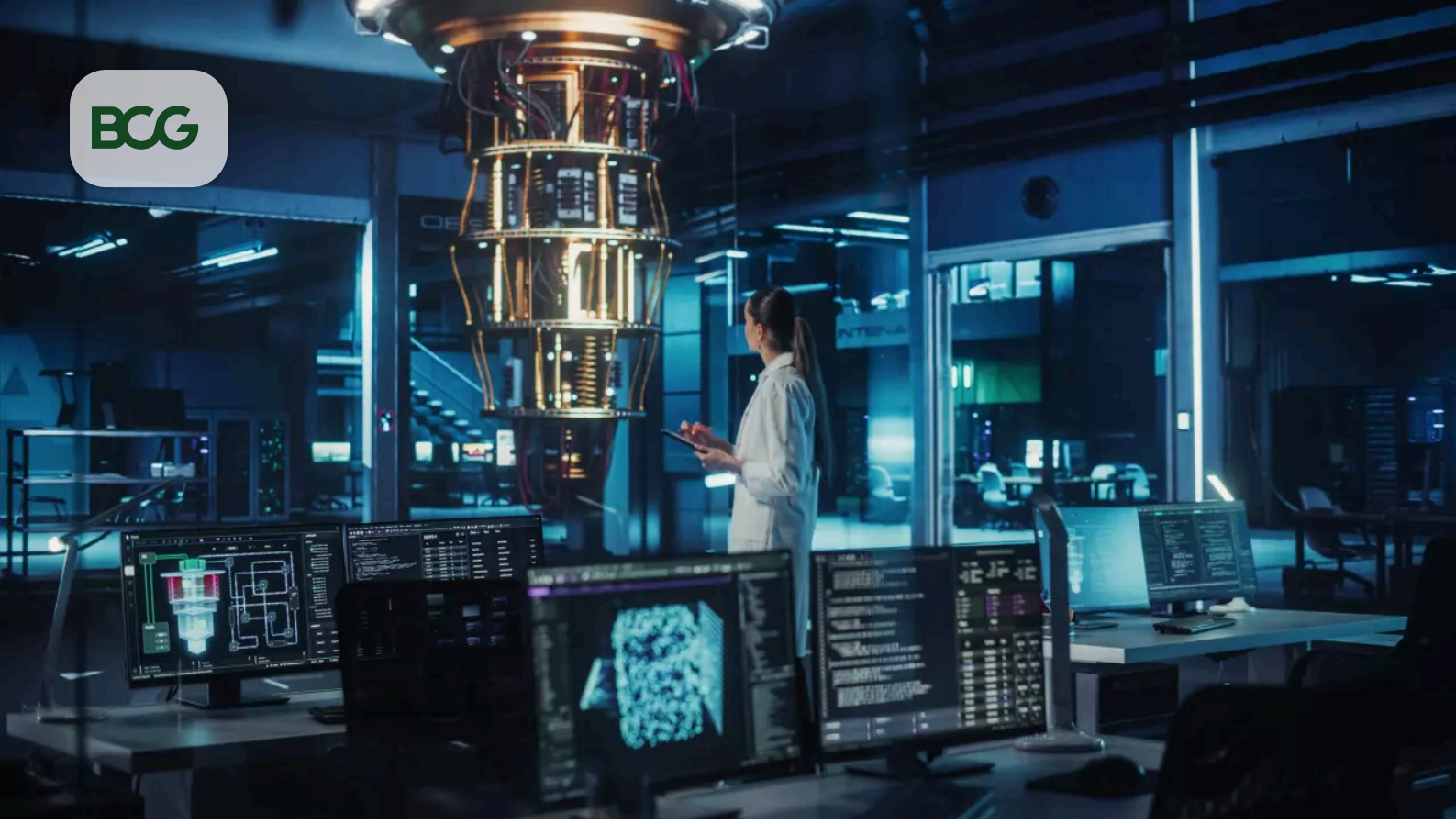


QUANTUM COMPUTING

Quantum Is Getting Real. CEOs Need to Shape Where It Creates Value.

By Matt Langione, Hanl Park, Jean-François Bobier, Brad Henderson, Dr. Harley T. Johnson, Sesh Iyer, and Zheng Cui

ARTICLE JUNE 04, 2026 12 MIN READ

Quantum computers are expected to massively accelerate the way we tackle complex, high-impact problems, with huge implications for companies' bottom line. BCG's prior study of more than 100 industry use cases—such as drug discovery, catalyst design, and logistics optimization—

showed that, at maturity, quantum computing can create up to $3.5 trillion of economic uplift. The question is: When?

To determine the answer, we studied the quantum activities of more than 200 large companies and conducted our second biennial enterprise adoption survey. The results showed sustained growth in enterprise demand along with significant tech breakthroughs in hardware and error correction. Taken together, these developments indicate that quantum's commercial inflection point—where the technology starts creating commercial value for end users—can arrive by 2030.

Despite this flurry of activity, however, we've also observed an emerging risk that new, powerful quantum machines may not live up to their potential to deliver value. Though theoretical speed-ups in the future are realistic, today's concrete application algorithms remain sparse compared to ambitious hardware roadmaps. The potential outcome is the arrival of staggering quantum capability that isn't all that useful to solving real-world problems. Closing this gap between potential and practicality requires academic researchers, tech companies, enterprise end users, and domain experts all collaborating on structural responses, as well as enterprises coordinating with the tech providers to build targeted applications.

For CEOs looking to engage with quantum now with an eye on value in the future, it's important to understand that the companies that define high-value use cases, build translational capability, and actively steer innovation today will be the ones that determine where quantum creates value—and who ultimately captures it.

Enterprise Demand for Quantum Continues to Rise

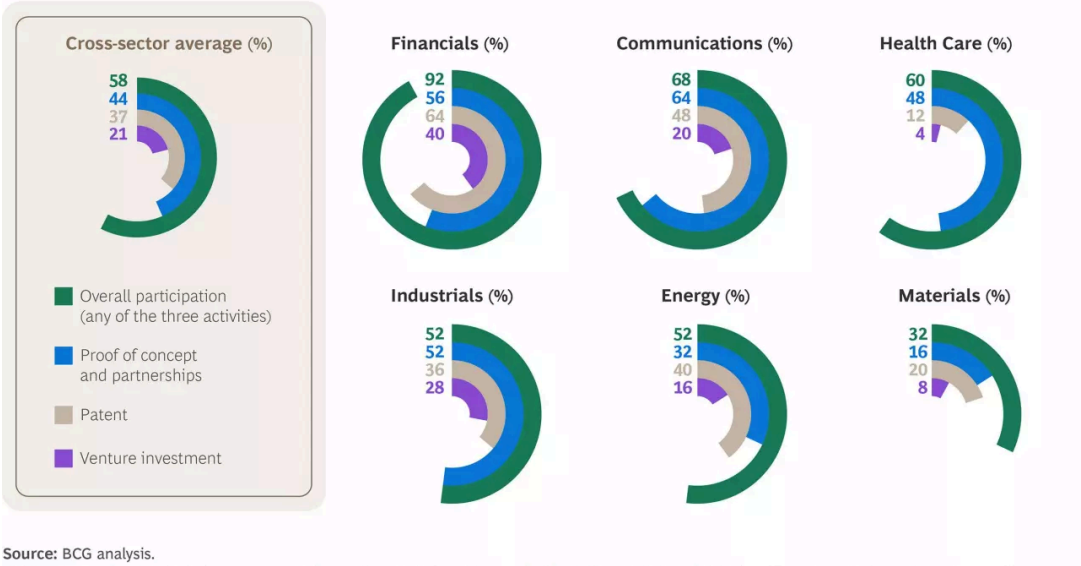
In 2025, enterprise spending on quantum computing reached new heights, pushing the market to about $550 million, according to the latest BCG research. Notably, enterprise end users surpassed the total investment of academia and government for the first time, accounting for more than half of the spend. This is a marked difference to other early-stage technologies that are largely fueled by academic institutions and government R&D spending. This milestone indicates that quantum computing has become an emerging strategic priority among large enterprises, rather than a long-term R&D endeavor.

In the sectors where quantum computing is expected to have the greatest impact, companies considered to be "early movers" have grown in number. Our analysis of leading companies' quantum investments found some 92% of top global finance and insurance firms, 56% of top global health care and biopharma companies, and 52% of industrials companies have all begun

investing in quantum computing. (See Exhibit 1.) On average, 56% of companies across sectors (excluding consumer and real estate) already have some form of investment in the technology.

EXHIBIT 1

Over Half of Global Top 25 Enterprises in Financials, Communications, Health Care, Industrials, and Energy Are Actively Exploring QC

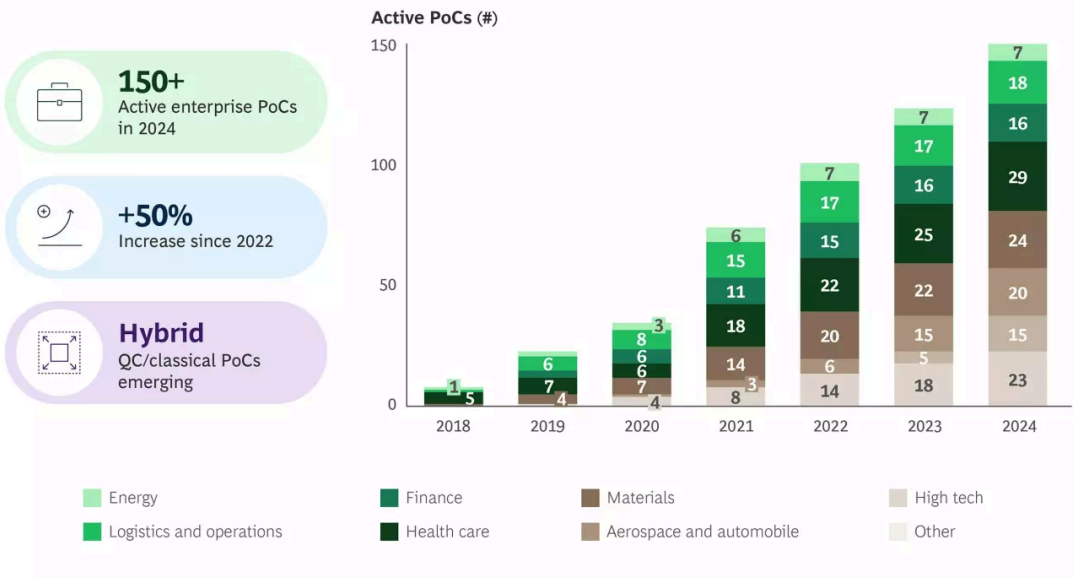


Source: BCG analysis.
Note: Communications includes quantum tech providers Alphabet, NTT, and China Telecom. Industrials includes quantum tech provider Honeywell. Consumer Discretionary, Consumer Staples, and Real Estate have <10% participation and are excluded from analysis.

These enterprise investments take a range of forms: proof-of-concept (POC) projects, vendor partnerships, internal talent hiring, and corporate venture investments. By the end of 2024, our data analysis showed a 50% increase in the number of POCs from two years earlier, with 100 enterprises across industries now active in approximately 150 POCs. (See Exhibit 2.)

EXHIBIT 2

Enterprise Proof-of-Concept Projects Topped 150 Globally at the End of 2024 After Sustained Growth



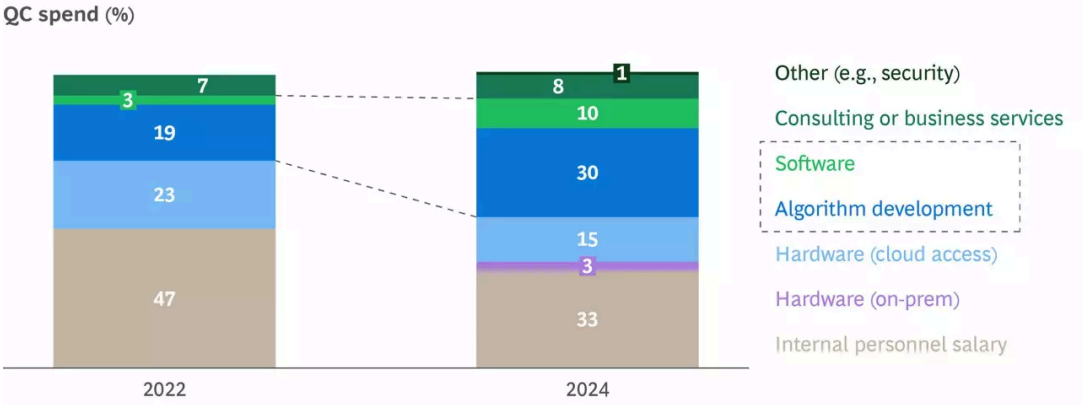
Sources: Company news releases; BCG analysis.
[1]Excluding QKD, PQC algorithm migration, and sensing.

Some examples of these projects include HSBC and IBM using quantum computing to improve automated bond trading; AstraZeneca, IonQ, AWS, and Nvidia simulating drug molecule synthesis; and Airbus, BMW, and Quantinuum modeling fuel cell efficiency. As more companies start to experiment with quantum, the enterprise spend is also increasing in depth: More than 60% of surveyed enterprises spend more than $1 million annually, an 11-percentage-point increase from our 2022 survey. The $1 million mark is an important milestone because our analysis showed that companies investing beyond this level are three times more likely to develop intellectual property (IP), twice as likely to be experimenting with AI, and twice as likely to be engaged in a public-private partnership.

The spending patterns that have emerged reflect an increasing sophistication in the marketplace. (See Exhibit 3.) Between 2022 and 2024, enterprises increased the proportion of their spending on algorithm and software development from 21% to 40%, targeting algorithm innovation rather than simply running test codes on prototype machines. In addition, IBM reports that its users programmed 10 times more qubits in 2024 than in 2022—signaling a shift toward more complex, application-scale use cases. As we will discuss later in the article, this shift will be a critical enabler to bridge the potential value gap.

EXHIBIT 3

Average Enterprise Spending on Software and Algorithm Development Grew Significantly as a Percentage of Total QC Spend



Sources: BCG end user survey (n=32); BCG analysis.

Technical Roadmaps Accelerate Across the Board

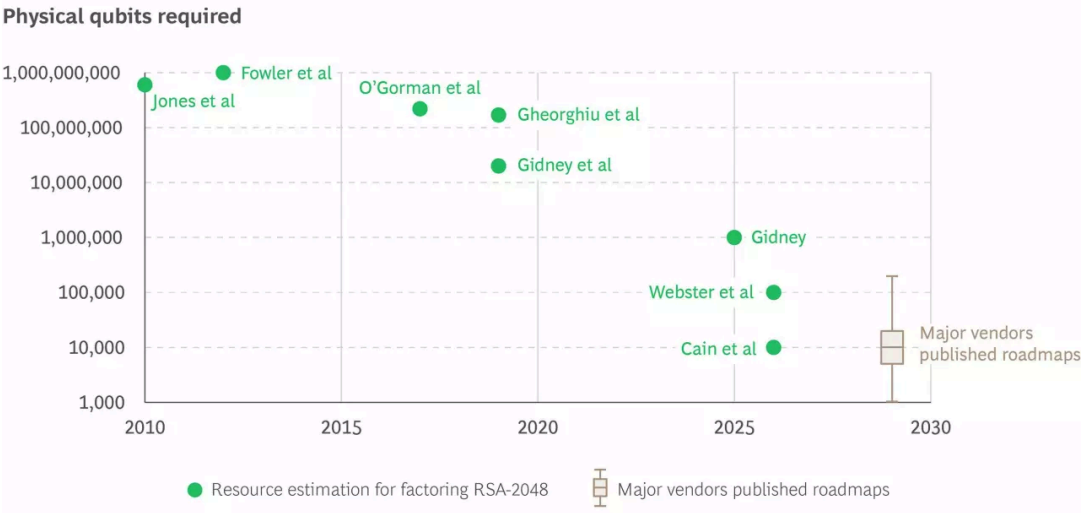
In 2025, the quantum computing industry achieved several consequential technical milestones—most notably in Quantum Error Correction (QEC) and improved resource estimation (for the factoring algorithm). Together, these advances speed up the expected timeline for practical quantum impact by years.

For decades, errors that destroy fragile quantum states have been the primary barrier to scale. Over the past year, leading platforms—including superconducting, trapped ion, and neutral atom quantum computers—have demonstrated that these errors can be effectively reduced with QEC. This progress prompted providers to accelerate their roadmaps for creating fault-tolerant quantum computers capable of reliable, practical computations. IBM now targets developing a 200 logical-qubit system by 2029. Quantinuum similarly aims for a few hundred logical qubits in the same timeframe, while IonQ has announced the most ambitious goal: 8,000 logical qubits by 2029. At these scales, high-value use cases like advanced materials simulation become viable. The implication is clear: Quantum hardware is on track to reach commercially useful scale before the end of the decade.

On the algorithm side, the code-breaking factoring algorithm—long viewed as a hallmark of quantum computing's disruptive potential—saw its biggest advance to date. (See Exhibit 4.) A breakthrough by a Google researcher reduced the resources required to run the algorithm by a factor of 20, making it easier to deploy and accelerating the projected threat to public-key encryption by an estimated five to ten years. While this development is more a security risk than an immediate economic opportunity, it provides further evidence that quantum computers are on pace to being able to solve problems that are intractable for classical computers by the end of the decade. (Note: During the preparation of this article, two other research papers from Google and Caltech in early 2026 appeared to further reduce the resource requirement. The Caltech paper has been added to Exhibit 4 as "Cain et al." The Google paper is not included in Exhibit 4 as it addresses a different class of encryption.)

EXHIBIT 4

Algorithm Advancements Have Significantly Reduced the Qubit Requirement for Shor's Factoring Algorithm



Sources: Academic literature; public vendor roadmaps; BCG analysis.
Note: Given uncertainty in all vendor roadmaps, box-and-whisker chart is used to represent a range.

The factoring algorithm's dramatic improvement over the past decade-plus is a reminder that technological progress is often discontinuous, with moments of calm and sudden bounds forward that can create strategic surprises. Enterprises can either proactively steer innovation to their benefit—or risk getting disrupted themselves.

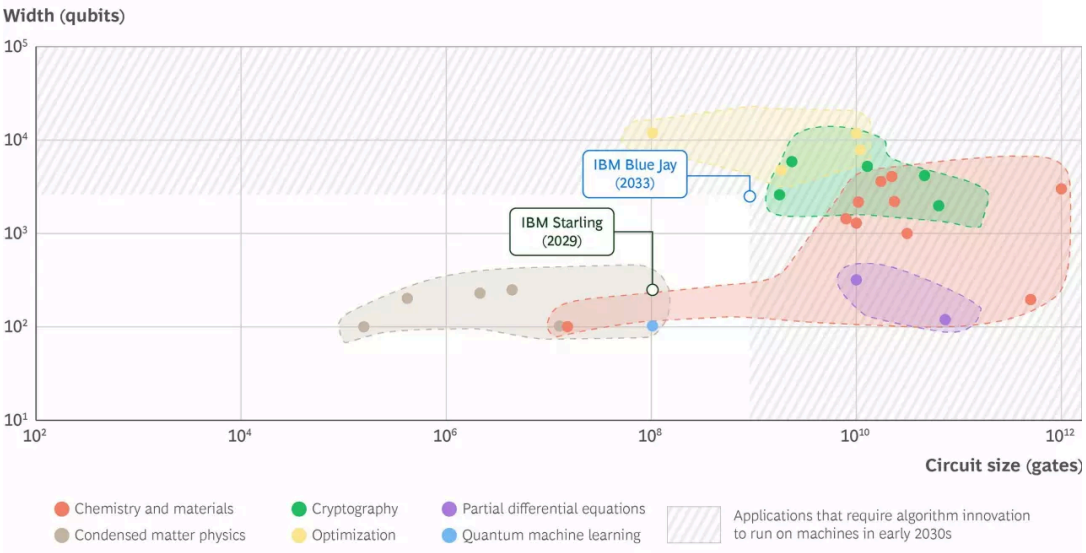
The Emerging Gap in Practical Algorithms

Despite this growth in enterprise investment along with improved tech capabilities (mainly in hardware), concrete applications that can be deployed against complex, real world problems remain scarce. On one hand, quantum scientists and mathematicians who create powerful mathematical building blocks lack the deep domain knowledge about state-of-the-art industry workflows to develop useful, end-to-end applications. On the other hand, many enterprises are stuck in the early stage of exploration and learning, without the ability to align quantum investments and capabilities to core business challenges and create lasting value.

This structural disconnect is evident when we map resource requirements for various applications (for example, materials simulation, optimization, cryptography) against expected machine capabilities. (See Exhibit 5.) The problem that emerges is a scenario where hardware advances create the world's most powerful specialty computer by the early 2030s—with few practical uses. This disconnect can create a gap between computing capability and value creation that will continue to widen without directed innovation efforts.

EXHIBIT 5

Algorithm Innovations Could Lower the Compute Resource Barrier and Enable More Practical QC Applications by the Early 2030s



Source: IBM research.
Note: IBM "Starling" and "Blue Jay" are chosen as illustrative examples due to detailed public roadmap available. Several other vendors also have public roadmaps.

Consortium efforts—like the National Quantum Algorithm Center (NQAC) at the Illinois Quantum and Microelectronics Park—aim to help address this structural value gap by connecting academic researchers, quantum tech providers, enterprise end users, and domain experts to ensure quantum application development that is useful. Created as a public-private partnership, NQAC is designed to help secure funding and attract and foster talent, while also guiding research focus.

The rise of such collaborative efforts reflects the deeper truth that closing the gap requires deliberate coordination. For enterprise end users, active participation in co-innovation will shape

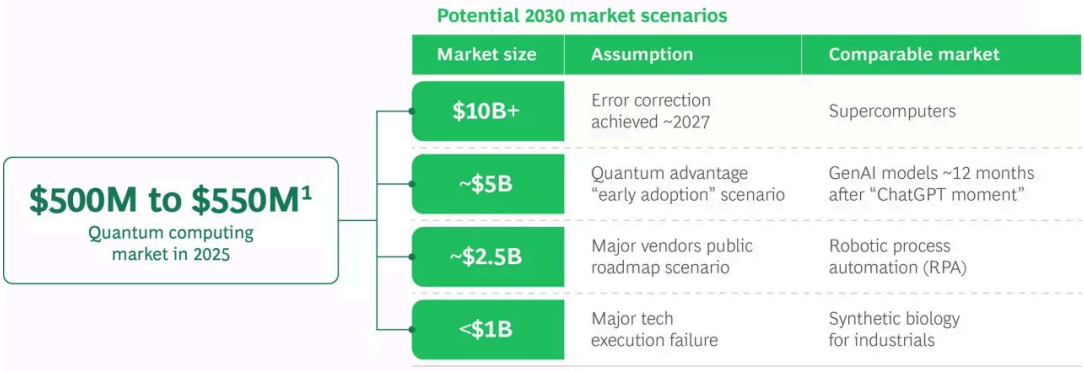
the trajectory of the technology, resulting in applications that actually address their core business challenges and can create competitive advantage.

The Scale of the Prize

To better understand how the technical leaps forward and enterprise investment momentum in 2025 could impact the commercial timeline of quantum computing, we modeled market evolution from 2025 to 2030 based on three drivers: hardware and error-correction progress, algorithmic innovation, and enterprise adoption readiness. (See Exhibit 6.) In a baseline scenario that assumes steady hardware progress, but limited algorithmic breakthroughs, the quantum market will reach approximately $2.5 billion by 2030. In this scenario, value stays concentrated in a small number of high-impact use cases, like chemistry and materials simulation, that are accessible to approximately 100- to 200-logical qubit quantum computers. Revenue in this case is driven primarily by hardware access and solution services.

EXHIBIT 6

Market Sizing Scenarios for 2030 Depend on Hardware Roadmap Progress and Enterprise Adoption Rates



Source: BCG analysis.
[1]Low end excludes quantum-inspired solutions; high end includes quantum-inspired solutions.

A more optimistic scenario—based on innovation beyond steady hardware and algorithmic progress that significantly reduces resource requirements for optimization and quantum machine learning use cases—shows a potential $5 billion market by the end of the decade. By comparison, that would put the market for quantum computing on par with the first 12 to 18 months of GenAI model markets following the "ChatGPT moment." Even under conservative assumptions, quantum computing, absent major execution failures, becomes a multi-billion-dollar market by the end of the decade, with a long-term estimate of $450 to $850 billion in value creation.

Across each scenario, companies investing in and adopting the technology will play a large role in its ability to produce value. Despite technological advances, enterprise readiness—spanning education, alignment, business problem mapping, and data and infrastructure integration—remains a critical enabler of turning quantum potential into value.

What Enterprises Need to Do Now

Initial value pools created by quantum computing will be resource- and IP-intensive and therefore concentrated among a few, large players. For CEOs of enterprises outside this group, it is still important to invest strategically. The first scalable use cases could have great importance, with the potential to set standards and define how ecosystems operate. These small early markets, therefore, could have outsized influence in determining the long-term control of large value pools. The question for leaders then is not whether quantum will matter, but who will determine where the value emerges.

BMW offers a compelling example of proactive leadership. Nearly a decade ago, the company assembled an expert team specifically to assess how to approach quantum computing. By 2020, after rigorous evaluation, BMW formalized its quantum strategy and a year later it launched an open "Quantum Computing Challenge." The challenge was itself a collaborative effort, as BMW partnered with AWS, and later Airbus in 2024, to crowdsource breakthrough use cases from across the ecosystem. Insights from these challenges helped define business constraints and fueled targeted collaborative research with tech leaders Quantinuum, Nvidia, and Classiq, as well as BCG, in high-impact areas, such as battery design, system engineering, and pricing optimization.

Today, BMW sits at the center of this demand-driven partner network. Due to its forward-looking investment in quantum, BMW secured valuable intellectual property, forged strategic partnerships, and built internal capabilities that position it to capture outsized returns as quantum technology matures.

Even though many large enterprises are exploring the market, our research shows that companies like BMW are outliers in their structural approach to quantum. Getting the most out of quantum advantage requires deliberate co-evolution of enterprise demand and technological supply. For CEOs looking to invest with purpose, here are three steps your enterprise should be taking.

Shape your internal quantum demand.

Understand what quantum computing is and is not—what problems it's best at solving. Find the overlap between answers to "What can quantum do?" and "What constrains our business?" to identify three to five high-value use cases tailored specifically for your business. These may be areas where quantum can complement classical computer workflows (such as more accurate molecular simulation for drug discovery) or where computation is avoided today and quantum can fill the void (for example, when logistics optimization takes too long to run on classical computers, companies simply find a workable solution without optimizing for efficiency).

It's important for enterprises to reorient relevant functions around quantum capabilities and then align leadership priorities with those use cases, as well as assemble domain experts and document workflows to prepare for research, testing, and integration of quantum computing solutions.

Build and deploy capabilities against this demand.

Invest early in a nimble translational team or center of excellence (COE) to attract scarce quantum talent, educate the broader organization, and develop both technical solutions and change management plans tailored to use cases identified in step one. Appoint a dedicated leader and empowered team to drive execution. The COE's mandate should address both long-term readiness and near-term value creation, potentially with quantum-inspired algorithms, such as Tensor networks running on today's CPUs and GPUs. For organizations, effective COEs should be able to create IP while successfully developing end-to-end hybrid workflows that integrate classical high-performance computing, AI, and quantum computing solutions.

Form strategic partnerships.

Engage the ecosystem now. Future quantum success will depend on forging strategic partnerships today—and leading providers are already in high demand. Make it a part of the COE's mission to map the ecosystem, identify critical players, and secure partnerships that provide access to hardware compute capacity along with specialized talent and expertise. High-impact use cases will ultimately be collaborative, requiring the company's internal domain expertise and a quantum provider's know-how. Creating domain-driven demand will also help influence vendor roadmaps. Institutions like NQAC can help create shared translational infrastructure that can accelerate this alignment—providing a model for ecosystem participation and coordination.

The inflection point for the quantum computing market is not just a question of technological advancement—it's also a question of organizational capacity to shape and adopt that

technology. When will enterprises' organizational capabilities catch up to the technology and translate business constraints into quantum-ready problems to be solved?

Our research clearly shows the quantum market is accelerating with increased enterprise investment and technological advancement, but that a value gap has emerged. More companies are entering the quantum market and experimenting, but few are shaping the technology itself to provide solutions to core business problems. CEOs that can shape demand, direct innovation, and define ecosystems today are those that will determine not just where quantum creates value, but who captures it.

The BCG Henderson Institute is Boston Consulting Group's strategy think tank, dedicated to exploring and developing valuable new insights from business, technology, and science by embracing the powerful technology of ideas. The Institute engages leaders in provocative discussion and experimentation to expand the boundaries of business theory and practice and to translate innovative ideas from within and beyond business. For more ideas and inspiration from the Institute, please visit our website and follow us on LinkedIn and X (formerly Twitter).

Authors

Matt Langione

Managing Director & Partner
Boston

Hanl Park

Consultant
New Jersey

Jean-François Bobier

Partner and Vice President, Deep Tech
Paris

Brad Henderson

Founding CEO of P33, Former Managing Director and Senior Partner, BCG

Dr. Harley T. Johnson

CEO, Illinois Quantum and Microelectronics Park
Founder Professor, Mechanical Science and Engineering, University of Illinois at Urbana-Champaign

Sesh Iyer

Alumnus

Zheng Cui

Alumnus

ABOUT BOSTON CONSULTING GROUP

Boston Consulting Group partners with leaders in business and society to tackle their most important challenges and capture their greatest opportunities. BCG was the pioneer in business strategy when it was founded in 1963. Today, we work closely with clients to embrace a transformational approach aimed at benefiting all stakeholders—empowering organizations to grow, build sustainable competitive advantage, and drive positive societal impact.

Our diverse, global teams bring deep industry and functional expertise and a range of perspectives that question the status quo and spark change. BCG delivers solutions through leading-edge management consulting, technology and design, and corporate and digital ventures. We work in a uniquely collaborative model across the firm and throughout all levels of the client organization, fueled by the goal of helping our clients thrive and enabling them to make the world a better place.