Testimony of

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From Policy to Progress:
How the National Quantum Initiative Shapes U.S. Quantum Technology Leadership

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Chairman Babin, Ranking Member Lofgren, and Members of the Committee, thank you for the opportunity to testify this morning. I am Celia Merzbacher, Executive Director of the Quantum Economic Development Consortium (QED-C®), which is managed by SRI International, a nonprofit research institute based in Menlo Park, California.

QED-C is the premier global industry consortium, with the mission to grow the U.S. quantum economy and support the development of a robust quantum technology ecosystem. QED-C was established by the National Quantum Initiative (NQI) Act of 2018 (PL115-368) and with funding and support from the National Institute for Standards and Technology (NIST). We also have received funding from the Air Force Research Lab for work related to the Air Force mission and quantum strategy. Today, QED-C has approximately 220 members across the quantum ecosystem, of which 70 percent (154) are corporate members representing suppliers, hardware and software system developers, end users and service providers. Three quarters of the corporate members are small- to mid-sized businesses or startups.[1] More than 50 government agencies have also engaged in QED-C activities, including NIST, the National Science Foundation (NSF), Department of Energy (DOE), NASA, State Department, and various agencies in the defense and national security area.

My testimony focuses in particular on the state of the global quantum industry, the U.S. position in that global industry, and how the National Quantum Initiative can promote a robust quantum ecosystem that helps to ensure economic and national security.

Quantum: From science to applications

Quantum information science and technology (QIST) is based on the properties of light and matter governed by quantum mechanics. Quantum properties, such as superposition and entanglement, open the door for novel ways to gather, transmit and analyze data. Advances in the ability to control and utilize these properties is leading to applications in sensing, networking and communications, cybersecurity, and computing and have broad economic and societal potential, as well as national security implications.

Quantum sensing applications are among the most advanced and near term. Quantum sensors that can measure extremely small variations in electric or magnetic fields or the pull of gravity could be used, for example, to detect submarines undersea or mineral deposits underground. Quantum sensors can enable navigation in areas where access to GPS is denied or unavailable. They could be used for novel bioimaging of electrical activity in the brain or fetal health. Quantum sensing technologies also are being developed to answer scientific questions about the nature of dark matter and in fundamental studies of the universe. A QED-C survey of 67 quantum sensing companies reported $375 million in revenues in 2024 and expected growth to more than $900 million in 2028.[2]

Technologies for networking and communication of quantum information are less mature than those for quantum sensing. Hardware used in conventional telecommunication systems for long-distance communication is not necessarily suited to transmission of quantum information. New types of interconnects, repeaters, etc. are needed to realize the benefits of quantum networks, such as improved cybersecurity and more accurate and reliable worldwide time synchronization which underpins financial

[1] See current QED-C members online.
[2] https://quantumconsortium.org/publication/2025-market-forecast-quantum-sensing/

systems and other critical infrastructure. Quantum networks will also be needed to connect quantum processors to each other in order to scale up computing capabilities and performance.

The most anticipated application of quantum technology is quantum computing, which has the potential to solve certain problems that are beyond the capability of current classical computers and to impact almost every sector. Examples of such computational problems include modeling and simulation, optimization, and machine learning. These problems are fundamental to many practical applications, including drug discovery, development of advanced materials (e.g., for batteries), energy efficient chemical processing, transportation logistics, electric grid management, and financial fraud detection and portfolio optimization. Quantum computing is complementary to artificial intelligence (AI), as described in a recent QED-C report.[3] AI can advance the design and use of quantum computers and quantum computers may improve AI model training and reduce resource requirements.

The fifth annual QED-C assessment of the global quantum computing market estimated revenues of $1.07 billion with an average annual growth rate of 27 percent. Based on a survey of 82 companies, the market is expected to top $2 billion in 2027. Approximately half of the respondents expect a utility-scale quantum computer will be available in 2-5 years, while 30 percent believe it will take longer.

Progress in the ability to harness quantum science for practical use led to increasing investments by the private sector starting more than a decade ago. Companies that supply components for quantum research also saw more opportunities as the field grew. With increasing public and private investments as well as potential value to the nation, Congress passed the National Quantum Initiative (NQI) Act in 2018 to ensure U.S. leadership through a coordinated program.

NQI: The US national quantum program

Building upon decades of federal investment in quantum research, the NQI Act aimed to ensure continued U.S. leadership by supporting research, development, demonstration, and application of QIST. The Act provided for planning and coordination across Federal agencies. It also called for "promoting collaboration among the Federal Government, Federal laboratories, industry, and universities". Agencies were to partner with industry to leverage knowledge and resources and to include industry as collaborators in the NQI centers that were authorized for funding by the National Science Foundation and Department of Energy. However, the core of the NQI program has been a broad, multidisciplinary suite of investments in basic scientific research to advance the field and to create a pipeline of relevantly educated talent. Goals and activities related to translating research results into practical applications for commercial or government applications were not explicitly stated.

QED-C: The Quantum Consortium®

The NQI Act called for NIST to establish a "consortium of stakeholders" to identify research and other needs to support a robust quantum industry, as well as the gaps that need to be filled and to make recommendations for how the program can fill the gaps. The Quantum Economic Development Consortium (QED-C) is that consortium. QED-C is a novel public-private partnership that is supported by a combination of funds from the Federal government and the consortium members. It is industry-driven but recognizes the need for all segments of the research and innovation enterprise to be strong and collectively engaged. With its diversity of corporate members from suppliers to system developers to

[3] https://quantumconsortium.org/quantum-computing-and-artificial-intelligence-use-cases/

end users as well as universities and national laboratories, QED-C represents and serves the ecosystem broadly. With leadership and contributions from the members, the consortium is tackling diverse issues on the path to a strong quantum industry. It assesses use cases for quantum technologies, roadmaps enabling technology gaps, develops and publishes benchmarking tools, identifies workforce needs and strategies, and provides input on policymaking, e.g., through responses to requests for information. Government employees are welcome to participate in QED-C meetings and activities, including technical advisory committees, which undertake many of the activities and projects of the consortium.

Examples of QED-C assessments[4] include:

- Use cases of quantum sensors, including positioning, navigation, and timing (PNT) and biomedicine
- Use cases of quantum computers, including managing, improving and securing the electric grid; transportation; logistics; and securing financial messaging
- Quantum technician needs and training
- Experiential, hands-on quantum learning

QED-C has assessed needs and gaps in the following enabling technologies and has shared the results with members and government agencies.

- Cryogenic technologies
- Quantum-enabling laser technologies
- Control and readout electronics
- Materials for superconducting qubits
- Packaging for quantum sensors
- Single photon sources and detectors
- Photonic integrated circuits

Addressing the gaps in these critical areas should be a focus of the next phase of the NQI.

The Global Landscape and the U.S. Position

The United States is not the only nation that is in the race to be a leader in quantum technology. In March of this year, QED-C released the first State of the Global Quantum Industry report[5] with key metrics that characterize the size and impact of the global quantum industry. The report, which is appended at the end of this testimony, provides a data-driven analysis of the number and geographic distribution of companies, investments, market sizes, workforce, and patents. The report shows that the United States is leading in many areas but there are others that are making large bets.

The United States leads in the number of quantum-focused firms, including hardware, software and service providers with 447 out of a worldwide total of 1,440 and in the number of "pure play" quantum startups with 148, followed by the UK (64), Canada (56), Germany (48) and France (25). The US startups raised a median of $12 million and about two thirds have fewer than 25 employees, indicating a vibrant early-stage pipeline. The United States is also home to large tech companies that are among the leaders

[4] QED-C reports are available online.
[5] https://quantumconsortium.org/stateofthequantumindustry2025/

in the development of quantum computing technologies, including IBM, Google, Microsoft, Amazon, Nvidia, and Intel.

Thanks to a strong startup culture, the United States leads in venture capital investments, with US-based quantum companies securing nearly $1.7 billion in venture capital in 2024, far outpacing all other countries. The amount of venture investment was up in 2024 to a new high of nearly $2.6 billion after a dip in 2023. However, the number of venture deals fell by about 25 percent as startups and their technology begin to mature and the size of deals increases.

Public investments are up by more than $3 billion with the total investment worldwide by governments growing to an estimated $44.5 billion. After China which has invested a reported $15 billion, the United States has made the largest investment of public funding at $7.7 billion. However, quantum technologies are recognized by nations worldwide as having significant economic and national security implications and many countries have launched national quantum strategies and initiatives. The UK National Quantum Technologies Programme is a £1 billion collaboration among industry, academia and overall, the UK government has committed $4.3 billion.[6] Germany published a "Quantum Technologies Conceptual Framework Programme" in 2024[7] and has pledged to invest €3 billion for development of a "universal quantum computer" by 2026. As part of Canada's National Quantum Strategy[8], in January 2025 the Canadian government announced CA$74 million in new funding for quantum technology projects. The European Union's Quantum Flagship released an updated quantum strategy in February 2024 that emphasizes "economic and technological sovereignty".[9] And within the last two weeks, Spain launched a 5-year quantum technology strategy and announced €800 million in funding.[10] Numerous other countries have coordinated strategies and substantial government programs, including Japan, Australia, and the Netherlands.

Although its national quantum program is less clear from publicly available information, China is making strides in quantum technology R&D, reportedly investing $15 billion (including significant funding for research facilities and infrastructure). Based on an analysis of highly cited research publications, the United States leads the world in quantum computing, but China has taken the lead in the areas of quantum communication, quantum sensors, and post-quantum cryptography.[11] The study, which looks at 64 technologies, shows China also leads in areas that are critical to the quantum supply chain, such as optical and RF technologies and photonic sensors. Chinese companies in these critical enabling technologies, including cryogenic technologies and lasers, are aggressively pursuing customers worldwide and in some cases are dominant suppliers.

While research publications do not necessarily translate into technological leadership, they indicate a concentration of research capacity, knowledge and people, which provides a strong foundation for

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[6] https://uknqt.ukri.org/
[7] https://www.quantentechnologien.de/fileadmin/public/Redaktion/Dokumente/PDF/Publikationen/Quantum-Technologies-Conceptual-Framework-2023_english_bf_C1.pdf
[8] https://ised-isde.canada.ca/site/national-quantum-strategy/en/canadas-national-quantum-strategy
[9] https://qt.eu/media/pdf/Strategic-Reseach-and-Industry-Agenda-2030.pdf?m=1707900786&
[10] https://quantumcomputingreport.com/spain-launches-e808m-917m-usd-quantum-technologies-strategy-to-strengthen-national-and-eu-leadership/
[11] ASPI's Critical Technology Tracker: the global race for future power, Australia Strategy Policy Institute (2023)

innovation. And China's well-funded and deliberate research program is matched by strides in technology development, patent applications, and engagement in standards setting organizations.

Patents are another measure of output from research and development. As reported in the 2025 State of the Global Quantum Industry Report, a broad search of international patents using keywords reveals that Chinese patents represent more than half of quantum filings in 2020 – 2024, four times more than U.S. filings. It should be noted that the number of patents does not necessarily correlate with actual commercialization or the value of the invention for which protection is being sought. An earlier QED-C assessment of patent trends that focused separately on quantum computing and quantum communication patents[12] found that among the top 10 entities that are being awarded quantum computing patents (vs. filing applications), seven are U.S. firms. And more quantum computing patents, regardless of where the inventor is based, are filed in the U.S. patent office indicating that the United States is seen as the largest market. The picture is markedly different in the quantum communications sector, where Chinese entities represent eight of the top 10 recipients of patents and there are no U.S. entities.

The investments, albeit difficult to verify, and outputs are hallmarks of a growing Chinese quantum industry and intense competition for 'first to market' advantage is likely.

Assessment of the NQI

Strengths

Thanks to the NQI, the United States is a leader in many QIST areas. This enviable position is the result of decades of federal investments in basic quantum research, as well as advances in many adjacent fields such as photonics, electronics, applied math, and other areas that are not necessarily considered "quantum research". Recognizing that technical breakthroughs are still needed for the potential of quantum technologies to be realized, the NQI is investing in physics, materials, computer science, and engineering to continue advancements at the cutting edge of science. The centers launched by NSF and DOE bring together top-notch multidisciplinary teams and are focused on key areas, predominantly related to quantum computing. These investments are also creating and growing research capacity, especially at the DOE laboratories. Funding for academic research is producing a growing stream of graduates who are ready for QIST careers in the public and private sectors. The facilities and people supported during the first six years have been a great start and should be sustained.

As called for in the NQI Act, the National Quantum Coordination Office, located within the Office of Science and Technology Policy in the Executive Office of the President, provides invaluable coordination functions—across agencies, but also with the private sector. QED-C and its members see the NQCO as a central point of contact regarding the federal quantum policies, programs, and priorities. QED-C leadership communicates with the NQCO regularly on topics of mutual interest. However, the office is relatively small, limiting its ability to undertake activities that require more time and resources. QED-C and its members welcome broader two-way communication between the NQCO and the quantum industry as a whole.

[12] https://quantumconsortium.org/publication/state-of-quantum-industry-innovation-what-patents-tell-us/

Weaknesses

Interaction between NQI-funded researchers and industry is called for in the Act but needs to be strengthened. DOE and NSF are making substantial investments in basic scientific research, but those programs are not connected to industry in a way that allows industry-identified gaps to inform program priorities or scientific results to flow to those who can use them in applications. In addition, greater interaction between industry and students at NQI-funded universities would allow those students to gain an understanding of opportunities and careers in the field, and at the same time help U.S. companies identify, develop, and recruit top talent.

The NQI has focused its investments on quantum systems, and in particular on quantum computing, but has not focused on the supply chain for enabling technologies that are critical to being able to build those systems, such as cryogenics, specialty lasers and photonics, microwave and RF electronics, critical materials, and test and measurement equipment. As the industry matures it has become increasingly clear that sourcing specialized enabling technologies is a significant bottleneck for quantum companies, and the government could help develop and strengthen the supply chain for technologies that are needed across the industry.

Meanwhile, the UK, Netherlands, Australia, Japan, Canada and others have established quantum investment programs with the goal of creating a complete ecosystem from suppliers to end users. Many of these countries have strong collaborations between industry and government-funded research institutions. The United States recently launched programs with similar objectives. Last year, Elevate Quantum, based in Colorado and the surrounding region, was selected as a Dedicated TechHub by the Economic Development Administration in the Department of Commerce. This regional effort can be expanded by ensuring the NQI centers launched by NSF and DOE are not only encouraged but are assessed on the outcomes.

There is a need for quantum workers at every level and with a range of knowledge and skills. With increased investments in university research, the number of graduates with advanced degrees and relevant experience, knowledge, and skills is growing. However, demand for quantum-ready workers continues to outpace supply, especially in engineering fields and increasingly for specialized technicians.

A study supported by QED-C shows that the majority of jobs in the quantum industry do not require a PhD or significant quantum-specific skills.[13] Instead, an undergraduate or master's degree in a traditional discipline, with an introduction to quantum as part of the curriculum leaves graduates well-prepared for positions in the emerging industry. As industry shifts from R&D to production, there is a growing demand for engineers who are experienced in product development and project management and for technicians with hands-on experience using photonic, vacuum, RF electronics, and cryogenic equipment. It should be noted that the skills required by "quantum makers" (businesses that are developing quantum-based products) are different from those required by "quantum takers" (the end users). Over time, the takers will outnumber the makers, creating a demand for people who can understand the domain of the business (pharma, finance, energy, etc.) and the potential of quantum technologies to provide solutions. The quantum education system needs to adapt to the needs of both components of the growing industry.

[13] Assessing the needs of the quantum industry

Opportunities for improving the NQI

More than six years have passed since the NQI was enacted and there has been a lot of progress, but much is yet to be done to advance science and technology, to realize the economic benefits, and to build the necessary workforce, while protecting national security. Applications in sensing, networking and computing are within grasp, but most are still over the horizon. Now is the time to examine where there are gaps that need to be filled and to start building the necessary bridges through strategic investments, public-private partnerships, and innovative programs and policies.

In addition to sustaining investment in basic research, the following are areas that Congress has the opportunity to address in the reauthorization of the NQI.

Build an innovation pipeline from basic research to a robust quantum economy.

- Deepen engagement with industry. Since the inception of the NQI, QED-C has been established and now represents the broad quantum industry. The consortium not only serves its industry members, but it is also a resource to the Federal government. The QED-C reports on use cases and technology gaps are based on collective expert assessments and can serve as guides for basic research investments at NQI agencies and can inform others about relevant applications and uses. QED-C is a public-private partnership and can support Federal agencies to achieve their respective missions.
- Connect industry with academia and national labs. Industry could benefit by more collaboration with researchers in academia and at national laboratories. And academic faculty and students and national laboratory researchers could benefit from interactions and collaboration with industry. Small companies in particular don't have the capacity or financial resources to perform longer term R&D. As part of the investments by NSF and DOE, NQI should incorporate meaningful partnerships between industry and academia and hold recipients of funding accountable.

Be an early customer.

- Fund QUEST. The Quantum User Expansion for Science and Technology (QUEST) program was authorized in the CHIPS and Science Act. It will enhance research, educate students, and support development of useful quantum computers by U.S. companies by providing researchers and developers access to commercial quantum computing resources. The program aims to expand the use of U.S. quantum computers in diverse areas of research such as biomedicine, industrial systems, materials science, etc. Connecting researchers, including those from application developers, directly with providers promotes interactions that can accelerate progress in the development of useful systems. In addition, student users will learn how to program and use quantum computers, gaining valuable skills that they will take with them into their next job. QUEST is an example of the government being an "early adopter" by paying the cost of using currently available, privately owned quantum computers. It is platform agnostic and open to the various types of quantum computers being developed. Buying cloud-based services makes sense because the available systems are rapidly improving. The program is a win for academic, government and industry researchers, students, and the quantum computing industry.

- Stimulate US government agencies to become skilled early adopters of quantum technologies. As envisioned in the National Strategic Computing Initiative (NSCI)[14] there should be "Deployment Agencies" tasked and funded to participate in a co-design process to meet the requirements of their respective missions. The DOE Grid Modernization Initiative is an example of this approach and a good start. The National Aeronautics and Space Administration (NASA) and Department of Homeland Security (DHS) are also well positioned to be Deployment Agencies, thereby supporting the development of technologies for their needs and complementing the foundational research supported by and at DOE, DOD, NIST and NSF.
- Provide incentives for private investment. The NQI can incentivize the private sector to make investments by using existing authorities such as prizes and advanced market commitments. These incentives can unleash substantial private capital toward applications in areas that are relevant to government missions, such as secure critical infrastructure and improved public health and safety. They may be milestone-based or reward delivery of a complete solution or capability. Examples include the X-Prize Quantum Applications challenge in partnership with Google Quantum AI[15], the Airbus-BMW Quantum Computing Challenge[16] concluded in 2024, and the 2025 Global Industry Challenge[17] hosted by the Potomac Quantum Innovation Center and focusing on applications in finance, risk management, infrastructure and life sciences. A QED-C report identifies several areas in which near-term applications are most likely.[18]

Provide infrastructure for scalable manufacturing

There is a gap between university facilities that are set up to support experimentation and large-scale, high-volume manufacturing facilities that are not designed to accommodate new materials or processes required for quantum technology fabrication. NQI needs to invest in the infrastructure that will support prototyping now and can grow to support the needs of the quantum industry as it matures, before those capabilities are developed elsewhere. We do not want to have to spend billions to reshore quantum manufacturing in the future.

Ensure development of the necessary workforce

One of the most tangible outputs of investment in academic research is science and engineering talent. In addition to educating students at the graduate and undergraduate level, NQI should develop programs as part of the NSF quantum program to extend and expand the pipeline by engaging secondary teachers and students and by providing education to members of the current workforce who are interested in pivoting into careers in quantum. Such programs could leverage existing programs offered by community colleges and other technical educational institutions and by professional societies and organizations that provide professional development for their members. Programs aimed at

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[14] Executive Order Creating a National Strategic Computing Initiative (2015)
[15] https://www.xprize.org/prizes/qc-apps
[16] https://www.airbus.com/en/innovation/digital-transformation/quantum-technologies/airbus-and-bmw-quantum-computing-challenge
[17] https://www.pqic.org/challenge
[18] https://quantumconsortium.org/publication/public-private-partnerships-2022/

educating end users are especially needed in order to promote practical uses and rapid adoption. A model for such a program is the Quantum Algorithms Institute in British Columbia, Canada.[19]

Take full advantage of NIST

In the Department of Commerce, NIST has a mission to promote U.S. industrial competitiveness and is home to world-leading expertise in metrology and technologies that are critical for the quantum industry. Five NIST researchers have won Nobel prizes for work related to quantum and numerous leaders in the quantum ecosystem were post-docs or researchers at NIST at one time. As part of the NQI reauthorization, NIST's role in support of accelerating the practical application of quantum technologies should be expanded.

- Create a quantum engineering center. The capabilities to engineer various quantum systems are multidisciplinary and cross the NIST labs. In addition, NIST has a history of partnering with other research institutions, e.g., at JILA with the University of Colorado and the Joint Quantum Institute with the University of Maryland. Finally, NIST is creating a semiconductor technology center that will "support critical research and development to drive U.S. leadership in semiconductor innovation, economic growth, and national security." A purpose-built NIST quantum engineering center would be a natural partner with other public-private partnerships that NIST or NQI might create similar to this semiconductor-focused model.
- Establish a public-private partnership to explore and accelerate applications, with a focus on near-term opportunities that have potentially widespread utility and can serve as early steppingstones to future applications. Clear opportunities for partnerships with NIST exist in Position, Navigation and Timing (PNT) and in quantum sensors of various sorts. NIST has unique capabilities and facilities for characterization and testing that small companies cannot afford. Such a "sandbox" could also partner with NSF- and DOE-funded researchers to promote technology transfer to the applications that are identified.
- Be a pipeline for top notch talent. Growing the NIST quantum effort, especially in quantum applications, should be accompanied by hiring more NIST post-docs working in quantum. NIST post-docs have experience working on leading-edge quantum technologies. A substantial number of former NIST post-docs or researchers have started companies or taken leading positions in existing quantum companies, acting as a multiplier to the US quantum economy. Among QED-C members, examples of positions held by former NIST employees include:
    - Multiple founders, especially in Colorado and Maryland near the NIST campuses, helping to make these regional hubs of quantum innovation
    - CTO
    - Center director
    - Numerous engineers and scientists in key roles
- Support implementation of post-quantum cryptographic standards. While QIST has the potential for enormous economic value and societal benefit, it also poses threats. A sufficiently powerful quantum computer will be able to break some of the most commonly used encryption techniques. Such a quantum computer would therefore pose a threat to existing IT systems and the security of data that are stored and transmitted, for example, as part of online banking and

[19] Quantum Algorithms Institute homepage

e-commerce or sharing of medical information between doctors and patients or insurers. Steps are being taken to address this threat. In August 2024, the National Institute of Standard and Technology (NIST) approved three standards for post-quantum cryptography (PQC).[20] The Quantum Computing Cybersecurity Preparedness Act[21] directs federal agencies to take certain steps to prepare for and adopt PQC standards. And the Cybersecurity & Infrastructure Security Agency (CISA) has provided guidance to owners and operators of critical infrastructure systems on preparing for PQC[22]. Although it may be a decade or more before a cryptographically relevant quantum computer is built, data encrypted using the old standards are vulnerable to being captured and stored now and decrypted in the future when such a quantum computer is available. Those responsible for protecting sensitive data need to take steps now to implement the new PQC standards. While NIST is not responsible for enforcing migration to the new standards, it supports dissemination of information and works with the community to accelerate adoption.

Take full advantage of DOE

- DOE is not only a funder of basic research, it manages much of the nation's high performance computing (HPC) infrastructure in support of the DOE science and nuclear security missions. NQI programs at DOE should be integrating quantum into plans for future HPC projects and facilities. Other countries and international groups are investing in this area, including the Open Compute Project[23], UK[24], Japan[25], the European Union[26] et al. DOE must lead, not follow, in researching and developing hybrid quantum-classical computers to maintain the agency's leadership class capabilities.
- DOE has been authorized to create the QUEST program, which would build on the existing Quantum Computing User Program[27] managed by Oak Ridge National Laboratory. Since QUEST was first proposed, other countries have implemented similar programs which benefit both the researchers who get to use the quantum computers and the companies who get funding to provide the service and learn from the users.

Take full advantage of QED-C

Congress called for a consortium in the original NQI Act, leading to the creation of QED-C. The growing membership and remarkable level of engagement across the quantum ecosystem is a testament to its value. While NIST was charged with establishing the consortium, the structure allows any government agency to participate and partner with the QED-C community. To date we have collaborated with DOE to identify energy-related use cases, NIH to explore biomedical uses cases, the Department of

[20] https://csrc.nist.gov/news/2024/postquantum-cryptography-fips-approved
[21] Quantum Computing Cybersecurity Preparedness Act (enacted Dec 21, 2022)
[22] Preparing Critical Infrastructure for Post-Quantum Cryptography, CISA (2022)
[23] https://www.opencompute.org/blog/building-and-connecting-hybrid-quantum-ai-and-hpc-data-centers
[24] https://www.hartree.stfc.ac.uk/events/quantum-and-hybrid-quantum-classical-computing-approaches-workshop/
[25] https://medium.com/ai-frontiers/japans-hybrid-quantum-supercomputer-a-game-changer-in-computing-a69a33d38a53
[26] https://quantera.eu/hqcc/
[27] https://www.olcf.ornl.gov/olcf-resources/compute-systems/quantum-computing-user-program/

Commerce to inform export and import regulations, State Department to provide industry perspectives during dialogues with allies, DOD to inform the design of the new Office of Strategic Capital and the Microelectronics Commons program and others. Partnerships between QED-C and government agencies is a win-win. Now that QED-C exists, the NQI should support and utilize the consortium to inform and accelerate their own quantum strategies.

Collaborate with international partners.

Countries around the world that share values with the United States are launching and expanding quantum technology programs. Many are home to research centers of excellence and support a flourishing startup culture that is producing a growing number of startups and businesses that are entering the quantum supply chain. It is in the national interest to collaborate not only at the research level, but on the business level as well. Working with allies and partners to open markets, develop appropriate standards, and stimulate competition and collaboration will help to enable and grow a robust quantum industry and ensure the technology is controlled by allies not adversaries.

Conclusion

The combined economic, societal, and national security impacts of QIST make it a critical emerging technology and a field in which ***the United States must be a global leader***. The nation is in a strong position but cannot afford to be complacent. The National Quantum Initiative is a centerpiece of the national quantum enterprise that will be essential to American leadership in quantum technologies. At this moment, your committee is in a unique position to ensure the NQI supports all parts of the innovation ecosystem—from basic research to commercialization. Together, we can accelerate progress and win the quantum race.

QED-C

STATE OF THE GLOBAL QUANTUM INDUSTRY 2025

The quantum industry has experienced strong growth driven by advances in quantum hardware and software, increased government and private investments, and growing interest from industries such as finance, health care, materials science, logistics, and defense. This report primarily reflects the global industry as of the end of 2024.

COMPOSITION

6,502
QUANTUM-ENGAGED ORGANIZATIONS

513
PURE-PLAY QUANTUM COMPANIES

MARKET

$1.45B+
2024 MARKET SIZE

$1.07B
REVENUE FROM QUANTUM COMPUTING

$375M
REVENUE FROM QUANTUM SENSING

WORKFORCE

14,500+ PURE-PLAY WORKERS ADVANCING QUANTUM

7,400+ QUANTUM-RELATED POSITION OPENINGS IN 2024

INVESTMENT

$3.1B
GOVERNMENT FUNDING COMMITMENT IN 2024

$2.6B
PRIVATE VENTURE CAPITAL IN 2024

INTELLECTUAL PROPERTY

55,293
ACTIVE PATENTS

13%
AVG ANNUAL PATENT GROWTH OVER LAST FOUR YEARS

FOR METHODOLOGY VISIT:
BIT.LY/SQIR2025

Note: Monetary amounts are reported in US dollars.

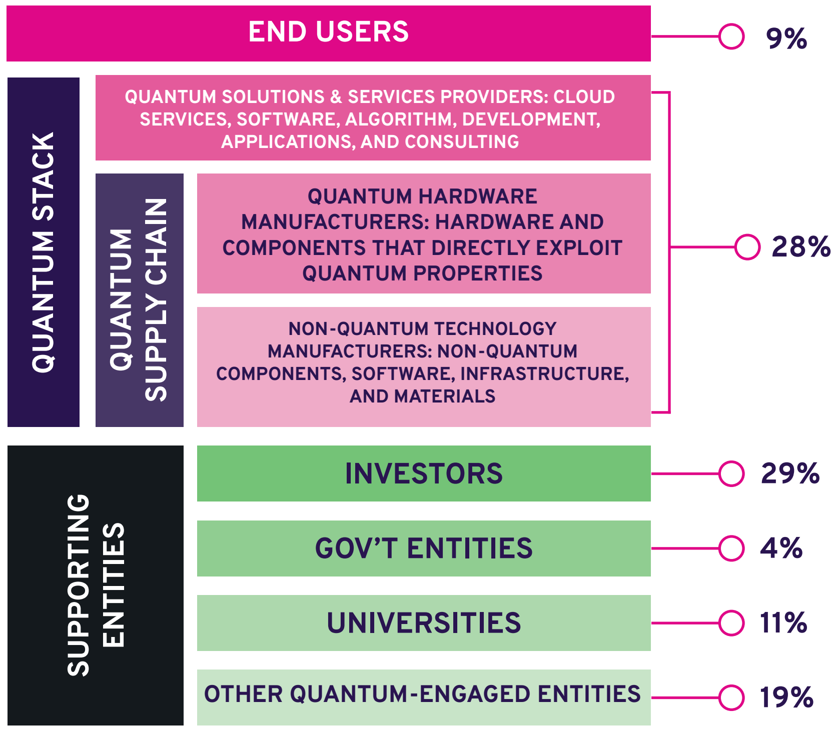
COMPOSITION

The quantum industry spans segments including computing—which makes up the most significant portion of the market—sensors, cryptography, and communication technologies. It comprises companies that focus solely on quantum technology (pure-play) as well as established technology companies, universities, laboratories, and other entities that dedicate a portion of their attention and resources to advancing quantum technology (partial-play).

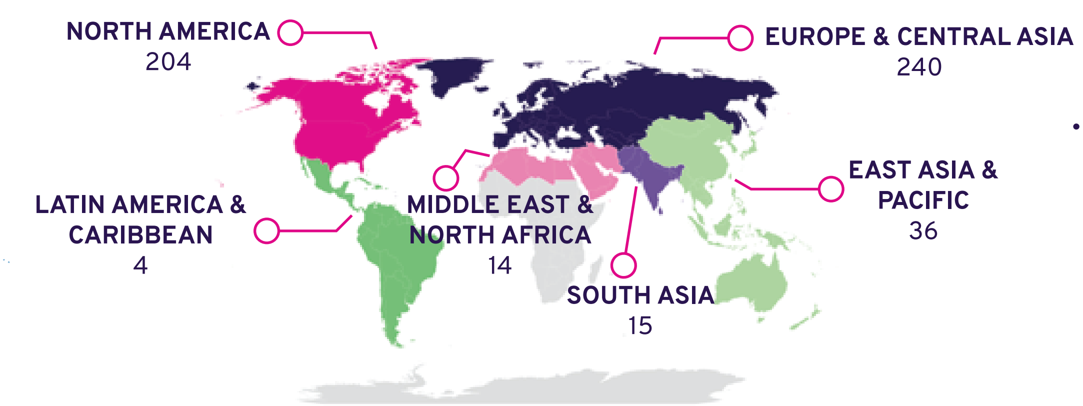
QUANTUM-ENGAGED ORGANIZATIONS

- Strong commercialization focus via investors (29%) and quantum stack entities (28%)
- Universities and 'other quantum-engaged entities' (research laboratories, quantum technology centers, etc.) together account for 30% of market, reflecting their foundational role in advancing quantum research
- High ratio of quantum stack entities to end users is typical for emerging deep-tech sectors and signals opportunity for ecosystem development as industry scales

QUANTUM ECOSYSTEM STRUCTURE

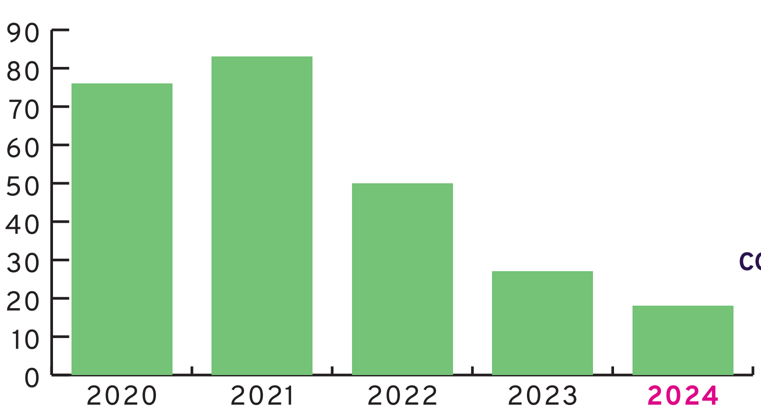


PURE-PLAY COMPANIES BY REGION

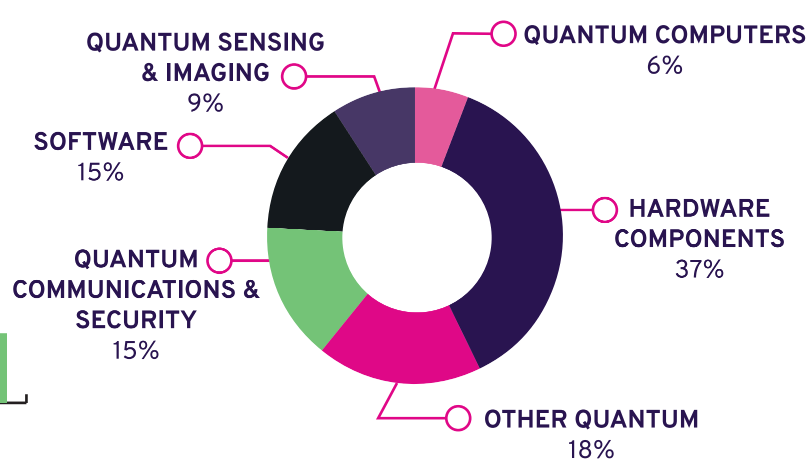


- United States leads overall in number of pure-play companies (148), followed by United Kingdom (64), Canada (56), Germany (48), and France (25), reflecting their favorable ecosystems for quantum technology innovation

PURE-PLAY COMPANIES BY YEAR FOUNDED



CLASSIFICATION OF QUANTUM STACK COMPANIES



- Average of 51 pure-play companies formed each year in 2020–24
- Decrease in new pure-play companies since 2021 reflects a maturing marketplace, increase in mergers & acquisitions, and concentration of venture funding on fewer, less risky firms and technology

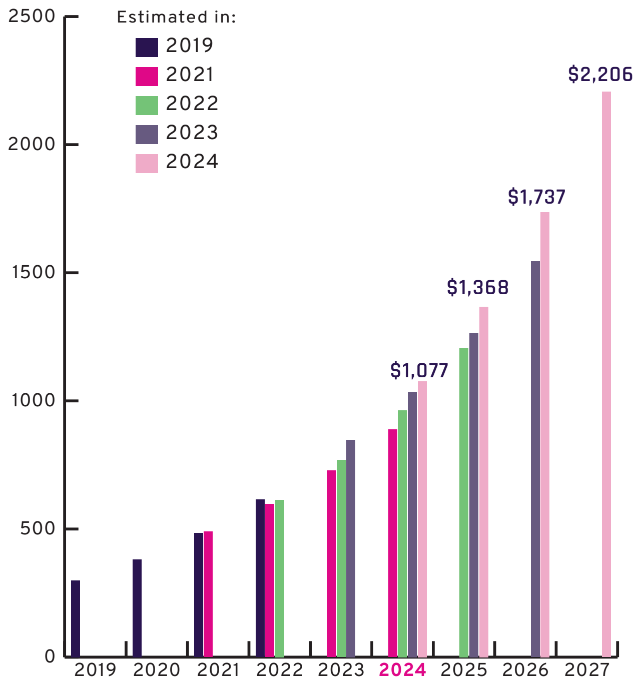
MARKET

Quantum computing and quantum sensing show the most significant promise among all quantum technologies for generating the most revenue in the near future. North America comprises 44% of the global market for Quantum computing and 35% of the global market for quantum sensing.

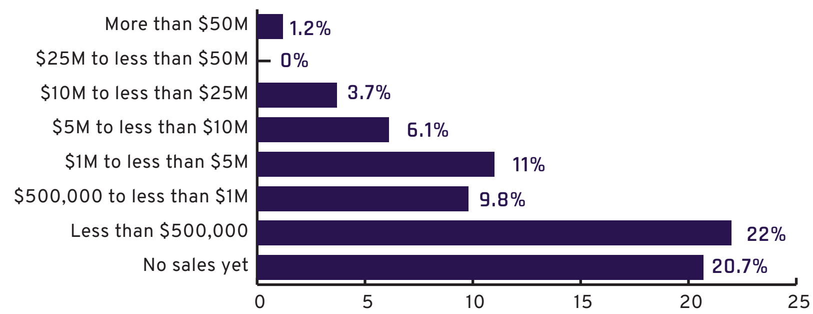
QUANTUM COMPUTING MARKET ESTIMATE: $1.07B IN 2024

27% ANNUAL GROWTH RATE ESTIMATED TO DRIVE GLOBAL QUANTUM COMPUTING MARKET TO $2.2B IN 2027

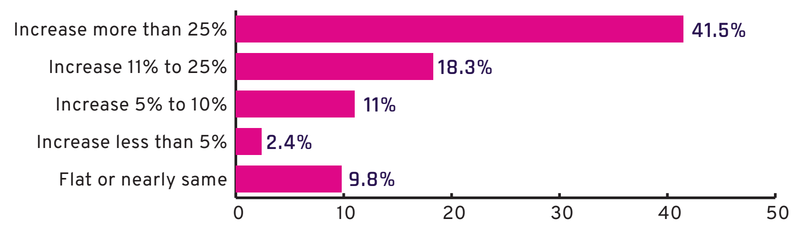
GLOBAL QUANTUM COMPUTING MARKET ($M)



2024 QUANTUM COMPUTING-RELATED COMPANY REVENUE



PROJECTED QUANTUM COMPUTING-RELATED COMPANY REVENUE CHANGE FROM 2024 TO 2025

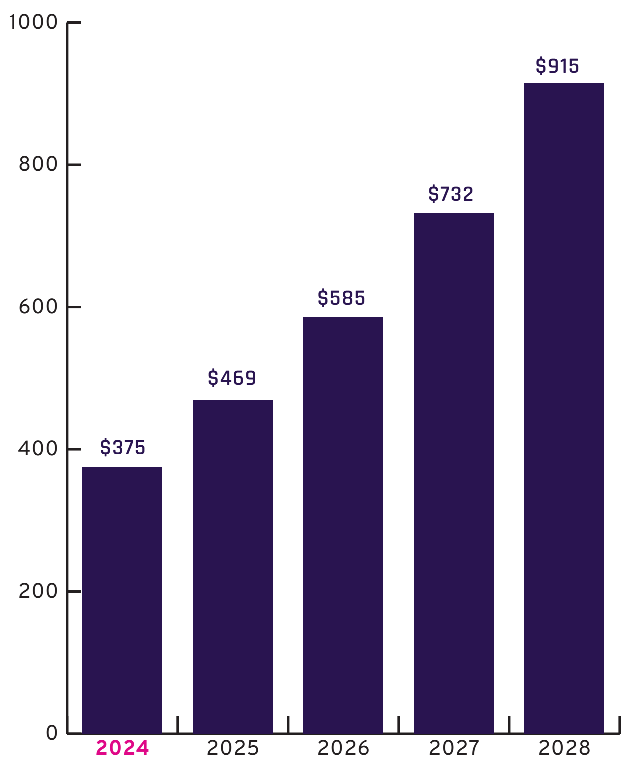


- End-user sectors seen as most attractive for quantum computing suppliers in near future: (1) chemistry and materials, (2) financial services, and (3) logistics
- Top quantum computing algorithms in near future: (1) simulation/modeling, (2) hybrid quantum computing algorithms, (3) optimization, and (4) artificial intelligence
- While quantum computing companies' own revenue projections are optimistic, there is concern over potential decrease in investment

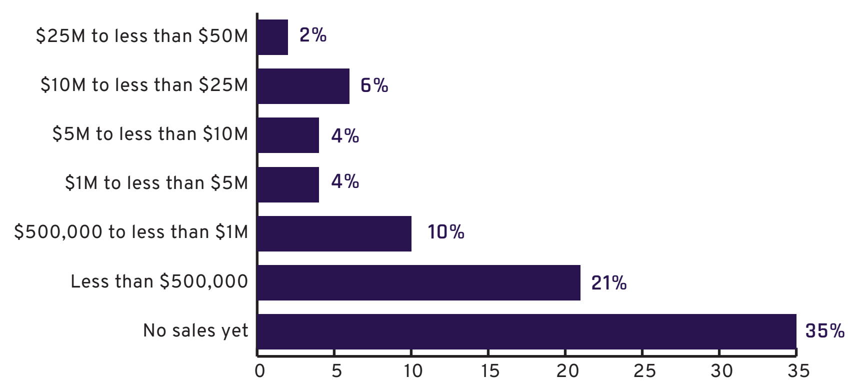
QUANTUM SENSING MARKET ESTIMATE: $375M IN 2024

25% ANNUAL GROWTH RATE ESTIMATED TO DRIVE GLOBAL QUANTUM SENSING MARKET TO $915M IN 2028

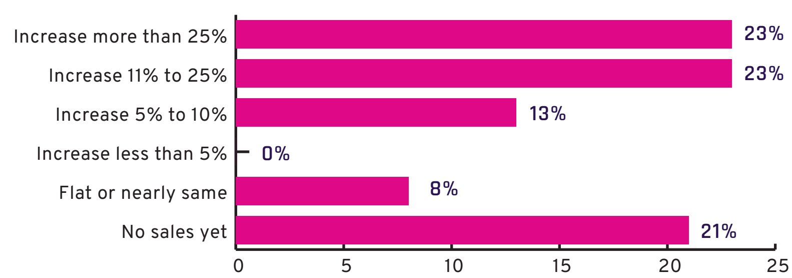
GLOBAL QUANTUM SENSING MARKET ($M)



2024 QUANTUM SENSING-RELATED COMPANY REVENUE



PROJECTED QUANTUM SENSING-RELATED COMPANY REVENUE CHANGE FROM 2024 TO 2025



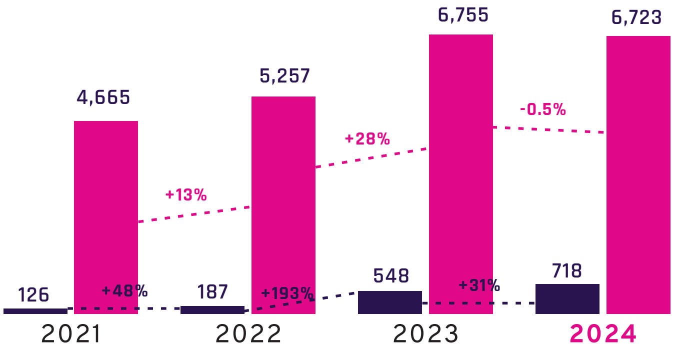
- Global market for quantum sensors is expected to grow over next decade, driven by applications in health care, defense, and advanced manufacturing
- Atomic clocks are currently among most in-demand quantum sensors, with applications related to geospatial navigation, telecommunications, and financial services

Note: For graphs conveying percentages of companies estimating revenue, companies with unshareable proprietary information or uncertainty in their estimates were excluded, hence percentages may sum to less than 100%.

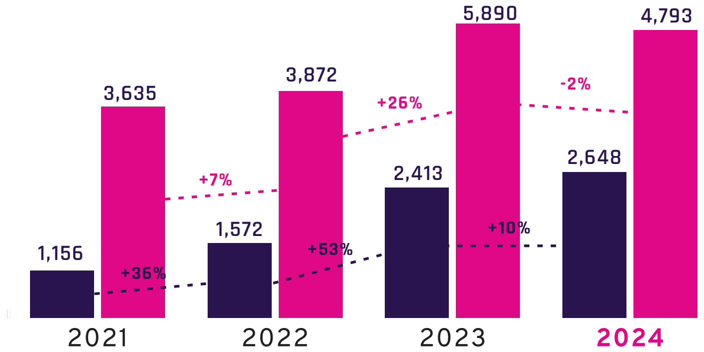
WORKFORCE & PIPELINE

The pure-play quantum workforce is estimated to be 14,517 professionals globally as of 2024, while the estimate of all quantum-engaged workers may be close to 200,000. This includes physicists, computer scientists, engineers, mathematicians, and software developers. The number of quantum-related job and internship openings has increased globally since 2021, with 7,300+ openings in both 2023 and 2024.

QUANTUM-RELATED OPENINGS BY POSITION TYPE

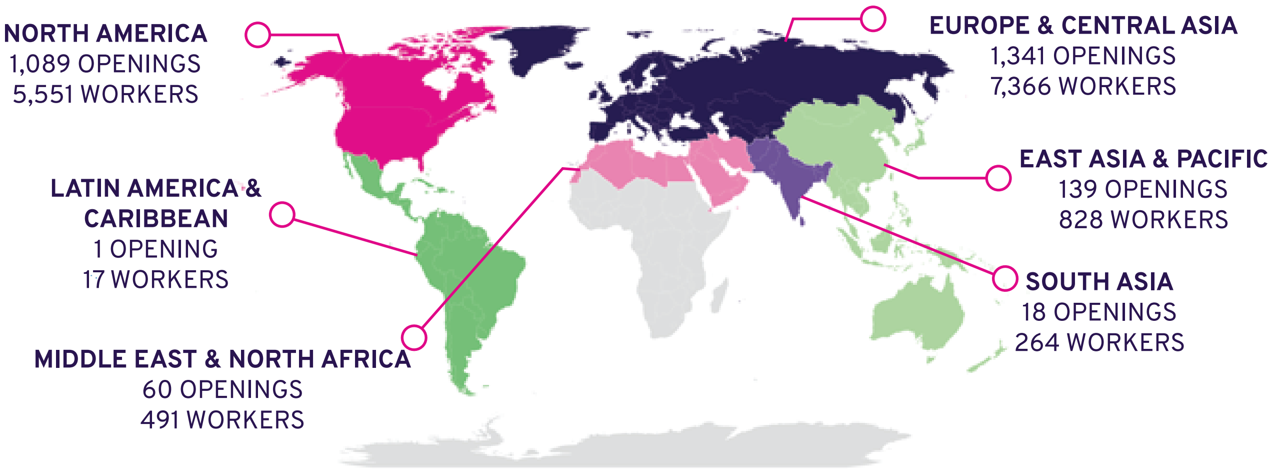


QUANTUM-RELATED OPENINGS BY ORGANIZATION TYPE



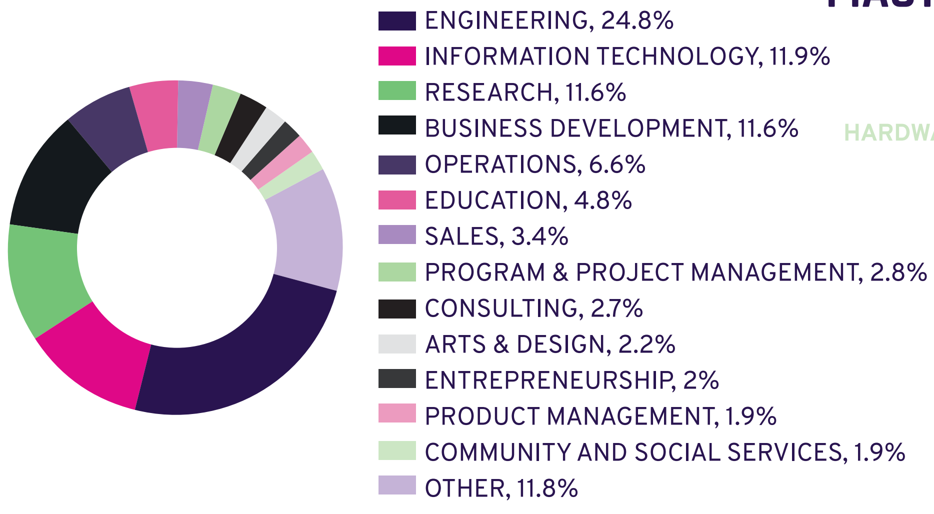
- Over past three years, annual growth rates of quantum-related internship openings outpaced those of quantum-related job openings, and annual growth rates of job & internship openings among pure-play companies outpaced those among partial-play organizations
- 2024 saw substantial increase in number of recruiters engaged in candidate searches for quantum technology workers

PURE-PLAY JOB & INTERNSHIP OPENINGS AND WORKERS BY REGION IN 2024

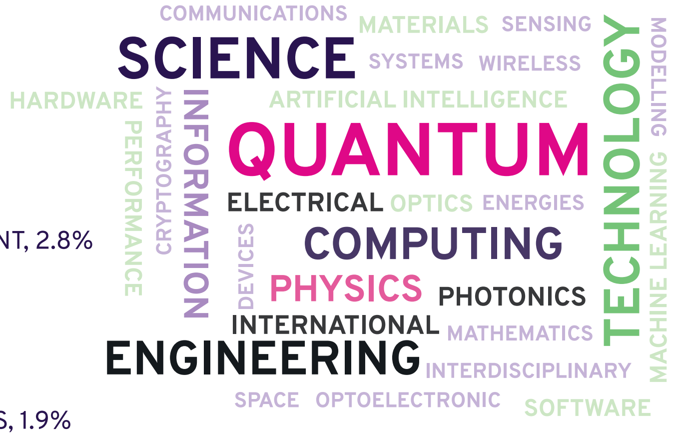


Note: Remote job & internship openings are not represented on the map.

QUANTUM WORKFORCE BY ROLE



KEY TERMS AMONG QUANTUM MASTER'S DEGREE PROGRAM TITLES

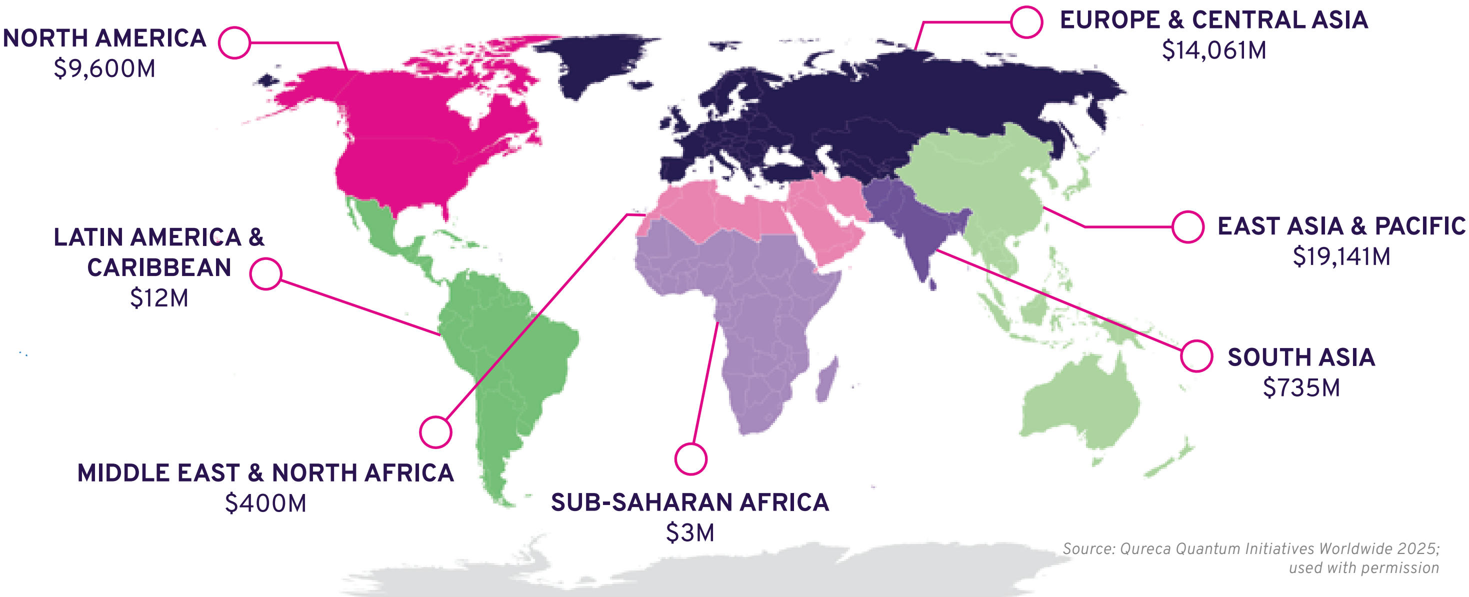


- Top three roles in quantum workforce—engineering, information technology, and research—account for almost half (48.3%), reflecting industry's reliance on STEM skills; however, non-STEM expertise is also common, reflecting multidisciplinary collaboration among technical, business, and end-use roles in quantum technology development
- Universities are increasingly offering quantum-specialized graduate programs in engineering, computing, physics, and related fields, creating more focused pathways to quantum careers

INVESTMENT & INTELLECTUAL PROPERTY

Both public and private funding for quantum technology continues to grow year-over-year globally. Public funding commitments for quantum research and innovation increased by more than $3.1B over the past year, reaching an estimated $44.5B total. Private venture capital investment in the quantum industry reached a record high of nearly $2.6B in 2024, rebounding from the decline seen in 2022–23. Patents also indicate the pace and geographic distribution of quantum advances and markets, and currently more than half of the patents across all quantum technologies are filed in China.

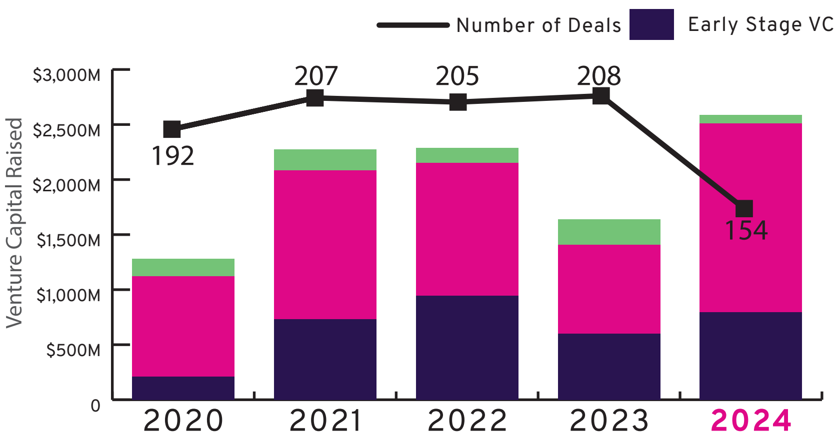
PUBLIC INVESTMENTS IN QUANTUM TECHNOLOGY BY REGION



Source: Qureca Quantum Initiatives Worldwide 2025; used with permission

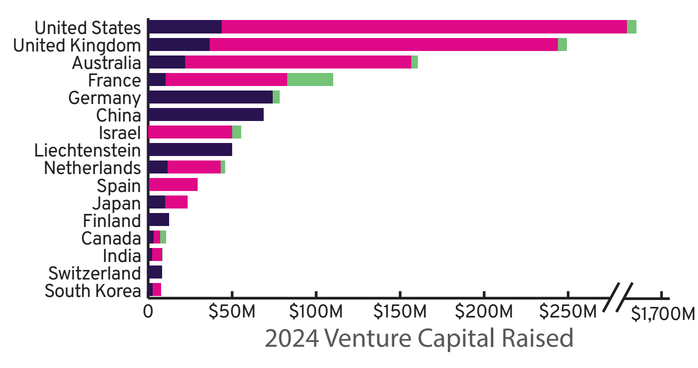
- China's estimated public funding for quantum research and innovation ($15B) accounts for 78% of funding in East Asia and the Pacific and 34% of global public investment
- United States ($7.7B) and United Kingdom ($4.3B) are next highest funders of quantum by aggregate commitments

VENTURE CAPITAL RAISED & NUMBER OF DEALS BY YEAR



Source: PitchBook Data, Inc.; used with permission

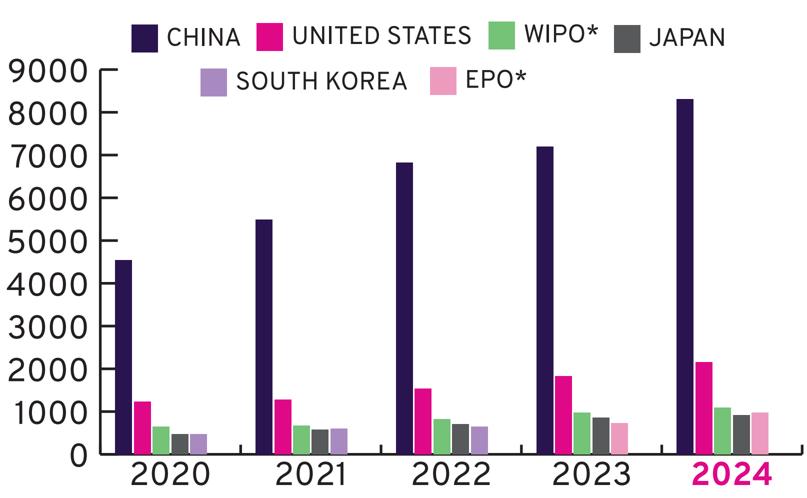
2024 VENTURE CAPITAL LEADERS BY QUANTUM COMPANY HQ COUNTRY



Source: PitchBook Data, Inc.; used with permission

- 58% increase in funding from 2023 to 2024 went to 54 fewer deals, highlighting maturation of quantum startups and their technology
- US-based quantum companies raised nearly $1.7B in venture capital in 2024, far surpassing any other global leaders

QUANTUM-RELATED PATENTS FILED IN TOP JURISDICTIONS ANNUALLY 2020–24



- Chinese patents represent more than half (54%) of quantum filings in 2020-24, approximately four times that of United States. Similarly, number of patent-filing entities is four times higher in China than in United States during this period
- Between 2020 and 2024, ~70% of WIPO patents expired, reflecting not only maintenance cost pressures but also strategic decisions by organizations to focus on key patents and markets

**World Intellectual Property Organization (WIPO) and European Patent Office (EPO) each represent regional patent coverage*