ecosystem with early stage PQC	Enterprise pilots in pharma, finance, semiconductors. Private sector PQC	Novo Nordisk, Maersk, Microsoft collaborations. Private sector PQC	DBS, Singtel, ST Engineering, GovTech pilots. Public and private sector PQC
Talent pipeline	Strong PhD production but limited industrial absorption	Quantum education programmes through PQI	Dedicated quantum courses at NTNU	Strong physics and engineering graduates	Quantum 2030 workforce programmes	MSc/PhD pipeline through NQCP and Quantum DTU	National Quantum-Safe Network Plus workforce initiatives
International Partnerships	Australia, UK, US, Korea collaborations; Dodd-Walls highly international	Quantum Flagship participation	Quantum Flagship participation; Nordic collaborations	Quantum Flagship participation	IBM, Microsoft, Horizon Europe, US partnerships	Microsoft, NVIDIA, Atom Computing, EU Quantum Flagship	MIT, Oxford, NUS, National Quantum Office partnerships
Infrastructure and testbeds	Limited dedicated facilities	Emerging photonics facilities	National quantum labs emerging	National quantum research infrastructure	Tyndall facilities and national testbeds	NQCP quantum campus, fabrication and test facilities	National Quantum Computing Hub, telecom testbeds
Ecosystem connectivity	Weak links between academia, startups and industry	Growing but fragmented ecosystem	Strong collaboration in energy and maritime	Improving collaboration networks through EU programmes	Strong linkages via Tyndall and research centers	Strong collaboration through NQCP and Quantum Denmark	Highly connected ecosystem coordinated by NQO
Supply chain advantage	Limited domestic quantum supply chain; geographically isolated	Access to EU photonics ecosystems	Strength in advanced materials, cryogenics, and energy	Central European manufacturing base and engineering talent	Access to EU market and semiconductor ecosystem	Strong position in advanced materials, and photonics	Strategic position within Asian electronics
Corporate champions & VC ecosystem	Limited quantum-focused VC activity; no quantum champion	Small but growing deep-tech investment ecosystem	Limited VC depth; few quantum champions	Emerging startup ecosystem; limited specialist capital	Equal1, Horizon Quantum, strong multinational presence	Novo Nordisk Foundation, active VC/PE ecosystem	Active corporate champions and venture funding

Source: The Quantum Insider, press release, Resonance analysis
Note: New Zealand funding includes QTA (NZD $12M) and NZ-Korea quantum funding (NZD $1.35M); excludes broader science funding not exclusively dedicated to quantum; New Zealand academic excellence institutions selection based on concentration of quantum publications, research activity, and participation in national quantum initiatives; New Zealand's limited domestic supply chain also encourages specialization in globally competitive niches and international partnerships

New Zealand can accelerate quantum ecosystem development through a coordinated supply-and-demand strategy

Detailed next

1 Supply creation

"Without supply, innovation stalls"

A — Expand Research Excellence
Increase support for leading quantum research programmes and strengthen New Zealand's capabilities in photonics, sensing, and quantum-adjacent technologies

B — Accelerate Commercialisation
Improve the conversion of research into startups, IP, and commercial products through dedicated commercialisation support and funding

C — Develop Quantum Workforce
Build a pipeline of researchers, engineers, and industry professionals with quantum-relevant skills across academia and industry

D — Establish Infrastructure & Testbeds
Develop shared facilities, test environments, and demonstration platforms to support technology development and validation

2 Demand generation

"Without demand, talent leaves"

A — Launch Infrastructure Challenge Program
Deploy Quantum Sensing pilots across critical infrastructure sectors such as transport, utilities, water, and environmental monitoring

B — Build Telecom & Quantum Communications Readiness
Partner with Spark and other telecom stakeholders to pilot quantum-safe communications, precision timing, PQC migration, and future quantum networking capabilities

C — Accelerate Quantum Computing Adoption
Facilitate industry access to Quantum Computing through cloud access, leasing models, strategic partnerships, and pilot programmes with global quantum providers

D — Build Encryption & Quantum Security Readiness
Prepare government and industry for Q-Day through quantum-safe cryptography adoption, security assessments, standards compliance, and workforce training

1B. Targeted interventions can help New Zealand bridge the TRL 4-6 commercialization gap

TRL 1-3
Proof of concept

TRL 4-6
Prototype development

TRL 7-9
Commercial track

Challenges

- **Expertise gap:** Researchers require engineering and product-development support
- **Infrastructure gap:** Access to fabrication, testing, and commercial platforms is limited
- **Funding gap:** Grants fall short at TRL 4–6, before technologies are ready for VC capital

	Potential mechanisms	Illustrative partners	Expected impact
International Translation Partnerships	• Researcher exchanges and visiting experts • Joint commercialization programs • Access to engineering, fabrication, and product-development expertise	Australia, UK, US, Canada, Singapore, South Korea	• Faster TRL progression • Access to specialist expertise • Stronger international networks
Access to Commercial Infrastructure & Industry Networks	• Access to quantum computing platforms • Shared testing and prototyping facilities • Industry pilot programs and technical support	IBM, D-Wave, IonQ, Quantinuum, Rigetti	• Faster prototype development • Reduced infrastructure barriers • Earlier industry engagement
Translation & Commercialization Fund	• Competition-based funding • Industry participation requirements • Support for engineering, testing, and prototype development	Innovate UK, NQIT	• More spin-outs and startups • Increased commercial readiness • Improved attractiveness for private investment

1C. Building a quantum workforce requires interventions across multiple talent levels and career stages

	Quantum Awareness & Industry Training	Quantum Technician & Engineering Pathway	Advanced Research & Commercialization Fellows
Target audience	Industry professionals, engineers, government agencies, corporates	Technicians, engineers, photonics specialists, electronics graduates	MSc, PhD and postdoctoral researchers
Programs	• Short courses on quantum fundamentals • Executive education for industry leaders • PQC and quantum cybersecurity certifications • Industry workshops with end users	• One-year quantum technician certificate • Cryogenics and photonics training • Quantum hardware apprenticeships • Industry placements at Quantifi Photonics, QTA, and research labs	• Industry-funded PhDs • Commercialization fellowships • International exchange programs • Startup residency programs
Examples	• Florida's Palm Beach State College Quantum Innovation Center • IBM Quantum Educators Program • MIT xPRO quantum courses	• Palm Beach State College quantum systems certification • Quantum Technology Training Program (Germany) • Quantum Computing Inc. workforce partnerships	• Mitacs (Canada) • Quantum Delta NL talent programs • UK National Quantum Technologies Programme CDT network
Timeline	6-12 months	1-3 years	3-5 years
Expected outcomes	• Increased awareness of quantum technologies across industry and government • Improved readiness for quantum-safe cybersecurity and future technology deployment	• Stronger links between academia, vocational education, and industry • Reduced dependence on overseas talent • Improved startup scaling capability	• Higher researcher retention • Increased startup formation • Stronger university-industry collaboration

1D. A testbed program should bridge academic R&D and sector-led commercialization, under a dedicated coordinating entity

1. Dedicated leadership body

- **NZIAT likely acts as funder, not operator**
- **A central entity should coordinate** themes, grants, industry engagement and reviews
- **Likely candidate: Dodd-Walls Centre**, to be confirmed
- **Role: "connective tissue"** between government, academia and end users

2. Two funding tracks

Academic R&D track

- **Supports research aligned with existing NZ strengths** and QTA themes
- **Focus areas could include sensing, maritime,** agriculture, rare earths, environment, health or defence
- **Objective:** accelerate research with commercialization potential

Applied innovation track

- **Supports prototypes, pilots and de-risking** with sector users
- **Companies may participate as partners,** not necessarily direct grant recipients
- **Objective:** translate quantum into real-world use cases

3. Thematic allocation and governance

- **Funding should be allocated against priority themes,** not open-ended equipment wish lists (energy, energy resilience, sustainability, national security, disaster preparedness)
- **Themes should align with NZ national priorities a**nd existing research strengths
- **Infrastructure spend should be selective,** as hardware-heavy projects can quickly absorb the budget

4. Staged reviews and spending curve

Typical structure: 5-year program

- **Year 1:** light-touch review
- **Year 2.5:** mid-term review
- **Year 5:** final review / renewal decision
- **Spending likely front-loaded,** then tapering over time

Testbeds may take different forms depending on the selected priority area, ranging from software platforms and shared datasets to specialised hardware and sector-specific demonstrators

2B. Leading telecom operators and enterprises are already piloting quantum communication technologies

Use case & example	Partners	What was done	Outcome
Quantum-safe banking communications	IBM HSBC	• **Assessed exposure of banking systems** to future quantum threats • **Tested post-quantum cryptography across payments**, digital banking, and sensitive communications • **Evaluated migration pathways** for critical financial infrastructure	• **Established a roadmap for quantum-safe migration** • **Improved resilience of banking communications** and transactions • **Increased preparedness for future cybersecurity** and regulatory requirements
Quantum-secure government communications	SK telecom ICHNP	• **Deployed quantum-safe security technologies** across government communications networks • **Tested secure mobile communications** for public-sector users • **Integrated quantum security solutions** into existing telecom infrastructure	• **Enhanced protection of sensitive government communications** • **Demonstrated operational deployment** of quantum-safe technologies • **Accelerated adoption of quantum security** across public institutions
Quantum-safe telecom infrastructure	Telefónica LUXQUANTA POLITÉCNICA UNIVERSIDAD POLITÉCNICA DE MADRID	• **Piloted QKD and quantum-safe networking** over operational fiber networks • **Tested secure key distribution** and encrypted communications • **Validated interoperability** with existing telecom and enterprise infrastructure	• **Demonstrated feasibility of quantum-secure communications** on existing networks • **Developed technical expertise in quantum networking technologies** • **Established foundations for future quantum communication services**

2C. Cloud-based access models provide the most practical pathway for New Zealand to develop quantum computing capabilities

Strategic recommendations for NZ

Model family	What it provides	Operating model	Best suited to
QCaaS	**Remote job submission on shared systems**, with no hardware ownership	**The provider handles calibration**, maintenance, uptime, upgrades and scheduling	**Learning, benchmarking, early R&D** and trying multiple modalities
Reserved capacity	**A specific machine or block of time**, held exclusively	**Vendor-operated cloud**, with the customer reserving the window	**Queue-sensitive work, demos, workshops** and time-sensitive runs
Premium / co-design	**Cloud access** plus vendor scientists and application support	**Vendor-operated,** with onboarding and workflow assistance	**Teams needing expert help** to build and deploy applications
Lease	**A temporary right to use hardware** or capacity	**An on-prem physical lease**, or a multi-year capacity agreement	**Fixed-term access** without an outright purchase
On-prem managed	**A system sited close to the customer** and vendor-serviced	**Between lease or purchase and QCaaS**; the vendor remains heavily involved	**Proximity and control without the full ownership** burden
Colocation / sovereign	**Direct, secure or region-specific access**, without owning the machine	**Vendor hardware hosted** in a neutral or in-region data centre	**Latency, security or data-residency requirements**
Purchase	**Hands-on access**, local security and deep stack control	**Customer owns and operates**; requires facilities, integration and staff	**Workforce development and strategic ownership** of the stack

Leasing may become attractive once demand is established and priority technology pathways emerge, but is likely premature given the current scale and maturity of New Zealand's ecosystem

Investment in quantum should prioritize differentiated capabilities and near-term value creation

Why invest now?

Build on existing strengths
- **Focus on areas** where NZ already has research and industrial capabilities
- **Specialize in selected niches** rather than competing across the full quantum value chain

Capture first-mover advantages
- **Establish NZ as a recognised hub for selected capabilities** (e.g., sensing, photonics, testbeds)
- **Attract international partners, talent and investment**

Preserve future strategic optionality
- **Early investment creates the capability to participate in future quantum value chains** as markets mature
- **Waiting reduces NZ's ability to influence future ecosystems** and capture emerging opportunities

Key caveats

Limited funding (~NZ$70m)
- **Insufficient to compete** across multiple technology areas
- **Hardware-heavy infrastructure could rapidly consume available funding**

Risk of moving too early
- **Some applications remain immature**
- **Returns may take years** to materialize

Execution risk
- **Requires strong coordination,** leadership and industry participation
- **Funding dispersed across too many initiatives** is unlikely to achieve critical mass

What success looks like

Focus on one or two strategic niches
- **Align investments with NZ strengths** and national priorities

Prioritize low-capital, high-impact initiatives
- **Cloud-based quantum computing access**
- **International partnerships**
- **Shared testbeds**
- **Innovation and commercialization programmes**

Measure outcomes
- **Industry pilots** launched
- **International partnerships** established
- **Commercial prototypes** demonstrated
- **New companies and investment** attracted
- **Research translated** into real-world deployment

TQI experts considered the main issue for New Zealand is "how to invest" rather than "whether to invest". With a constrained budget, success depends on focused specialization, selective investment and translating research into commercial applications

QUANTUM INSIDER
powered by RESONANCE

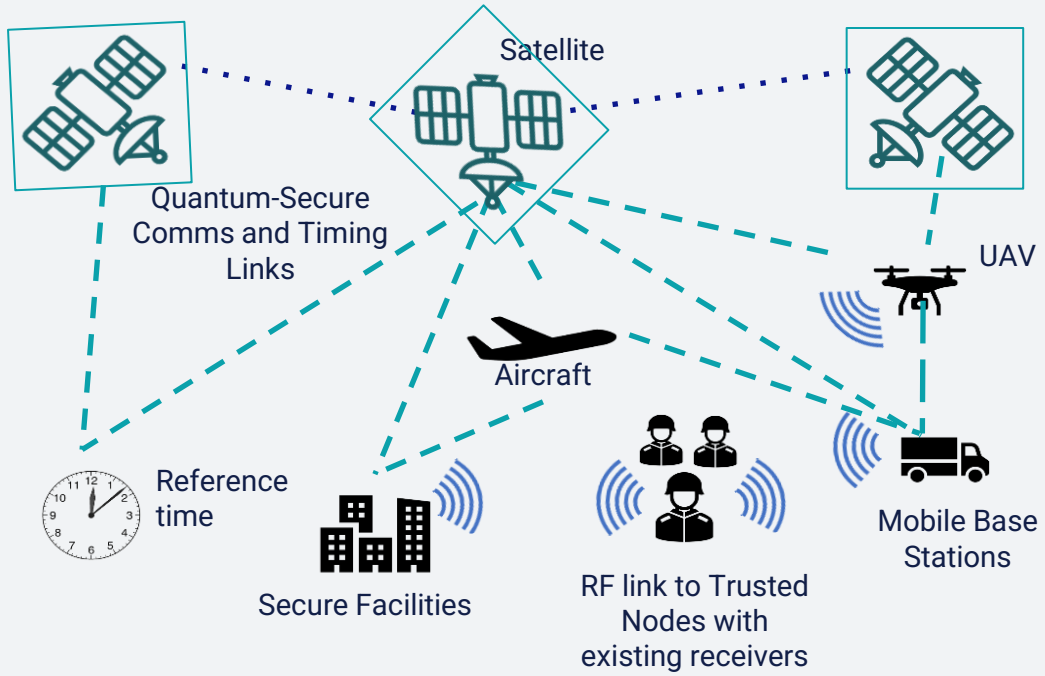
Appendix

Defence forces are exploring Quantum Sensing to operate effectively in contested environments

Defence operations rely heavily on GNSS for targeting, communications, and force coordination. However, **recent conflicts have demonstrated the vulnerability of satellite-based positioning to jamming and spoofing, exposing operational risks across multi-domain environments.**

Quantum Sensing technologies offer signal-agnostic alternatives to satellite-derived PNT. Cold-atom inertial systems provide low-drift navigation independent of GNSS, while advanced atomic clocks enhance secure timing for ISR, command-and-control, and strike coordination. Emerging quantum gravimeters and magnetometers may further support passive navigation in select land, sea, and air applications.

Domain	Quantum Solution	Operational Impact
Land	• Quantum INS Backpacks • Entanglement Time Transfer	Special forces navigation in tunnels/jammed urban terrain
Sea	• Submarine Gravimeters • Cold Atom Interferometry	Stealth positioning without surfacing (e.g., Virginia-class)
Air/Space	• Optical Clocks on Satellites • Chip-scale Atomic clocks	Hypersonic missile guidance (500 m to 5 m CEP)
Cyber/EW	• Rydberg RF Sensors	Detect/jam enemy signals across GHz-THz spectrum



Case Study - Military and Strategic Vulnerabilities

Case Study Overview

- The war in Ukraine has shown how GPS jamming and spoofing by Russia can degrade drone operations, disrupt ISR missions, and misdirect guided weapons.[1]
- Russia's use of Pole-21, Tirada-2 and RB-341V EW systems created PNT-denied zones, undermining GPS-reliant NATO and Ukrainian systems.[2]
- This demonstrates a critical need for resilient, sovereign PNT systems that can operate without reliance on space-based signals.
- Subterranean, underwater, urban canyon, and polar operations suffer from GNSS signal attenuation or loss.
- In these environments often the domain of special forces, submarines, or autonomous systems, GNSS is unreliable or inaccessible.

Russian EW Arsenal in Action

System	Impact	Typical operational impact
Pole-21	Area-denial jamming	Degrades GPS-guided bombs, rockets and UAV navigation near front lines.
Tirada-2	Spoofing (false coordinates)	Targets military/commercial satcom links, complicating beyond-line-of-sight C2.
RB-341V	GNSS/comm jamming	Disrupts mobile comms, geolocates phone users, and supports information operations.

Source: 1. Airandspaceforces.com; 2. "Russian Electronic Warfare System" report;

Quantum Computing could materially accelerate drug discovery by improving molecular simulation capabilities

Commercial Relevance

- **Drug discovery typically takes 10-15 years** and costs >$1B per approved drug
- **Molecular simulation is a major bottleneck** in early-stage R&D
- **Quantum Computing could improve prediction accuracy** and reduce screening requirements
- Even modest reductions in development timelines create significant value

Case Study

- **Boehringer Ingelheim and Google Quantum AI partnered in 2021 to apply Quantum Computing to pharma R&D**
- A study on the P450 enzyme demonstrated quantum advantage over classical HPC
- A workflow on Google Sycamore ranked diabetes/fibrosis molecules with 3x faster key subroutines versus traditional HPC

Organizations

Boehringer Ingelheim

Google AI Quantum

University of Toronto

QCWARE

Source: The Quantum Insider, press release, Resonance analysis