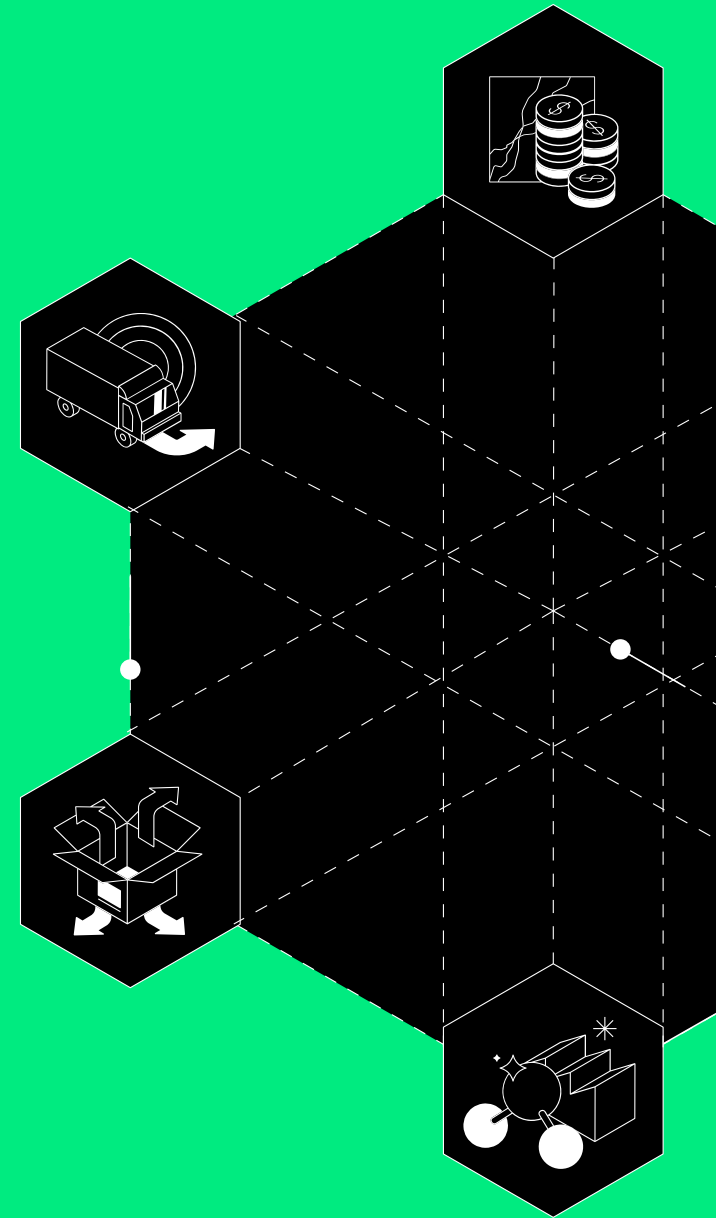




The Second Annual Report on **Enterprise Quantum Computing Adoption**

Quantum computing continues its transition from a future concept to a high-priority, funded business initiative as enterprises get serious about gaining a near-term competitive advantage.

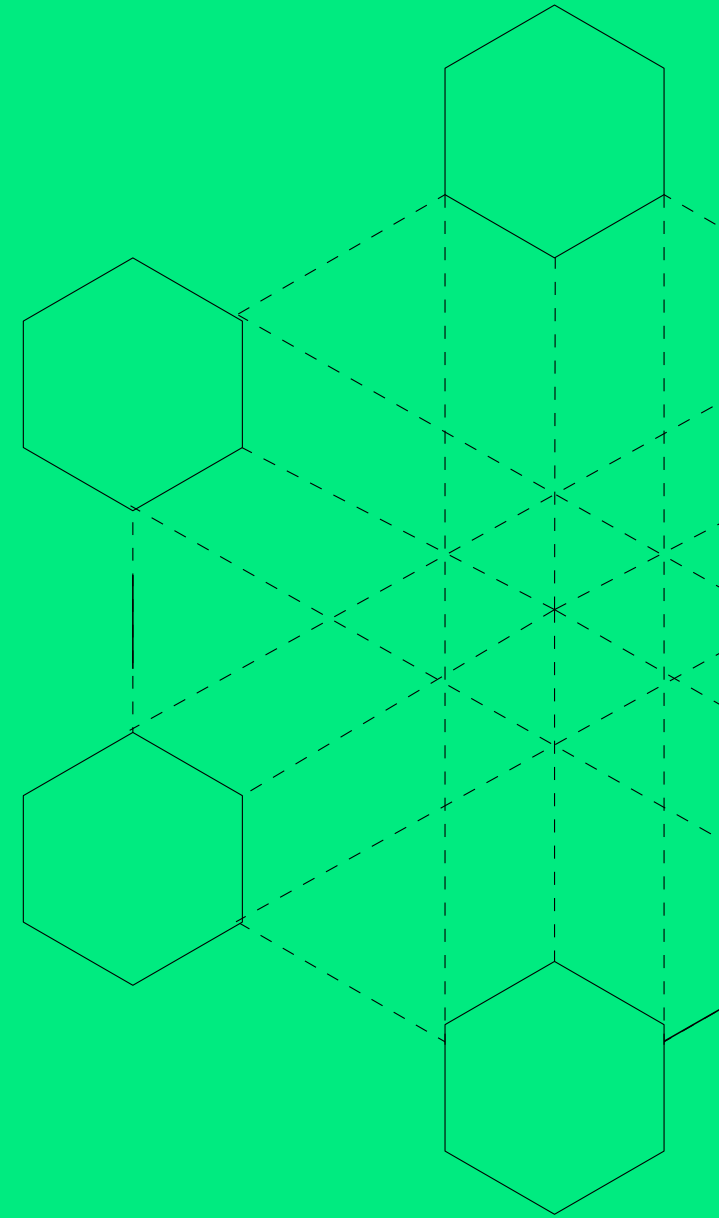
December 2022



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Executive Summary and Key Findings



In 2022, quantum computing continued its transition from a nascent, experimental technology to one that is on the verge of addressing real-world business problems. Enterprise customers are increasingly serious about quantum adoption: defining specific quantum strategies and tactics, committing seven-figure budgets, and unleashing internal and external teams to focus on multi-year plans for achieving a competitive advantage with quantum computing.

For more insight on enterprises' progress in adopting quantum computing and the challenges they face, Zapata Computing commissioned its second annual survey targeting an executive-level (i.e., decision-making status), global, and enterprise-only cohort to differentiate it from the many competing industry surveys and get a peek into the minds of the people who are – and will be – the buyers of quantum computing products and services.

The survey was fielded in November, 2022 and exclusively targeted 300 decision-making leaders (CIOs, CTOs and other VP-level and above executives) at large global enterprises with estimated 2022 revenues of over USD \$250 million, and estimated computing budgets over \$1 million. The survey included 100 respondents each from North America (US & Canada), EMEA (UK, France, & Germany), and APAC (Japan, China, India, Australia), with results collected between October 26th and November 9th, 2022 using an email invitation and an online survey.

The results portray a vignette of a rapidly maturing technology, one with more realistic expectations from its end users and a clearer path to providing a competitive advantage. With this clarity comes a growing determination from the early adopters to reap a first-mover advantage in their industry and invest the financial and personnel resources to achieve it.

Below are the top 10 takeaways from this report:

1. The Race is On for a Quantum Competitive Advantage

Enterprise leaders believe a competitive advantage due to quantum is rapidly approaching, with 6% already claiming an advantage, 30% of respondents expecting an advantage within 1 year, and nearly half (46%) expecting an advantage within 1-5 years. While more respondents are optimistic about claiming an advantage within one year than in last year's survey (4%), overall slightly fewer total respondents expect to gain an advantage within 5 years (82%) relative to 2021 (83%). This may be due to greater clarity in the market over which use cases are likely to be realized in the near-term versus use cases that are further out, on the timeline of a decade or longer.

2. Most Enterprises Are Committing Over \$1M to Quantum

More than two-thirds (71%) of quantum-adopting enterprises surveyed have current quantum computing budgets of more than \$1 million, up from just 28% of respondents in 2021. This represents a major turning point from the small R&D budgets of the past and a deeper commitment to building quantum capabilities.

3. Expectations of Better Business Results Drive Quantum Adoption

The top motivation for exploring quantum computing is driving better performance and business results, with 70% of respondents citing this metric. Up from 60% in 2021, this finding reinforces the trend of enterprises applying the technology to real-world business problems, beyond the technical experiments of the past.

4. Enterprises Get Tactical about Quantum Adoption

Enterprises are conducting tactical steps to make quantum computing a reality, with respondents noting that they are increasing their engagement with outside vendors (48%), building new applications (48%), running experiments on quantum hardware or simulators (62%), and experimenting and building proofs of concept (51%). Each of these steps saw increased activity by enterprises in 2022 compared with the previous year. The biggest shift was towards running experiments on quantum hardware, which grew from 48% of enterprises in 2021 to 62% in this year's survey.

5. Quantum Adoption Outpaces AI Adoption

Enterprises are adopting quantum technology more quickly than they did with artificial intelligence (AI). Nearly half (49%) of respondents say they are deploying quantum more quickly than they did with AI, with only 17% indicating they're taking a slower pace.

6. Machine Learning and Data Analytics Emerges as Leading Quantum Use Case

Beyond basic research experiments, enterprises are now focused on well-defined use cases and problems, with 71% of respondents indicating they were focused on machine learning/data analytics problems, compared to only 55% in 2021.

7. Enterprises Put a Premium on Vendor Partners

Enterprises have realized the value of working with outside vendors to augment and strengthen their quantum expertise, with 65% of respondents indicating they have partnered with outside vendors, compared to 58% in 2021. Enterprises

believe that vendors are critical to the success of quantum initiatives, with 86% of respondents indicating that they do not believe they can successfully adopt quantum computing without the help of a trusted vendor.

8. Vendor Lock-in Concerns Are Nearly Universal

Demonstrating the growing maturity of quantum, most (91%) respondents indicate they are concerned about vendor lock-in, which becomes a bigger concern the closer a technology is to being used in production with real-world, commercial applications.

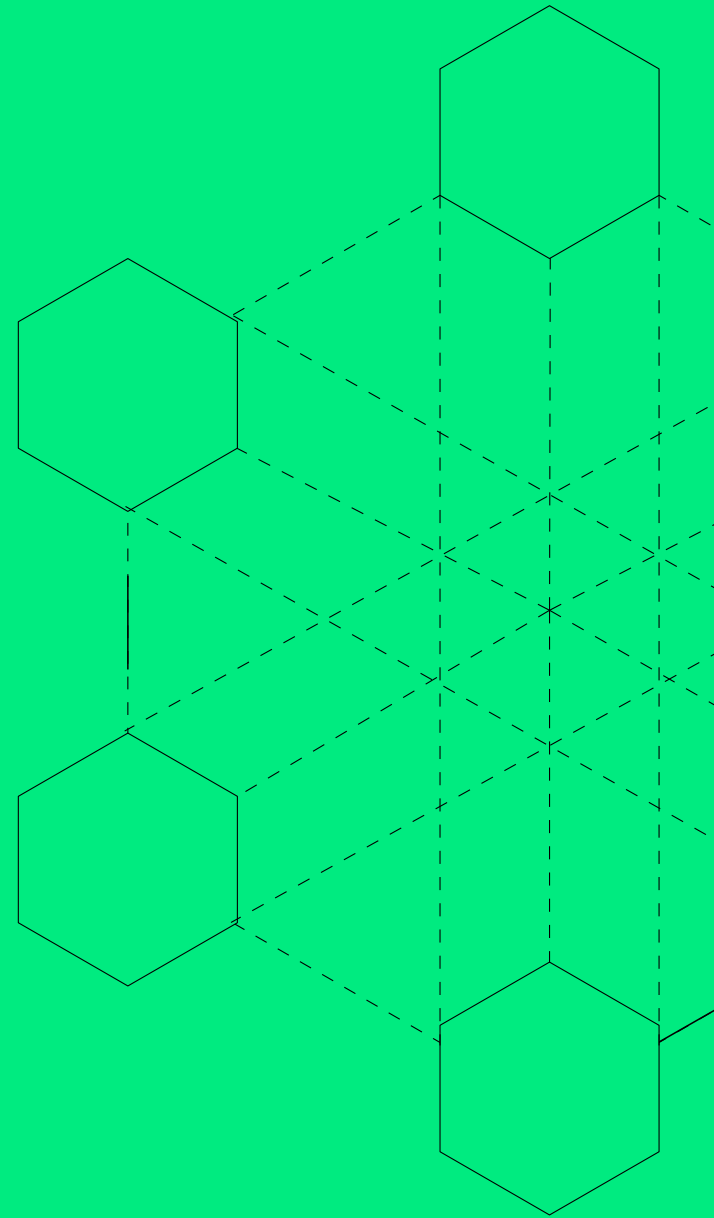
9. Integration Challenges Remain an Obstacle to Adoption

The complexity of integrating quantum computing with existing IT stacks fell just behind security concerns as the top hurdle to quantum adoption. The persistence of this challenge was also reflected by the top considerations for selecting quantum vendors, with 51% prioritizing easy-to-use solutions and 50% prioritizing easy integration with existing IT.

10. Post-Quantum Cybersecurity Threats Loom Large

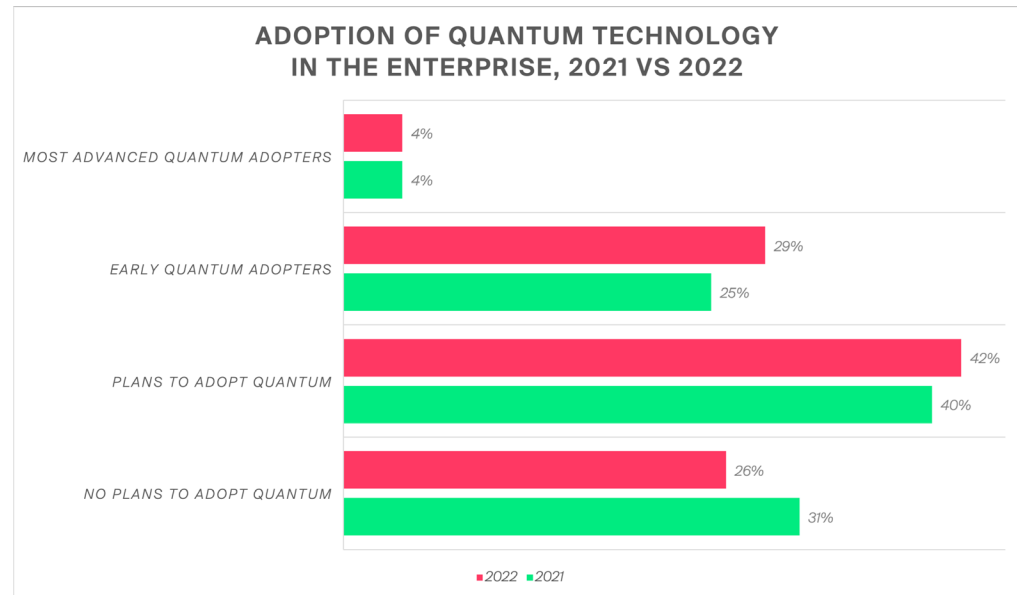
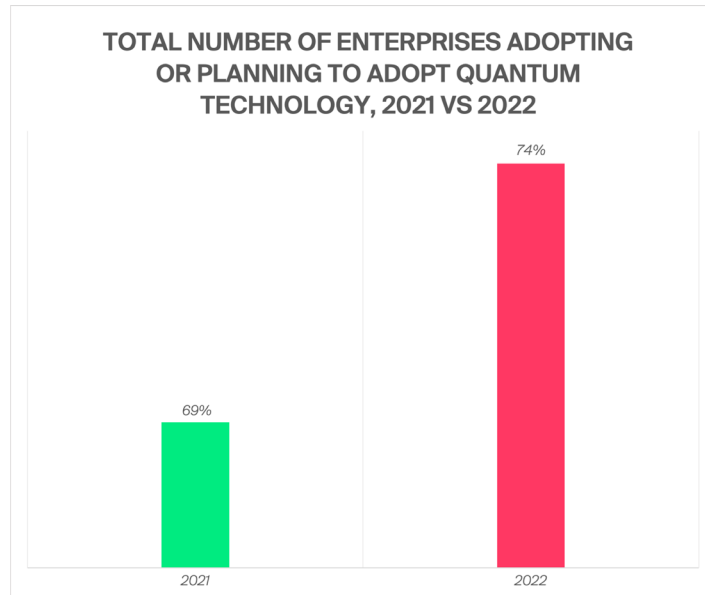
In addition to being the biggest challenge to quantum adoption cited by respondents, nearly two-thirds (65%) of respondents are extremely or very concerned about post-quantum cryptography (PQC), and 63% of respondents are actively working with a vendor to prepare. The concerns reflect both the magnitude of the threat posed by quantum computers and the absence of clearly reliable solutions.

Detailed Findings



1. The Current State of Quantum Computing Adoption

Global Adoption of Quantum Computing Reaches New Heights



74% of Enterprises Have Adopted or Plan to Adopt Quantum Computing

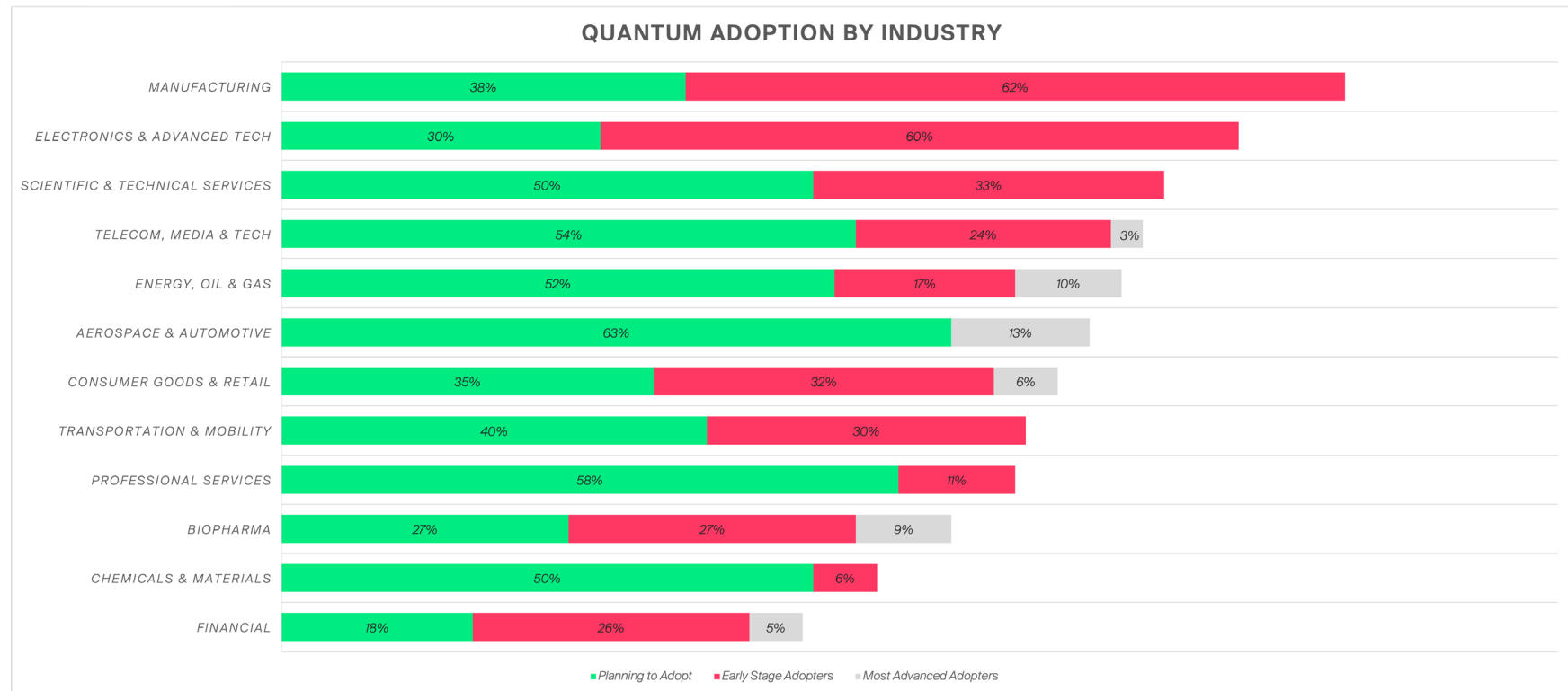
Quantum has moved from the conceptual stage to real implementation in the enterprise, with 33% of respondents classifying their organizations as being in an early (29%) or most advanced (i.e., “mature”)(4%) state of adopting quantum computing in 2022, up from 29% in 2021.

Meanwhile, the percentage of respondents indicating they were planning to adopt quantum computing increased to

42% in 2022, up from 40% in 2021.

The percentage of respondents indicating they had no plans to adopt quantum computing fell from 31% in 2021, to 26% in 2022, reflective of the increasing awareness and use of quantum and quantum-related technology across a variety of vertical markets.

Manufacturing Sector Leads in Early Quantum Adoption



Manufacturing has taken the lead in adopting quantum computing, with 62% of respondents indicating they're in the early stages of adoption, and the remaining 38% indicating they have plans to adopt quantum computing.

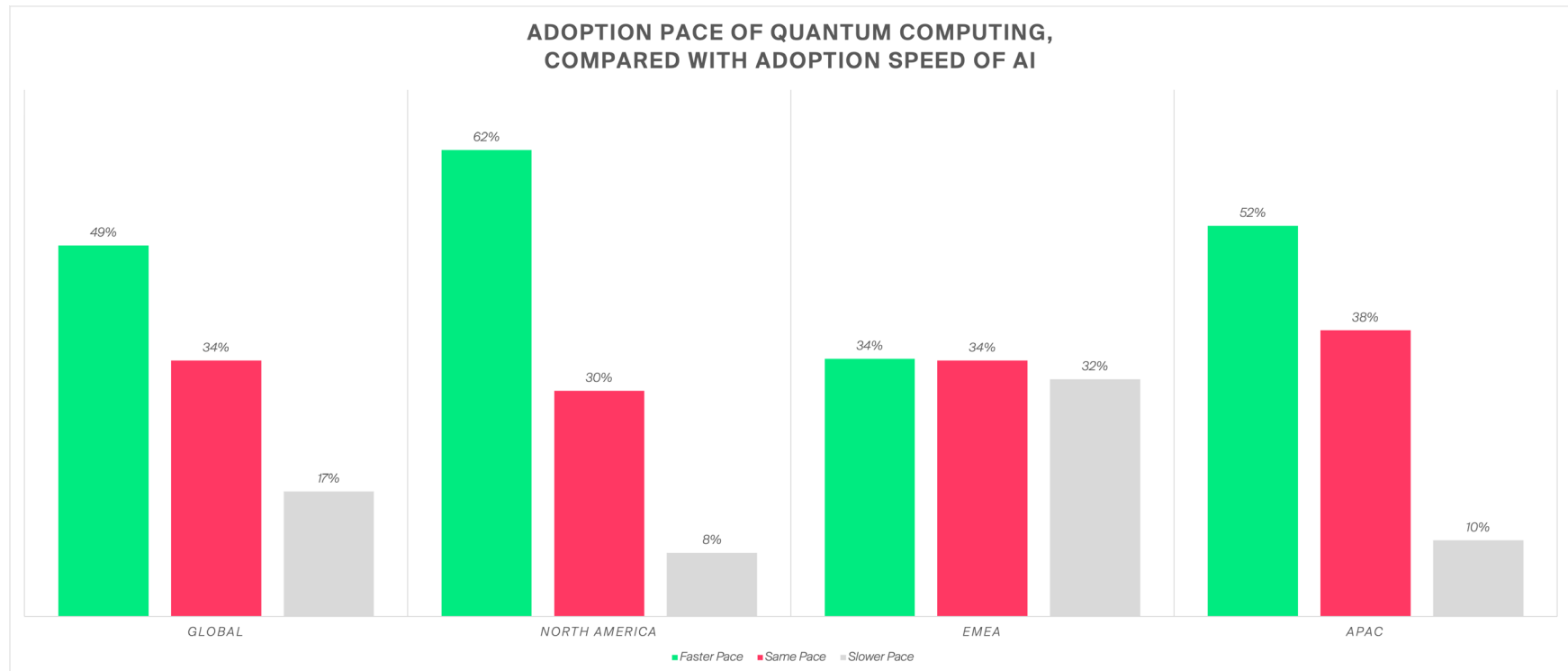
This may be due to the opportunities for quantum-boosted optimization of manufacturing operations and supply chain logistics in the near term, with enterprises seeking greater operational efficiencies, throughput, and cost reductions. In the long term, quantum computing may also support more precise simulations of chemistry and fluid dynamics in the product design stage, however this will require error corrected qubit counts well beyond the capabilities of today's Noisy Intermediate Stage Quantum (NISQ) devices.

Similar factors are at work in the Aerospace & Automotive industry, where 13% of respondents say they are in the most advanced adopters cohort stage of adopting quantum computing, with another 17% responding as early-stage adopters, and 63% are planning to adopt quantum computing. In addition to optimizing manufacturing here, quantum computing could also optimize network scheduling and routing for fleets of airplanes or cars.

Perhaps unsurprisingly, the Electronics & Advanced Tech sector had the second highest rate of respondents reporting early quantum adoption (60%). This industry also reported the highest rates of early adoption of technology more generally, with 65% of respondents reporting to be among the first to adopt (35%) or early adopters (30%) of new technology – a full 15% more than the next industry (Manufacturing) in early technology adoption.

Meanwhile, the Energy, Oil & Gas industry reported the highest rate of most advanced adoption (10%), with an additional 17% reporting they're early adopters. The high degree of activity in this segment may be due to the many opportunities

for optimization across the value chain from energy production to distribution and consumption.

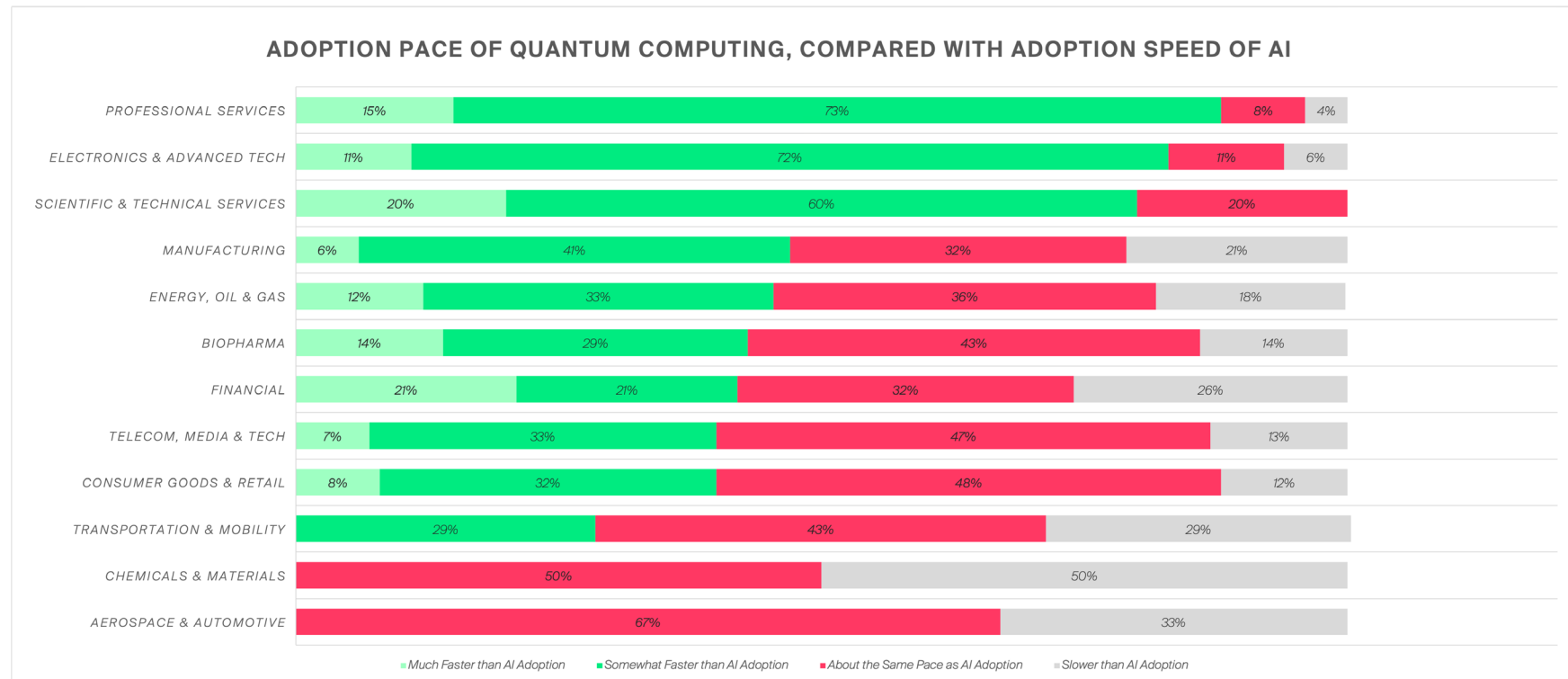


Quantum Adoption Outpaces Earlier AI Adoption

Around the world, enterprise leaders responded that they are adopting quantum technology more quickly than they did artificial intelligence (AI). Nearly half (49%) of respondents say they are adopting quantum more quickly than they did with AI, with only 17% indicating they're taking a slower pace.

This trend is pronounced in both North America (62% of respondents) and APAC (52%), where significantly more respondents indicated their enterprises are adopting quantum faster than AI.

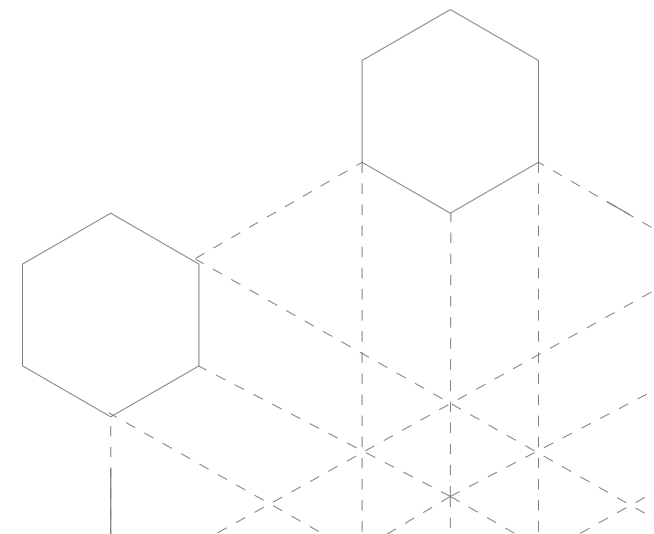
The faster pace of adoption is surely related to the exponential future benefits that enterprises expect from quantum computing. However, enterprises are also likely learning from the difficulties of adopting AI. As with AI, quantum can't be installed overnight, particularly in its nascent stage. Most enterprises will need years to build quantum capabilities before they can reap an advantage.



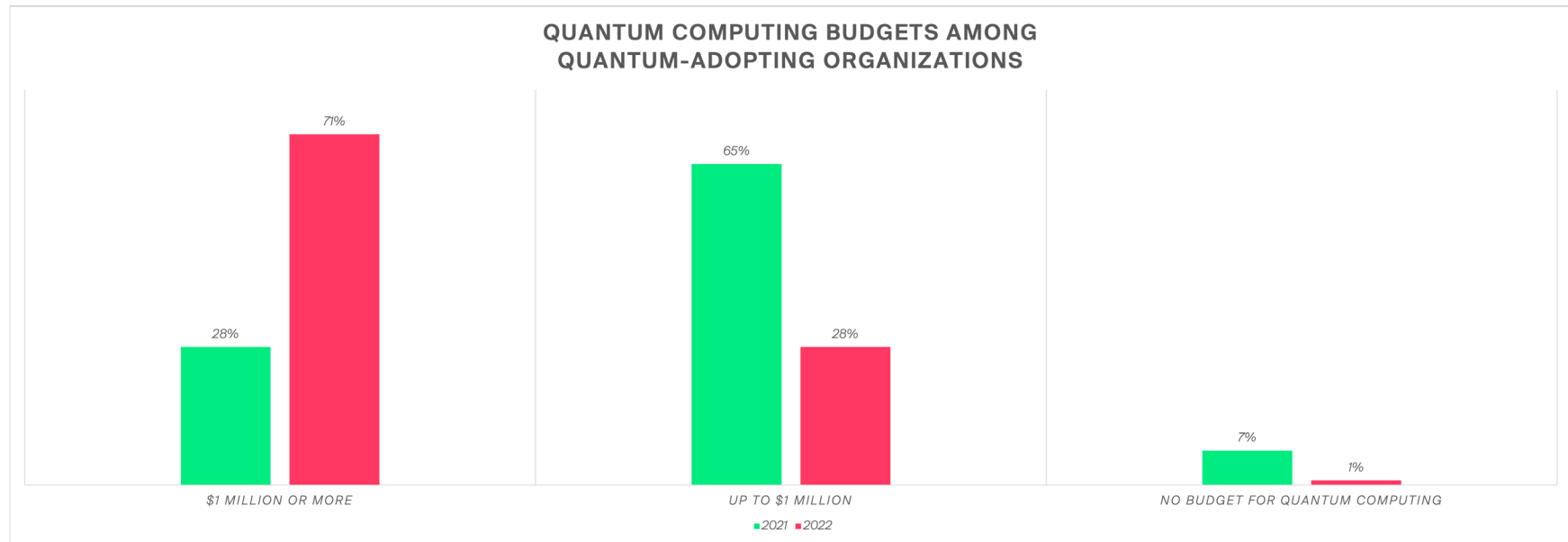
Multiple Industries Are Adopting Quantum Faster Than AI

Quantum computing is being adopted more quickly than AI in a number of industries, including Professional Services (73%), Electronics & Advanced Technology (72%), and Scientific & Technical Services (60%). The increased pace of quantum adoption in these industries may be due to the presence of more sophisticated analytics capabilities to build on from previous AI adoption cycles.

Conversely, the slower pace of adoption in highly technical industries such as Aerospace & Automotive, Chemicals & Materials, and Transportation & Mobility may be due to a lack of advanced capabilities or due to the highly complex nature of the problems at hand, which will require more advanced quantum computers and a prudent, measured approach to incorporate and integrate quantum into established workflows and systems.



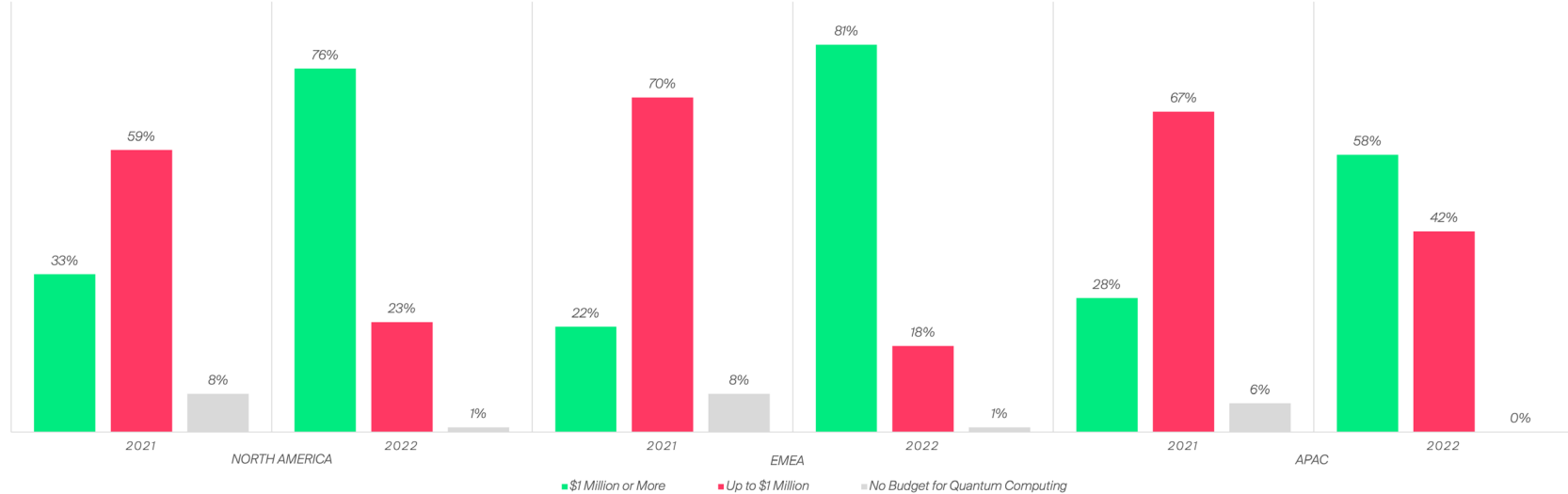
2. Investments in Quantum Capabilities



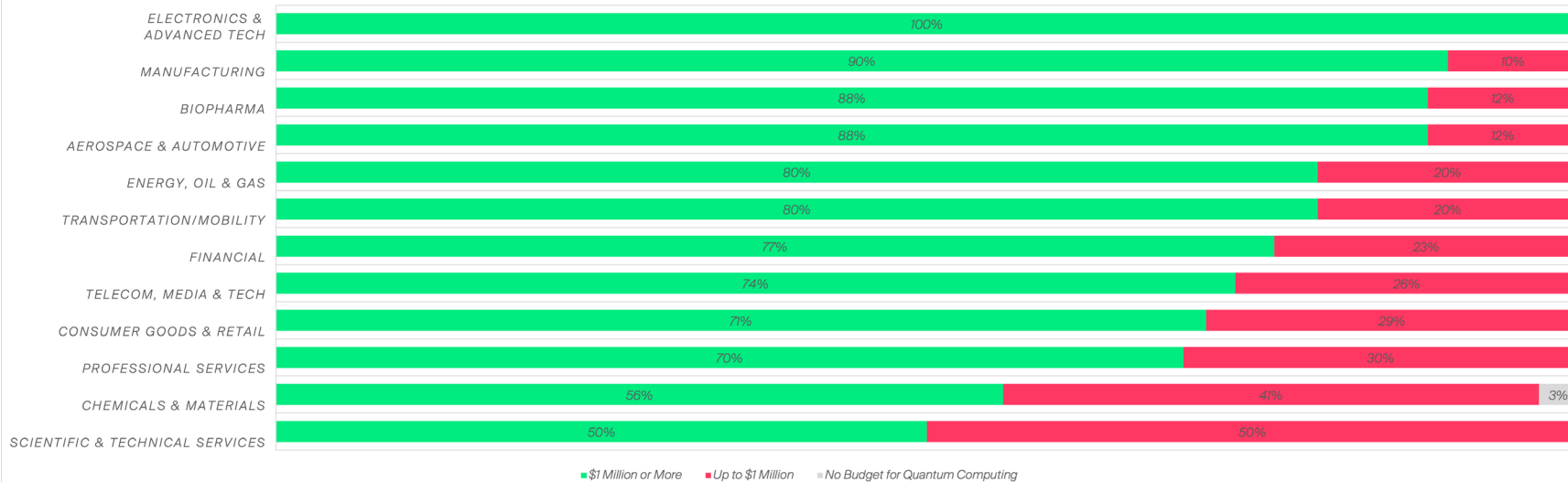
71% of Quantum Computing Budgets Top \$1 Million

In the clearest signal of momentum for quantum adoption yet, enterprises are putting their money where their mouth is. 71% of respondents on the path to quantum adoption indicated their organization was investing more than \$1 million in quantum, up from just 28% investing that amount in 2021. The increased investment shows quantum computing efforts are scaling beyond the one-off experiments and small pilot programs of the past.

CURRENT BUDGET FOR QUANTUM COMPUTING, 2021 VS 2022, REGIONAL BREAKOUT

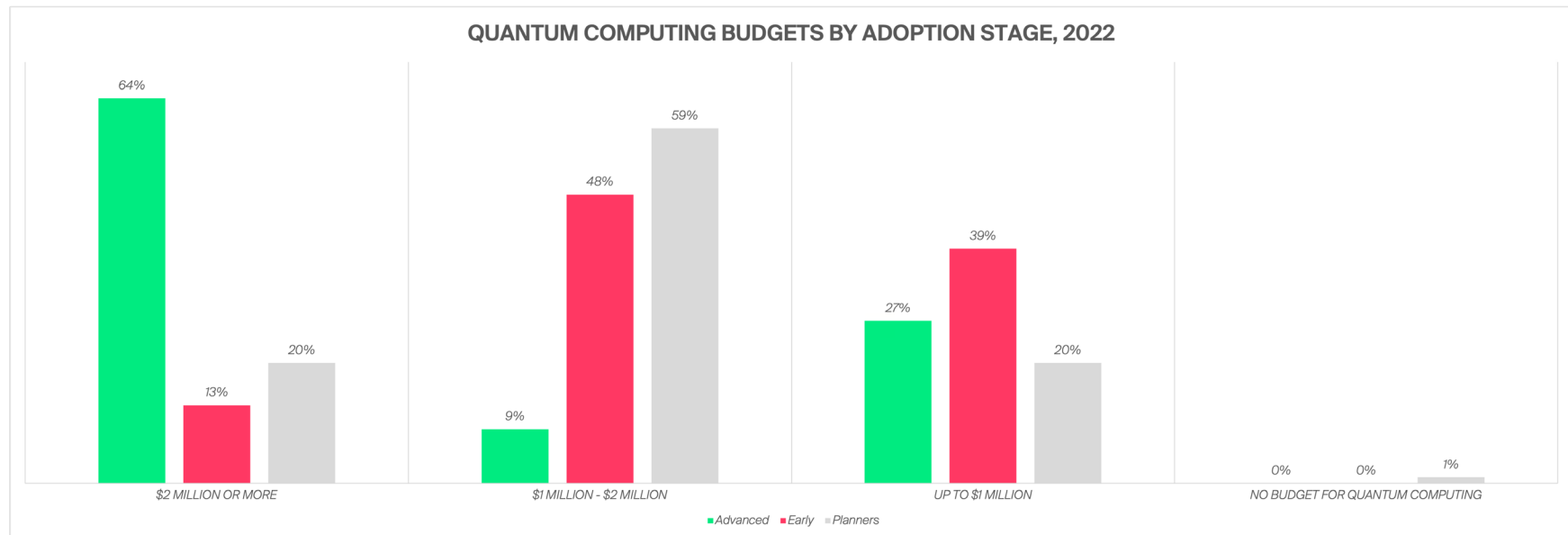


CURRENT BUDGET FOR QUANTUM COMPUTING BY INDUSTRY, 2022



Majority of Enterprises Across Industries Invest More Than \$1 Million in Quantum

Across the board, 50% or more of respondents from each industry group reported a current quantum computing budget of \$1 million or more, reflecting the horizontal appeal of quantum computing. Quantum budgets were highest for Scientific & Technical Services, perhaps because enterprises in this sector may be relied upon to support adoption in other sectors.



Unsurprisingly, the most advanced quantum adopters reported the largest budget allocations, with 64% indicating they had quantum budgets of more than \$2 million. Early adopters and those planning to adopt, however, appear bullish on quantum computing, with 48% of early adopters and 59% of quantum planners reporting quantum computing budgets of \$1 to \$2 million.

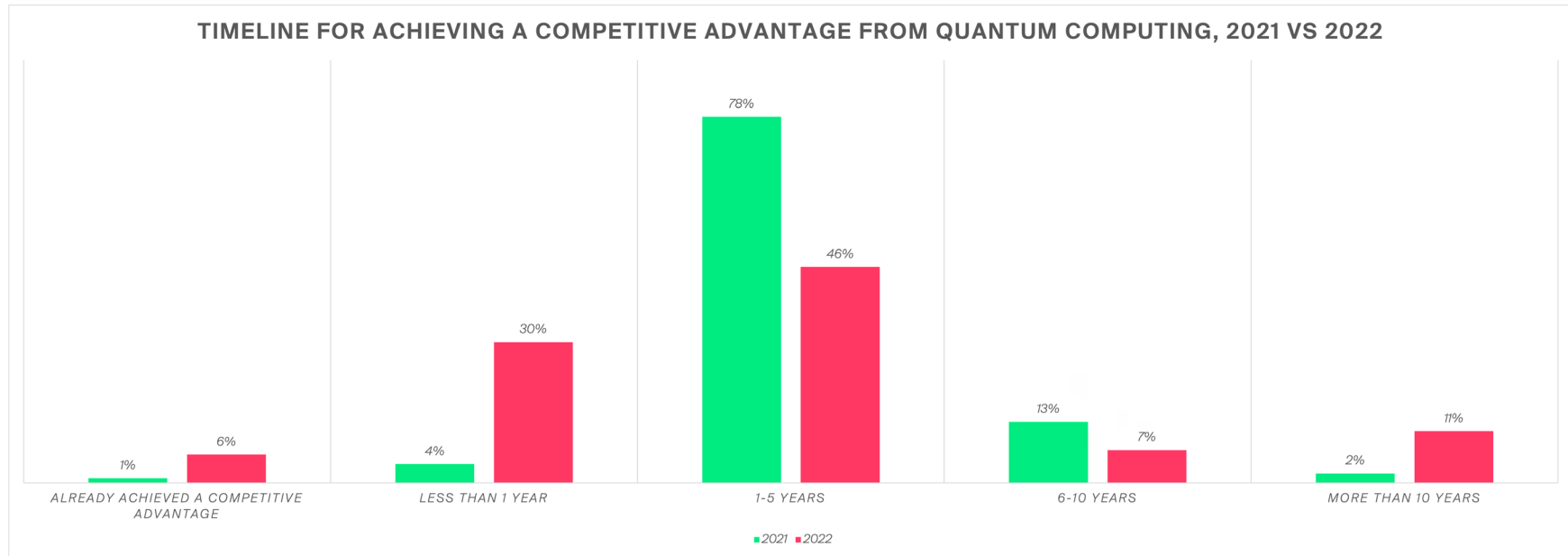


“It’s no surprise that large organizations are dedicating multimillion dollar budgets to quantum computing. At this stage, investments in infrastructure to support heterogeneous computing – not just quantum but also existing high performance compute (HPC) resources like CPU and GPUs – will deliver the greatest ROI today and in the future. Building the infrastructure to support a ‘Big Compute’ framework will allow enterprises to solve more complex problems today and ease the process of integrating quantum devices into their IT stack.”

Yudong Cao

Co-founder and CTO at Zapata Computing

3. Timeline to a Quantum Competitive Advantage



6% of Quantum Adopters Already Claim a Quantum Competitive Advantage

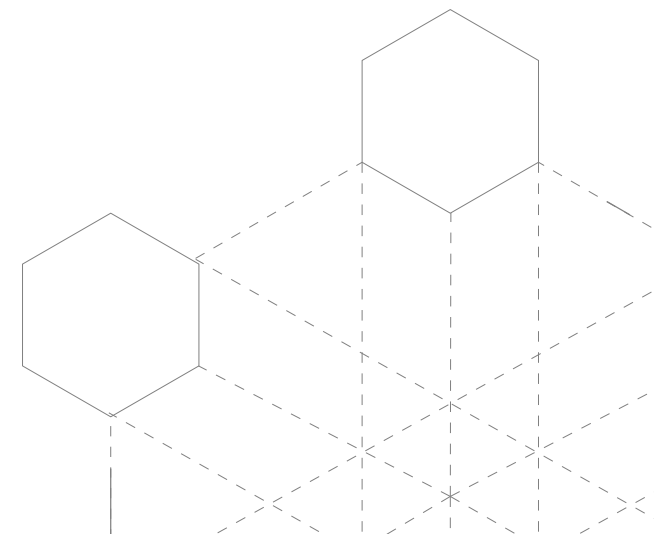
Another 30% of quantum adopters or those planning to adopt expect quantum computing to give them a competitive advantage within one year, while 46% expect a competitive advantage within 5 years.

It's unclear from the survey what respondents classify as a competitive advantage. However, it should be noted that a quantum competitive advantage is not necessarily the same as the conventional definition for “quantum advantage”, which typically refers to the demonstrated and measured ability of a quantum computer to process a real-world problem

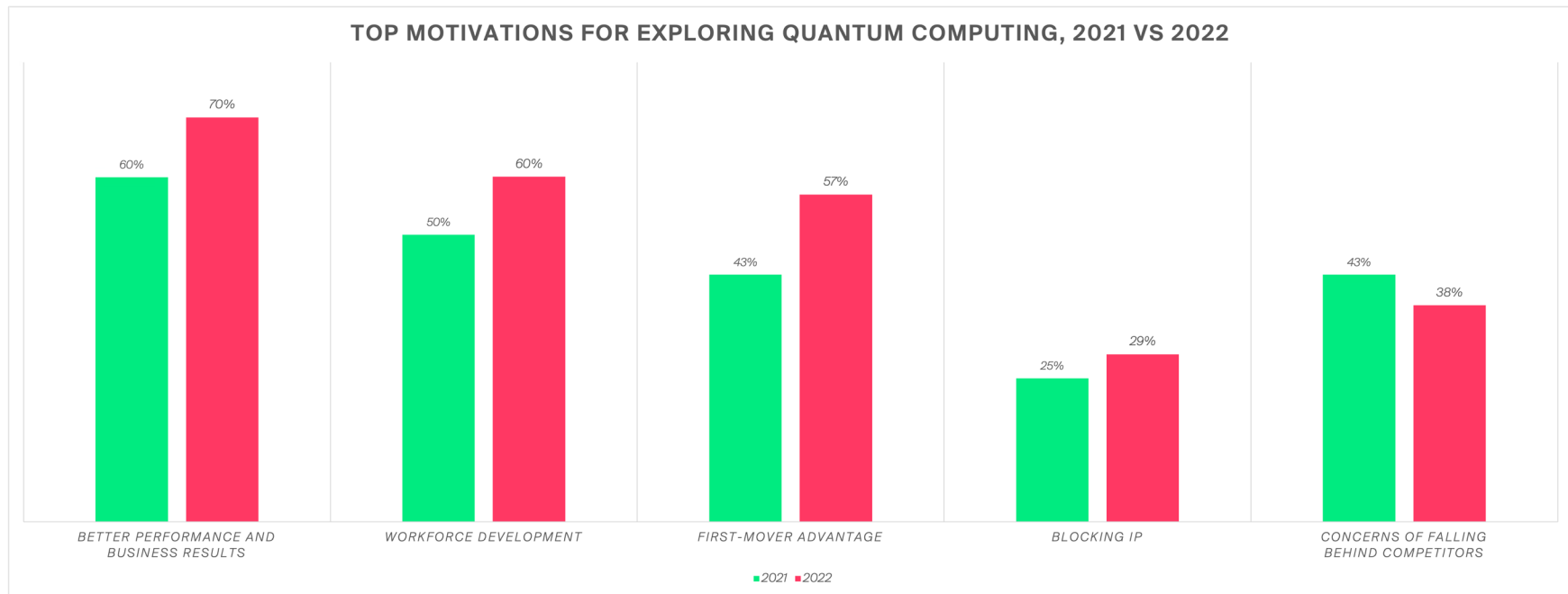
faster than would be possible on a classic computer.

Given the nascent stage of the technology, it's possible that even acquiring quantum-capable expertise from the very limited talent pool could be considered a competitive advantage. However, there are also near-term use cases in optimization and random number generation where noisy quantum devices or quantum-inspired techniques can deliver an edge today or in the near future.

While more respondents are bullish on an advantage within one year, overall slightly fewer total respondents expect to gain an advantage within 5 years (82%) relative to 2021 (83%). What's more, significantly more respondents are now expecting an advantage to take 10 years or more (11%) compared to 2021 (2%). This shift points to more realistic expectations for some quantum use cases, such as Monte Carlo simulations and quantum chemistry simulations, which are likely to take more than 10 years to deliver tangible value. To reference the famous hype cycle of emerging technologies, the results suggest a move beyond the peak of inflated expectations.



4. Why Quantum: Benefits and Motivators



70% of Enterprises Motivated by Better Performance and Business Results

Improving business performance was cited by 70% of enterprise respondents as the top motivation for exploring quantum computing in 2022, up from 60% in 2021. This is reflective of the growing confidence that quantum computing is capable of solving real-world business problems in the near future. The potential value at stake across industries is immense.

Quantum computing is increasingly being seen as a key competitive differentiator, with 57% of respondents indicating

that clinching a first-mover advantage was a top motivator for quantum adoption in 2022, up from 43% in 2021. Meanwhile, fewer enterprises were motivated by concerns of falling behind their competitors than in 2021. In a major shift, more enterprises are now playing to win rather than to merely keep up with their peers.

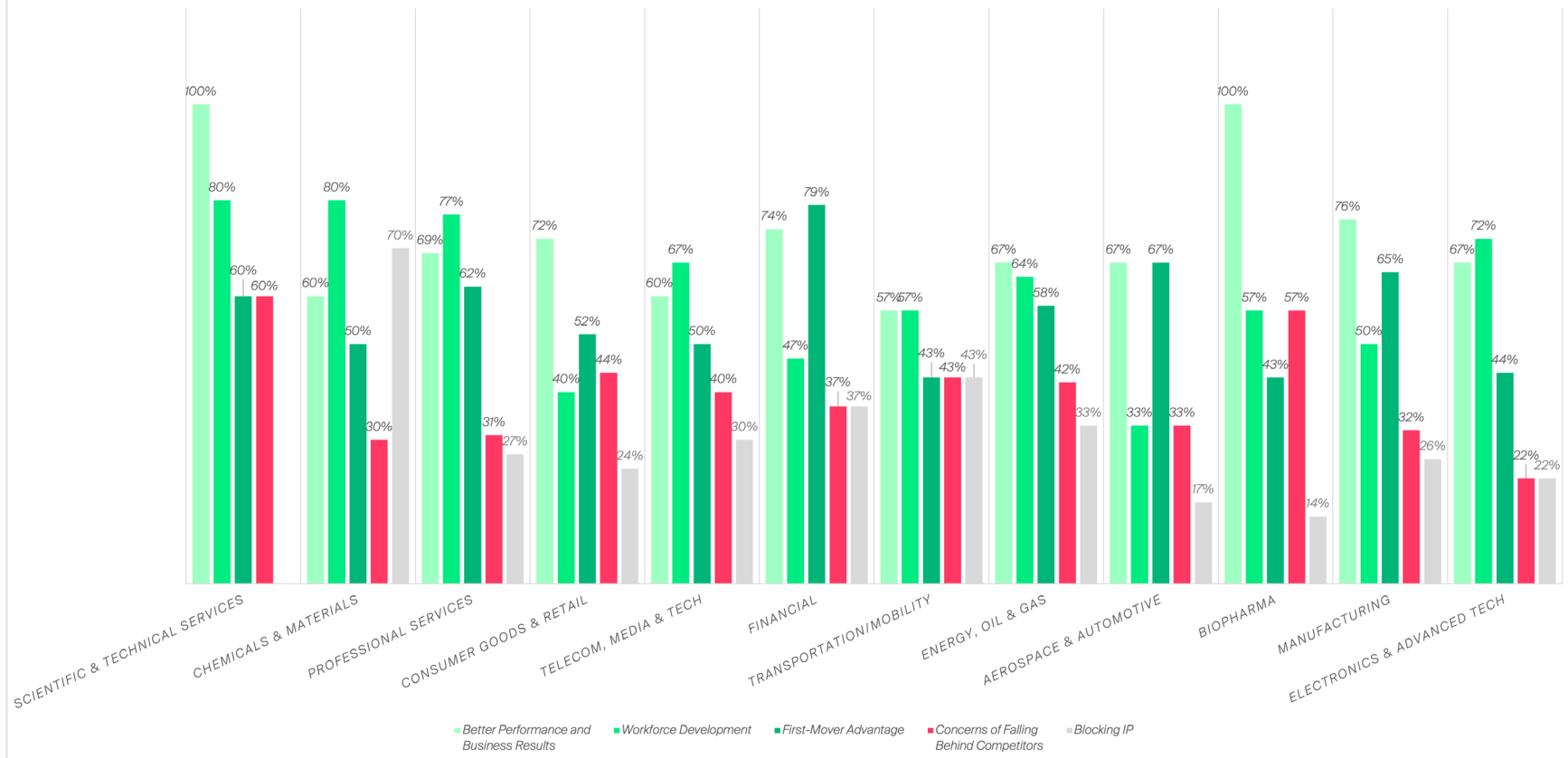


“Working side-by-side with enterprise customers, I regularly see the enthusiasm they have for not just quantum computing’s potential down the road, but from the real results generated by pilot applications and infrastructure upgrades that constitute getting ‘quantum-ready’ today. As with the majority of enterprises polled in this survey, these organizations have moved beyond thinking of quantum as a futuristic technology and are instead pursuing high-impact quantum and quantum-inspired use cases that they expect to play a role in business performance in the next few years.”

Jhonathan Romero Fontalvo

Co-founder and Director, Professional Services at Zapata Computing

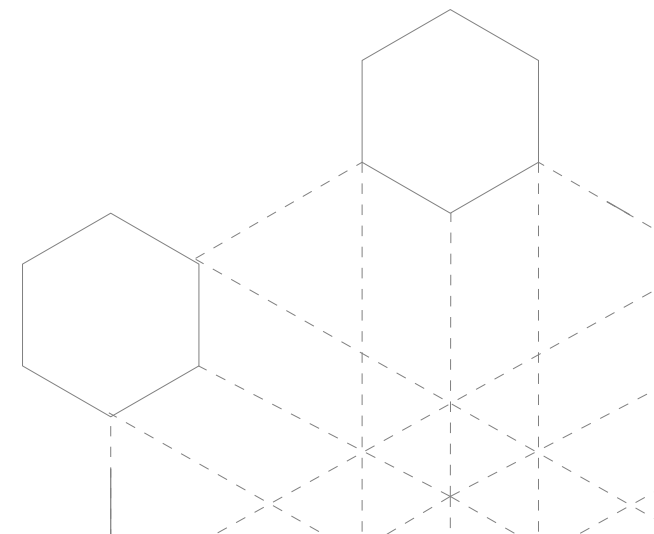
TOP MOTIVATIONS FOR EXPLORING QUANTUM COMPUTING, BY INDUSTRY



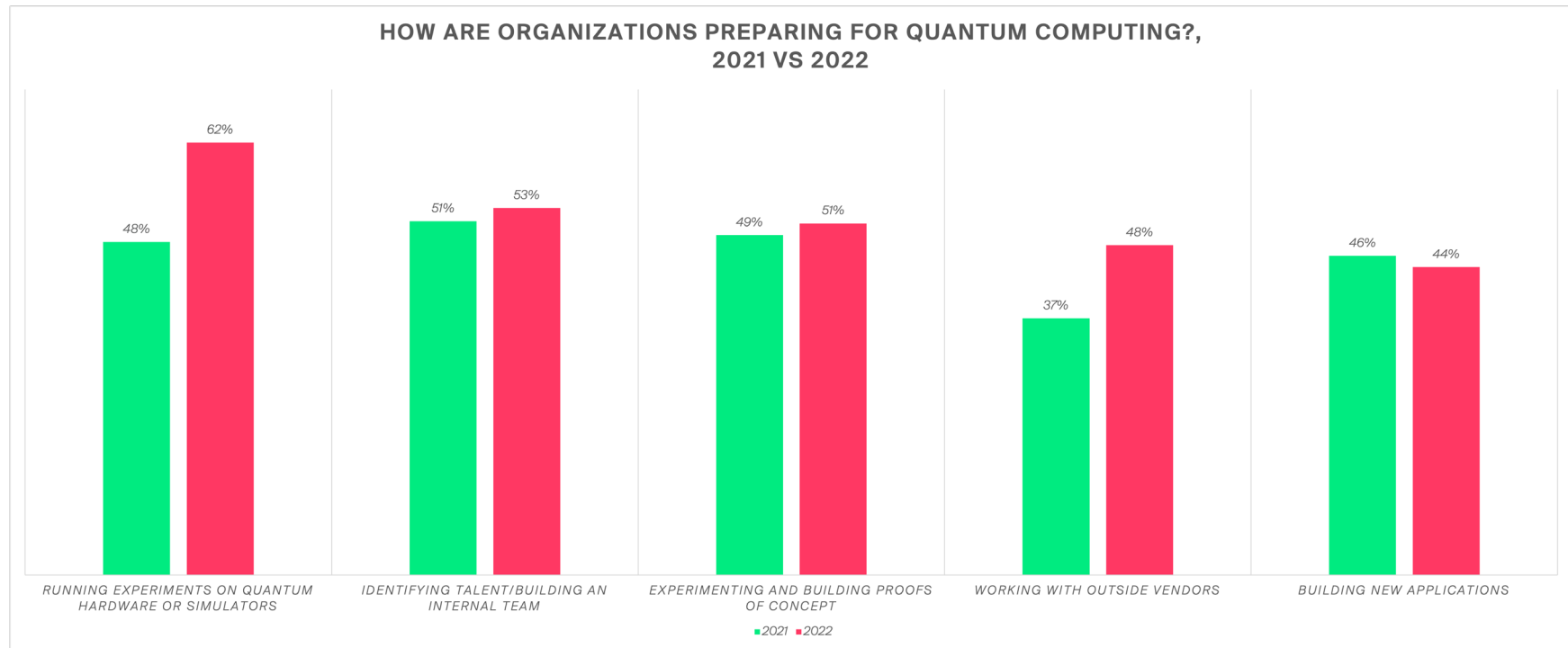
All (100%) respondents from both the Scientific & Technical Services and Biopharma industries cited better performance and business results as a key decision criterion for exploring quantum computing.

Workforce development and first-mover advantage were also key motivations for organizations to explore quantum

computing, with both motivations being mentioned by at least 50% of respondents from nine different industries. These results suggest that the limited pool of quantum-capable talent is motivating enterprises to build their internal quantum capabilities. Even if an advantage with quantum isn't yet possible in production, enterprises that build internal teams, infrastructure, and pilot applications now will be positioned to leverage more powerful devices when they come online.



5. Becoming Quantum Capable



62% of Quantum-Adopting Enterprises are Running Experiments on Quantum Hardware or Simulators

Significantly more enterprises are running experiments on quantum hardware or simulators in 2022 (62%) relative to 2021 (48%). This may be due to the increased availability of access to these devices and simulators via the cloud as the quantum ecosystem continues to proliferate. Enterprises may also be benchmarking their applications on different hardware backends to determine the best solution for their given problems. Either way, the results show further evidence

that enterprises are getting serious about applying quantum technology.

Furthermore, the growth in respondents working with outside vendors (48% in 2022 vs. 37% in 2021) suggests that more enterprises are acknowledging that they can't adopt quantum alone. This is perhaps unsurprising given the high development costs of producing and using a quantum computer in-house and the limited pool of talent with quantum applications expertise.

Helpful Resources to Prepare for Quantum Computing

What Does It Mean to Be Quantum Ready?

Zapata Computing | <https://www.zapatacomputing.com/quantum-readiness/>

State of Quantum Computing: Building a Quantum Economy

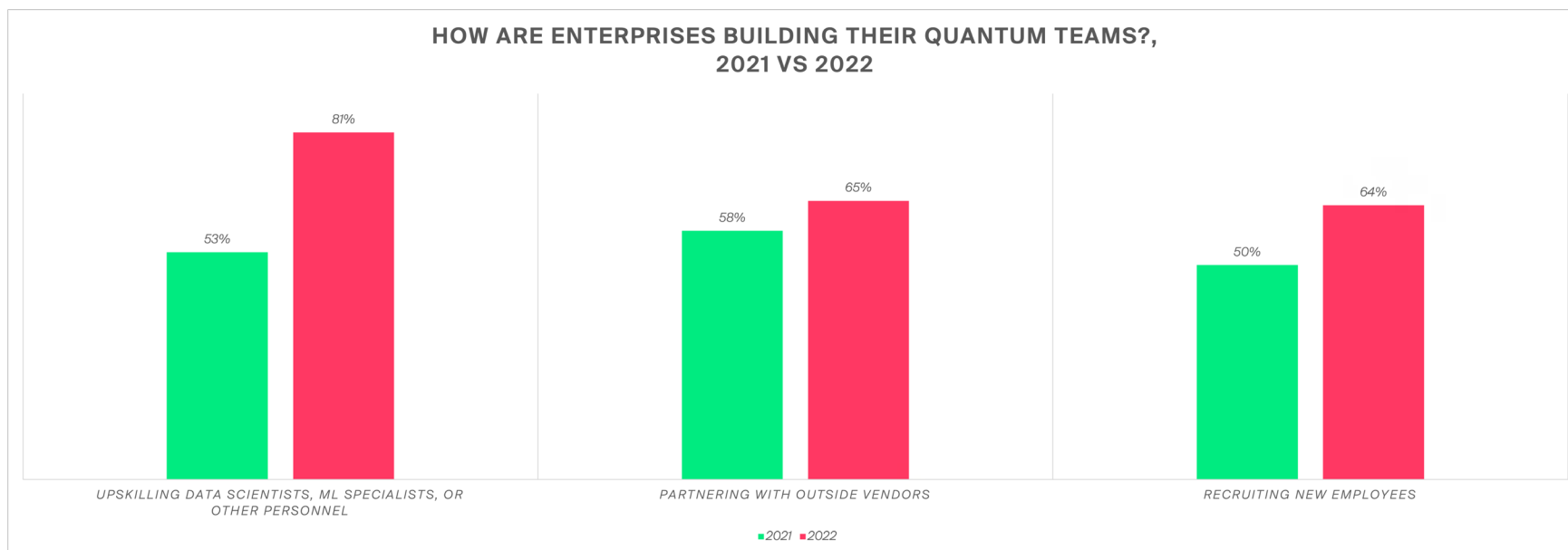
World Economic Forum | https://www3.weforum.org/docs/WEF_State_of_Quantum_Computing_2022.pdf

Quantum computing use cases are getting real – what you need to know

McKinsey | <https://www.mckinsey.com/capabilities/mckinsey-digital/our-insights/quantum-computing-use-cases-are-getting-real-what-you-need-to-know>

First Annual Report on Enterprise Quantum Computing Adoption

Zapata Computing | <https://www.zapatacomputing.com/enterprise-survey/>

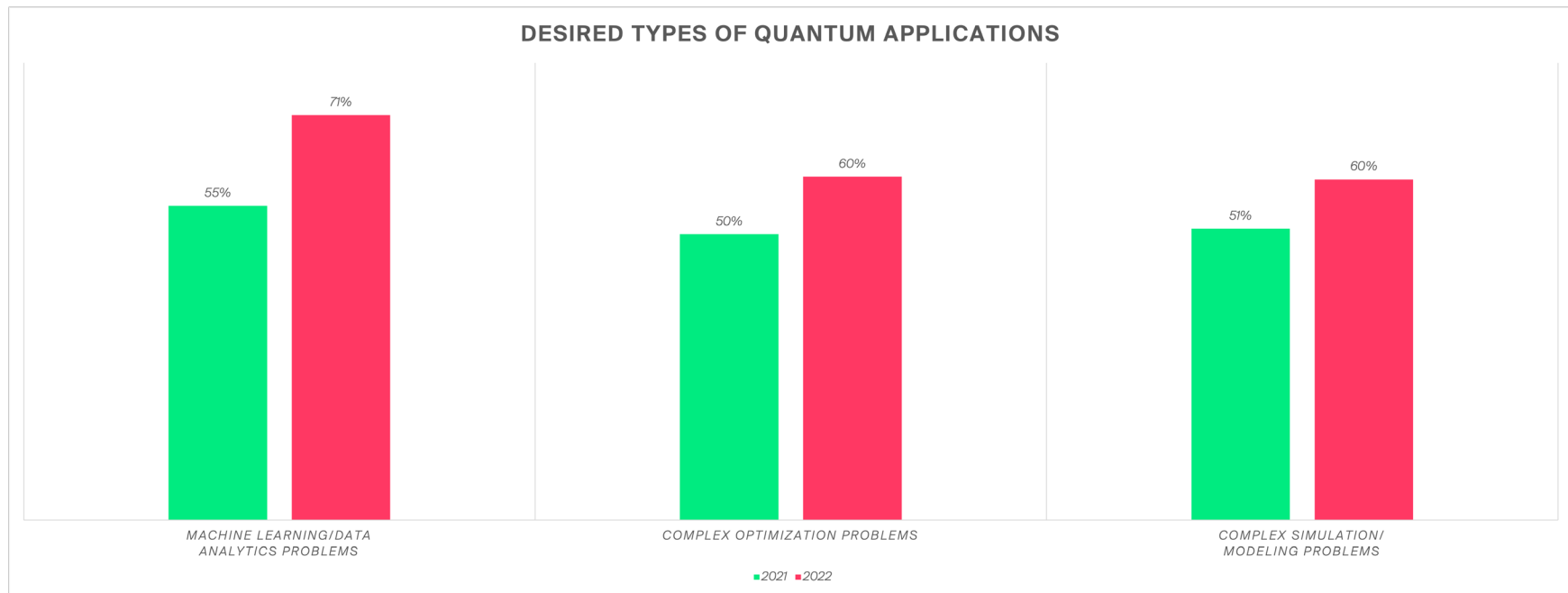


81% of Adopters Building a Quantum Team Are Upskilling Existing Talent

Among enterprises that indicated they are identifying talent or building a quantum team, 81% reported they were building their team by upskilling existing talent. However, the majority were also partnering with outside vendors and recruiting new employees. The growth across all categories of team development suggests that the quantum talent pool is so limited that enterprises cannot rely on any one avenue for developing their quantum team.

Nearly-two thirds of respondents building a quantum team in 2022 indicated they are working with outside vendors to support their team development. Vendors can be a valuable resource for upskilling internal teams and recruiting new team members, guiding enterprises to develop or recruit the skills they will need to leverage quantum.

6. Top Quantum Use Cases



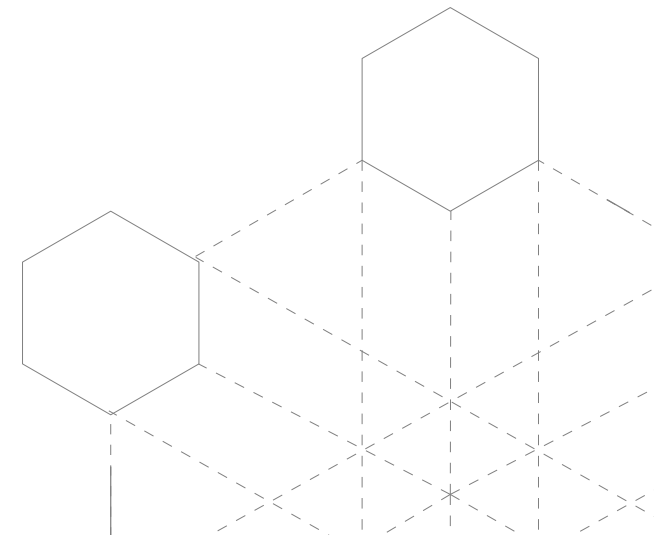
Machine Learning and Data Analytics Cement Lead as Top Quantum Use Case

Although respondents reported an increase in all types of applications, the disproportionate growth of machine learning/analytics problems reflects the growing realization that quantum and quantum-inspired techniques can be deployed today to augment machine learning and data analytics work for an incremental performance boost.

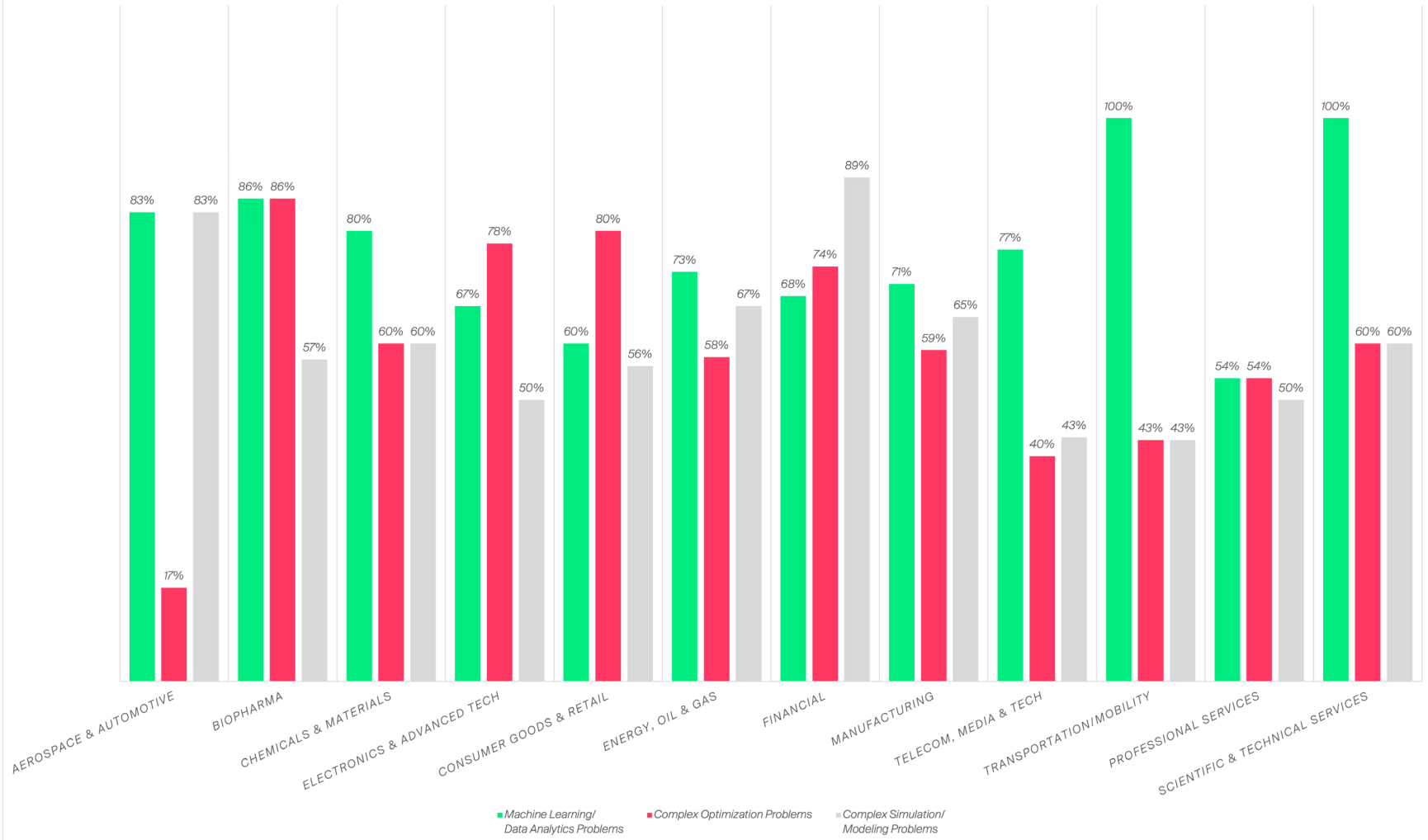
Our own research has shown that generative modeling in particular, also known as generative AI, is the most promising

near-term avenue for a practical quantum advantage. This is due to quantum computers' ability to encode and sample from complex probability distributions that are classically intractable.

While optimization and simulation use cases both saw relatively similar growth in our 2022 survey compared to 2021, optimization use cases are far more likely to see practical value added from quantum computers in the near term. In fact, [quantum-inspired generative modeling techniques](#) have already proven to be competitive with state-of-the-art classical solvers for complex optimization problems. The technical overhead required for simulation problems far exceeds the capabilities of today's quantum devices and will for some time.



DESIRED QUANTUM APPLICATIONS BY INDUSTRY

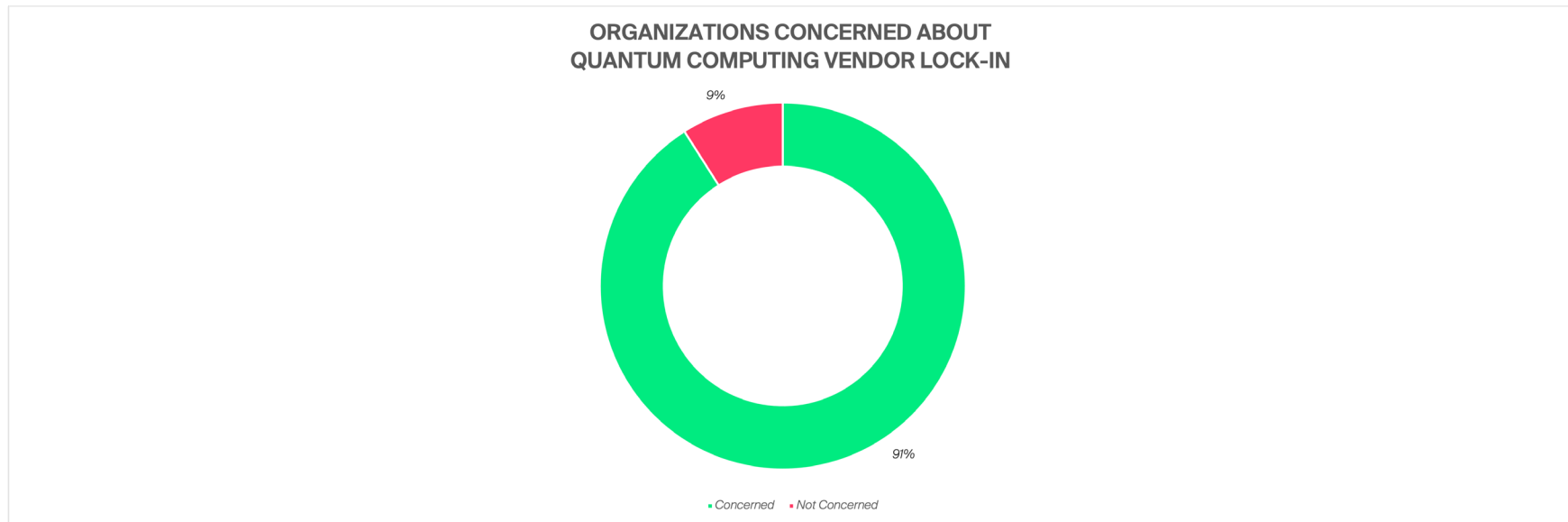


Indeed, respondents from across nearly all industry groups surveyed highlighted machine learning/data analytics problems as being a key area of focus for quantum computing, with 100% of respondents citing this group of problems in both the Scientific & Technical Services and Transportation & Mobility industries. More than 70% of respondents in six other industry groups also highlighted ML and analytics problems as a key focus for their quantum efforts.

Only the Financial and Aerospace & Automotive sectors cited simulation and modeling problems as their top use case for quantum computing. In the case of the Financial industry, this may be due to the higher maturity level of their classical ML, analytics and optimization applications relative to other industries, raising the bar for a potential quantum advantage. Quantum could one day provide an advantage for Monte Carlo simulations used in stress testing and derivative pricing, but likely not for another 10-20 years – although the value at stake is enormous and financial enterprises are positioning now to capture it. That said, there are nearer term opportunities in ML and optimization that these respondents may be missing.

Similarly, the Aerospace & Automotive industry may need to wait at least a decade before quantum can boost the computational fluid dynamics (CFD) simulations common in designing new vehicles. Thus, it was surprising to see the lowest interest in optimization use cases among all industries in the Aerospace & Automotive sector, when quantum or quantum-inspired techniques could aid in optimizing manufacturing and network planning for fleets of airplanes or cars much sooner than they could aid in simulations.

7. Quantum Is a Team Sport: The Role of Quantum Vendors



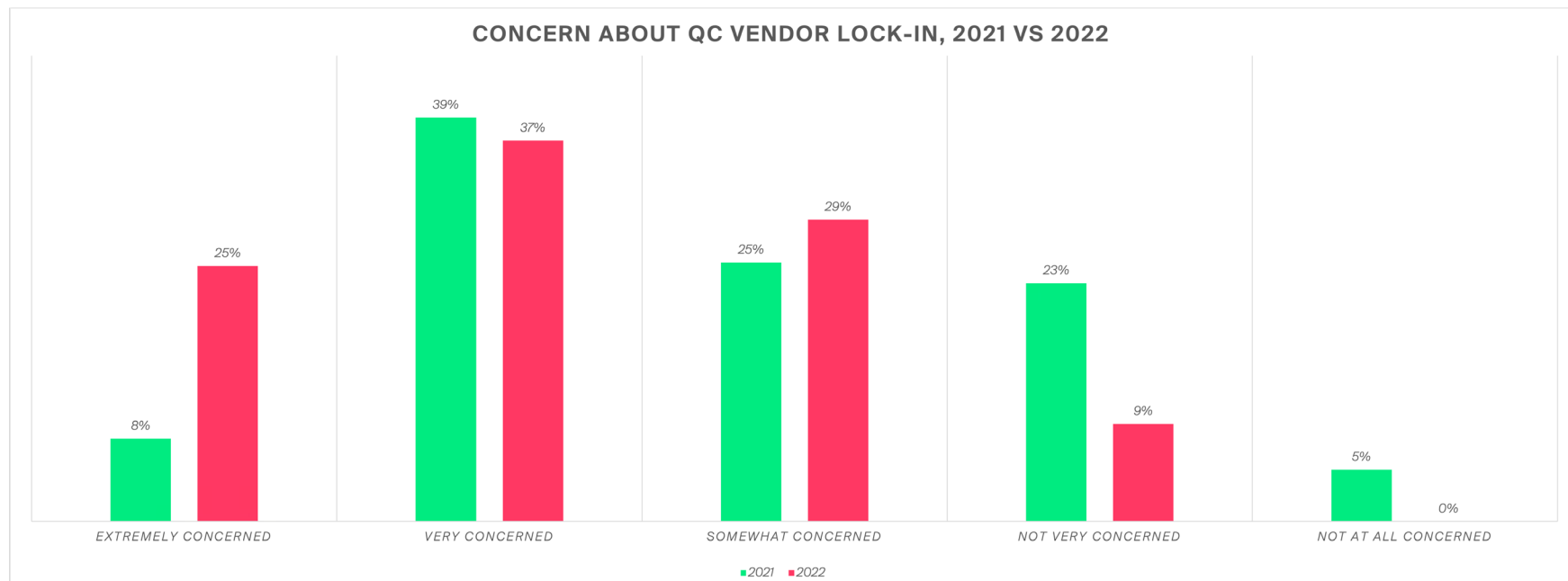
Vendor Lock-In Concerns Are Nearly Universal

91% of quantum-adopting respondents in 2022 indicated they are, to some degree, concerned about being locked-in with a quantum computing vendor, up from 72% in 2021. Furthermore, 62% were very or extremely concerned, compared to 47% in 2021.

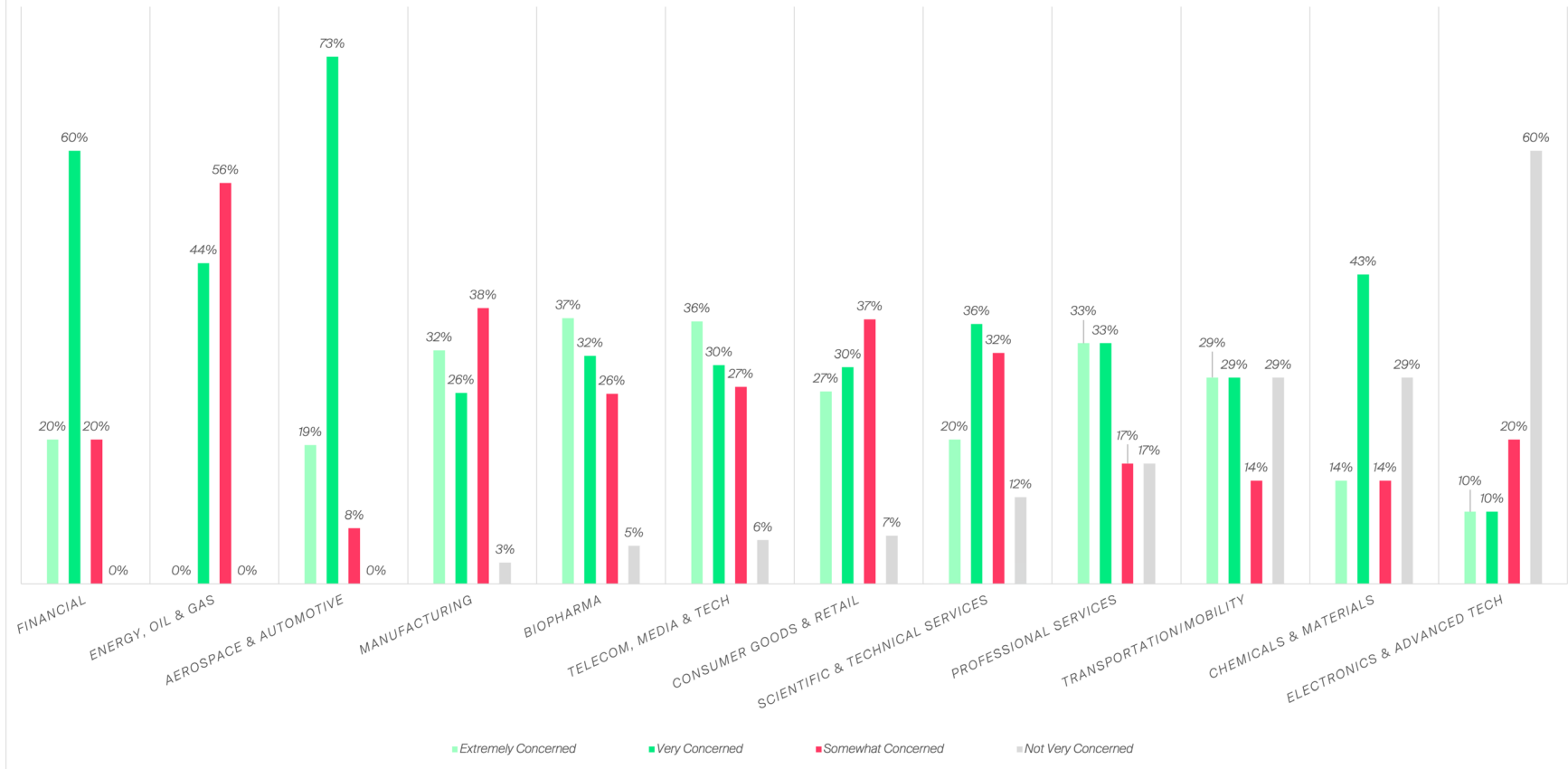
Vendor lock-in typically becomes a larger issue when the use of technology shifts from the experimentation phase to real-world use. As enterprises get serious about building applications, they run the risk of building their quantum tech stack around a hardware or software vendor that may not ultimately be the best solution for their application in the years

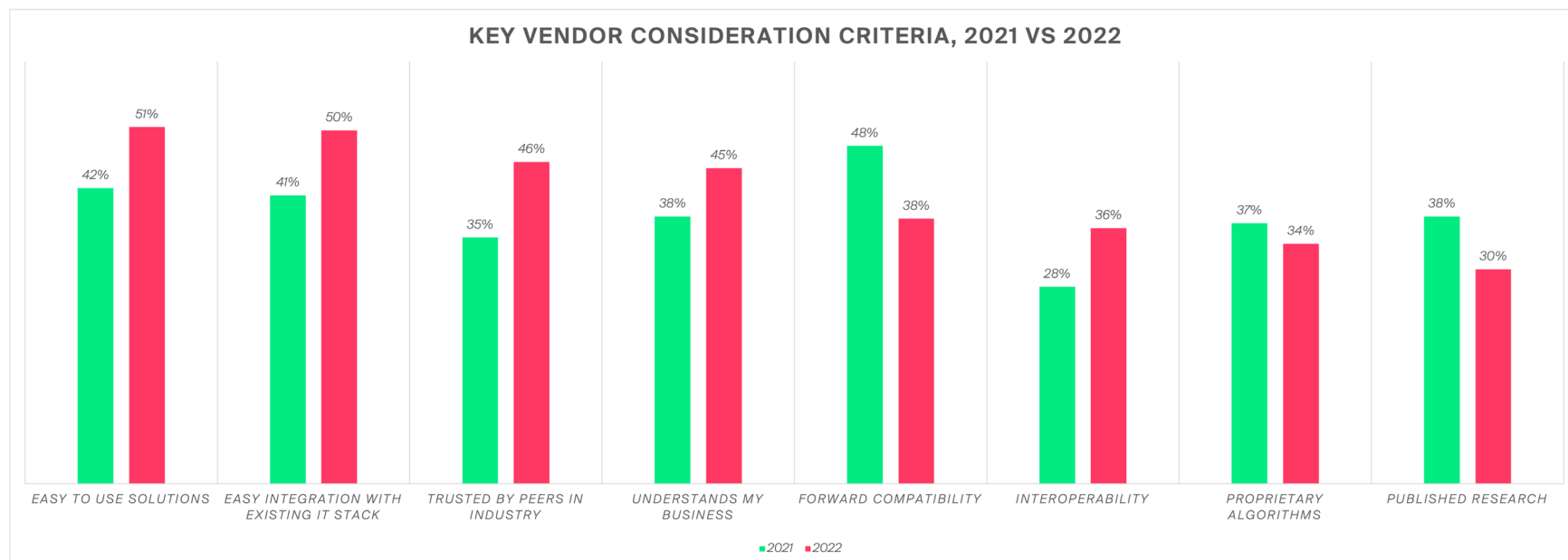
to come. Given the growing number of quantum hardware paradigms, including superconducting, quantum annealing, photonics, cold/neutral ions, and more, this is a valid concern: it's unclear which hardware configuration will be best equipped to solve different problem classes.

These vendor lock-in concerns call for a flexible, hardware-agnostic approach to quantum computing. Ideally, quantum applications should be interoperable with both different quantum hardware devices and different classical computing resources. Given that some quantum devices will be better for specific use cases than others, organizations will need the flexibility to swap devices in and out of their workflows as their needs change and the technology matures.



CONCERNS ABOUT VENDOR LOCK-IN BY INDUSTRY, 2022



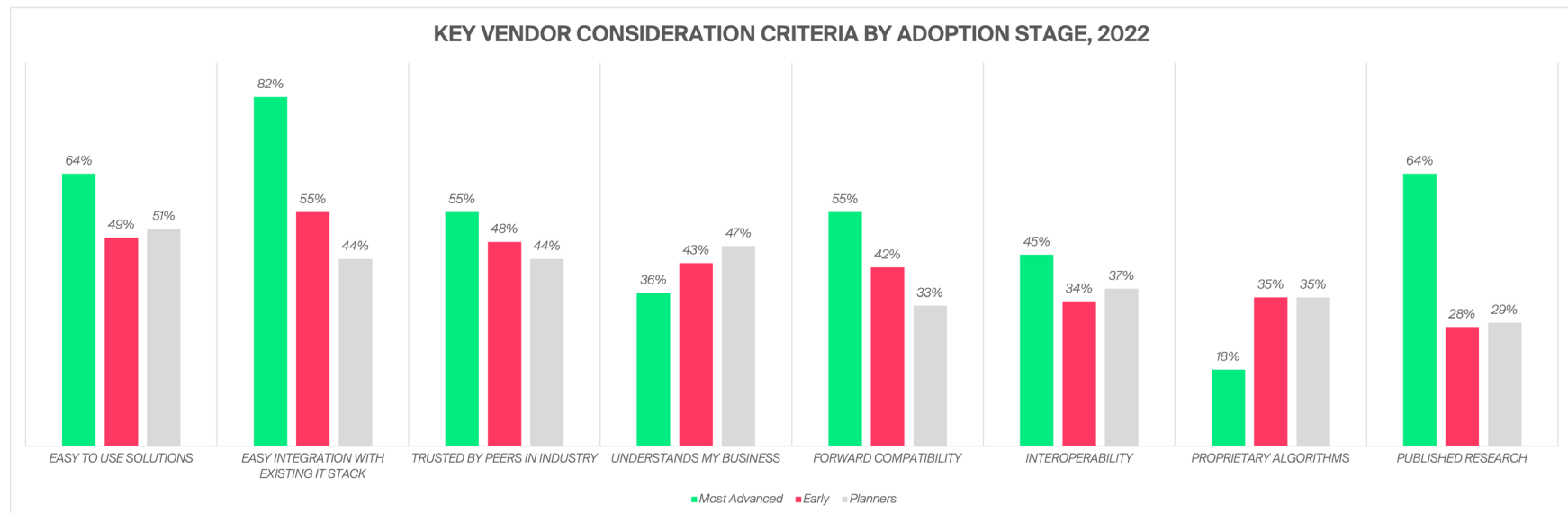


Ease of Use, Easy Integration Are Key Vendor Considerations

Selecting quantum computing vendors is based on several criteria, and the weight assigned to each one is dependent upon each organization's specific level of quantum expertise, its available resources, and desire to integrate quantum into its existing tech stack.

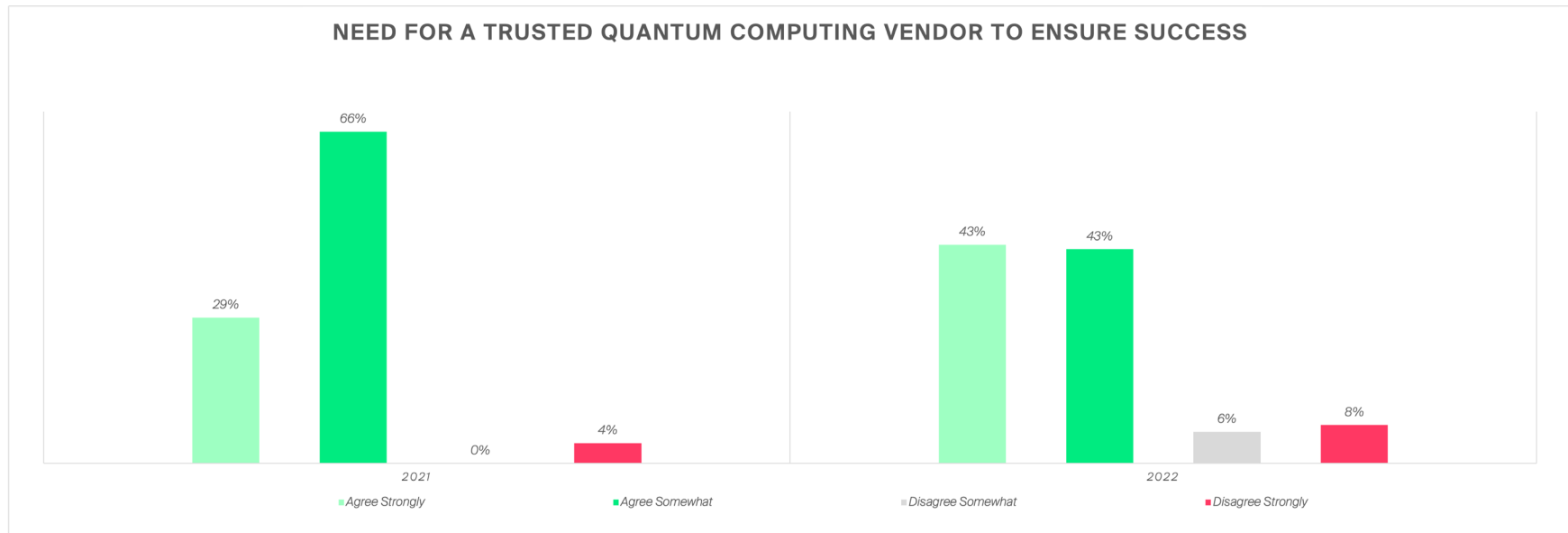
However, a key vendor consideration is facility of use, illustrated in the “easy to use solutions” and “easy integration with existing tech stack,” which both saw a 9% increase from 2021 to take the lead as the top vendor considerations. Interoperability saw a similar increase as a top consideration since 2021.

This is not surprising given that the complexity of integrating quantum with enterprises' existing IT stack was the second biggest hurdle to adoption reported by respondents in this year's survey, as later results will show. Considering the complexity of quantum computing and the limited quantum talent pool, it's reasonable that enterprises would want the complexity abstracted and simplified. Integration was a common stumbling block with AI adoption as well, and enterprises may be learning from past frustration.



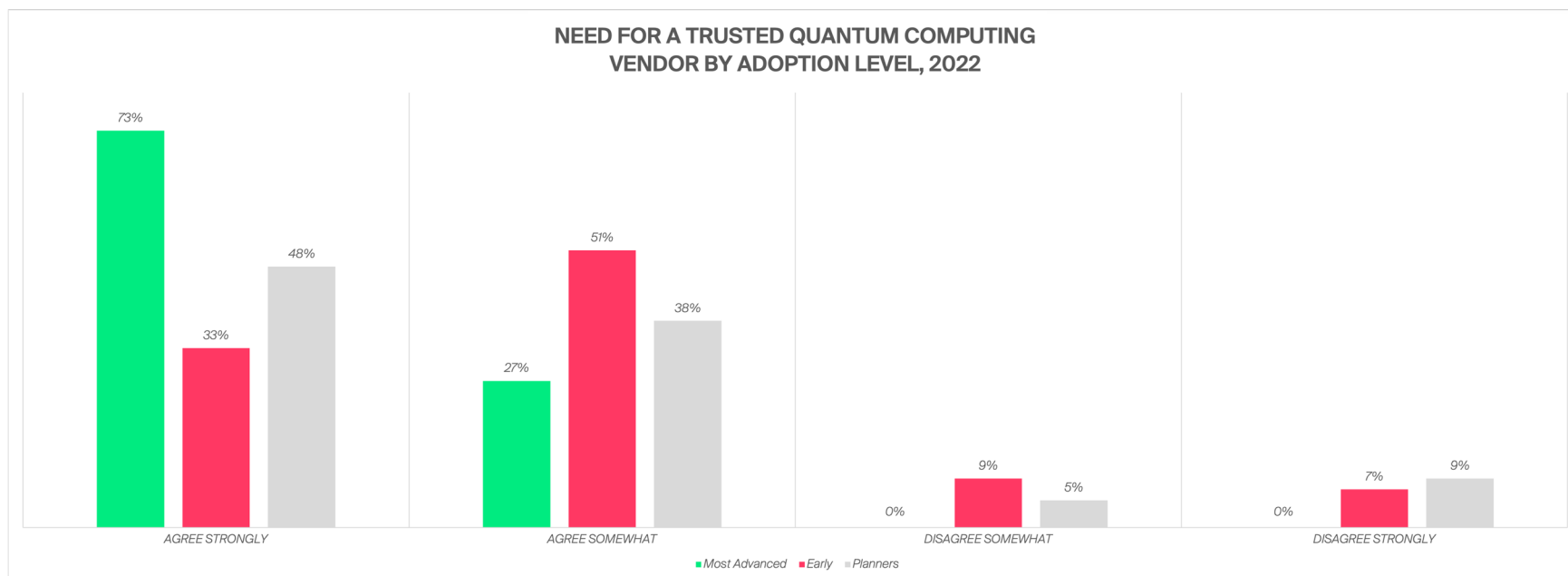
Easy integration and ease of use were even higher considerations among the most advanced quantum adopters, who may have already experienced the difficulty of running jobs on mostly remote quantum devices and integrating quantum workflows with the existing classical parts of their stack. Forward compatibility criteria was also noticeably higher among the most advanced adopters, reflecting heightened vendor lock-in fears referenced earlier.

Another noticeable trend among the most advanced adopters was an emphasis on published research as a top criteria for evaluating vendors, reflecting the real-world, tactical-focused approaches for quantum pioneers that are ready to integrate quantum into their workflows. These decision makers are looking for real solutions backed up by peer-reviewed scientific evidence.



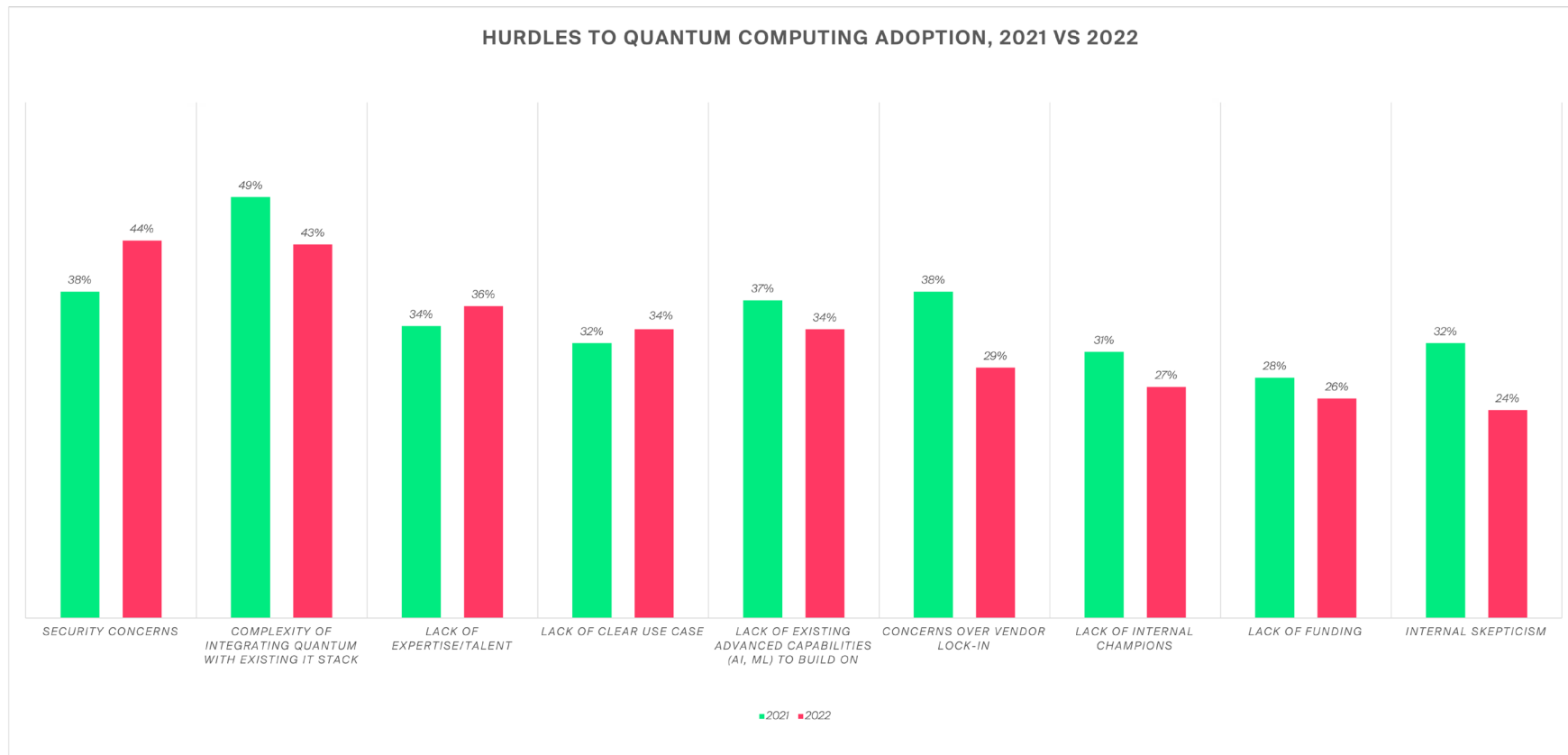
Trusted Vendors Increasingly Seen as Essential to Success with Quantum

Vendors are increasingly seen as critical to success in quantum adoption. 43% of respondents in 2022 said they “agree strongly” that “My organization could not successfully adopt quantum computing without the help of a trusted vendor,” compared with just 29% in 2021.



Nowhere were trusted vendors valued more highly than among the most advanced quantum adopters, 73% of whom agreed strongly that their organization could not successfully adopt quantum computing without the help of a trusted vendor. These more advanced quantum adopters have realized firsthand the value of working with trusted partners as they integrate quantum capabilities into their business.

8. Top Hurdles to Quantum Computing Adoption



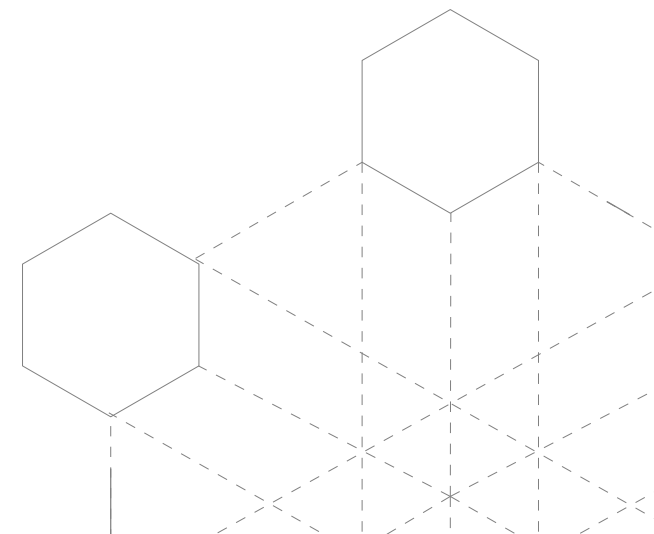
Security Concerns, Integration Complexity Are Top Hurdles to Quantum Adoption

There is no single hurdle to quantum computing adoption, as each industry and enterprise operating within the industry has unique concerns, level of expertise and comfort with quantum computing, and available financial resources.

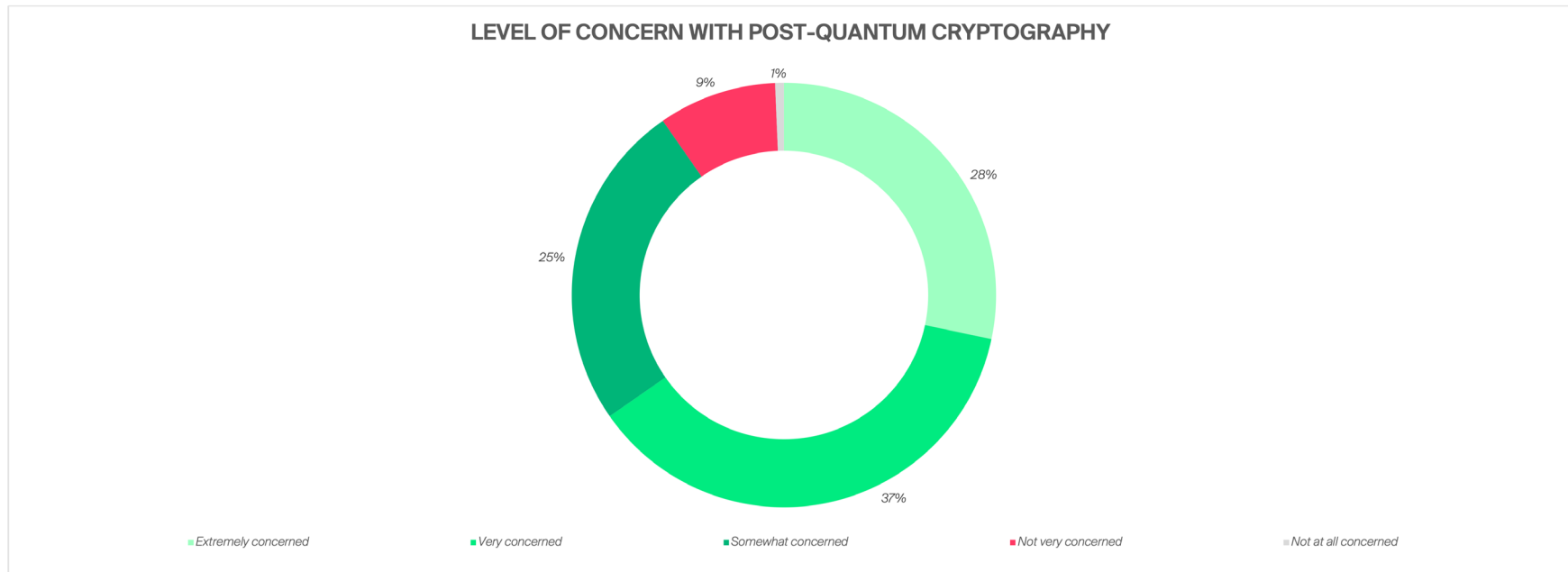
However, security concerns and the complexity of integrating quantum computing with the existing IT stack were the top hurdles by a wide margin. The security concerns likely reflect a growing awareness of post-quantum cybersecurity risks, which will be covered in more depth in the next section.

The persistent challenge of integrating quantum computing into enterprises's existing IT stack – the top hurdle to adoption in last year's study – reflects an acknowledgement that quantum will not exist in a vacuum, nor will it “rip and replace” high performance classical computers (HPC). Rather, quantum will always function in a hybrid model combining novel quantum resources and existing classical resources.

The challenges of integration are exacerbated further by the fact that quantum devices are almost exclusively accessed remotely via the cloud, which will likely remain the case for several years to come as quantum computers remain extremely complex to build and maintain. This remote access comes with security, data management, and compliance issues. The findings suggest that hardware and software vendors should prioritize integration, flexibility, and interoperability.



9. Post-Quantum Cybersecurity



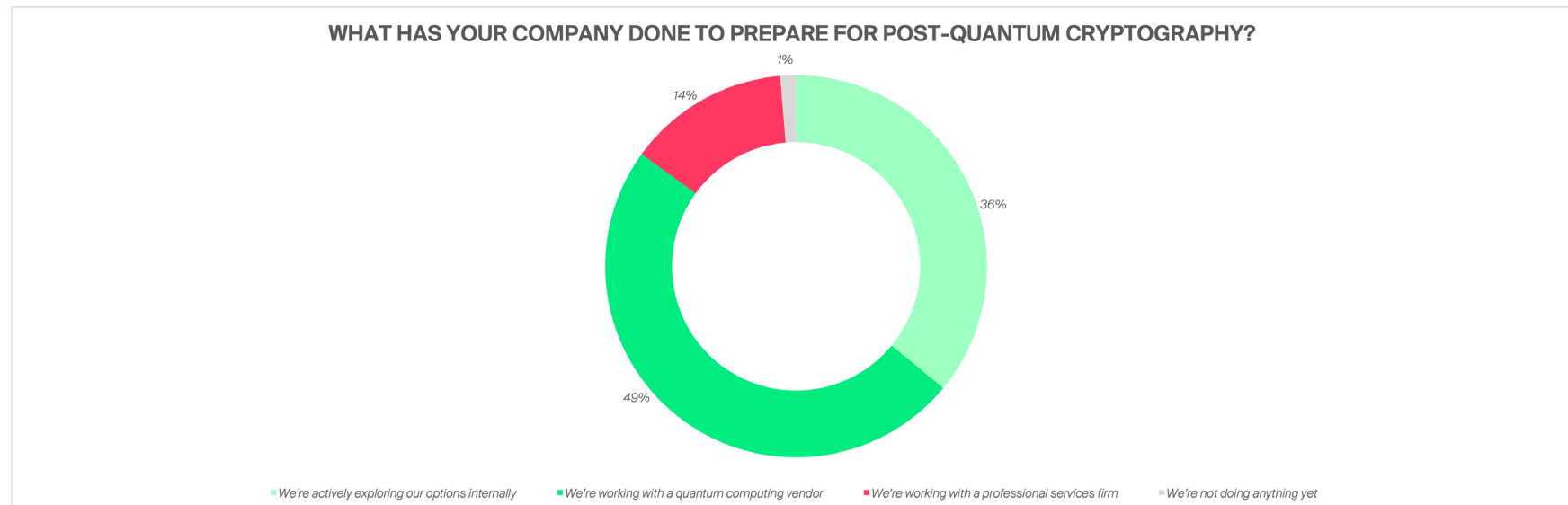
90% of Respondents Concerned About Post-Quantum Cryptography

Fully 90% of respondents are either extremely concerned, very concerned, or somewhat concerned about the specter of post-quantum cryptography (PQC), a forthcoming era in which quantum computers will be able to break current encryption technologies and standards, like RSA. Just 10% of respondents indicate they're not very concerned, or not at all concerned.

While Shor's Algorithm is the most well documented threat to encryption, it is unlikely to pose a threat for at least another

decade due to its requirement for millions of error-corrected qubits. A more near-term threat could come in the form of hybrid quantum-classical heuristic algorithms, such as variational quantum factoring (VQF). Heuristic algorithms sacrifice accuracy, precision, optimality or, completeness for speed. While they may not be able to crack every instance of RSA encryption like Shor's, a heuristic algorithm could threaten some instances of RSA with only a few thousand qubits.

The uncertain timeline for when these hybrid heuristic algorithms could pose a threat means that organizations are under pressure to begin preparing in the event that a threat emerges in the next few years.

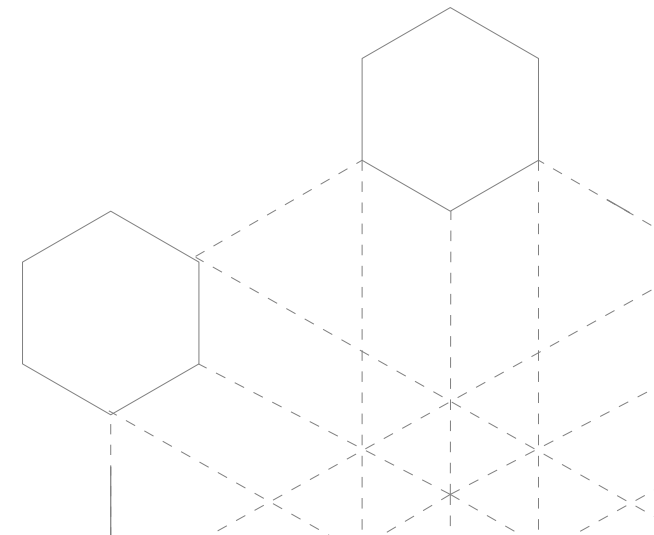


Enterprises Turn to Vendors For Post-Quantum Cybersecurity Needs

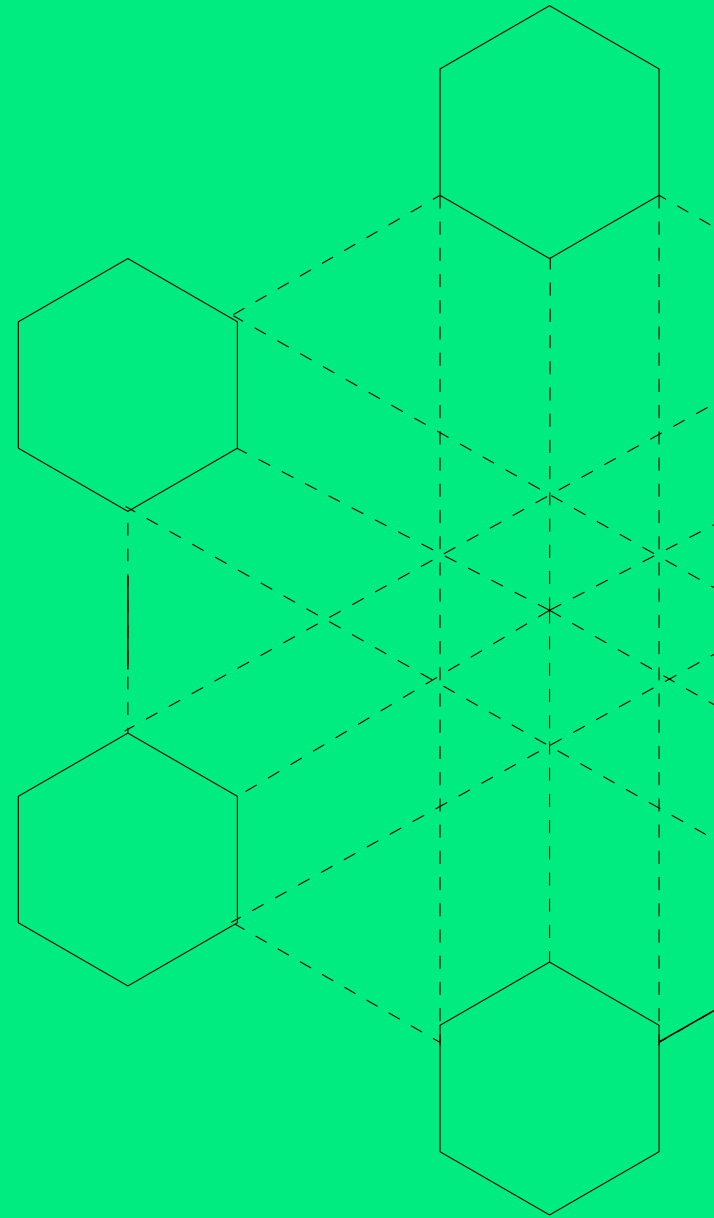
The PQC era, in which quantum computers will be able to break commonly used encryption standards such as RSA, presents a challenge to many organizations. Nearly half (49%) of respondents in 2022 say they're working with a quantum computing vendor, while an additional 14% are working with a professional services firm. And while 36% of respondents say they're preparing using internal resources, just 1% of respondents aren't yet addressing their options.

Given the lack of clarity over which post-quantum encryption schemes will be the safest, enterprises should prioritize crypto-agility – or the ability to quickly swap the encryption on their most sensitive assets should it become vulnerable – in their search for PQC solutions.

Migrating an entire enterprise's systems, data, and communications to quantum-secure cryptography will likely take years and cost millions of dollars – a risk management process no enterprise will want to undergo twice. Planning for crypto-agility from the start will make it easier to switch encryption schemes should a new quantum or classical threat emerge.



Conclusion



Taken together, the results of this year's survey point to steady progress for quantum adoption in the enterprise market. Far from showing signs of enterprises pulling back from quantum or a "quantum winter", the results instead show we may have reached an inflection point in the industry.

This is perhaps most noticeable in the uptick in investments in quantum budgets. The majority of quantum-adopting enterprises now have quantum computing budgets exceeding \$1 million.

The fact that enterprises are increasing their funding for quantum amidst a year of heightened economic uncertainty and recession fears says a lot about their commitment and the value they see at stake.

What's more, the study showed that quantum adoption is happening as fast or faster than AI adoption in a majority of cases. Given the nascence of the quantum hardware market, the speed of quantum adoption points to a robustness in the quantum software ecosystem that is enabling enterprises to build demonstrable quantum capabilities and become "quantum-ready" in preparation for a practical quantum advantage.

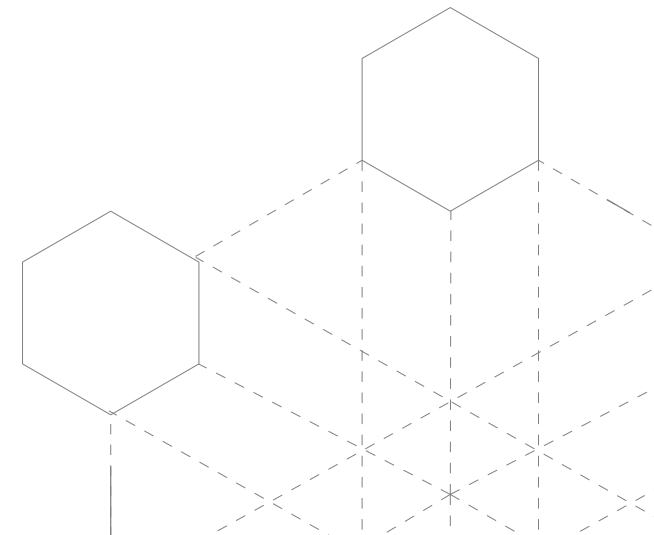
The results support our hypothesis that the vast majority of global enterprises understand the value—and disruptions—that quantum computing is expected to bring, with 70% of respondents citing better performance and business results as their top motivation for adoption. They also understand that implementing quantum into their existing stack is a long, complex process that requires action sooner rather than later.

The year-over-year results allowed us to track deltas in key industry maturity metrics. However, this year's survey also

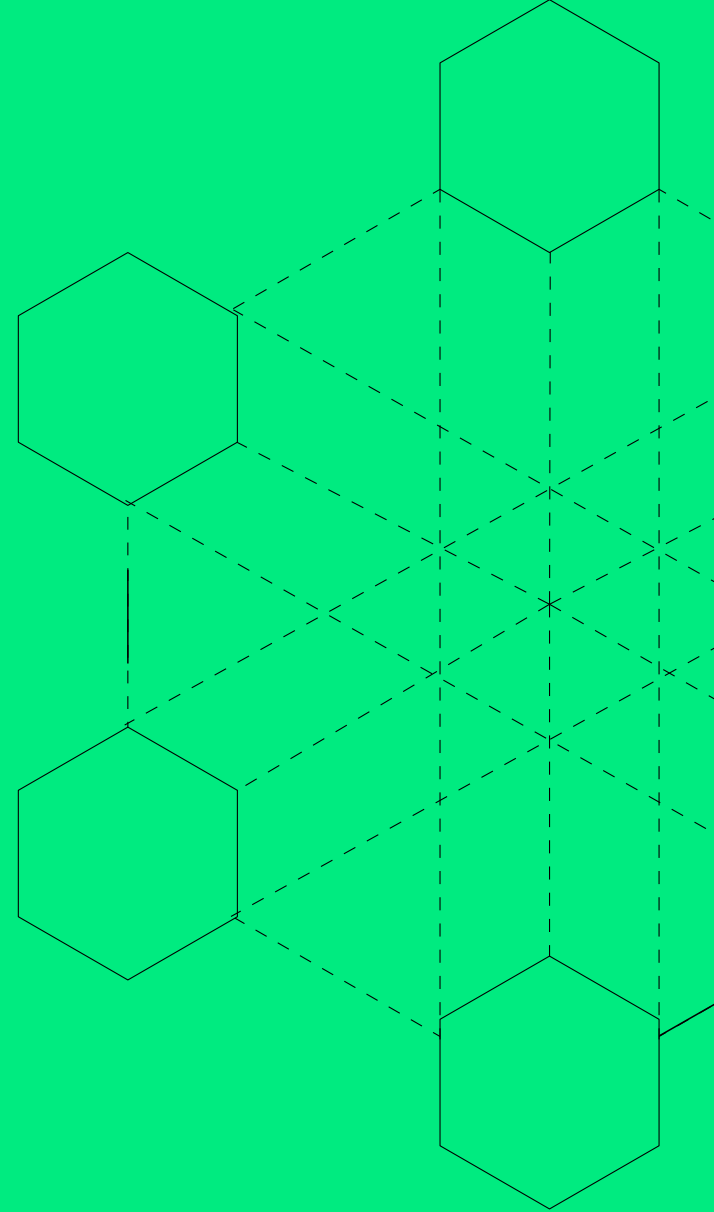
explored a new area: post-quantum cryptography (PQC). With 90% of enterprises concerned about PQC, this will be a space to monitor closely as vendors integrate PQC solutions into their product lines to address these concerns.

As we enter 2023, recent and expected advances in AI and related technologies, such as OpenAI's ChatGPT and GPT-4, will be fascinating subplots to the quantum computing story as the hardware becomes more powerful and software more useful and production-ready.

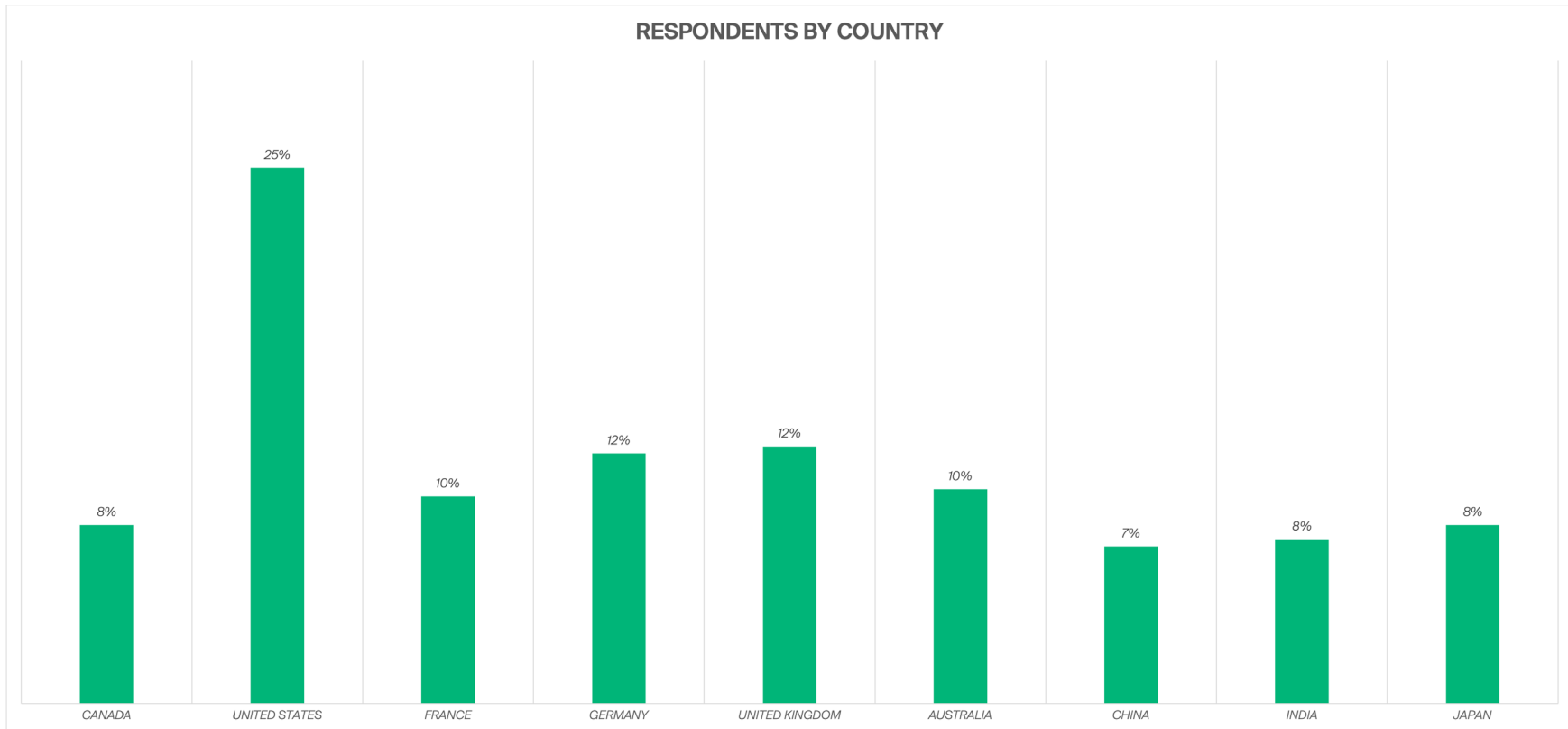
Ultimately, the survey results are in line with what we have seen in our own work with customers, and will help us better support our customers and ecosystem partners on their quantum journeys. Of course, our 300 responses do not capture the entirety of the quantum adoption landscape and may not have included your organization. Respondents were recruited by an independent research firm, Wakefield Research, screening only for enterprise size, revenue, estimated computing budget, and seniority level — they were not recruited from our contacts in any way. We welcome any comments, questions and challenges to the data and our analysis of it, and invite an ongoing dialogue to address the challenges and opportunities identified by our study.



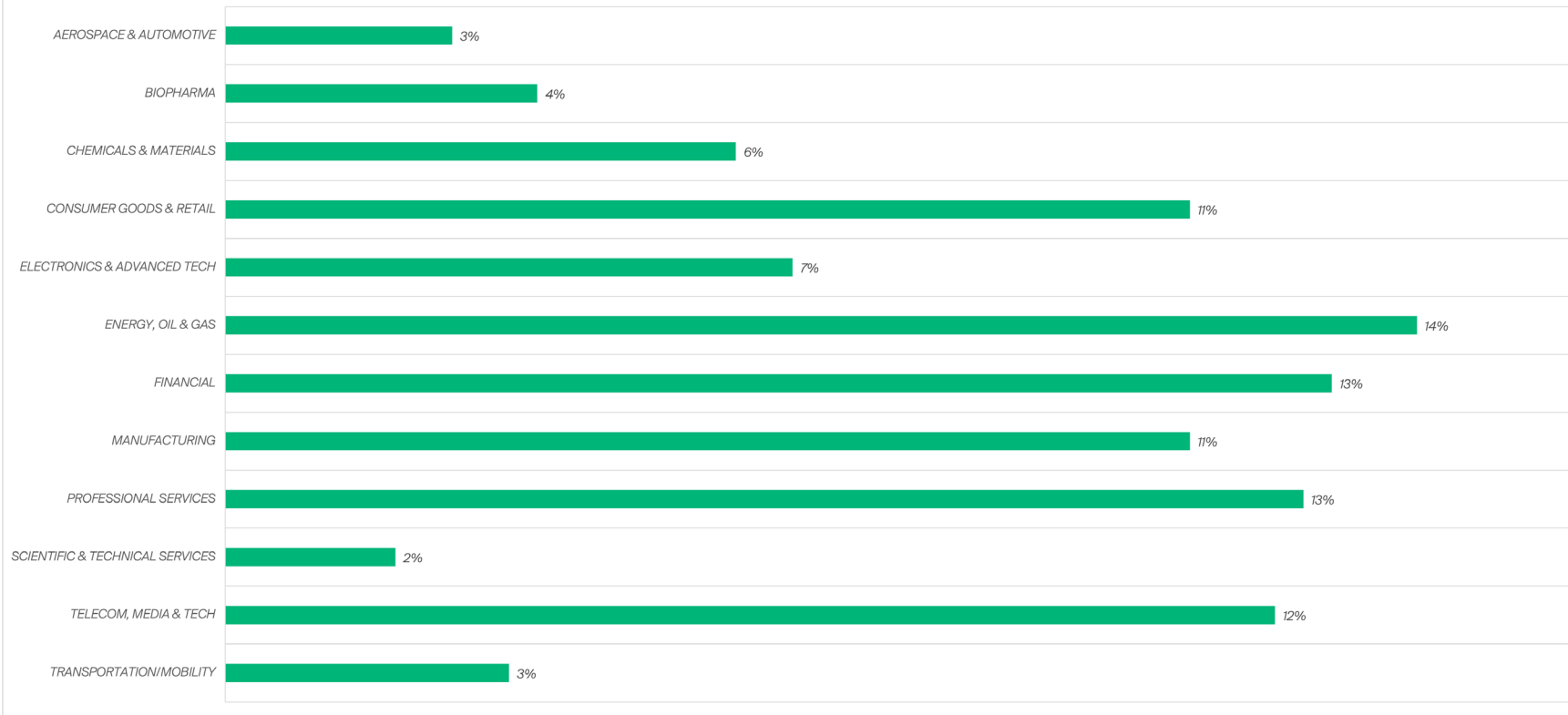
Appendix



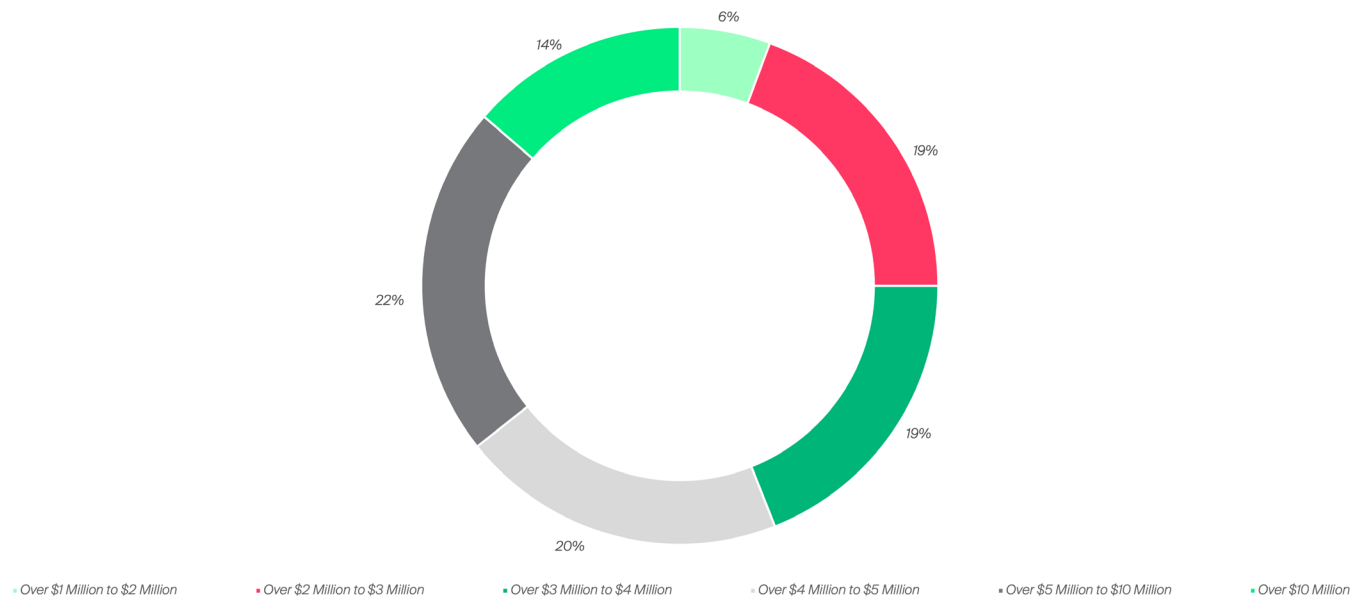
RESPONDENTS BY COUNTRY



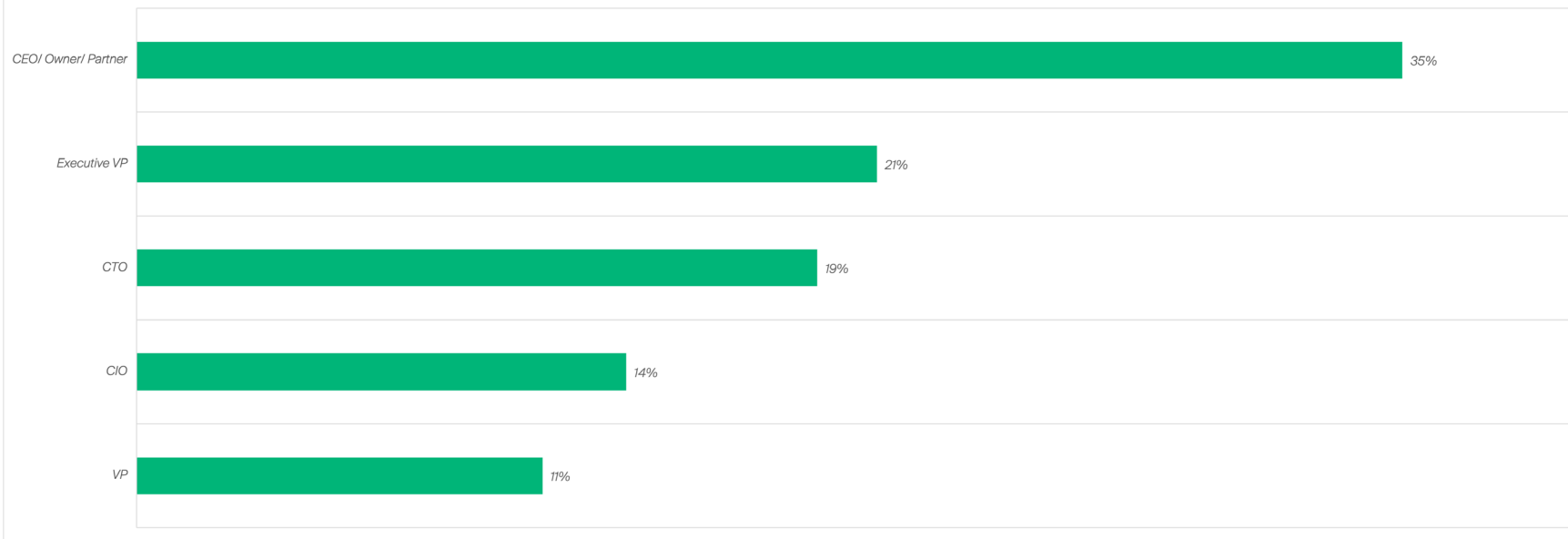
RESPONDENTS BY INDUSTRY



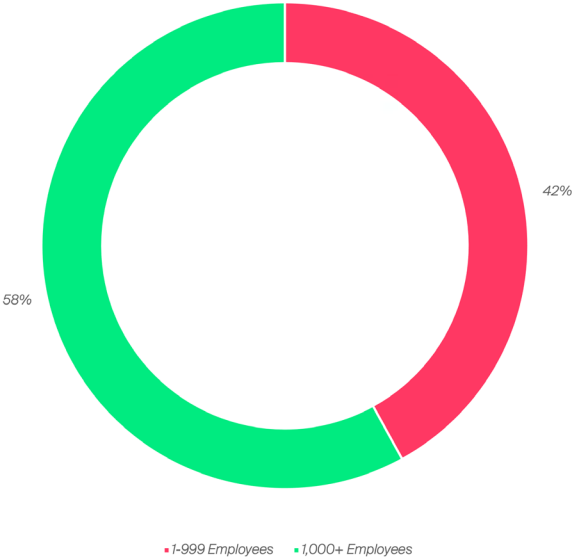
RESPONDENTS BY COMPUTE BUDGET

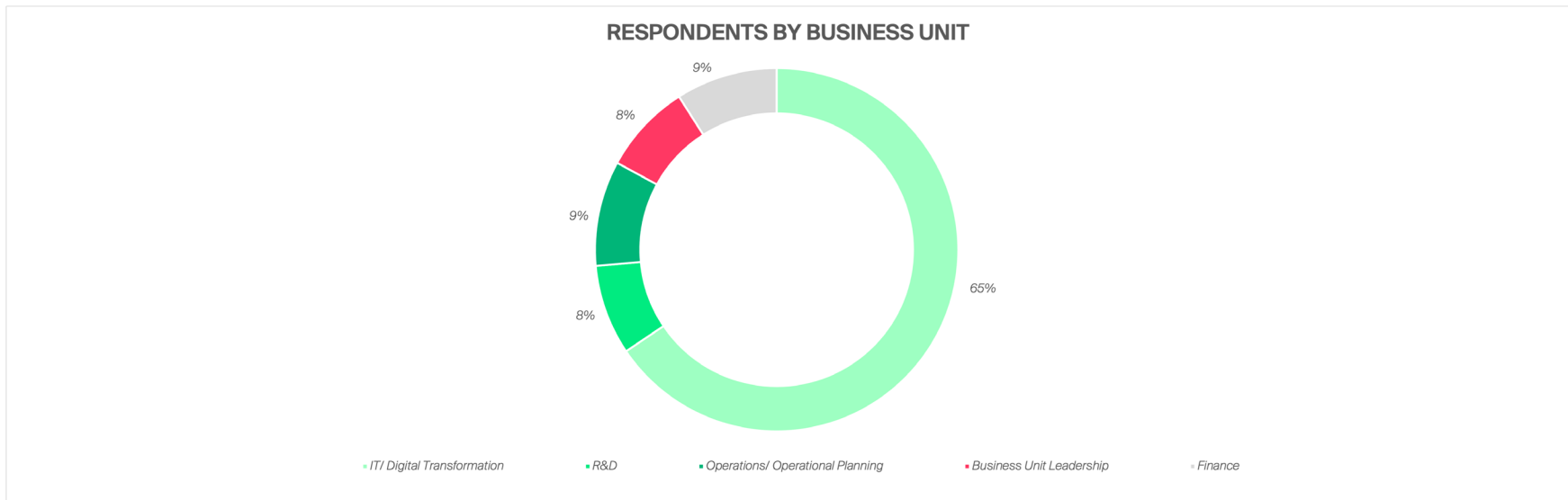


RESPONDENTS BY SENIORITY

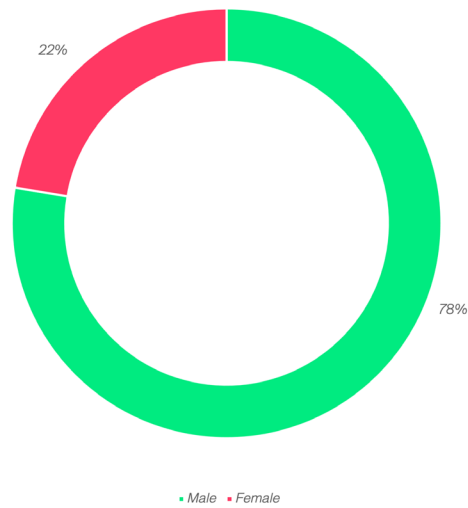


RESPONDENTS BY COMPANY SIZE

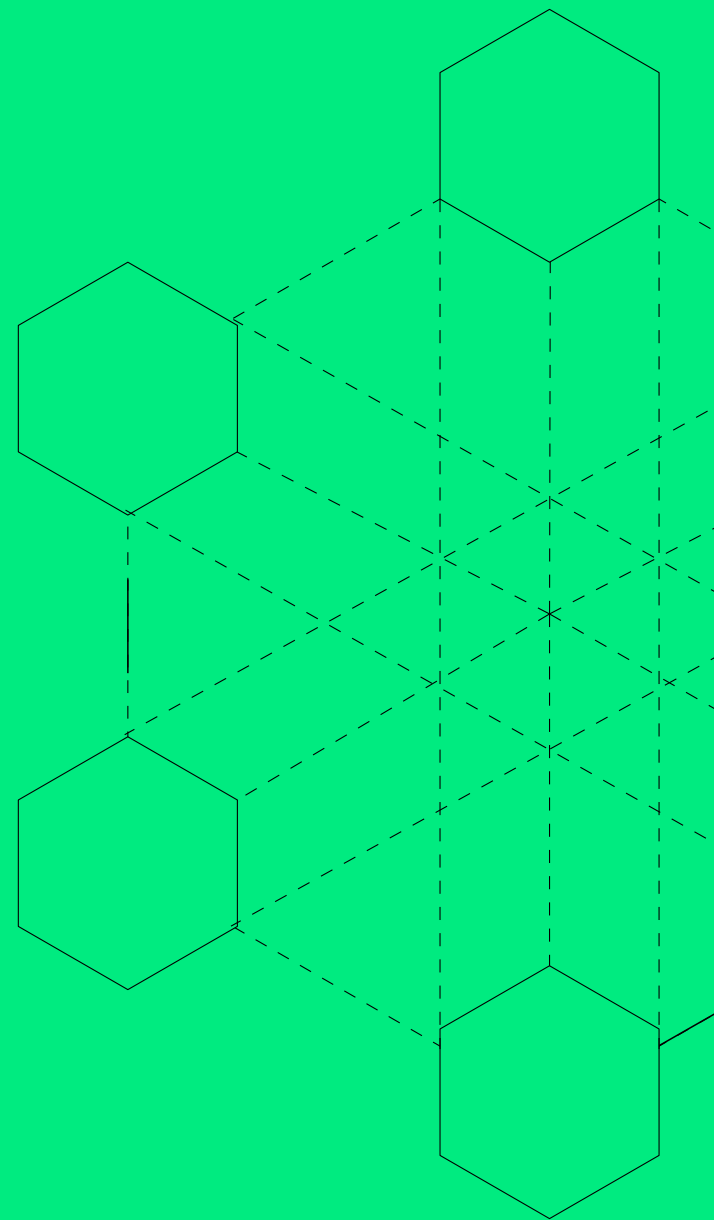




RESPONDENTS BY GENDER



About Zapata



About Zapata Computing

Zapata Computing, Inc. is a leading enterprise quantum software company. The Company's Orchestra® platform supports the research, development, and deployment of quantum-ready applications® for enterprises' most computationally complex problems using quantum and/or other Big Compute™ technology.. Zapata has pioneered new methods in ML, optimization, and simulation to maximize value from near-term quantum devices, and works closely with ecosystem hardware providers such as Amazon, D-Wave, Google, NVIDIA, Quantinuum, IBM, IonQ and Rigetti. Zapata was founded in 2017 and is headquartered in Boston, Massachusetts.

For more information about this report, contact: survey@zapatacomputing.com

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