

The Global Quantum Computing Supply Chain 2026–2036: Materials, Components and Enabling Hardware

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Abstracts

The global quantum computing hardware supply chain has emerged as one of the most strategically consequential — and structurally constrained — supplier ecosystems in advanced technology. The market spans the complete physical infrastructure required to build, operate, and scale quantum computers across every commercially relevant qubit modality: superconducting circuits, trapped ions, neutral atoms, photonic qubits, silicon spin qubits, and diamond defect-centre platforms. Each modality imposes distinct material and component requirements, but the supply chains converge on a common set of strategically critical inputs — dilution refrigerators, helium-3, ultra-high-vacuum systems, quantum-grade lasers, isotopically enriched silicon-28, wafer-scale CVD diamond, cryogenic cabling, and cryo-CMOS controllers — where supplier concentration and capacity constraints already constrain the pace of quantum computing scaling.

The market structure is defined by extreme supplier concentration in several strategically critical categories. A small number of specialty vendors dominate dilution refrigeration, non-evaporable getter pumps, deposition equipment for superconducting qubit fabrication, and pulse-tube cryocoolers — creating single-source risk profiles that materially affect the pace of industry scaling. Helium-3, the rarest commercially traded isotope and produced almost exclusively as a tritium decay byproduct from nuclear weapons programmes, sits at the apex of the structural bottleneck stack. Quantum-grade CVD diamond, isotopically enriched silicon-28, cryo-CMOS foundry access, and ultra-narrow-linewidth UV/visible lasers complete the set of supply-side constraints that increasingly determine which qubit modalities can scale and on what timeline.

Demand drivers span government and defence procurement (particularly for cryptanalysis, secure communications, and precision sensing), commercial enterprise

quantum computing customers (including pharmaceutical, financial services, materials science, and logistics applications), and the rapidly emerging quantum-classical hybrid data-centre infrastructure anchored by NVIDIA's NVQLink architecture connecting GPU computing to quantum processors. Through the forecast period, the market transitions from research-grade to production-grade volumes, with progressive standardisation, industrialisation of manufacturing processes, and consolidation among emerging suppliers. The convergence of quantum and classical compute infrastructure represents the most consequential single architectural development in the broader quantum hardware industry — and the supply chain implications cascade across every component category covered in this report. The decade ahead will be defined by which suppliers, which sovereign jurisdictions, and which technology pathways emerge from the current bottlenecks with durable competitive positions.

The *Global Quantum Computing Supply Chain 2026–2036: Materials, Components and Enabling Hardware Across Qubit Modalities* provides the most comprehensive analysis published of the materials, components, and enabling hardware that underpin commercial quantum computing across all major qubit modalities. The report addresses a critical gap in market intelligence: while extensive coverage exists for quantum algorithms, software, and end-user applications, the physical supply chain that makes quantum computing possible has been systematically underanalysed. As the industry transitions from research-grade demonstrations to commercial deployment, supply-side constraints — not algorithmic limits — increasingly determine the pace of scaling.

This report delivers detailed analysis through 2036 across the complete quantum hardware stack, covering cryogenic infrastructure, control electronics and cryo-CMOS, lasers and photonic components, ultra-high-vacuum systems, qubit substrates and thin films, ion and atom traps, and microwave and optical interconnects. The report identifies critical bottlenecks across the supply chain — helium-3 supply, dilution refrigerator production capacity, ²⁸Si enrichment, wafer-scale quantum-grade CVD diamond, cryo-CMOS foundry access, UV/visible quantum-grade lasers, high-density cryogenic connectors, and SNSPD wafer-scale uniformity. Each bottleneck is assessed for severity, probability, time-to-resolution, and mitigation pathways, with implications mapped across all six commercial qubit modalities.

The report includes detailed company profiles spanning QPU developers, cryogenic infrastructure suppliers, control electronics and cryo-CMOS specialists, laser and photonic component manufacturers, substrate and thin-film suppliers, UHV system manufacturers, and cryogenic interconnect specialists. Each profile includes current funding status (with 2025–2026 funding rounds reflected), product portfolios, technology

positioning, and strategic significance within the broader supply chain.

Designed for quantum hardware companies, component suppliers, institutional investors, government policymakers, and procurement managers at large enterprise quantum computing customers, the report provides the authoritative reference for navigating the most strategically critical supplier ecosystem in advanced technology through 2036.

Contents include:

Executive summary with state-of-the-supply-chain in 2026, critical materials and bottlenecks, supplier concentration and geopolitical exposure, total addressable market by stack layer, top 25 strategic suppliers across all modalities, ten-year outlook, and strategic recommendations

Methodology including the supply chain framework, Tier 1/2/3 component definitions, critical-bottleneck-strategic material taxonomy, forecasting assumptions, scenario definitions (conservative, base, optimistic), and limitations

Qubit modality landscape with side-by-side comparison of superconducting, trapped-ion, neutral-atom, photonic, silicon spin, NV-diamond, and topological/bosonic platforms — including SWOT analyses, cross-modality bill-of-materials comparison, and modality-by-modality material demand analysis

Cryogenic infrastructure covering dilution refrigerator architecture and pricing, pulse-tube cryocoolers, helium-3 and helium-4 supply (including DOE, Russian, and lunar-regolith sources), alternative cooling technologies (ADR, Pomeranchuk, ?He-free), the dilution refrigerator vendor landscape, partnership models, and ten-year installed-base outlook

Cryogenic control electronics and cryo-CMOS including the wiring crisis, architectural approaches (4 K, sub-100 mK, hybrid photonic-electronic), NVQLink and the quantum-classical data-centre convergence, cryo-CMOS device technology and PDKs, vendor landscape (Intel, Microsoft, Google, IBM, plus the emerging cryo-CMOS specialists), cryogenic amplifiers (TWPAs, HEMTs, parametric), and ten-year cryo-CMOS market outlook

Lasers and photonic components by modality with the complete laser bill of

materials, wavelength requirements for every atomic and solid-state modality, laser technology platforms (DBR/DFB/ECDL diodes, solid-state, fibre, frequency-doubled, quantum dot, frequency combs), linewidth and stability requirements, single-photon detection (SNSPDs, TES, SPADs), photonic integrated circuits and foundry access, and ten-year photonic component demand outlook

Ultra-high-vacuum systems covering chamber design and materials, vacuum pumps and hardware, feedthroughs and hermetic seals, cryogenic-UHV integration, vapour cell technology and atomic sources, and ten-year UHV equipment demand outlook

Qubit substrates and thin films including sapphire substrates, high-resistivity float-zone silicon, isotopically pure ^{28}Si (with cost trajectory and strategic stockpiling analysis), diamond substrates and CVD versus HPHT synthesis, niobium and tantalum thin films, and ten-year substrate demand outlook

Ion and atom traps covering trap architectures (Paul, surface-electrode, Penning, QCCD, 2D tweezer), trap materials and anomalous heating, microfabrication and foundry access, integrated photonics on ion traps, atom tweezer optics and SLM-based reconfigurable arrays, and ten-year trap production outlook

Microwave and optical interconnects including cryogenic microwave cabling, high-density connectors (Q-CON, F2C-40, SMA/MMPX/GPPO), cryogenic attenuators and filters, circulators/isolators/switches, optical interconnects for photonic and modular quantum systems, microwave-to-optical transducers, and cost-per-channel outlook

Component vendor landscape and lead-time analysis including aggregated vendor map, market concentration and single-source risk index, lead-time and pricing benchmarks, patent landscape, and government sovereignty programmes (US, EU, UK, China, Japan, Korea, India, Australia, Canada)

Bottleneck assessment with severity-probability-time-to-resolution methodology, critical bottlenecks (helium-3, DR capacity, ^{28}Si , CVD diamond, cryo-CMOS), high-severity bottlenecks (UV/visible lasers, TWPAs, connectors, photonic wire bonding, wafer-scale diamond, tantalum), long-term bottlenecks (2030+), mitigation strategies, and modality-specific heat-maps

Ten-year outlook (2026–2036) with scenario analysis, breakdowns by component layer, modality, and region, helium-3 supply-demand balance, cost-per-qubit trajectories, sensitivity analysis (tornado diagram), risk-adjusted commentary, strategic recommendations for investors and suppliers, and long-range outlook to 2046

Company profiles of more than 100 companies across QPU developers, cryogenic infrastructure, control electronics and cryo-CMOS, lasers and photonics, substrates and thin films, UHV systems, and cryogenic interconnect. Companies profiled include Alice & Bob, Alpine Quantum Technologies (AQT), Anyon Systems, Atom Computing, D-Wave Quantum, Diraq, eleQtron, Google Quantum AI, IBM Quantum, Infleqtion, IonQ, IQM Quantum Computers, Nord Quantique, ORCA Computing, Origin Quantum, Oxford Quantum Circuits (OQC), Pasqal, Photonic Inc., Planqc, PsiQuantum, Quandela, QuantWare, Quantum Brilliance, Quantum Motion, Quantinuum, Quobly, QuEra Computing, QuiX Quantum, Rigetti Computing, SaxonQ, Universal Quantum, Xanadu Quantum Technologies, Bluefors, Cryomagnetics, FormFactor, Hanyuan Quantum, ICEoxford, Kiutra and more.....

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