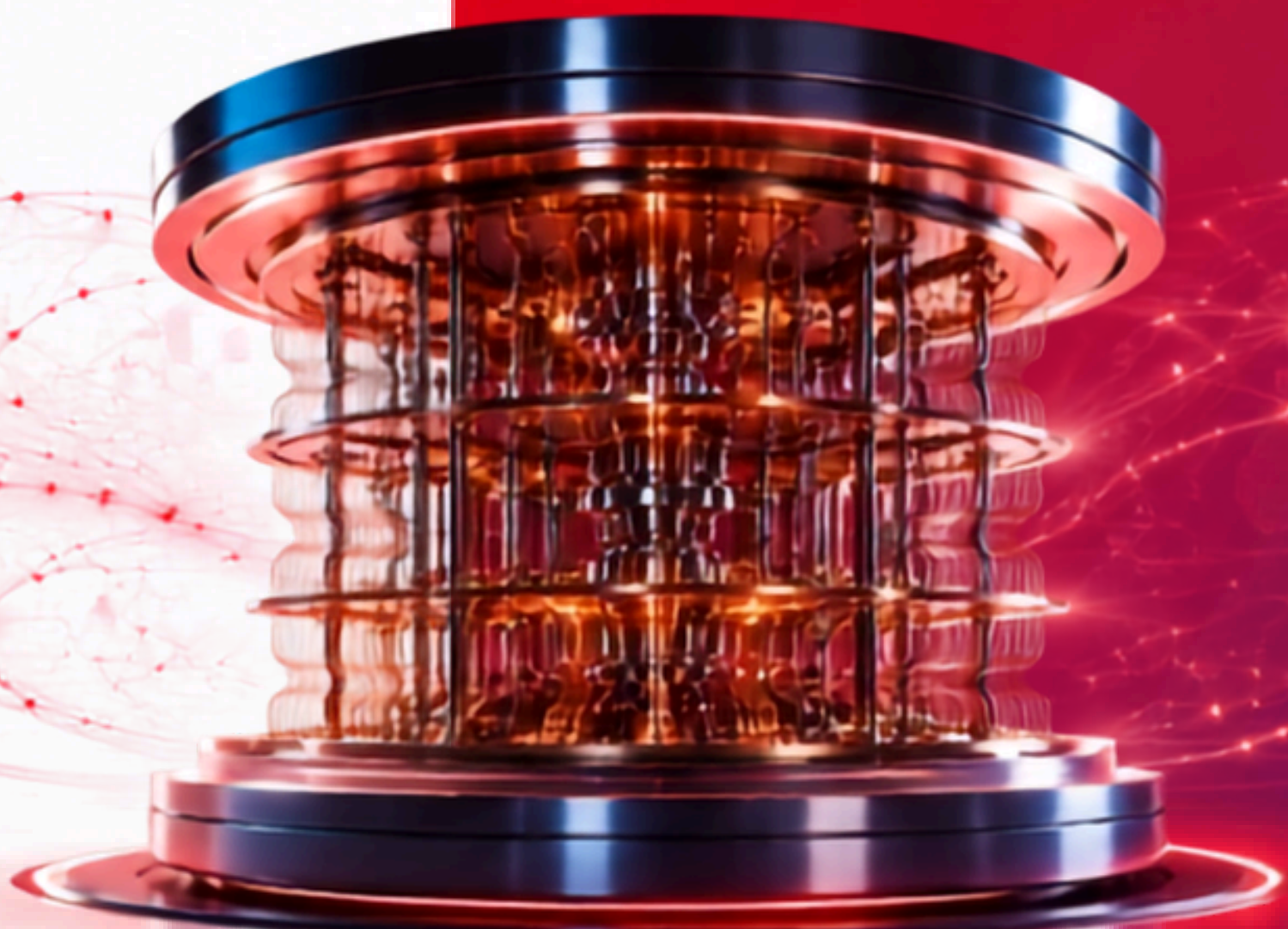




IRRESISTIBLE INDIA

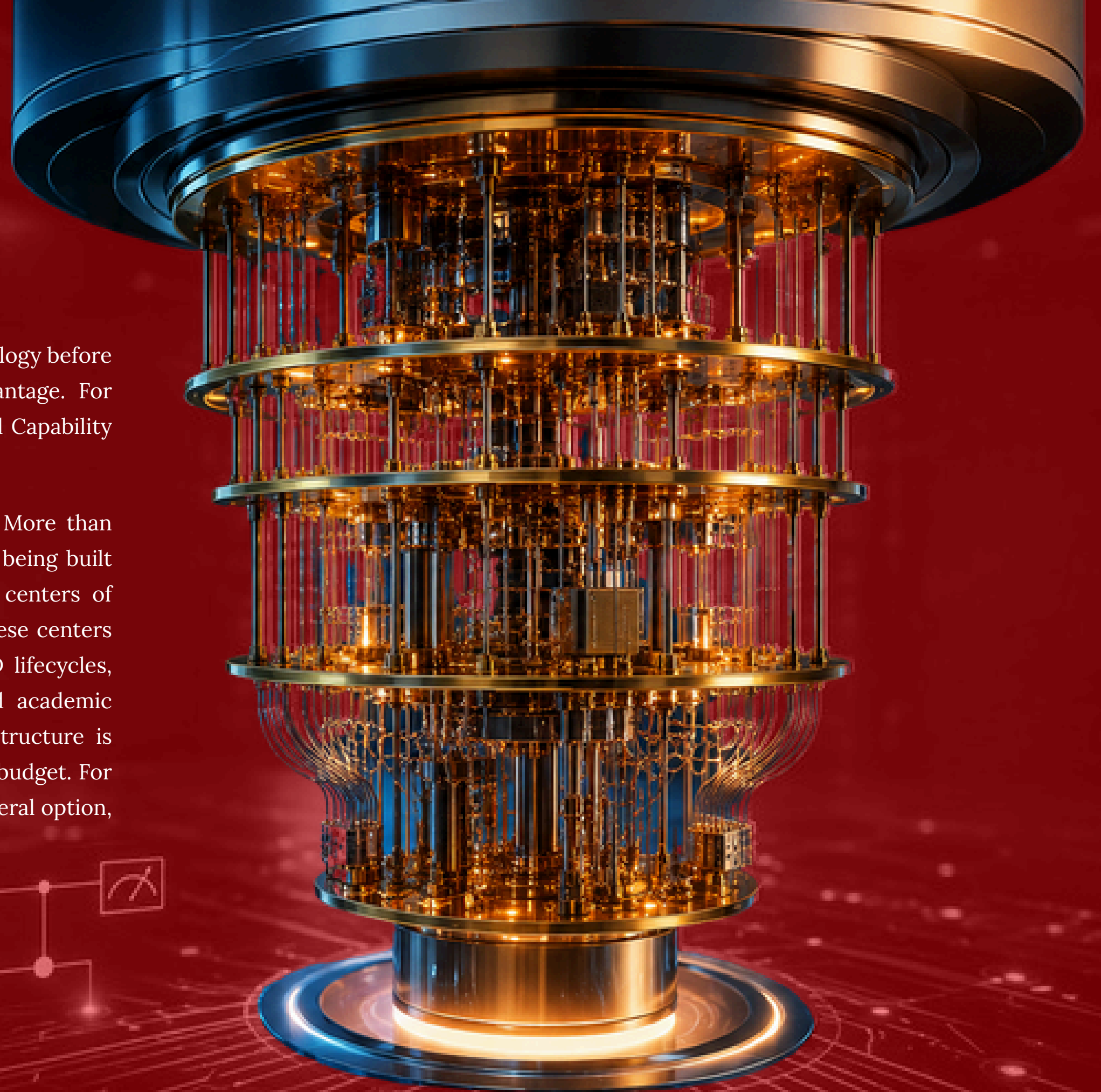
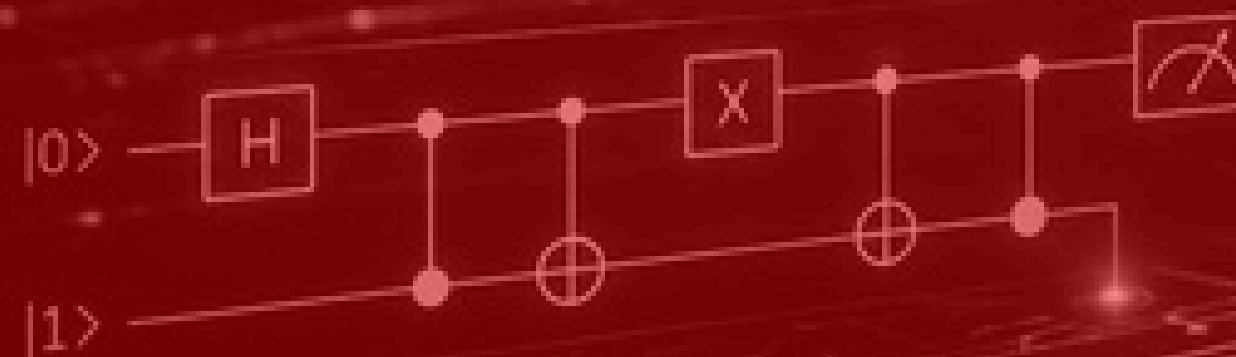
India's Quantum Opportunity: Positioning GCCs as Global Centers for Quantum Innovation



Executive Summary

Quantum computing is following the trajectory of every major enterprise technology before it: a narrowing window between early positioning and competitive disadvantage. For multinational enterprises deciding where to build that capability, India's Global Capability Centers (GCCs)/Offshore Delivery Centers (ODCs) offer the clearest answer.

GCCs in India have already moved past their traditional cost-arbitrage role. More than 2,100+ centers now employ 2.4 million professionals, and a growing share are being built around advanced technology mandates from inception, including dedicated centers of excellence exploring quantum computing and post-quantum cryptography. These centers are not merely adopting quantum tools; they are managing end-to-end R&D lifecycles, creating proprietary IP, and converting India's deep STEM talent base and academic partnerships into industry-ready quantum engineering capability. The infrastructure is funded, the talent pipeline is scaling, and early movers are already committing budget. For an MNC weighing where to build quantum capability, India is no longer a peripheral option, it is the default one.



Why India?

- **Access to Cost-Competitive Quantum Talent:** Build quantum capabilities with India's deep engineering and STEM talent pool.
- **Leverage India's Quantum Ecosystem:** Tap into the National Quantum Mission, research institutions, startups, and innovation hubs.
- **Scale Through Mature GCC Models:** Extend existing GCC operations into quantum with lower execution risk.
- **Accelerate Innovation Through Partnerships:** Collaborate with academia, startups, and industry to fast-track quantum R&D.
- **Secure First Mover Advantage:** Establish quantum capabilities early to access talent, IP, and long-term competitive advantage.

- **Key Takeaways:**

- Global quantum startup investment hit **\$12.6 billion in 2025, six times 2024's, with 60%** concentrated in just ten deals.
- India's National Quantum Mission has committed **\$730 million** over eight years across four thematic hubs.
- India hosts **2,100+ GCCs** employing 2.4 million professionals, with **12%** of new tech GCCs now exploring post-quantum cryptography and quantum computing.
- GCCs are shifting from cost centers to innovation hubs—managing end-to-end quantum R&D, building proprietary IP, and partnering with universities to develop industry-ready talent.
- Phased roadmap is emerging: quantum-safe security and workforce readiness now, algorithm development and pilots in 12–24 months, production applications in 3–5 years.

- **This Report Answers:**

- Why does quantum computing demand enterprise attention now, not after commercial maturity?
- Where India's quantum ecosystem stands—its strengths and its genuine gaps?
- How are GCCs already evolving into quantum engineering and IP-generating partners?
- What a practical, phased entry roadmap looks like for an MNC building this capability in India?

The infrastructure is funded, the talent is emerging, and early movers are already placing bets. India offers the clearest answer.



Table of CONTENTS

1. The Global Quantum Inflection Point

- 1.1 Market Acceleration and Investment Surge
- 1.2 The AI-2020 Parallel
- 1.3 The Commercial Inflection Point

2. The Quantum Threat Landscape: Why "Q-Day" Demands Early Action

- 2.1 Defining "Q-Day" and Its Implications
- 2.2 The "Harvest Now, Decrypt Later" (HNDL) Threat
- 2.3 The Four Pillars of Digital Trust at Risk
- 2.4 The Cost of Delay and Forced Migration
- 2.5 The Leadership Playbook: A 90-Day Action Plan

3. India's Quantum Ecosystem: The National Quantum Mission and Beyond

- 3.1 The National Quantum Mission (NQM)
- 3.2 Strengthening the Research Foundation
- 3.3 India's Sovereign Quantum Security Roadmap: India's "Middle Path" Advantage

4. India's Talent, Research, and Innovation Infrastructure

- 4.1 India's STEM Talent Pool
- 4.2 Institutional and Research Capacity
- 4.3 Government Initiatives for Talent Development
- 4.4 A Self-Sustaining Research Loop
- 4.5 The Semiconductor Synergy: Building on India's Deep-Tech Foundation

5. GCCs in Transition: From Cost Centers to Quantum Innovation Hubs

- 5.1 The GCC Maturity Curve
- 5.2 Building Quantum Capability: The CoE Model
- 5.3 Managing Global Mandates
- 5.4 Talent and Infrastructure Ready
- 5.5 New GCC Policy & Infrastructure Incentives: A Lower-Risk Business Case
- 5.6 The Tier-II City Expansion Playbook: Talent and Cost at Scale

6. Key Players: Enterprises and GCCs Already Leading in Quantum

- 6.1 MNCs Committing to Quantum
- 6.2 GCCs at the Frontier
- 6.3 India's Growing Role

7. The Talent, Research, and Innovation Engine

- 7.1 Industry-Academia-Startup Partnerships
- 7.2 A Pipeline of Industry-Ready Engineers
- 7.3 The Advantage of Scale

8. A Phased Roadmap for MNCs: From Strategy to Production

- 8.1 Phase 1: Establish Quantum-Safe Security and Workforce Readiness (0-12 Months)
- 8.2 Phase 2: Algorithm Development and Pilots (12-24 Months)
- 8.3 Phase 3: Production-Ready Applications (3-5 Years)
- 8.4 Key Recommendations for MNCs

9. Conclusion

- 9.1 The Window is Closing
- 9.2 India as the Default Answer
- 9.3 A Clear Mandate for Action

10. References

Chapter 01

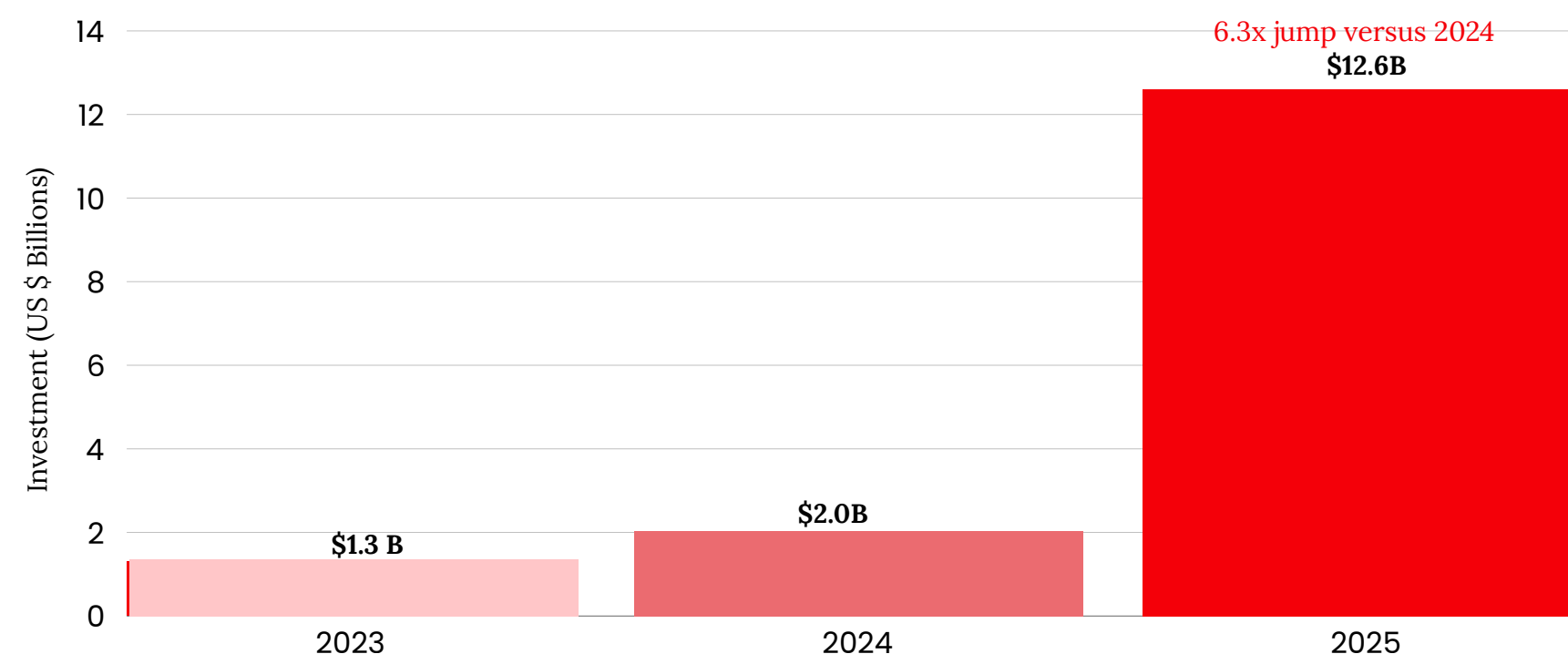
The Global Quantum Inflection Point

- 1.1 Market Acceleration and Investment Surge
- 1.2 The AI-2020 Parallel
- 1.3 The Commercial Inflection Point

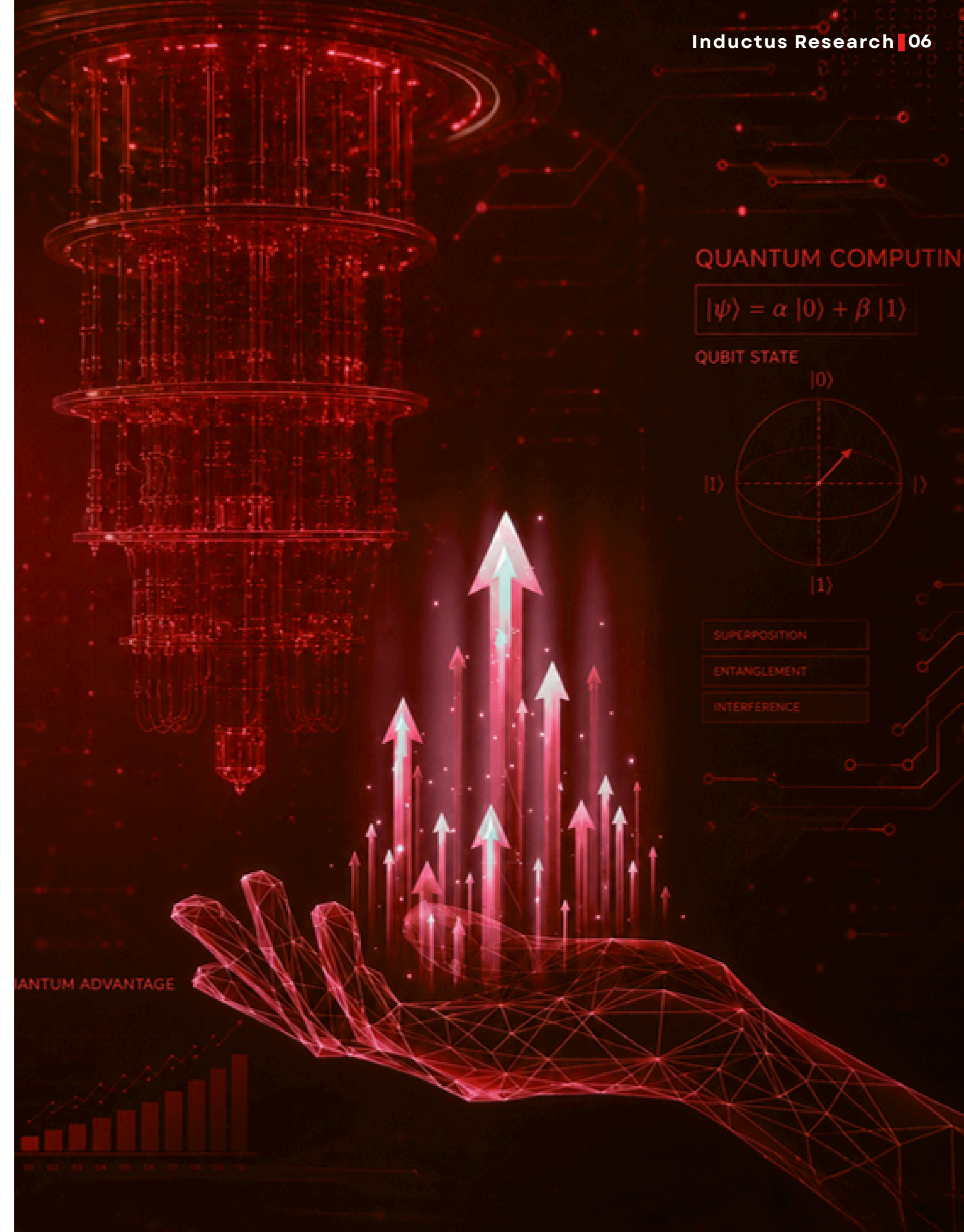
Market Acceleration and Investment Surge

Quantum computing has crossed from speculative science into a strategic capital priority. According to McKinsey's Quantum Technology Monitor 2026, investment in quantum technology startups reached **\$12.6 billion in 2025, a 6.3 times increase over 2024**, with roughly **90%** of that capital flowing specifically into quantum computing startups rather than adjacent fields such as sensing or communication.

Global Quantum Technology Startup Investment



The surge is not evenly distributed. A small number of platform bets, including **PsiQuantum**, **Quantinuum**, and **D-Wave**, captured the majority of capital deployed in 2025, and 2025 also saw major consolidation, including **IonQ's \$1.1 billion** acquisition of Oxford Ionics and Xanadu's public listing through a special purpose acquisition company. McKinsey projects that quantum computing could create up to **\$2.7 trillion** of economic value worldwide by 2035, with the internal quantum technology market (hardware, software, and services) reaching between **\$60 billion** and **\$100 billion** by that year, of which quantum computing alone could represent **\$43 billion** to **\$71 billion**.



1.2 The AI-2020 Parallel

Enterprise leaders who lived through the artificial intelligence buildout of the early 2020s are recognizing a familiar pattern in quantum computing today. In both cases, a technology moved from academic curiosity to boardroom priority once early commercial proof points appeared, capital concentrated quickly around a handful of leaders, and the enterprises that built internal capability early captured a durable advantage over those that waited for the technology to fully mature. Just as AI talent and infrastructure became scarce and expensive once demand accelerated, quantum talent, cryogenic hardware capacity, and specialized research partnerships are already showing early signs of the same scarcity dynamic. The lesson enterprises took from the AI buildout, that capability built ahead of commercial necessity compounds into a competitive advantage, is the same lesson now shaping quantum strategy.



1.3 The Commercial Inflection Point

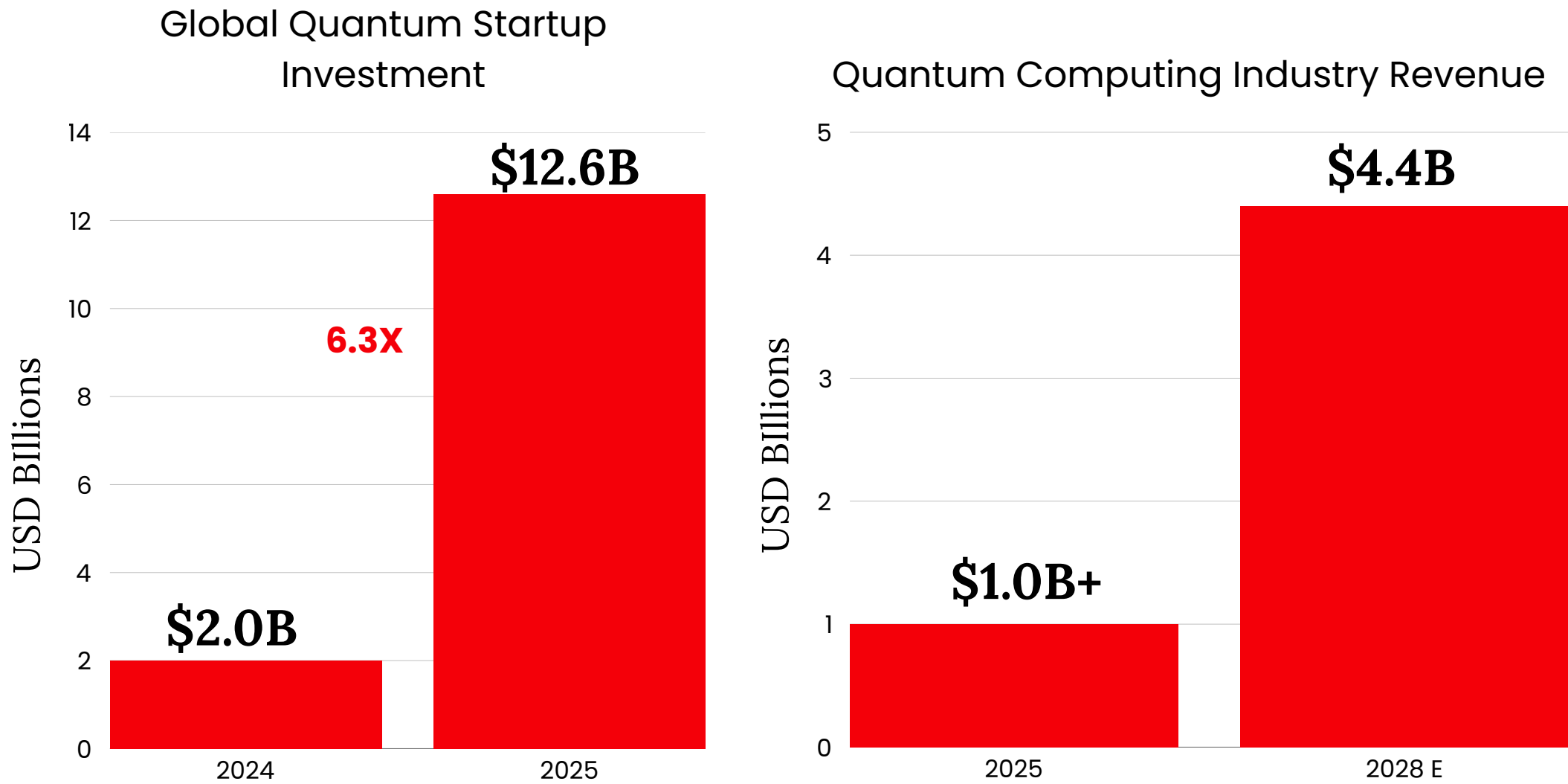
Quantum computing is no longer confined to government laboratories and academic research groups. Existing research identifies more than 300 global companies now actively adopting quantum computing in some form, and quantum computing companies collectively generated more than **\$1 billion in revenue worldwide in 2025**, a figure McKinsey expects to grow to as much as **\$4.4 billion by 2028**. Enterprise adoption is concentrated in financial services, pharmaceuticals, chemicals, logistics, and materials science, where optimization, simulation, and cryptographic risk intersect most directly with core business value.

Metric	2024	2025
Global quantum startup investment	\$2.0 billion	\$12.6 billion
Share of investment to quantum computing	Approx. 80%	Approx. 90%
Companies actively adopting quantum	Growing base	300+
Quantum computing industry revenue	Emerging	\$1 billion+

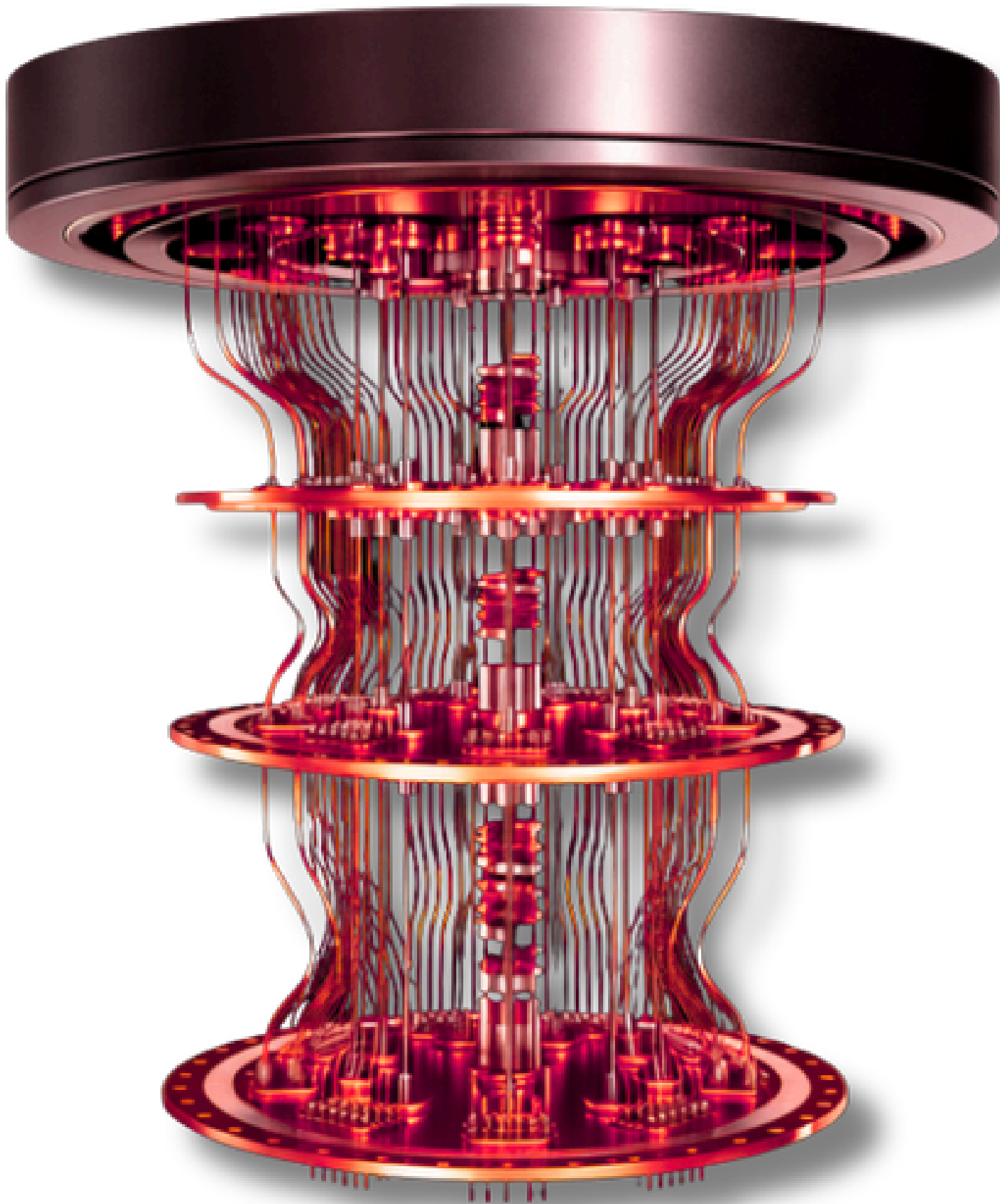
Table 1 : Year-over-year quantum market acceleration



Quantum Computing : From Speculative Science to Capital Priority



Source: McKinsey Quantum Technology Monitor 2026
Figure : Quantum Investment and revenue growth,2024-2028(Section 1.1/1.3)



Chapter 02

The Quantum Threat Landscape: Why "Q-Day" Demands Early Action

- 2.1 Defining "Q-Day" and Its Implications
- 2.2 The "Harvest Now, Decrypt Later" (HN DL) Threat
- 2.3 The Four Pillars of Digital Trust at Risk
- 2.4 The Cost of Delay and Forced Migration
- 2.5 The Leadership Playbook: A 90-Day Action Plan

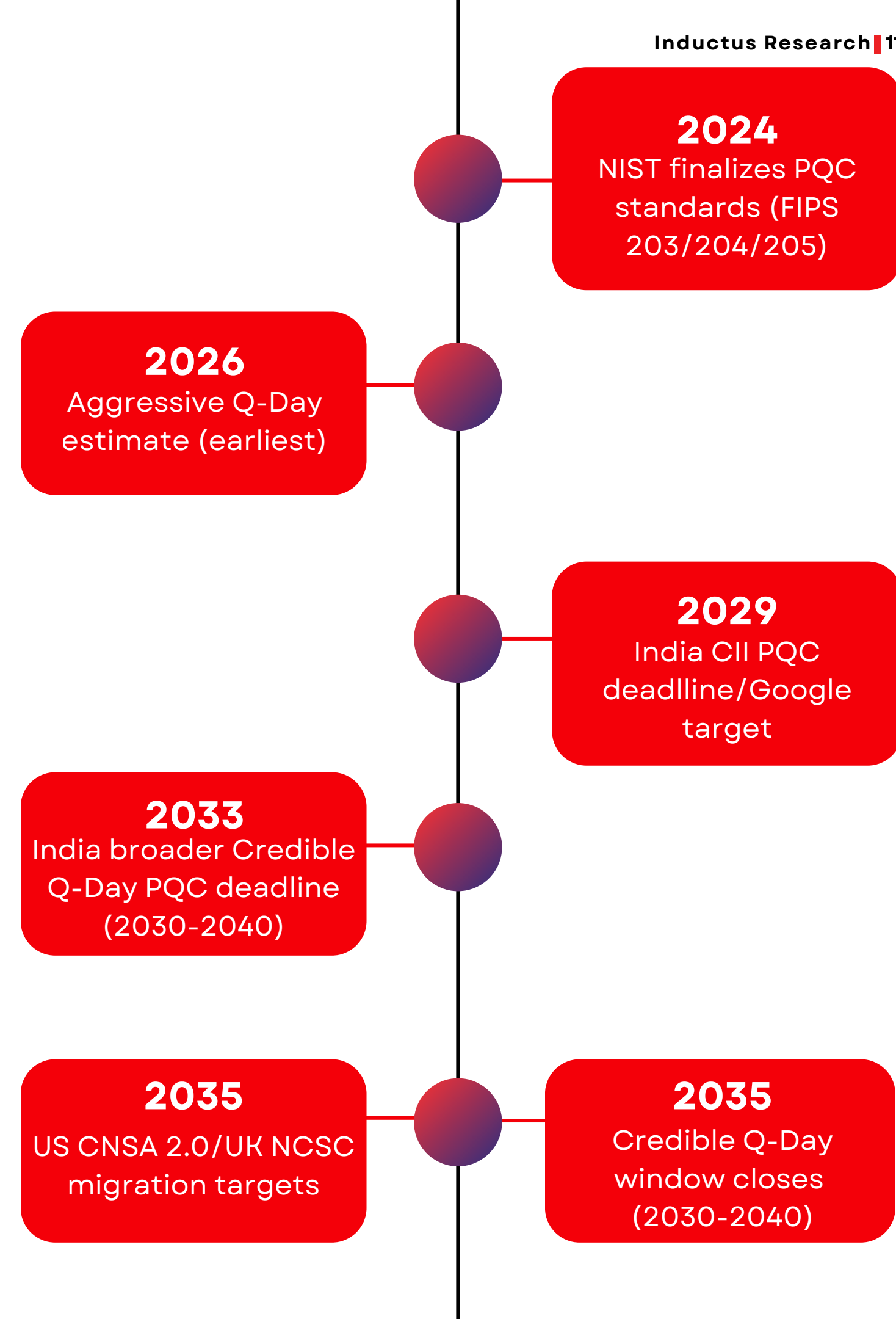
2.1 Defining "Q-Day" and Its Implications

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The exact arrival of Q-Day is uncertain, with credible analyses placing it somewhere between 2030 and 2040. Some more aggressive estimates suggest it could arrive as early as 2026. This uncertainty is a critical strategic challenge; it makes preparation difficult but also more urgent.

The urgency is driven not by the date of Q-Day itself, but by the multi-year timeline required for migration. The transition to post-quantum cryptography is a "complex, multi-year undertaking" that touches every layer of the digital economy.

- **Migration Timelines:** The UK's National Cyber Security Centre and the U.S. National Security Agency (through CNSA 2.0) have set staggered migration targets stretching to 2035. Google has a 2029 target for its own transition.
- **A Supply Chain Problem:** This migration is not a simple software update. It is "a global infrastructure upgrade" that depends on coordination across the entire supply chain, from semiconductor manufacturers to network providers and critical infrastructure operators. Semiconductors must embed PQC, hardware must be signed with quantum-safe keys, and public key infrastructure (PKI) must be upgraded. This interdependence creates a coordination challenge where delays at one stage ripple through the entire system.



2.2 The Harvest Now, Decrypt Later Threat

The HNDL threat is the central reason Q-Day is a present-tense priority. The risk is not the future possibility of decryption, but the certainty that data is being exfiltrated and stored today with the intention of decrypting it later. As one industry analysis states, "The data it [a future quantum computer] will decrypt has already been stolen."

This threat is especially severe for information with a long **"shelf life,"** meaning it remains sensitive for decades. **Key examples include:**

Personal Healthcare Records:

Genetic and patient data are permanent and invaluable.

Intellectual Property and Trade Secrets:

Corporate R&D and proprietary formulas lose value if compromised.

State Secrets and Government Communications:

Classified information can have a 50-60-year classification lifespan.

Financial Data:

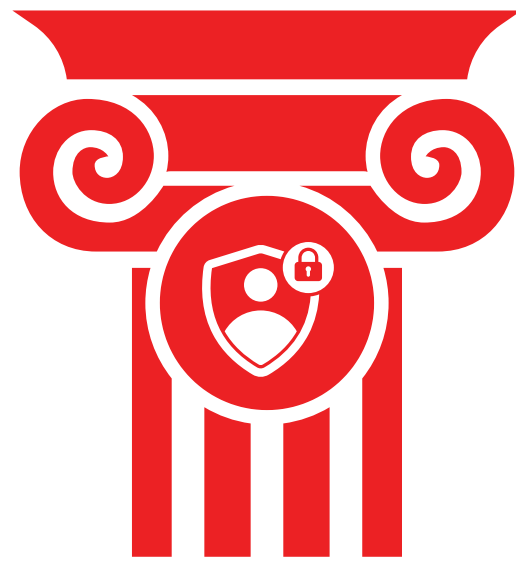
Long-term financial records and strategic M&A data remain valuable.

This threat is particularly acute in regions like Asia-Pacific, which is a hub for manufacturing and finance. The **"keep everything"** data hoarding culture, often driven by the desire to train AI models, creates massive digital archives that are prime targets for HNDL campaigns. This is combined with **"legacy cryptographic debt,"** where many critical systems have hard-coded cryptography that is difficult to update.



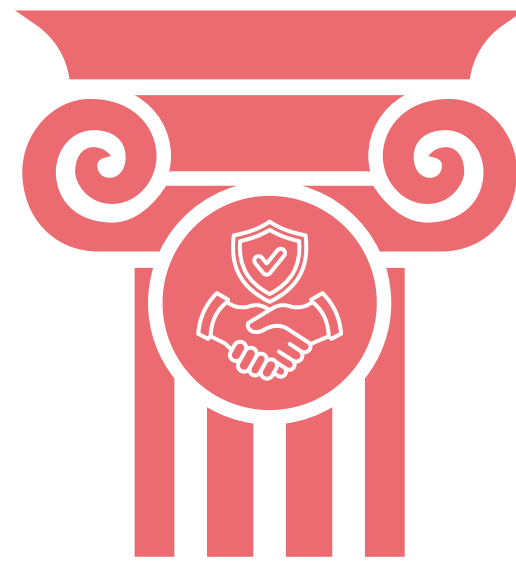
2.3 The Four Pillars of Digital Trust at Risk

Four Pillars of Digital Trust at Risk from Q Day



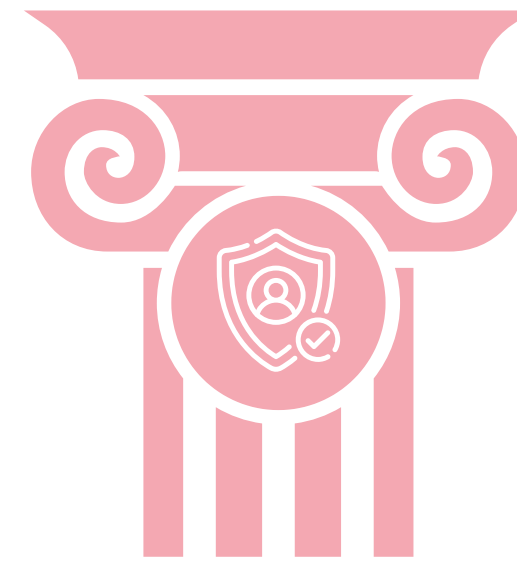
Confidentiality

Encrypted data harvested today can be decrypted later



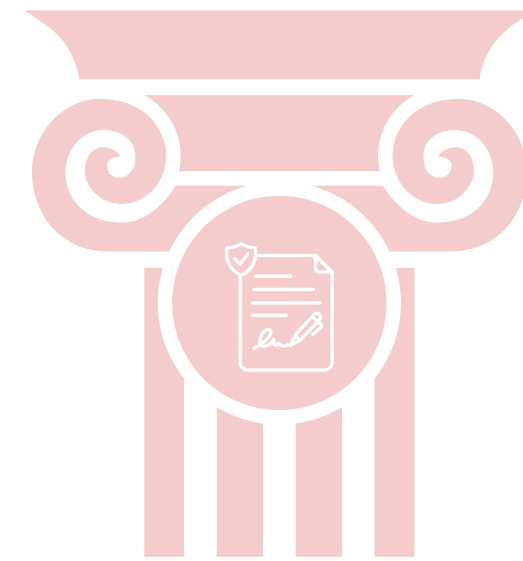
Integrity

Digital signatures and checksums can be forged by Q Day



Authentication

Identity and access systems relying on RSA / ECC are exposed



Non Repudiation

Legal and contractual proof of origin loses its Guarantee

Figure 2.3 : The four Pillars of digital trust exposed by quantum decryption capability.

Quantum decryption capability threatens four foundational pillars of digital trust:

- **Confidentiality** is at risk because encrypted communications and stored data harvested today can be decrypted retroactively.
- **Integrity** is at risk because checksums and digital signatures that rely on current cryptographic assumptions could be forged.
- **Authentication** is at risk because identity and access management systems built on RSA or elliptic curve cryptography lose their guarantee of uniqueness.
- **Non-repudiation** is at risk because legal and contractual proof of origin, which depends on digital signatures, loses its evidentiary reliability once those signatures can be forged.

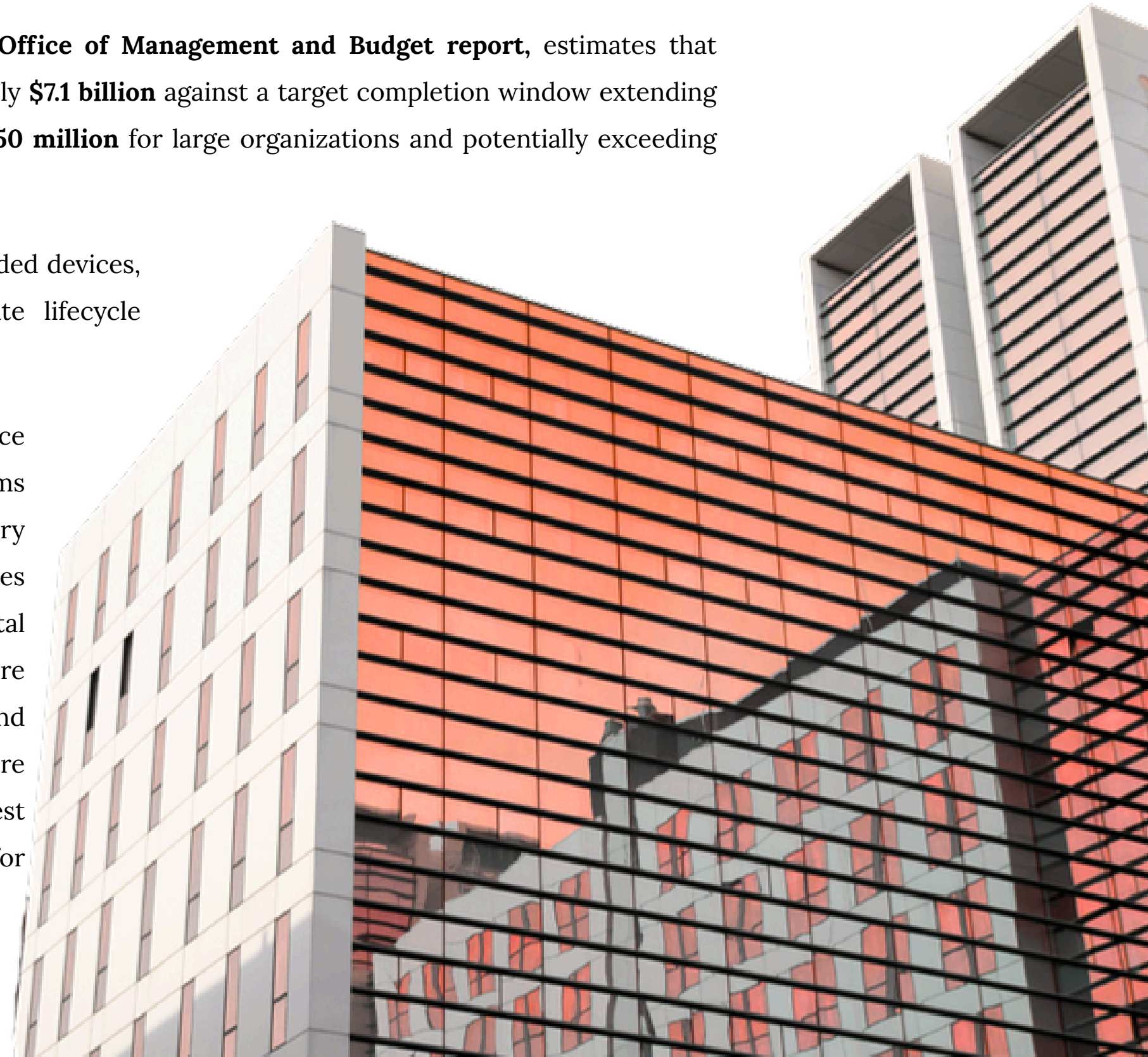
2.3 The Cost of Delay and Forced Migration

The **National Institute of Standards and Technology** finalized its first set of **post-quantum cryptography standards** in **August 2024: FIPS 203 (ML-KEM), FIPS 204 (ML-DSA), and FIPS 205 (SLH-DSA)**, providing enterprises with concrete migration targets while simultaneously establishing an implicit deadline as regulatory mandates loom.

Research published by the Computing Research Association, drawing on a 2024 U.S. Office of Management and Budget report, estimates that migrating non-national security systems in the United States alone could cost approximately **\$7.1 billion** against a target completion window extending toward 2035, with Gartner estimating per-enterprise costs ranging from **\$10 million to \$50 million** for large organizations and potentially exceeding \$100 million for Fortune 500 companies with complex legacy-dependent infrastructures.

These costs encompass discovery and inventory, hardware upgrades for HSMs and embedded devices, software engineering for algorithm implementation, testing and validation, certificate lifecycle management, and vendor coordination across the supply chain.

Organizations that postpone migration face three compounding cost drivers: resource scarcity as demand for specialized PQC expertise intensifies, technical debt as legacy systems with hard-coded cryptography become more expensive to replace over time, and regulatory or breach-driven costs that consistently exceed the expense of planned migration. Enterprises that initiate migration in a planned, phased manner consistently report materially lower total migration cost and operational disruption than those that delay, as early movers secure favorable vendor terms, build internal expertise gradually, and avoid the premium pricing and compressed timelines characteristic of reactive migration. The true cost of delay is therefore not simply increased migration expenditure but the accumulation of unmitigated Harvest Now, Decrypt Later risk, the erosion of cryptographic agility, and the potential for catastrophic breach-related losses that far exceed any savings from deferral.



2.5 The Leadership Playbook: A 90-Day Action Plan

DAYS 1–30:

Establish comprehensive cryptographic visibility by deploying automated discovery tools across code repositories, containers, network appliances, and infrastructure-as-code, supplemented by structured interviews with application owners to capture cryptography missed by scanners. Document all assets by algorithm type, key length, protocol, certificate issuer, and expiry and map third-party dependencies to create a machine-readable cryptographic bill of materials using standards such as **CycloneDX**.



DAYS 31–60:

Transform the raw inventory into a risk-based prioritization framework by enriching each asset with contextual attributes: system criticality, data sensitivity, confidentiality period, regulatory requirements, and end-of-life schedule. Categorize each as quantum-vulnerable (RSA, ECC), transitional, or quantum-safe, and develop a quantum risk score to prioritize systems protecting long-lived data most exposed to **Harvest Now, Decrypt Later** threats, including healthcare records, intellectual property, government communications, financial data, and personally identifiable information.



DAYS 61–90:

Establish governance by standing up a cross-functional Quantum Readiness Steering Group with executive sponsorship and budget authority, defining reporting cadence and success metrics. Select controlled pilot systems—internal PKI, code signing, or authentication—to execute NIST-standardized migrations while documenting lessons learned. Develop a phased enterprise roadmap prioritizing high-value, long-lived data systems and build crypto-agility into the target architecture to avoid repeating the full discovery cycle for future algorithm updates. Critical success factors include executive sponsorship, cross-functional collaboration, an incremental approach, early vendor engagement, and continuous visibility.



Chapter 03

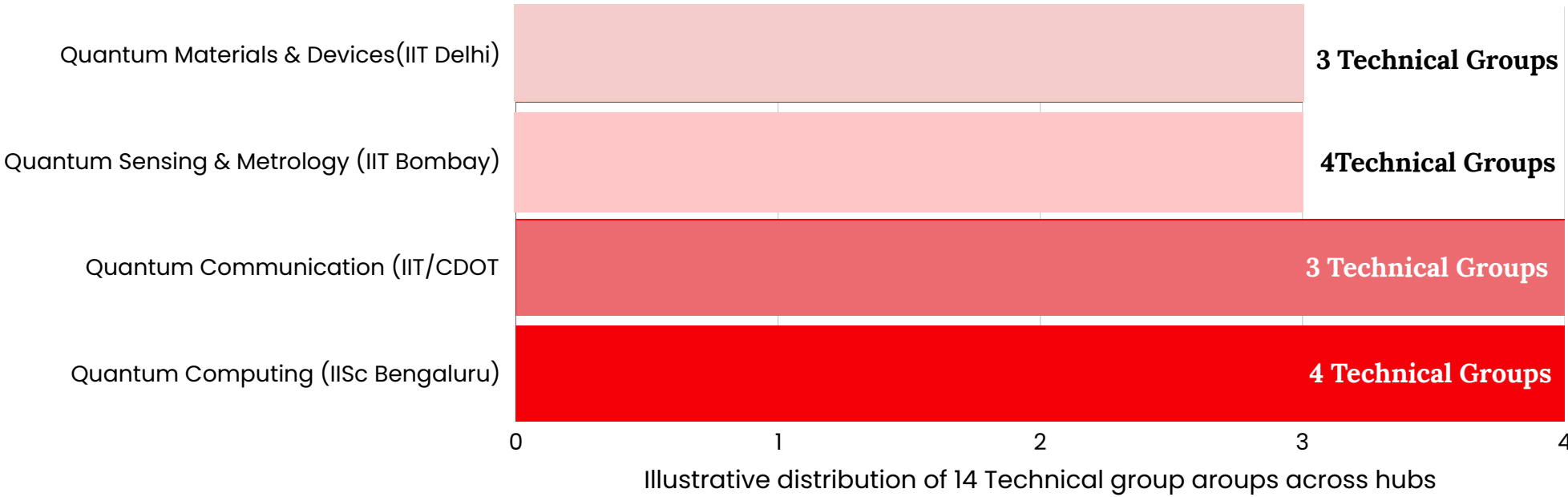
India's Quantum Ecosystem: The National Quantum Mission and Beyond

- 3.1 The National Quantum Mission (NQM)
- 3.2 Strengthening the Research Foundation
- 3.3 India's Sovereign Quantum Security Roadmap:
India's "Middle Path" Advantage

3.1 The National Quantum Mission

India's Union Cabinet approved the **National Quantum Mission on April 19, 2023**, with a **total outlay of Rs 6,003.65 crore**, approximately **\$730 million**, spanning fiscal year 2023 through fiscal year 2031. The mission is led by the Department of Science and Technology and aims to seed, nurture, and scale scientific and industrial research and development across quantum computing, quantum communication, quantum sensing and metrology, and quantum materials and devices. Its stated technical goals include developing intermediate-scale quantum computers with 50 to 1,000 physical qubits within eight years and enabling satellite-based secure quantum communication over distances of roughly 2,000 kilometers within India.

National Quantum Mission : Four Thematic Hubs (T Hubs)



The mission operates on a hub and spoke model. Four Thematic Hubs, announced in September 2024 after evaluation of 384 submissions, anchor the ecosystem: quantum computing at the Indian Institute of Science, Bengaluru; quantum communication at the Indian Institute of Technology Madras in partnership with the Centre for Development of Telematics; quantum sensing and metrology at the Indian Institute of Technology Bombay; and quantum materials and devices at the Indian Institute of Technology Delhi.

Each hub operates as an independent Section 8 company with autonomy to make decisions within the mission's overall framework.

Hub is distributed into four thematic forms:

01



Quantum Materials & Devices – IIT Delhi

This hub focuses on developing foundational components such as qubits, superconductors, and semiconductor materials essential for building quantum systems.

03



Quantum Communication – IIT Madras / CDOT

This hub is dedicated to secure quantum encryption technologies, including quantum key distribution, to enable unhackable communication networks.

02



Quantum Sensing & Metrology – IIT Bombay

This hub specializes in creating high-precision quantum sensors for applications in navigation, medical imaging, and detection of gravitational and magnetic field variations.

04



Quantum Computing – IISc Bengaluru

This hub works on quantum processors, hardware architectures, and algorithm development to solve complex problems beyond the reach of classical computers.

To operationalize research, the mission is structured into 14 Technical Groups distributed across the hubs based on thematic scope. IIT Delhi and IIT Bombay each host 3 technical groups, while IIT Madras/CDOT and IISc Bengaluru each host 4 technical groups. The four-hub model ensures specialized, non-overlapping focus areas while enabling collaborative synergies. IIT Delhi and IIT Bombay address foundational hardware and sensing; IIT Madras leads secure networks; and IISc Bengaluru spearheads computational advancements, together forming a comprehensive national quantum ecosystem.

Milestones from India's Research and Development Ecosystem



1

The mission currently has 14 technical groups active, comprising 152 researchers from 43 institutions across 17 states and 2 union territories.



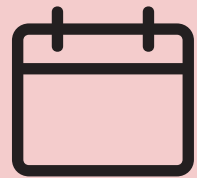
2

On April 14, 2025, Bengaluru-based startup QpiAI unveiled QpiAI Indus, India's first full-stack 25-qubit superconducting quantum computer developed under the mission's purview.



3

Through its dedicated startup program, one of the most generous government-backed quantum funding initiatives globally, the mission has supported eight startups, offering up to ₹30 crore per startup. The first cohort received ₹76 crore in disbursed and committed funding.



4

Two dedicated quantum fabrication facilities (clean rooms for manufacturing qubit chips) are under development at IISc Bengaluru and IIT Bombay, with smaller facilities planned at IIT Delhi and IIT Kanpur.

3.2 Strengthening the Research Foundation

India's quantum funding remains modest by global standards, roughly \$90 million annually against China's reported cumulative public investment approaching \$15 billion, an order of magnitude gap that mission leadership has openly acknowledged. Hardware dependence compounds this gap: qubit fabrication requires ultra-clean foundries, cryogenic systems, and specialized control electronics that India today largely imports. Even so, the mission's research foundation, spanning 43 institutions and a fast-moving grant and evaluation process that mission leaders describe as one of the fastest-moving programs in the Indian government, gives enterprises a credible academic base to build enterprise partnerships on, provided they pair it with their own hardware and capital investment rather than expecting India's public funding alone to close the global gap.

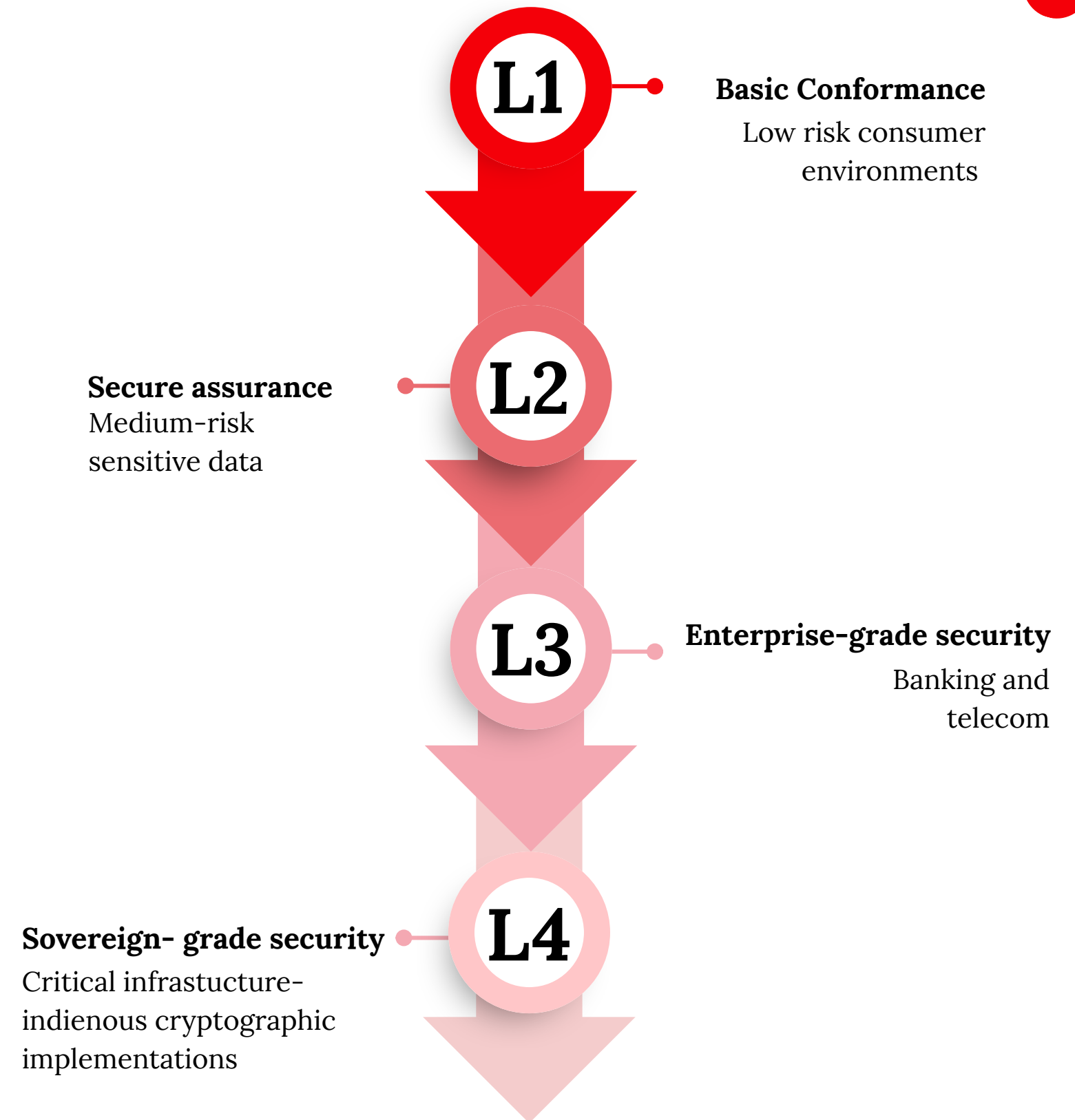
3.2 India's Sovereign Quantum Security Roadmap: India's "Middle Path" Advantage

India's approach to the quantum threat is distinct from Western strategies, adopting a "middle path" that combines software-based Post-Quantum Cryptography (PQC) with hardware-based Quantum Key Distribution (QKD). This dual-track framework creates a robust security backbone: PQC protects broad enterprise infrastructure and last-mile connectivity, while QKD provides information-theoretic security for strategic inter-city links, defense, and high-security sectors.

India has established aggressive, legally mandated timelines that outpace global peers. Critical Information Infrastructure (CII), including defense, power, and telecom, must achieve full PQC adoption by December 31, 2029, while broader enterprise adoption follows by 2033. This makes India's CII deadline six years faster than the US federal target of 2035.

To achieve technological sovereignty, India is building a four-tier assurance framework:

India's Four-Tier Quantum Security Assurance Framework



A National PQC Testing and Certification Program is planned for operationalization by December 2026, positioning India to independently validate quantum-safe technologies rather than relying on foreign certification.

Chapter 04

India's Talent, Research, and Innovation Infrastructure

- 4.1 India's STEM Talent Pool
- 4.2 Institutional and Research Capacity
- 4.3 Government Initiatives for Talent Development
- 4.4 A Self-Sustaining Research Loop
- 4.5 The Semiconductor Synergy: Building on India's Deep-Tech Foundation

4.1 India's STEM Talent Pool

India produces one of the largest annual pools of science, technology, engineering, and mathematics graduates in the world, a foundation that has already made the country the preferred location for enterprise GCCs across software engineering, data science, and analytics. That same pipeline is now being redirected toward quantum-specific disciplines: quantum information theory, quantum algorithm design, cryogenic and control engineering, and quantum-safe cryptography. The National Quantum Mission's own network, 152 researchers across 43 institutions, functions as a visible signal to global enterprises that a credentialed, English-speaking quantum research base already exists in the country, reducing the execution risk of standing up a dedicated quantum team.

4.2 Institutional and Research Capacity

India's quantum research capacity is anchored by its premier technical institutions. The Indian Institute of Science Bengaluru, the Indian Institutes of Technology at Madras, Bombay, Delhi, and Kanpur, and a growing set of Indian Institutes of Science Education and Research campuses now host dedicated quantum computing and quantum technology groups, several of which run their own workshops, hackathons, and industry-facing programs. The Foundation for Quantum Computing Innovation, hosted at the Indian Institute of Science Bengaluru's Department of Science and Technology hub, and the I Hub Quantum Technology Foundation at the Indian Institute of Science Education and Research Pune are examples of institutions actively convening academia, industry researchers, and doctoral students around applied quantum algorithms.



4.4 Government Initiatives for Talent Development

01



The National Quantum Mission has funded workshops and national conferences, such as the National Workshop on Quantum Computing and Quantum Technologies, which drew nearly 140 hybrid participants in its 2026 edition.

02



Structured academic pathways are being established: the Department of Science and Technology and AICTE have launched undergraduate minor and M.Tech programs in quantum technologies, with the UG curriculum now being adopted across AICTE-affiliated institutions.

03



In a notable scale-up, Andhra Pradesh enrolled 55,000 university students in a single quantum computing course delivered through NPTEL by IIT Madras and IBM Quantum specialists—one of the largest coordinated subnational quantum workforce training efforts globally.

04



Dedicated startup onboarding guidelines under the mission are designed to help early-stage quantum ventures access non-dilutive government funding alongside private co-investment.

05



Private sector initiatives are also contributing: QNu Labs launched QNu Academy in June 2025 to build talent in quantum cybersecurity domains such as quantum key distribution and post-quantum cryptography, offering center of excellence labs embedded in partner institutions.

06



A Mission Coordination Center established at IIT Kanpur's Noida campus tracks progress and keeps the mission's roadmap on schedule.

07



Active review participation from global technology leaders, including IBM, in evaluating mission proposals gives Indian quantum research early exposure to industry-grade technical standards.

4.4 A Self-Sustaining Research Loop

The combination of funded academic hubs, a dedicated startup pipeline, and growing enterprise GCC demand is forming a self-reinforcing loop. Academic research produces trained quantum engineers; startups and GCCs absorb that talent into applied, commercially relevant projects; and the IP generated feeds back into academic agendas and attracts further investment.

Startup momentum has accelerated—the mission now supports 17 startups, up from eight in the first cohort. Notable outcomes include QNu Labs' 1,000 km quantum secure network, one of the longest QKD deployments globally, achieved ahead of schedule.

Infrastructure is scaling to match: the Wadhvani-IISc Innovation Centre (Rs 1,400+ crore) provides hardware incubation through its InQubate platform, while the DRDO-established Quantum Technology Research Centre strengthens strategic and defense applications. With over 2,100 GCCs now driving quantum R&D in India, industry participation is deepening.

Talent demand reinforces the loop's scale—NITI Aayog projects India will need 100,000 quantum developers by the 2030s. Enterprises that plug into this loop early, rather than treating India purely as an execution location, stand to benefit from the compounding effect as the ecosystem matures.

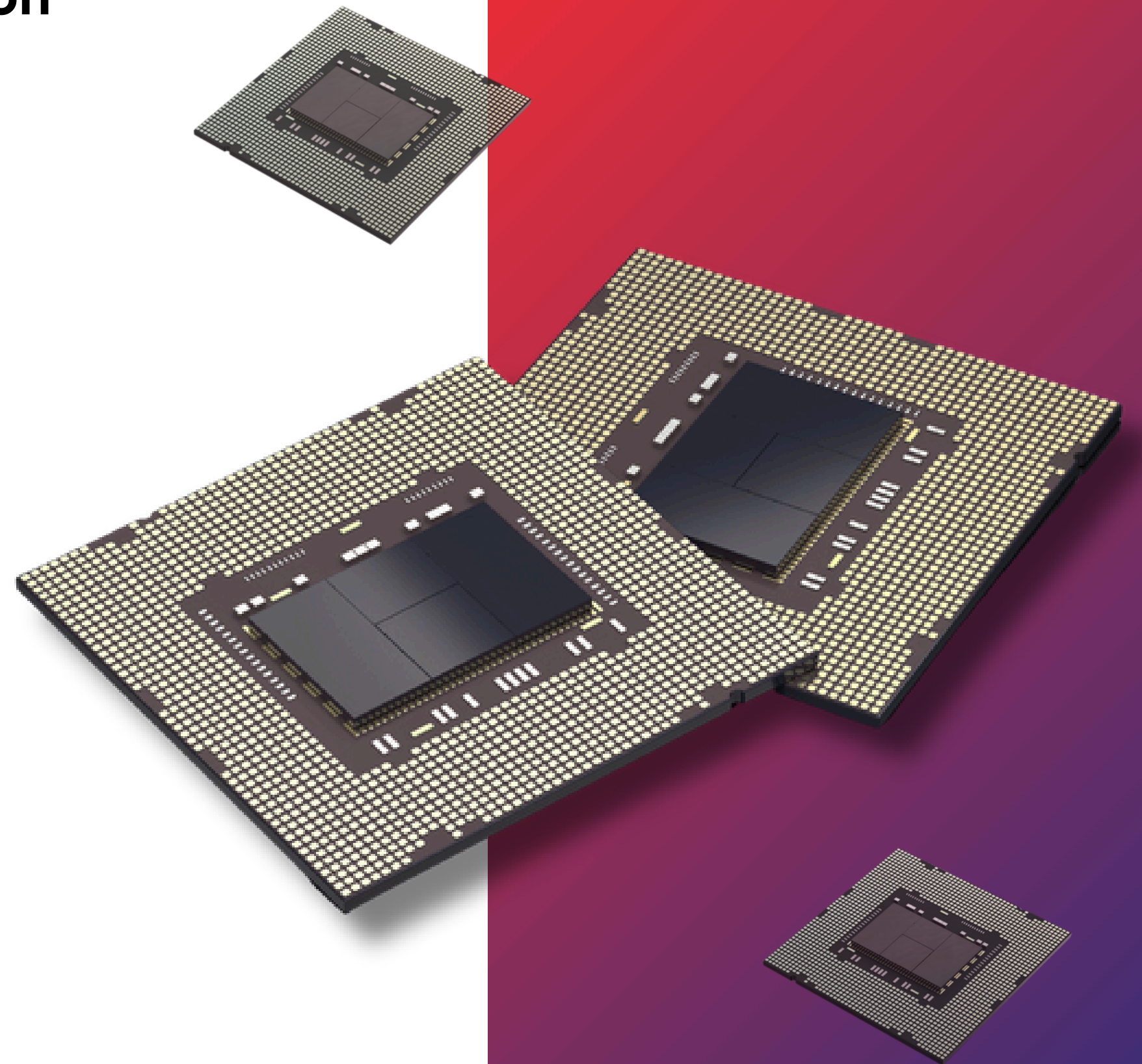


4.5 The Semiconductor Synergy: Building on India's Deep-Tech Foundation

India's quantum ambitions are being built on a rapidly scaling semiconductor ecosystem. The government's Semicon India Programme has attracted investment commitments of approximately **₹1.6 lakh crore (~\$19 billion)** within three years, with 10 units approved, including 2 fabrication plants and 8 assembly/test facilities.

The talent base is a critical asset. India hosts about **7%** of the world's semiconductor GCCs and employs nearly 20% of the global semiconductor chip design workforce. Indian engineers in these centers are designing advanced nodes, including 2 nm chips—a deep-tech engineering pool directly relevant to quantum control systems and hardware development. Under the Design Linked Incentive (DLI) Scheme, 24 chip design projects have been approved, 14 startups have raised venture funding, and 7 chips have been successfully fabricated across multiple foundries.

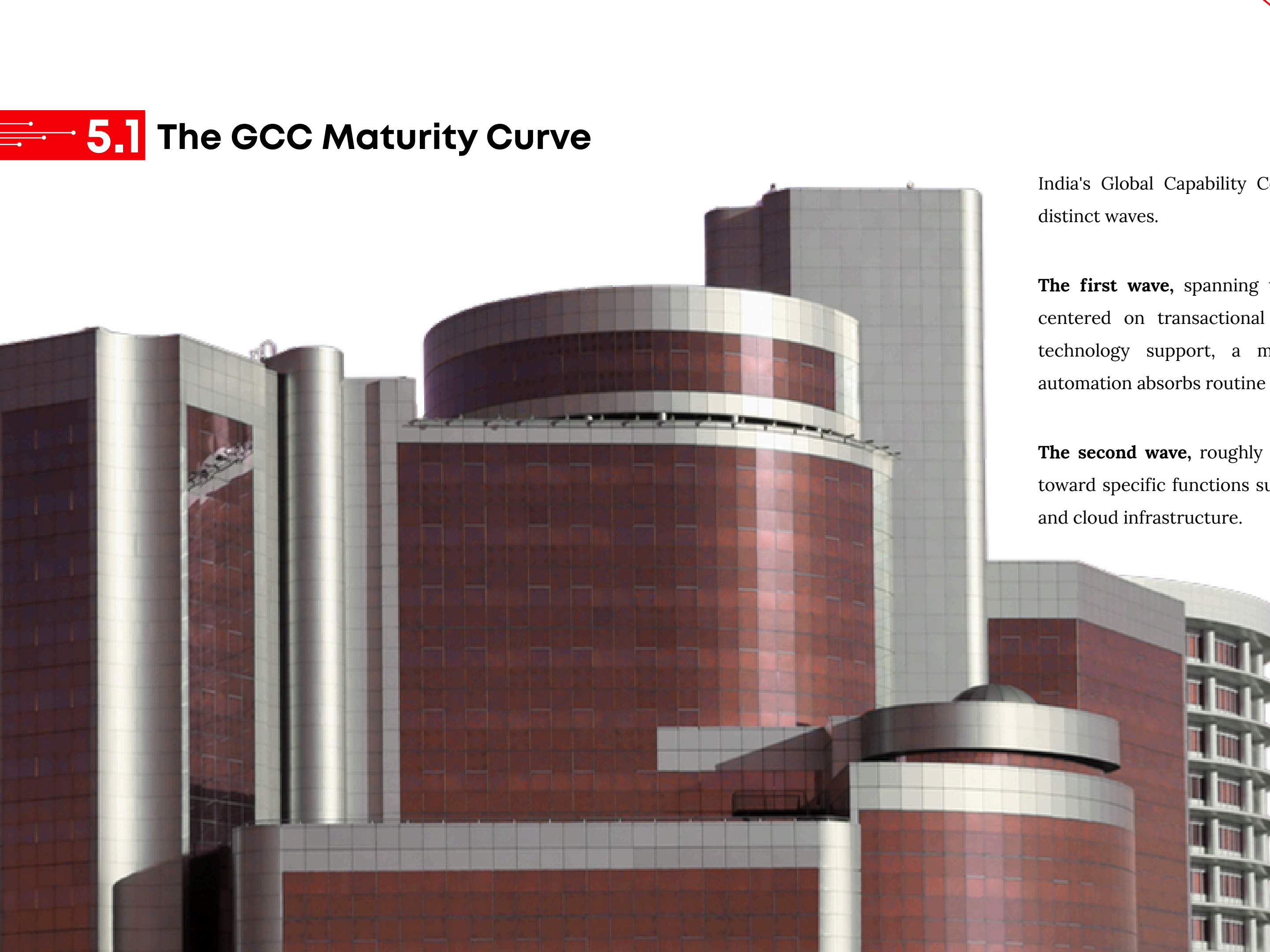
For MNCs, this convergence matters: Quantum R&D teams can be co-located with semiconductor design GCCs in the same cities (Bengaluru and Hyderabad), accessing the same engineering talent pool and infrastructure. The Union Budget 2026-27 announced the India Semiconductor Mission 2.0, expanding focus to equipment, materials, and IP and deepening the foundation for quantum hardware development.



Chapter 05

GCCs/ODCs in Transition: From Cost Centers to Quantum Innovation Hubs

- 5.1 The GCC Maturity Curve
- 5.2 Building Quantum Capability: The CoE Model
- 5.3 Managing Global Mandates
- 5.4 Talent and Infrastructure Ready
- 5.5 New GCC Policy & Infrastructure Incentives: A Lower-Risk Business Case
- 5.6 The Tier-II City Expansion Playbook: Talent and Cost at Scale



5.1 The GCC Maturity Curve

India's Global Capability Centers have moved through three distinct waves.

The first wave, spanning the late 1990s through the 2010s, centered on transactional processes and basic information technology support, a model that is now shrinking as automation absorbs routine work.

The second wave, roughly the last decade, shifted ownership toward specific functions such as data analytics, cybersecurity, and cloud infrastructure.

The current, third wave is defined not by headcount but by innovation output: centers now carry full profit and loss ownership, global product roadmaps, and, increasingly, C-suite leadership based in India rather than at headquarters.

5.2 Building Quantum Capability: The Center of Excellence Model

The clearest evidence that GCCs are moving into genuinely advanced technology mandates comes from the emergence of dedicated Centers of Excellence. According to KAS Business Consulting's 2026 GCC Landscape Report, 12% of new technology GCCs established in India are now explicitly exploring post-quantum cryptography and quantum computing as part of their founding mandate, alongside more than 50 GCCs that have stood up dedicated fabless semiconductor design units and a fast-growing cohort of environmental, social, and governance reporting hubs. These centers are not simply consuming quantum tools built elsewhere; they are being chartered from day one to manage end-to-end research and development lifecycles and to generate proprietary intellectual property that belongs to the parent enterprise.

India GCC Ecosystem Metric (2026)	Figure
Total active GCCs	2,117
Professionals employed	2.36 million
Annual market revenue generated	Approx. \$98.4 billion
Forbes Global 2000 companies with an India GCC	506+
Share of new tech GCCs exploring quantum / post-quantum cryptography	12%
GCCs with dedicated fabless semiconductor design units	50+
Share of Grade A office leasing driven by GCCs (2025)	38%
GCCs investing in agentic AI	58%

5.3 Managing Global Mandates

More than 400 India-based GCC leaders now hold global mandates, overseeing regions such as Europe, the Middle East, and Africa or the Americas directly from Bengaluru or Gurugram rather than from headquarters. Roughly a third of centers now operate as global profit centers rather than cost centers, and 35% of GCCs have implemented what industry practitioners describe as shadow boards, structures in which India-based leaders actively mentor headquarters executives on digital-first strategy. This shift in authority is precisely the organizational condition a quantum mandate requires: quantum research and development cannot be run as an offshored task list; it needs local leaders empowered to make architecture, hiring, and partnership decisions.

5.4 New GCC Policy & Infrastructure Incentives: A Lower-Risk Business Case

The Union Budget 2026-27 transformed India's fiscal framework to reduce execution risk for multinationals establishing deep-tech GCCs. Key measures include the following:

Unified Safe Harbor Margin: All IT services, including software development, KPO, and contract R&D, are now clubbed under a single category with a common safe harbor margin of 15.5% on operating profit. The eligibility threshold has been raised to ₹2,000 crore (from ₹300 crore), enabling far more GCCs to benefit.

Tax Holiday for Data Centers: A 20-year tax holiday until 2047 for foreign companies providing cloud services using India-based data centers, with a specific 15% safe harbor on cost for related-party data services. This directly addresses the infrastructure requirements of quantum computing workloads.

Fast-Track APAs: Advance Pricing Agreements can now be concluded within two years (extendable by six months), providing tax certainty for long-term R&D investments.

These measures address a core requirement for quantum and AI infrastructure: predictability. Industry estimates indicate over \$90 billion in data center investment commitments are already in motion.



5.5 The Tier-II City Expansion Playbook: Talent and Cost at Scale

Tier-II cities are emerging as strategic GCC expansion destinations, offering cost advantages and lower attrition. Their share of India's GCC ecosystem has increased from 5% in 2019 to 7% in 2025, with more than 170 GCCs now spread across 18 Tier-II cities, including Ahmedabad, Coimbatore, Kochi, Indore, and Bhubaneswar.

Key advantages for MNCs considering quantum capability expansion:

- **Cost:** 35% reduction in operational costs and 25% boost in profitability.
- **Attrition:** 20–30% lower employee turnover than Tier-I cities.
- **Regional Strengths:** Bhubaneswar and Vadodara are emerging as semiconductor and R&D hubs; Kochi is advancing in digital, cloud, and fintech engineering with support from the Kerala Global Capabilities Centre Framework.

Coimbatore alone hosts over 60 GCCs employing more than 75,000 professionals, including Bosch, State Street, and Amazon . Ahmedabad, the largest Tier-II GCC hub, hosts over 35 GCCs including Infineon Technologies, Google, and Oracle . State governments are catalyzing this shift through targeted policies offering land, tax, and operational incentives.

Nearly two new GCCs are being established every week in non-metro locations, underscoring sustained enterprise confidence in India's regional expansion



Chapter 06

Key Players: Enterprises and GCCs Already Leading in Quantum

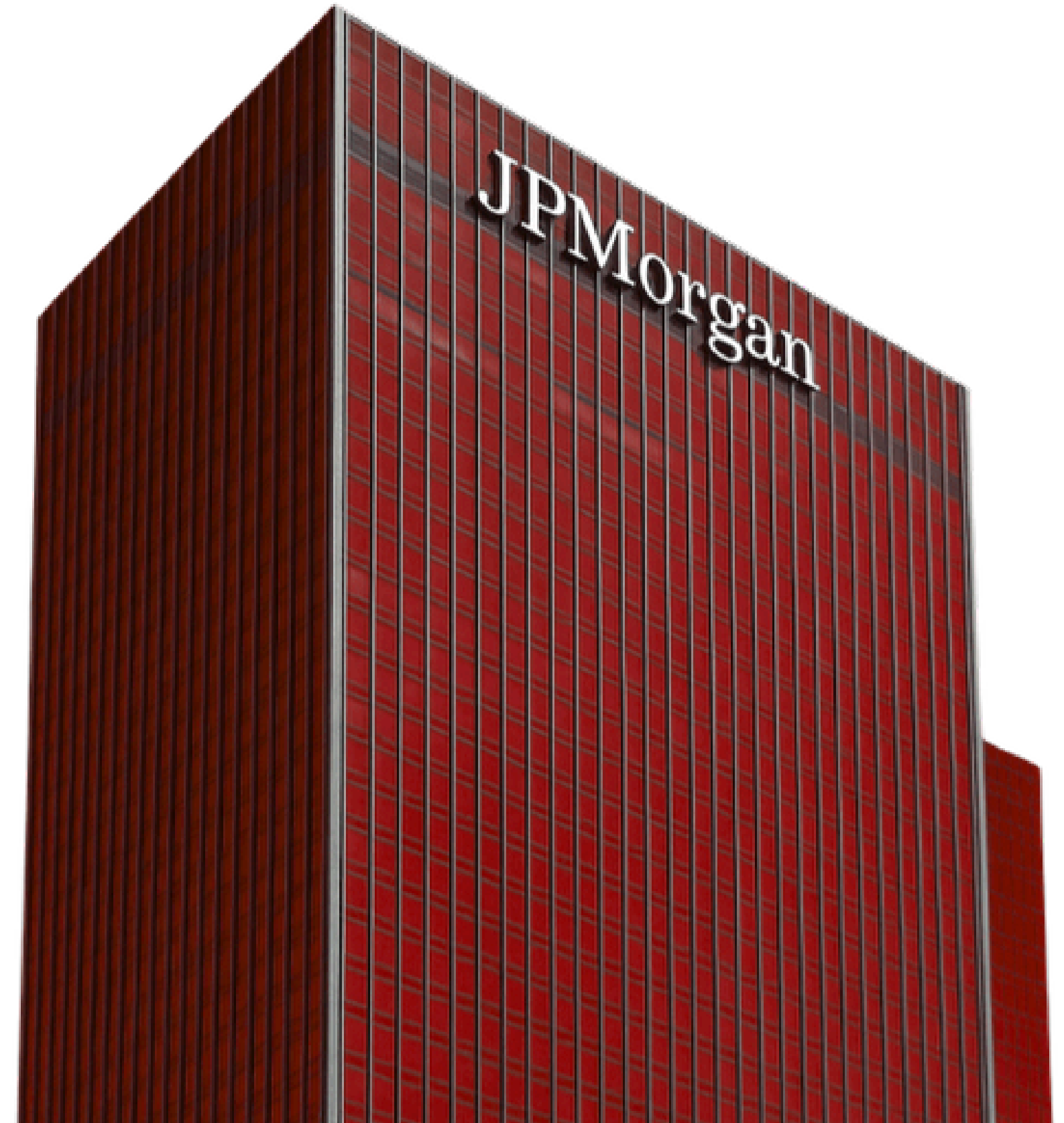
- 6.1 MNCs Committing to Quantum
- 6.2 GCCs at the Frontier
- 6.3 India's Growing Role

6.1 MNCs Committing to Quantum

Enterprise commitment to quantum computing has moved from exploratory R&D to funded, multi-year programs, most visibly in financial services, where the "harvest now, decrypt later" threat has forced both offensive (algorithmic advantage) and defensive (cryptographic migration) investment.

JPMorgan Chase is among the most advanced corporate adopters. Its Global Technology Applied Research (GTAR) group runs an internal team of scientists building new quantum algorithms and applications to address business use cases in finance, AI, optimization, and cryptography, and the firm has produced quantum algorithms for portfolio optimization, option pricing, and risk analysis. In March 2025, JPMorgan, working with Quantinuum, Argonne National Laboratory, Oak Ridge National Laboratory, and the University of Texas at Austin, demonstrated Certified Quantum Randomness, generating and mathematically certifying genuine randomness that classical supercomputers could not replicate, a milestone the firm described as bringing quantum computing into practical, real-world territory.

JPMorgan has also anchored quantum-industry capital formation directly, investing as lead anchor in a \$300 million equity round for Quantinuum in January 2024. Leadership continuity has wobbled; both the GTAR head and the global head of quantum communications and cryptography departed in 2025, with State Street's Rob Otter brought in to reset the function as the bank's new head of applied research covering quantum computing and other advanced technology, but the scale of the commitment (the team was advertising 28 quantum computing roles paying up to \$325,000 in the prior year) signals this is a structural bet, not a side project.



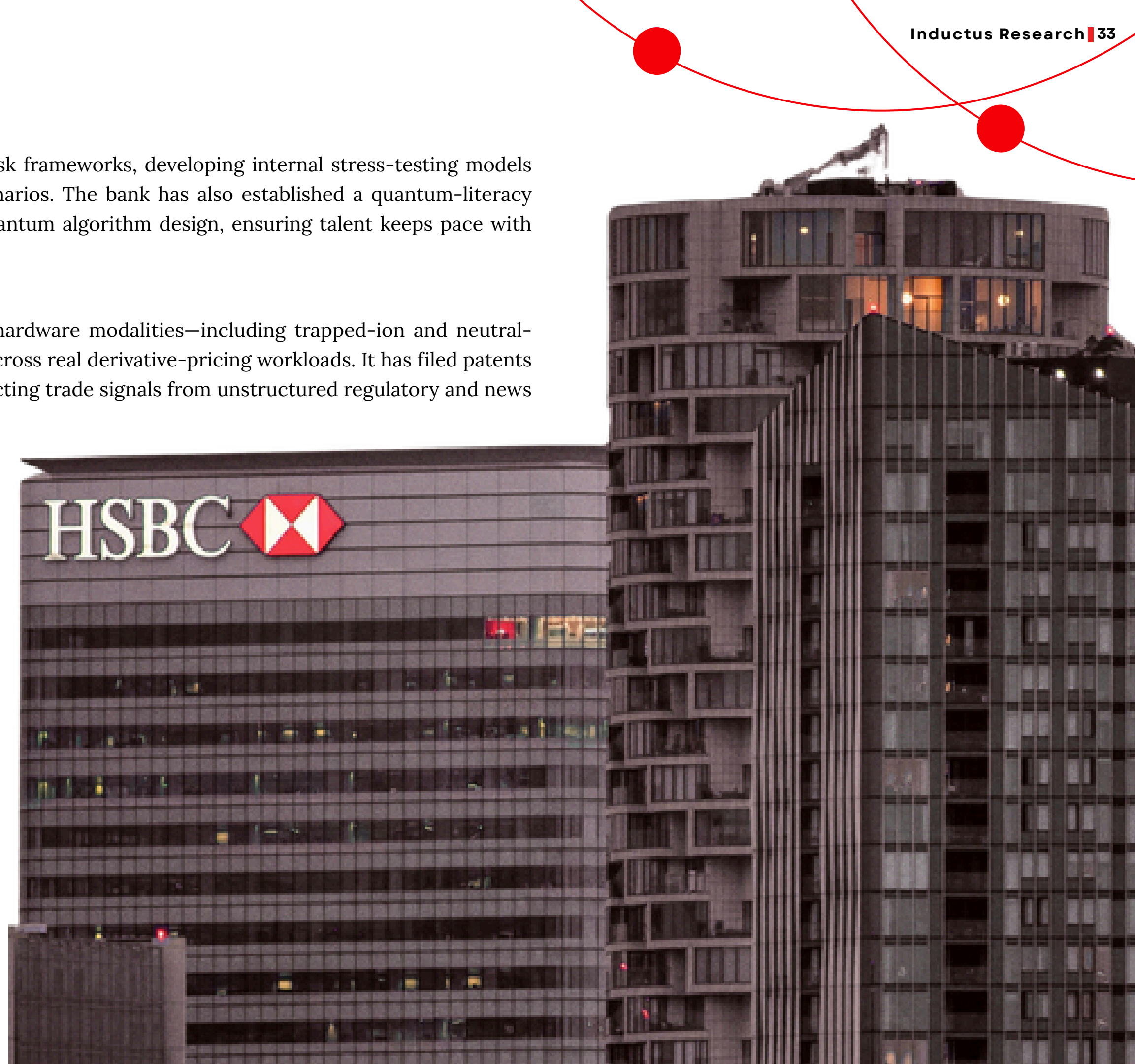
HSBC is actively embedding quantum readiness into its enterprise risk frameworks, developing internal stress-testing models that simulate quantum-driven market shocks alongside classical scenarios. The bank has also established a quantum-literacy program, training over 200 quants and traders in hybrid classical-quantum algorithm design, ensuring talent keeps pace with hardware evolution.

On the infrastructure front, HSBC is evaluating multiple quantum hardware modalities—including trapped-ion and neutral-atom systems—to avoid vendor lock-in and benchmark performance across real derivative-pricing workloads. It has filed patents for quantum-natural-language-processing applications aimed at extracting trade signals from unstructured regulatory and news text in sub-second timeframes.

Collaboratively, HSBC joined the Quantum Economic Development Consortium and contributes to ISO standards for post-quantum cryptography migration, mapping transition roadmaps for its global payments and settlement rails. Internally, the bank has created a quantum-safe cryptographic inventory, cataloging over 12,000 public-key certificates across its systems to prioritize replacement schedules before NIST's PQC deadline.

It is also exploring quantum annealing for collateral optimization, running early-stage simulations that suggest potential double-digit percentage reductions in margin requirements during intraday liquidity squeezes.

Finally, HSBC has committed to publishing annual quantum progress reports, aiming to set transparency benchmarks for the financial-services industry while actively engaging with central banks on cross-border quantum-secure messaging pilots.





Barclays, one of the earliest movers, launched quantum computing research in 2017 and, working with **IBM**, has demonstrated quantum algorithms for portfolio optimization using VQE and QAOA adapted to real-world constraints such as transaction costs and regulatory limits, while separately building out a quantum-cybersecurity workstream to migrate infrastructure to quantum-resistant standards.

More than fifteen global banks, including **JPMorgan, Goldman Sachs, BBVA, Barclays, BNP Paribas, HSBC, Citigroup, Deutsche Bank, ING, NatWest, Royal Bank of Canada, Société Générale, Standard Chartered, and Wells Fargo**, now run dedicated quantum programs, generally split between near-term algorithmic use cases (optimization, Monte Carlo simulation, and fraud detection) and a parallel, non-negotiable PQC migration track.

Outside financial services, **Bosch** has made quantum a named R&D pillar. Bosch Research is developing quantum algorithms for materials development and quantum sensors for future applications, and in 2022 the company joined the IBM Quantum Network to jointly investigate quantum computing applications in materials science, covering electromobility, renewable energy, and sensor technology.

The Common Thread: These are not innovation-theater budgets. They come with named executive owners, multi-year roadmaps, and increasingly an India component.

6.2 GCCs at the Frontier

A small but growing set of Indian GCCs has moved past supporting quantum programs administratively and is now doing the engineering itself.

JPMorgan's India technology centers (Mumbai, Bengaluru, and Hyderabad), which together make up a third of the firm's global technology organization across 21 global technology centers worldwide, are explicitly named in the bank's own account of its quantum strategy. Per JPMorgan's India technology leadership, the firm is "leading in the quantum space," exploring future opportunities for quantum computing and quantum communication, including quantum key distribution, as part of the India centers' broader mandate in emerging technology. This is a rare instance of a GCC being named directly, rather than inferred, as a contributor to a parent company's quantum roadmap.

IBM's India centers in **Bengaluru, Pune, and Hyderabad** are structurally built around advanced technology mandates, focusing on AI, hybrid cloud, blockchain, and quantum computing and playing an instrumental role in building enterprise cognitive systems for global clients. Given IBM's position as the anchor quantum hardware and Qiskit ecosystem partner for HSBC, Barclays, and Bosch alike, its Indian engineering base sits close to the center of the industry's applied quantum tooling.

Bosch Global Software Technologies (BGSW), Bangalore, is the clearest example of an Indian center carrying an explicit quantum product mandate rather than a support function. Bosch's own technology leadership has stated that Bosch India has concrete plans to tap quantum computing for materials simulations, building on years of experience in materials simulation using conventional computers.

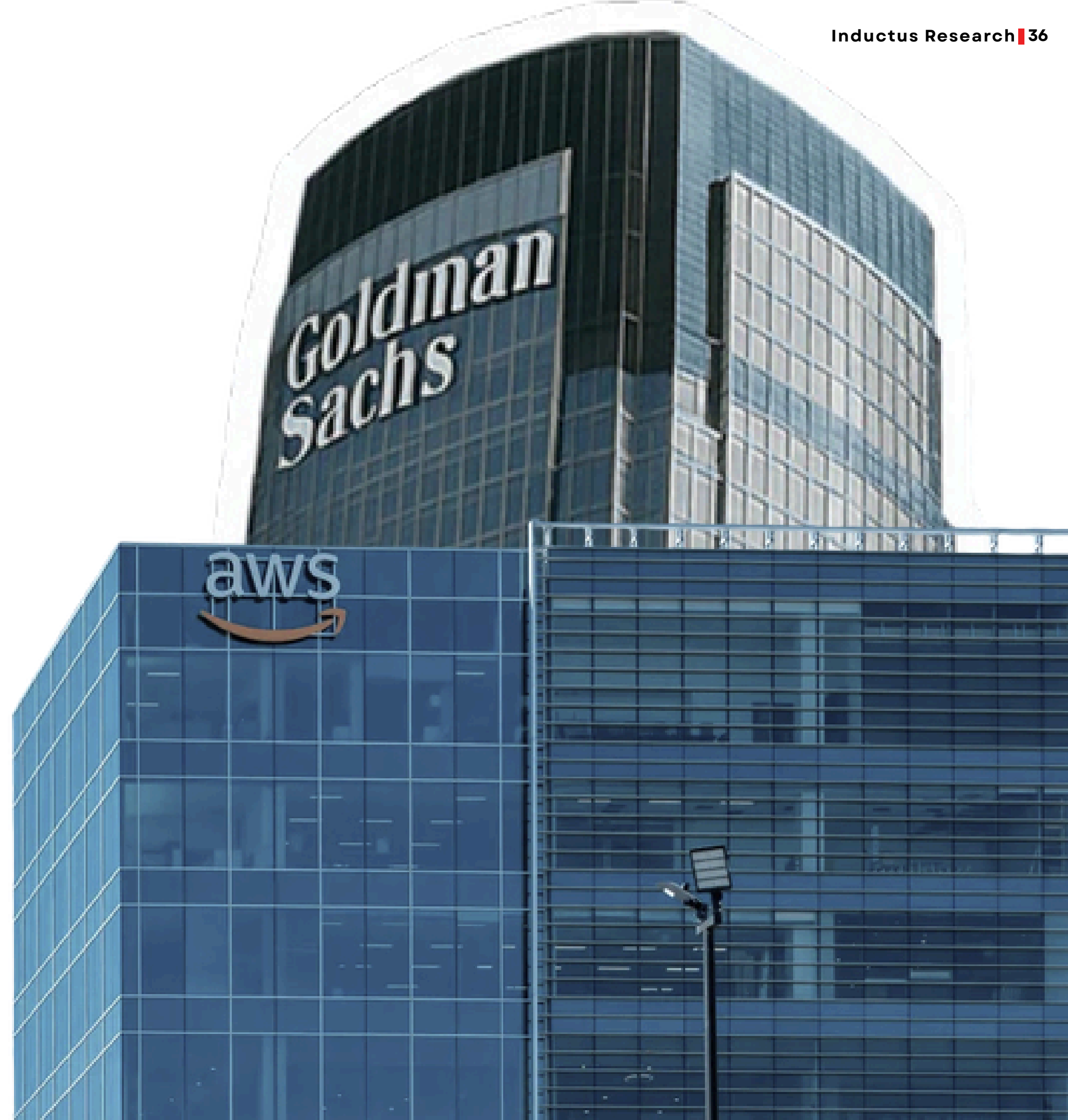
This directly extends Bosch's global IBM Quantum Network partnership on materials-science applications into an Indian R&D base, alongside BGSW's TISAX-certified Cybersecurity Verification & Validation Lab in Bangalore, laying relevant groundwork for the cryptographic-agility testing that PQC migration will require.



Goldman Sachs's Bengaluru and Hyderabad centers have a combined 9,000+ engineers and quants who own and develop mission-critical trading infrastructure, quantitative models, and risk systems used in real time across global markets and represent the deepest quantitative finance bench of any India GCC.

While Goldman's publicly disclosed quantum-specific research (quantum advantage studies with QC Ware and algorithmic work with IBM) is currently attributed to the global firm level rather than to the India center by name, the depth of India-based quantitative research capability makes this GCC a natural extension point as the firm's quantum finance work scales—a pattern GCC leaders should watch rather than assume.

At the ecosystem level, AWS India's role in the MeitY Quantum Computing Applications Lab (QCAL), the first quantum computing applications lab on AWS Cloud to support a government science and technology mission at a country level, providing free on-demand access to Amazon, matters for GCC strategy because two of its named cohort evaluators are Indian technology firms: AWS Partners Mphasis and Fractal support MeitY and AWS in evaluating research proposals and mentoring applicants in quantum computing, giving India-headquartered technology and analytics firms a direct seat in shaping the national applied-research pipeline that GCCs will eventually draw talent and IP from.



6.2 India's Growing Role: How Much Room Is Left to Expand

The honest answer is most of the runway is still ahead. The current footprint is real but narrow, concentrated in a handful of GCCs (JPMorgan, IBM, and Bosch) that have gone public with India-specific quantum mandates, against a backdrop of infrastructure and talent-pipeline investment that is scaling much faster than enterprise adoption inside GCCs.

Government infrastructure is ahead of enterprise uptake. India's National Quantum Mission has committed \$730 million over eight years across four thematic hubs. The hardware layer is materializing quickly: Indian startup QpiAI unveiled Indus, a 25-qubit superconducting quantum computer and India's first full-stack quantum computing system, selected under the National Quantum Mission, in April 2025, and the Quantum Valley Tech Park in Amaravati, India's first dedicated quantum technology park, being built by Larsen & Toubro, is scheduled to open in January 2026.

On the applications-access side, the MeitY-AWS Quantum Computing Applications Lab has already run multiple cohorts, drawing proposals from IITs, IISc, IISERs, BITS, NITs, and the Indian Statistical Institute on quantum algorithms, quantum machine learning, and quantum simulators. This is a genuinely deep and fast-scaling talent and infrastructure base, but it is largely academic and government-facing, not yet absorbed into enterprise GCC roadmaps at scale.

Adoption inside GCCs is still early and narrow. Industry tracking of new-GCC technical mandates suggests only a low double-digit share of newly established technology GCCs commonly cited around 12% are exploring quantum computing or post-quantum cryptography as a defined workstream. That figure, even taken as a directional estimate rather than a precise count, implies that roughly seven in eight new tech GCCs have not yet built a quantum or PQC mandate into their charter. Set against JPMorgan, IBM, and Bosch's explicit India commitments, this points to a market that is currently led by a small number of first movers rather than a broad wave.



PQC readiness is the more urgent and more measurable gap. Unlike quantum computing R&D, which is optional and exploratory, post-quantum cryptography migration is a compliance-adjacent necessity with a hard deadline set by NIST's PQC standardization and the "harvest now, decrypt later" threat. India-specific readiness here still lags global peers. The Reserve Bank Innovation Hub's own guidance to the sector is explicitly precautionary rather than descriptive of work already done: it recommends that Indian banks embark on a proactive transition to PQC algorithms designed to resist quantum attacks and lays out a migration strategy rather than reporting an in-progress migration.

This stands in contrast to global banks like HSBC and Barclays, which are several years into live PQC and QKD trials at the parent-company level. For MNC GCCs in India serving global banking, insurance, or payments clients, this is the clearest near-term entry point: cryptographic inventory, HSM/key-management modernization, and crypto-agility engineering are lower-risk, higher-certainty workstreams than speculative quantum-algorithm R&D, and India's GCCs—with deep security-engineering and BFSI domain benches already in place at firms like JPMorgan, Goldman Sachs, and HSBC's own India processing centers—are structurally well positioned to own this work end-to-end rather than simply execute it.

India's quantum ecosystem has the two hardest things to build, funded infrastructure and a scaling STEM/academic talent pipeline, largely in place or in motion. What is not yet built out is the enterprise absorption layer: the number of GCCs that have converted "quantum" from a watch-list technology into a funded, staffed mandate with deliverables is still small. That gap is precisely the opportunity. An MNC that commits now enters a field with only a handful of credible Indian precedents (JPMorgan's QKD and quantum communication work, IBM's advanced technology centers, and Bosch's materials science mandate) rather than a crowded one while drawing on a talent and infrastructure base that is already being built at a national scale.



Chapter 07

The Talent, Research, and Innovation Engine

- 7.1 Industry-Academia-Startup Partnerships
- 7.2 A Pipeline of Industry-Ready Engineers
- 7.3 The Advantage of Scale

7.1 Industry, Academia, and Startup Partnerships

The National Quantum Mission was designed around a hub, spoke, and spike structure specifically to make industry participation straightforward: research projects operate as spokes and individual research groups as spikes around each of the four central hubs, allowing enterprise GCCs to plug into a specific spoke without needing to negotiate a relationship with an entire university. Nearly 80 formal collaborations between institutes and researchers had already formed under the mission within its first year of active proposal evaluation, a pace mission leadership has described as one of the fastest-moving programs in the Indian government.



A Pipeline of Industry-Ready Engineers 7.2

India's quantum talent pipeline benefits from a structural advantage most other emerging quantum ecosystems lack: an existing base of over 2.36 million GCC professionals already trained in enterprise-grade software engineering, cloud infrastructure, and data science disciplines. Converting a subset of that existing base into quantum literate engineers, through targeted upskilling, workshops such as the National Workshop on Quantum Computing and Quantum Technologies, and rotational programs with academic hubs, is a materially faster path to a productive quantum team than building an equivalent pipeline from a standing start, which is the position most other emerging quantum markets are in.

7.3 The Advantage of Scale

Scale compounds in India's favor in three distinct ways. First, the sheer size of the STEM graduate pool means quantum-specific specialization can be pursued as a subset of a much larger base rather than requiring the entire pipeline to be built from zero. Second, the maturity of the existing GCC operating model, spanning facilities, compliance, immigration support, and management layers, means a Quantum Center of Excellence can be stood up as an extension of existing infrastructure rather than a standalone greenfield investment. Third, the concentration of GCCs in a small number of cities, with Bengaluru, Hyderabad, and Chennai together accounting for roughly 55 percent of all Indian GCCs, creates dense local networks of quantum researchers, cloud infrastructure, and specialized vendors that make hiring and partnership formation faster than in more geographically dispersed markets.



Chapter 08

A Phased Roadmap for MNCs: From Strategy to Production

- 8.1 Phase 1: Establish Quantum-Safe Security and Workforce Readiness (0-12 Months)
- 8.2 Phase 2: Algorithm Development and Pilots (12-24 Months)
- 8.3 Phase 3: Production-Ready Applications (3-5 Years)
- 8.4 Key Recommendations for MNCs

MNC Quantum Entry Roadmap in India



A Phased Roadmap for MNCs: From Strategy to Production



8.1 Phase 1: Establish Quantum Safe Security and Workforce Readiness (0 to 12 Months)

- Complete a cryptographic inventory across the enterprise to identify systems exposed to Harvest Now, Decrypt Later risk.
- Stand up a small, dedicated quantum readiness team within the existing India GCC, drawing initial talent from current cloud, security, and data science staff.
- Formalize a research relationship with at least one National Quantum Mission Thematic Hub relevant to the enterprise's industry.
- Begin post-quantum cryptography pilot migrations on the highest sensitivity, longest shelf life systems identified in the inventory.

8.2 Phase 2: Algorithm Development and Pilots (12 to 24 Months)

- Expand the India quantum team from a readiness function into an applied research function, hiring specifically for quantum algorithm design and hybrid classical quantum engineering.
- Launch two to three pilot use cases aligned to the enterprise's core value drivers, such as portfolio optimization, molecular simulation, or logistics routing.
- Establish access to quantum hardware and simulators, whether through cloud-based quantum computing platforms or direct partnerships with Indian quantum hardware startups.
- Begin filing joint intellectual property with academic and startup partners to establish durable ownership of pilot outcomes.



8.3 Phase 3: Production-Ready Applications (3 to 5 Years)

- Transition the highest-value pilots into production systems with defined service levels, moving the India quantum team from a research function to an operating one.
- Complete enterprise-wide post-quantum cryptography migration ahead of regulatory deadlines and anticipated Q Day timelines.
- Scale the India Quantum Center of Excellence to full profit and loss ownership of a defined quantum product or capability area, consistent with the broader shift toward global mandate ownership already underway across mature Indian GCCs.

8.4 Key Recommendations for MNCs

- Treat quantum-safe migration as a near-term security requirement, not a future technology bet; the Harvest Now, Decrypt The later threat is active today regardless of when Q Day arrives.
- Anchor India's quantum investment inside an existing GCC wherever possible, rather than standing up a standalone entity, to inherit facilities, compliance, and hiring infrastructure already in place.
- Formalize at least one academic partnership with a National Quantum Mission Thematic Hub within the first 12 months to secure early access to talent and research output.
- Budget for India's hardware dependence; enterprises should expect to co-invest in cryogenic and fabrication capacity rather than relying solely on national mission infrastructure.
- Give the India quantum team genuine mandate ownership early, mirroring the shadow board and global mandate models already proven across India's most mature GCCs.



Chapter 09

Conclusion

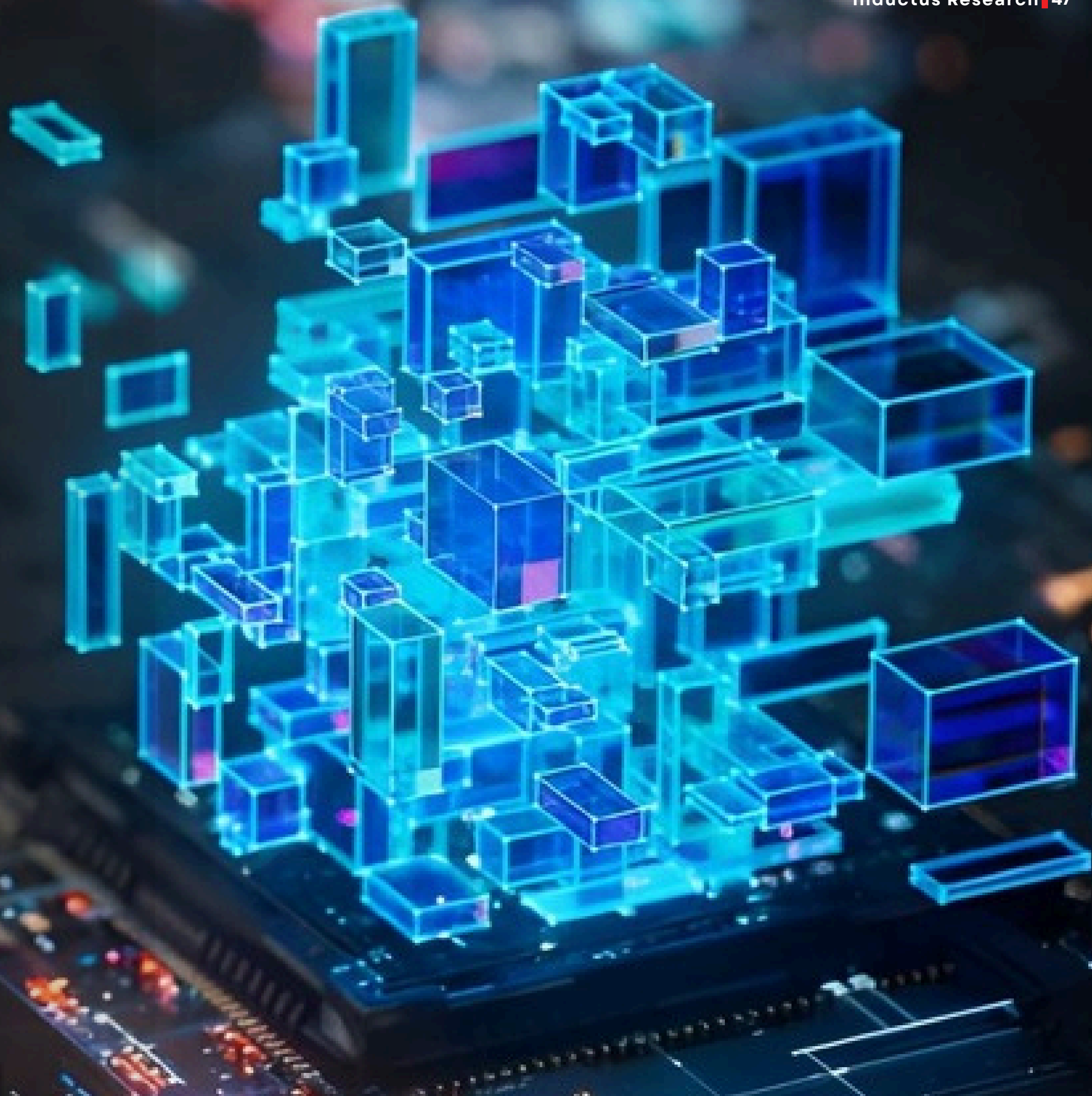
- 9.1 The Window is Closing
- 9.2 India as the Default Answer
- 9.3 A Clear Mandate for Action

9.1 The Window Is Closing

Every data point in this report points in the same direction: quantum computing is moving from research curiosity to enterprise necessity faster than most organizations are prepared for. Global investment has grown more than six times year over year; national governments have committed hundreds of millions to billions of dollars to secure early leadership; and standards bodies have already finalized the cryptographic standards enterprises need to begin migrating toward. The enterprises building capability now, while talent and hardware access remain comparatively available, are positioning themselves ahead of a scarcity curve that is already visible in the concentration of global venture capital around a small number of platform leaders.

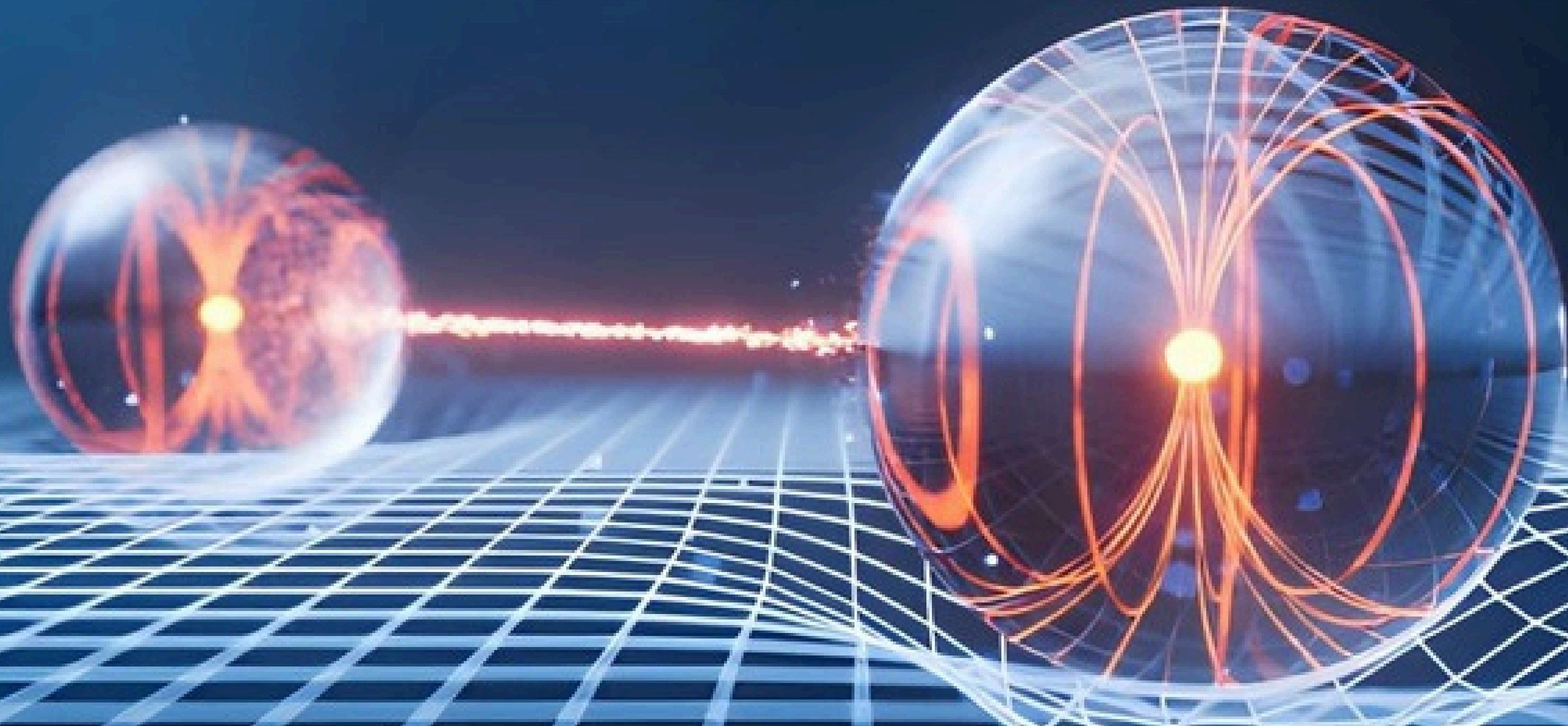
9.2 India as the Default Answer

For enterprises asking where to build that capability, India's answer is no longer a cost argument; it is a capability argument. A funded national mission, four dedicated research hubs spanning 43 institutions, a maturing startup ecosystem already producing hardware milestones such as India's first full-stack superconducting quantum computer, and a GCC ecosystem of 2.36 million professionals already operating at global mandate ownership levels together make India one of the few locations in the world where an enterprise can build quantum capability at meaningful scale within existing organizational infrastructure rather than starting from zero.



9.3 A Clear Mandate for Action

The infrastructure is funded, the talent pipeline is scaling, and early movers are already committing budget. The mandate for enterprise leaders is straightforward: complete a cryptographic risk assessment now, formalize an academic partnership within the National Quantum Mission ecosystem within the next 12 months, and give the India-based quantum team the same mandate ownership that has already made the broader GCC model successful. Enterprises that treat this as a five-year journey starting today will be substantially better positioned than those that wait for commercial maturity to force the decision.



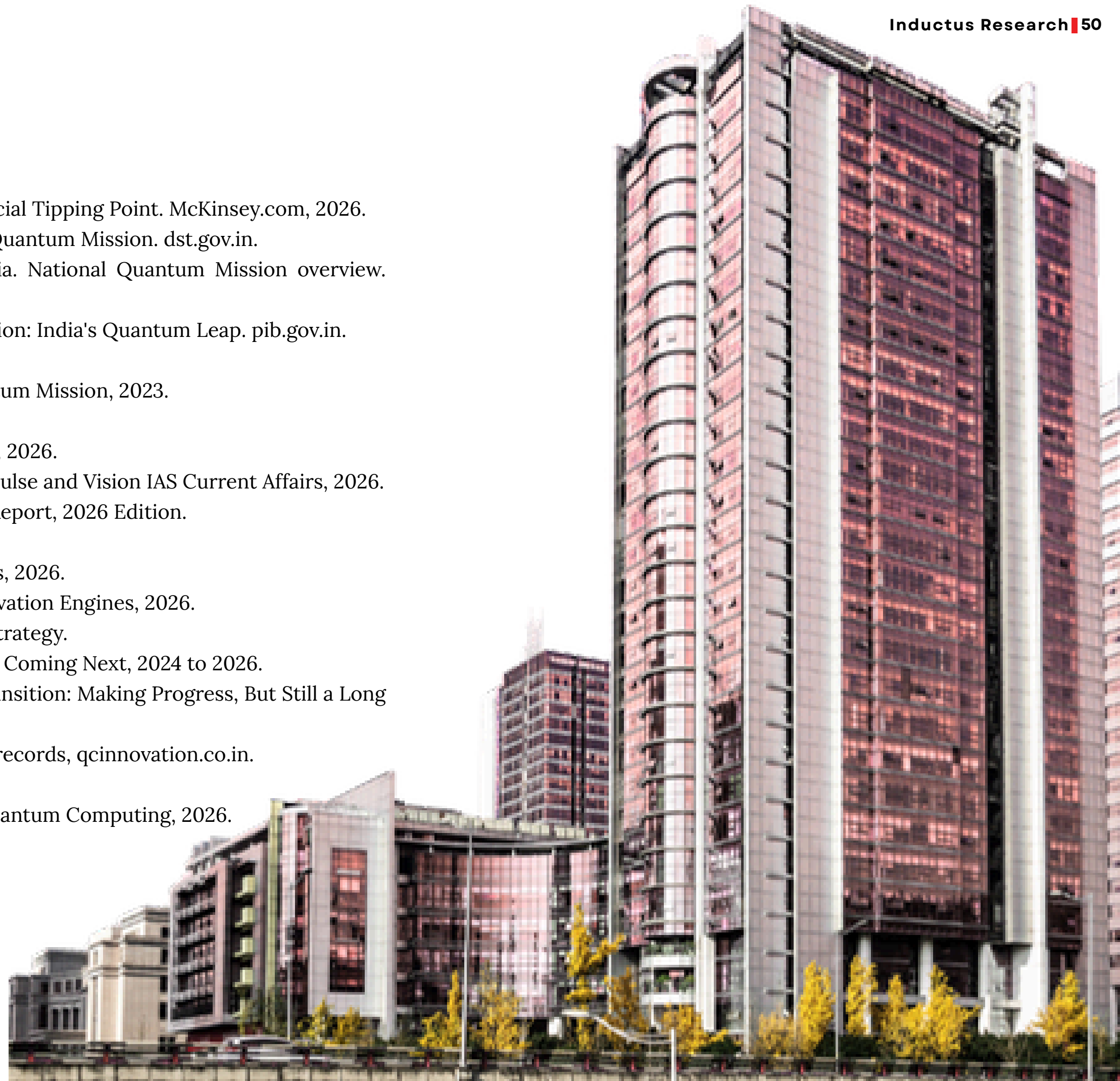
Glossary

Term	Definition
CRQC	Cryptographically Relevant Quantum Computer. A quantum computer powerful enough to break current encryption.
GCC	Global Capability Center. A wholly-owned offshore center of an MNC, evolving from cost centers to innovation hubs.
HNDL	Harvest Now, Decrypt Later. A threat where adversaries steal encrypted data today to decrypt it later with a quantum computer.
IISc	Indian Institute of Science, Bengaluru. A premier research institution and a hub for the National Quantum Mission.
IIT	Indian Institute of Technology. A group of premier public technical universities in India.
NIST	National Institute of Standards and Technology (U.S.). Published the first post-quantum cryptography standards.
NQM	National Quantum Mission. India's ₹6,003 crore (\$730M) initiative to develop quantum technologies.
PQC	Post-Quantum Cryptography. Cryptographic algorithms designed to resist quantum computer attacks.
Q-Day	The hypothetical date when a CRQC becomes available, breaking current
QKD	Quantum Key Distribution. A secure communication method using quantum mechanics to exchange encryption keys.
Qubit	The basic unit of quantum information, capable of existing in superposition (0, 1, or both).
STEM	Science, Technology, Engineering, and Mathematics. The talent pool India draws from for quantum capabilities.



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— Alouk Kumar - CEO, Inductus —

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Inductus GCC's Digital Twin and COPO (Company-Owned, Partner-Operated) Service Model creates a seamless, future-ready operational framework for global businesses setting up GCCs in India. The Digital Twin Process ensures real-time collaboration, decision-making, and operational efficiency by replicating physical systems in a virtual environment, enabling synchronized execution across multiple time zones. Meanwhile, the COPO Model allows MNCs to retain full ownership and strategic control while leveraging Inductus' expertise for execution, compliance, and scalability.

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