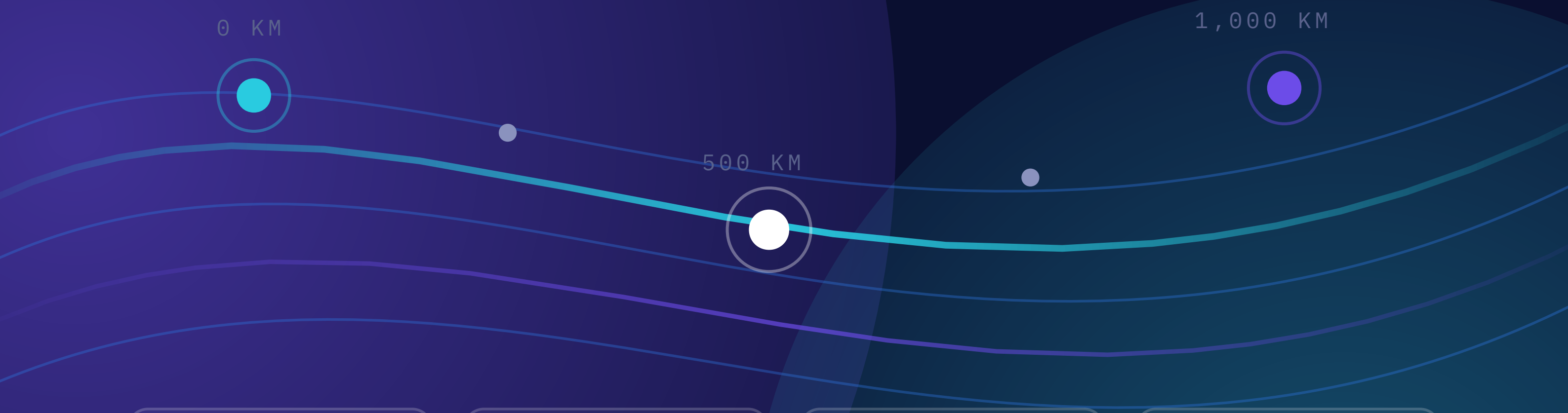
AISpectrum INDIA
The Business of AI and Industry Transformation

WHITEPAPER · DEEP-TECH POLICY ANALYSIS · JULY 2026

The Quantum Sprint.

How India Beat Its Own Roadmap

Eighteen months into an eight-year mission, India has demonstrated a 1,000-kilometre quantum-secured network — independently validated, indigenously built, and delivered by a startup. Inside the National Quantum Mission's race against its own clock.



1,000 km	**>50%**	**17**	**156 q**
QKD NETWORK · <2 YEARS	OUTCOMES IN 3 YEARS	STARTUPS BACKED	IBM HERON · SEP 2026

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JULY 2026
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EXECUTIVE SUMMARY

A Mission Running Ahead of Its Own Clock

In April 2026, during a routine review of the Department of Science and Technology, Union Minister for Science and Technology Dr Jitendra Singh was briefed on a number that would have seemed implausible when the National Quantum Mission (NQM) was approved three years earlier: **1,000 kilometres**. That is the length of the quantum-secured communication network India had just demonstrated — one of the longest such deployments anywhere in the world — using entirely indigenous technology, less than two years after the mission became operational in October 2024.

The mission's original roadmap allowed eight years to build a 2,000-kilometre quantum communication backbone. India crossed the halfway mark in under a quarter of that time. DST Secretary Dr Abhay Karandikar described the achievement as a landmark advancement in secure quantum communication and, notably, as progress *ahead of schedule* — a phrase that carries unusual weight in the vocabulary of Indian public science programmes, where timelines have historically been aspirations rather than commitments.

The 1,000-kilometre network is the most visible marker of a broader pattern. Across quantum computing hardware, startup formation, institutional infrastructure and talent development, the NQM has spent 2025 and 2026 compressing its own schedule. By mid-2026, the government could credibly claim that more than half of the mission's targeted outcomes had been achieved within three years of approval. This whitepaper examines how a mission budgeted at roughly one-twentieth of China's estimated public quantum investment has managed to sprint — and whether the pace can hold.

1,000 km
QKD NETWORK LIVE
Demonstrated in <2 years against an 8-year, 2,000-km target

>50%
OUTCOMES ACHIEVED
Of targeted mission outcomes delivered within three years

17
STARTUPS BACKED
Up from 8, spanning the full quantum component stack

₹6,003 cr
TOTAL OUTLAY
2023–24 to 2030–31 · ~US$720M · 7th dedicated national mission

THE SPRINT — MISSION MILESTONES, 2023–2026

FIG. 01 Milestone compression under the National Quantum Mission. Sources: DST, PIB, Quantum Computing Report.

TARGET COMPRESSION

8 years allowed. <2 years taken.

1,000 KM · APR 2026

0 KM · OCT 2024

2,000 KM · TARGET NOW DEC 2026 (WAS 2031)

SECTION 01

A Mission Designed to Move

01

The Union Cabinet approved the National Quantum Mission on 19 April 2023 with a total outlay of ₹6,003.65 crore covering 2023–24 to 2030–31, making India the seventh country to launch a dedicated national quantum programme, after the United States, China, Finland, Austria, France and Canada. The mission sits under the Ministry of Science and Technology as one of nine missions governed by the Prime Minister's Science, Technology and Innovation Advisory Council (PM-STIAC), with the Department of Science and Technology as the implementing agency.

Its headline targets were deliberately concrete. On computing: intermediate-scale quantum computers with 50 to 1,000 physical qubits within eight years, across superconducting and photonic platforms. On communication: satellite-based secure quantum links over 2,000 kilometres within India, long-distance links with other countries, inter-city quantum key distribution (QKD) over 2,000 kilometres, and multi-node quantum networks with quantum memories. On sensing and materials: high-sensitivity atomic magnetometers, precision atomic clocks, and indigenous capability in quantum materials — superconductors, novel semiconductor structures and topological materials — along with single-photon and entangled-photon sources and detectors.

What distinguishes the NQM's architecture from earlier Indian science missions is its execution model. Rather than concentrating resources in a single national laboratory, the mission established four Thematic Hubs hosted at IISc Bengaluru, IIT Madras, IIT Bombay and IIT Delhi, operating on a hub-and-spoke model that now connects 152 researchers from 43 institutions across 17 states and two Union Territories, organised into 14 Technical Groups.

MISSION ARCHITECTURE — FOUR THEMATIC HUBS, ONE NETWORK

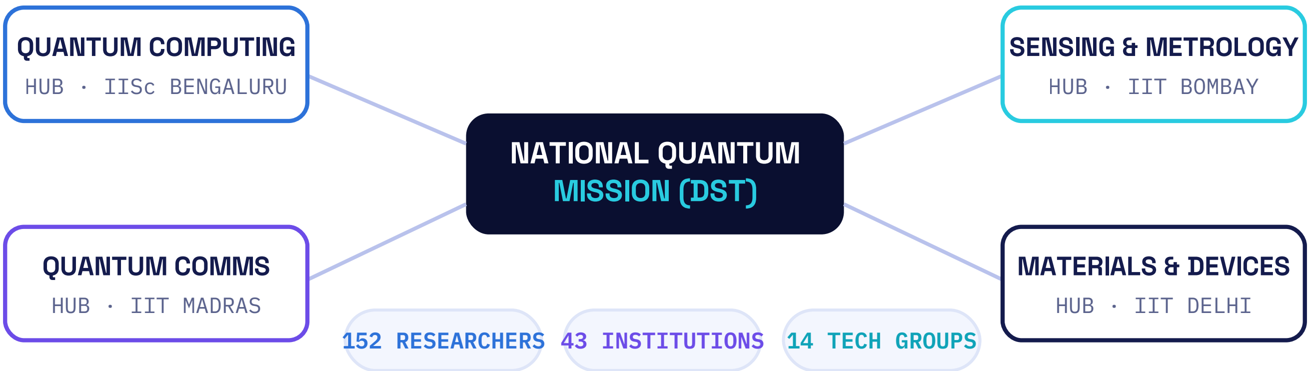


FIG. 02 Hub-and-spoke execution model spanning 17 states and 2 Union Territories. Source: Office of the PSA / DST.

The design borrows deliberately from the scaffolding built under two predecessor programmes: the DST's QuEST initiative, which seeded quantum research groups across the country from 2018 with a ₹250 crore budget across 51 national labs, and the National Mission on Interdisciplinary Cyber-Physical Systems, whose institution-building — including a ₹170 crore quantum hub at IISER Pune — became, in the words of IISER physicist Professor Umakant Rapol, the solid foundation on which the NQM would build. One programme, as he put it, dovetails into the other.

That continuity matters to the ahead-of-schedule story. The NQM did not start from zero in October 2024; it started from a decade of quiet capability accumulation, and its designers structured the mission to convert that stored energy into deliverables quickly. The results arrived faster than anyone — including the mission's own roadmap writers — had projected.

A DECADE OF SCAFFOLDING — PROGRAMME LINEAGE

QuEST · 2018 ▶ **NM-ICPS** ▶ **NQM · 2023–31**

₹250 CR · 51 NATIONAL LABS

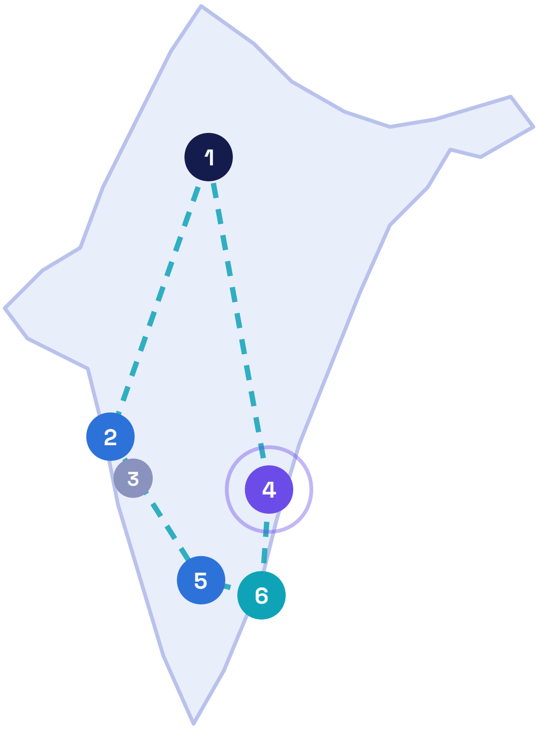
₹170 CR HUB · IISER PUNE

₹6,003.65 CR · 4 T-HUBS

FIG. 03 Stored energy: each programme built the institutional base the next one converted into deliverables.

THE QUANTUM MAP OF INDIA — WHERE THE MISSION LIVES

T-HUBS · INFRASTRUCTURE · FABRICATION · STYLISED MAP, POSITIONS INDICATIVE



1 NEW DELHI
T-HUB · MATERIALS & DEVICES (IIT DELHI)
QUTE ELECTRONICS · IUAC STARTUP

2 MUMBAI
T-HUB · SENSING & METROLOGY (IIT BOMBAY)
₹720 CR FAB FACILITY · LIQUID HELIUM PLANT

3 PUNE
IISER PUNE · 20-QUBIT ION TRAP (DUE 2026)
ATOM-INTERFEROMETRY GRAVITY SENSOR

4 AMARAVATI
QUANTUM VALLEY · IBM SYSTEM TWO, 156-QUBIT
HERON DUE SEP 2026 · 50-ACRE CAMPUS · AQRF

5 BENGALURU
T-HUB · COMPUTING (IISc) · FAB FACILITY
QpiAI · INDUS 25Q → KAVERI 64Q → EVEREST 1,00

6 CHENNAI
T-HUB · COMMUNICATION (IIT MADRAS)
QNU LABS · ARMOS QKD · 1,000-KM BACKBONE

- - - INDICATIVE NATIONAL QKD CORRIDOR · 2,000-K

FIG. 03B Six cities, one mission: the hubs, machines and startups behind the sprint. Sources: DST/PSA, PIB, IBM/AQCC, QpiAI, QNu Labs.

SECTION 02

The 1,000-Kilometre Proof

The communication vertical is where the compression of the timeline is most dramatic, and the sequence of milestones tells the story cleanly. The mission became operational in October 2024. By November 2025, India had demonstrated a 500-kilometre defence-grade quantum network. By March 2026, the 1,000-kilometre inter-city milestone was finalised. In April 2026, the achievement was announced publicly, positioned as one of the most extensive quantum key distribution deployments worldwide. The mission is now moving toward its full 2,000-kilometre national backbone objective by the end of 2026 — a target originally set for 2031.

The technology underpinning the network came not from a government laboratory but from QNu Labs, a quantum-safe cybersecurity startup incubated at IIT Madras and funded under the NQM. That provenance is itself significant: the mission's single most celebrated deliverable was executed by a venture-backed private company operating inside a public mission framework — precisely the industry-academia-government braiding the NQM's architects promised.

Quantum key distribution addresses a specific and urgent problem. Current public-key encryption is theoretically vulnerable to attack by sufficiently powerful quantum computers — the "harvest now, decrypt later" threat, in which adversaries store intercepted encrypted traffic today in anticipation of decrypting it once quantum hardware matures. QKD counters this by using the principles of quantum physics itself to distribute encryption keys, making any interception physically detectable. Officials have emphasised that the technology has been designed to operate across challenging terrains, including underwater and underground networks, widening both civilian and strategic applications.

WHY QKD — DEFEATING "HARVEST NOW, DECRYPT LATER"

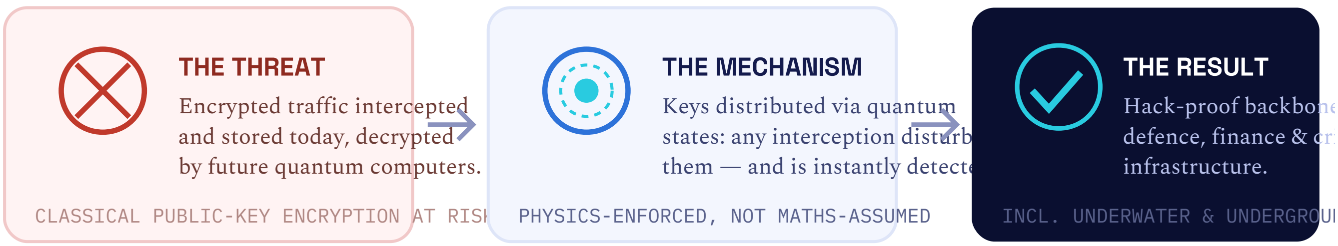


FIG. 04 The strategic problem QKD solves — and why a sovereign, indigenous backbone matters.

SECTION 03

Why the Validation Matters More Than the Number

Kilometre counts make headlines, but the detail that separates this milestone from press-release optimism is independent third-party validation. QNu Labs subjected its ARMOS QKD platform to testing by VIAVI Solutions, a global leader in network test and measurement, using the industry-standard MAP-300 test platform — the same instrumentation used to qualify commercial telecom equipment worldwide. By chaining validated 200-kilometre links, the mission scaled to the 1,000-kilometre benchmark.

Perhaps the most commercially consequential finding is coexistence: the quantum signal can share the same fibre with 10 Gbps of classical data traffic. This is not a laboratory nicety. It means Indian telecom operators can deploy quantum-secured channels over infrastructure they already own, rather than laying dedicated dark fibre — collapsing the cost curve for national rollout. Very few QKD deployments globally have demonstrated this combination of distance, error rate and classical coexistence on standard fibre, and fewer still have had the results verified by an independent test-and-measurement authority. The validation converts an announcement into an audit.

ARMOS QKD PLATFORM — INDEPENDENTLY VALIDATED PERFORMANCE (VIAVI SOLUTIONS · MAP-300)

200 km
SECURE KEY GENERATION ON STANDARD TELECOM FIBRE AT 40 dB LOSS, NO AMPLIFICATION

<4%
QUANTUM BIT ERROR RATE (QBER) ACROSS THE VALIDATED LINK

8,000 bps
KEY GENERATION RATE AT METRO DISTANCES

10 Gbps
CLASSICAL DATA COEXISTENCE ON THE SAME FIBRE · DECOY-STATE DPS PROTOCOL

FIG. 05 Validated link performance; the audit behind the announcement.

CHAINING THE BACKBONE — 200-KM LINKS TO A NATIONAL NETWORK

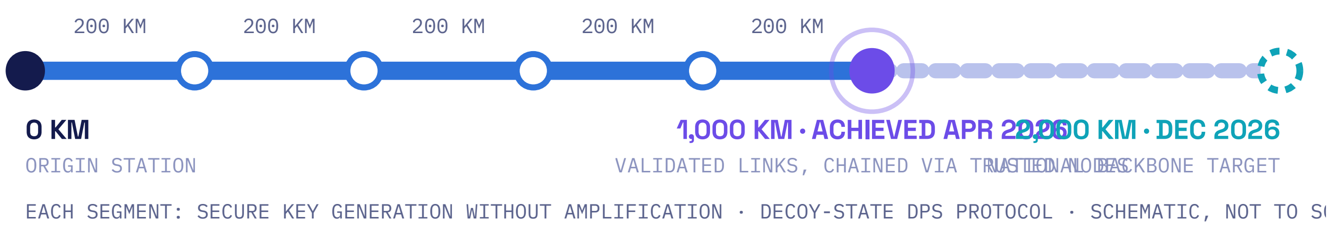


FIG. 05B How five validated 200-km hops become a 1,000-km backbone — and the dashed road to 2,000.

ONE FIBRE, TWO WORLDS — QUANTUM & CLASSICAL COEXISTENCE

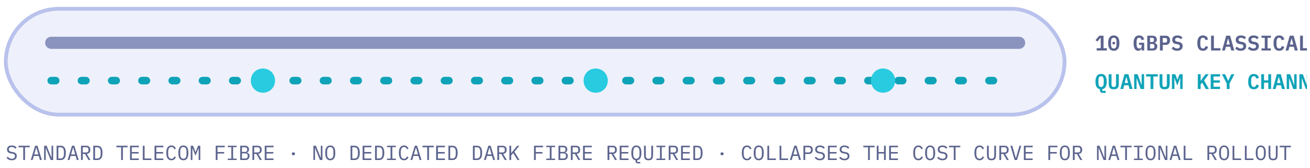


FIG. 05C The commercially decisive result: quantum keys sharing live fibre with 10 Gbps classical traffic.

SECTION 04

The Compute Track Keeps Pace

04

Quantum communication is the mission's sprint leader, but the computing vertical has maintained a striking cadence of its own — and here, too, a startup carries the flag. Bengaluru-based QpiAI launched QpiAI-Indus, a 25-qubit superconducting system and India's first full-stack quantum computer, on 14 April 2025, World Quantum Day. Barely seven months later, on 3 November 2025, Union Minister Dr Jitendra Singh unveiled the QpiAI Kaveri, a 64-qubit superconducting processor and India's most powerful quantum chip to date.

Kaveri's engineering choices signal scaling intent rather than one-off demonstration. The processor uses a flip-chip architecture that separates the qubit layer from the interconnect layer, with wafer-scale fabrication for high qubit density and low-loss interconnects — a design lineage that supports straightforward scaling. QpiAI's published roadmap runs through a 128-qubit Ganges processor targeted for early 2027 to a 1,000-qubit Everest system by 2028, which would place the company at the top of the NQM's eight-year computing target two to three years early if delivered. Kaveri is scheduled for commercial availability in the third quarter of 2026, and the company is targeting ₹100 crore in revenue by 2026 while expanding its workforce to 250 people, including more than 60 PhDs.

The capital structure behind QpiAI illustrates the mission's newest instrument: the state as co-investor rather than grant-giver. The company's $32 million (₹279 crore) Series A was co-led by Avataar Ventures and the National Quantum Mission itself — a government mission taking a lead position in a venture round, alongside private capital, on commercial terms.

INDIA'S QUBIT TRAJECTORY — DEPLOYED & ROADMAPPED SYSTEMS

PHYSICAL QUBITS · BAR LENGTHS NOT TO SCALE · SOLID = DEPLOYED / DUE · DASHED = ROADMAP

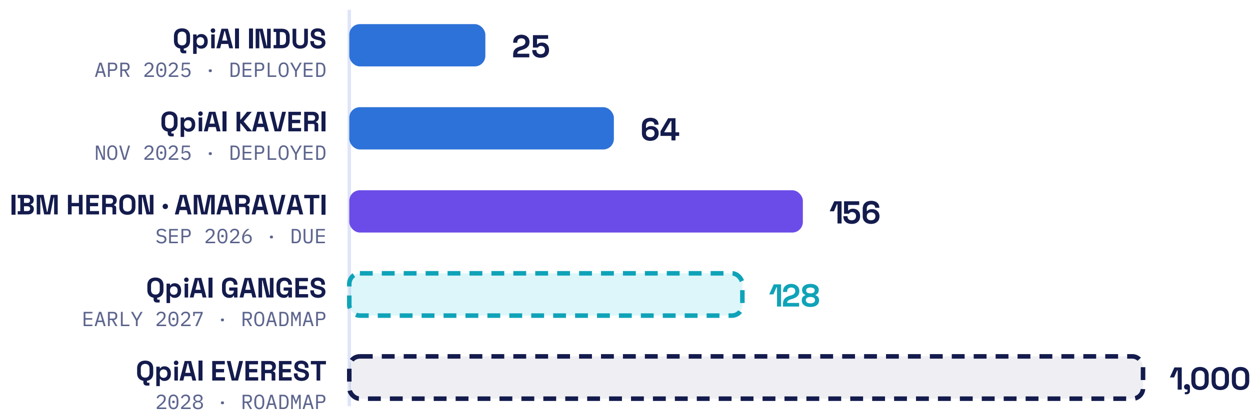


FIG. 06 From 25 to a roadmapped 1,000 qubits in under four years. Sources: QpiAI, IBM/AQCC, Quantum Computing Report.

Meanwhile, the mission's institutional infrastructure is materialising in concrete and steel. On 7 February 2026, Andhra Pradesh Chief Minister N. Chandrababu Naidu and Dr Jitendra Singh laid the foundation stone of the Amaravati Quantum Valley — India's first dedicated quantum technology hub — on a 50-acre campus, developed in partnership with IBM, Tata Consultancy Services and Larsen & Toubro. The valley was originally slated to host India's first 133-qubit quantum computer, operational by December 2026. That plan has since been upgraded on both specification and schedule: as of early July 2026, IBM is set to commission an IBM Quantum System Two featuring a 156-qubit Heron processor in Amaravati by September 2026 — a more powerful machine, arriving a quarter early. Even the mission's showcase infrastructure runs ahead of its own announcements.

Nor is the hardware story confined to superconducting platforms. At IISER Pune, Professor Rapol's group has trapped 25 calcium ions in vacuum and expects to deliver a 20-qubit ion-trap quantum computer by the end of 2026, while the same laboratory has demonstrated a gravity sensor based on atom interferometry — with applications from mineral exploration to underground tunnel detection. The mission's bet on multiple qubit modalities, rather than a single anointed platform, is quietly paying diversification dividends.

AMARAVATI QUANTUM VALLEY · INDIA'S FIRST QUANTUM HUB

Foundation laid Feb 2026. Machine due Sep 2026.

50 acres	156-qubit	50+ partners	365 hrs	100 use cases
CAMPUS · UDDANDARAYUNIPALEM	IBM SYSTEM TWO · HERON	IBM · TCS · L&T · IITs · STARTUPS	FREE ANNUAL STATE COMPUTE	AP TARGET BY 15 AUG 2026

FIG. 07 The showcase build: IBM supplies the system at no capital cost; the state provides facility, power and cooling. Also on site: the Amaravati Quantum Reference Facility — India's first open-access quantum testing, validation and benchmarking platform (SRM University-AP & Medha Towers).

SECTION 05

The Startup Engine

05

If the 1,000-kilometre network is the mission's proudest deliverable, its startup programme may be its most consequential institutional innovation. Recognising that quantum ventures need patient, structured capital, the NQM formulated dedicated startup guidelines with two funding tracks, administered through the four T-Hubs. The cohort has more than doubled, from an initial eight companies to 17 by April 2026, and the portfolio now spans the full stack — quantum biosensors for disease detection, photon sensing, quantum positioning systems, atomic memory, precision electronics, and indigenous cryogenic cables, a component critical to maintaining the near-absolute-zero environments quantum hardware demands.

The speed of the machinery is the detail founders keep repeating. Dr Sugam Kumar, a scientist at the Inter-University Accelerator Centre in Delhi, founded QUTE Electronics in November 2025 to build precision power supplies for quantum computers. He approached the NQM in February 2026 and submitted a proposal in the first week of March. Within two days he was called to interview; he pitched the next day; approval came within ten days. "I never thought that they would respond so fast," he said. For anyone who has navigated conventional Indian research funding cycles, a ten-day proposal-to-approval turnaround is not an incremental improvement — it is a different institutional species.

The surrounding capital environment is thickening in parallel. A coalition of US and Indian venture capital and private equity firms announced in September 2025 that it would pledge more than $1 billion to Indian deep-tech startups over the next decade, with NVIDIA and Qualcomm Ventures joining two months later. Within government, the Technology Development Board and BIRAC now function as second-level fund managers; the TDB received over 100 deep-tech proposals within two months of issuing a call, and the government is increasingly deploying optionally convertible debt — supplying growth capital while preserving founder equity.

NQM STARTUP FUNDING ARCHITECTURE COHORT: 8 → 17 COMPANIES · APR 2026

TRACK 1 · SEED	TRACK 2 · SCALE	TURNAROUND
Up to ₹5 cr	**Up to ₹25 cr**	**10 days**
Early-stage startups; the relevant T-Hub takes up to 4.5% equity.	Equity-linked instruments for scaling & commercialisation; T-Hub as lead or co-investor alongside VCs.	Proposal-to-approval for QUTE Electronics, March 2026 — interview call within 48 hours.

FIG. 08 The state as structured co-investor, at startup speed.

THE 17-COMPANY PORTFOLIO — SELECTED VENTURES

QNu Labs
QUANTUM-SAFE COMMS · 1,000-KM QKD BACKBONE

QpiAI
FULL-STACK SUPERCONDUCTING QUANTUM COMPUTING

Dimira Technologies
INDIGENOUS CRYOGENIC CABLES

Prenishq
PRECISION QUANTUM HARDWARE

QuBeats
QUANTUM POSITIONING SYSTEMS

Quantum Biosciences
QUANTUM BIOSENSORS · DISEASE DETECTION

Sense-XT
PHOTON SENSING TECHNOLOGIES

bloq
NEW COHORT · APRIL 2026

ORVISSEMI
NEW COHORT · APRIL 2026

GDQ Labs
NEW COHORT · APRIL 2026

SAS Qute Electronics
PRECISION POWER SYSTEMS FOR QUANTUM COMPUTERS

Bumble Bee Instruments
NEW COHORT · APRIL 2026

Quantum AI Global
NEW COHORT · APRIL 2026

+ 4 more
ORIGINAL COHORT VENTURES ACROSS THE FOUR T-HUBS

FIG. 09 Blue rule: original cohort · Violet rule: April 2026 expansion. Domains span sensing, positioning, atomic memory, electronics and components.

SECTION 06

Building the Bench: Talent at Scale

Hardware milestones are visible; talent pipelines are not — but the mission has been assembling one with the same urgency. Twenty-three academic institutions have been approved to establish quantum teaching laboratories, with more than 100 additional proposals under evaluation, and the NQM has worked with the All India Council for Technical Education to introduce quantum technology curricula into higher education.

From the 2026 academic year, Andhra University will launch India's first full-scale quantum computing degree programme, offering 30 seats through an interdisciplinary curriculum spanning electronics, computer science, physics and mathematics. In Amaravati, a specialised Quantum and AI-focused university campus is planned under NIELIT as a national centre of excellence. The bet is straightforward: the countries that win in quantum over a 20-year horizon will be the ones that industrialised talent production early, and India's demographic scale gives it an asymmetric advantage if the training infrastructure exists.

THE TALENT PIPELINE — FROM PROPOSALS TO PRACTITIONERS

FIG. 10 Plus: a Quantum & AI university campus planned in Amaravati under NIELIT as a national centre of excellence.

SECTION 07

The Global Scoreboard — and the Capital-Efficiency Argument

India's quantum budget looks modest against the global field, and that is precisely what makes the mission's output remarkable. Worldwide government investment in quantum science and technology now exceeds $65.9 billion in announced commitments. China's public investment is widely estimated at around $15 billion, and its 15th Five-Year Plan (2026–2030) names quantum technology first among seven designated future industries. The United States, having authorised roughly $1.2 billion under the original National Quantum Initiative and $1.8 billion in reauthorised funding for 2025–2029, escalated dramatically in May 2026 when the Department of Commerce announced $2.013 billion in CHIPS Act funding across nine quantum companies — including $1 billion to IBM for a quantum-grade superconducting wafer foundry — with the government taking minority equity stakes.

The United Kingdom has committed £2.5 billion over ten years and added a further £2 billion for quantum procurement and scaling in March 2026. Private capital is accelerating just as fast: global quantum computing investment grew 6.3-fold in 2025 to reach $12.6 billion, according to McKinsey. Against this backdrop, India's ₹6,003.65 crore — roughly $720 million — is a rounding error in the global race by dollar volume. Yet within three years, that allocation has produced one of the world's longest validated QKD deployments, two generations of indigenous quantum processors, a 17-company startup portfolio, a 50-acre quantum industrial campus with IBM and TCS as anchor tenants, and a national teaching-lab network in the making.

ANNOUNCED PUBLIC QUANTUM INVESTMENT — SELECTED PROGRAMMES (US$ B

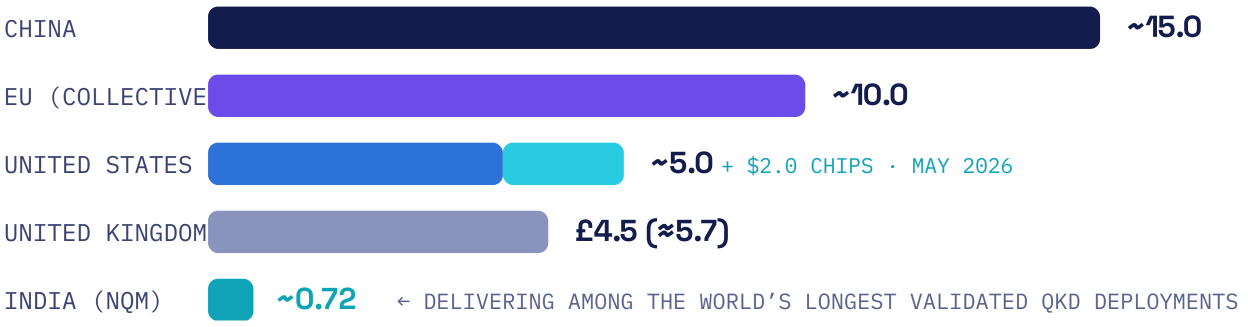


FIG. 11 Capital efficiency as India's claim. Sources: Qureca Global Quantum Initiatives 2026; ECIPE; US DoC; UK DSIT. Estimates vary; China figures are contested.

If the global quantum race is ultimately decided by capital efficiency — output per dollar of public investment — India has quietly built one of the strongest claims in the field. NITI Aayog's estimate that quantum technology could unlock $1–2 trillion in global value by 2035 frames the size of the prize that efficiency is buying access to.

The strategic logic of moving early is equally clear. Post-quantum security is a sovereign imperative: nations that depend on foreign quantum-safe infrastructure will have outsourced the confidentiality of their defence, financial and governmental communications. By demonstrating an indigenous, validated QKD backbone before its own deadline, India has converted a dependency risk into a capability — and potentially an exportable one, given that few countries outside China have deployed quantum-secured networks at comparable scale.

SECTION 08

The Road to 2,000 Kilometres — and What Comes After

None of this is a declaration of victory, and the mission's own leadership has been careful not to frame it as one. The remaining 1,000 kilometres of the national backbone must be completed by the end of 2026 to sustain the ahead-of-schedule narrative. Satellite-based QKD over 2,000 kilometres — a materially harder problem than terrestrial fibre — remains on the books. On the computing side, the distance between India's 64 qubits and the global frontier is real: IBM crossed 1,000 qubits in 2023, and China's Origin Quantum shipped a fully self-developed 180-qubit system in May 2026. Critical components, including specialised lasers, are still imported, and error correction remains an open research frontier for everyone, India included.

The mission is already moving on the component question: in November 2025, Dr Jitendra Singh announced two major quantum fabrication and central facilities at IIT Bombay and IISc Bengaluru with a combined investment of ₹720 crore, to indigenise the fabrication of quantum components, alongside a Liquid Helium Facility at IIT Bombay expected to cut the cost of cryogenic experiments to a tenth of present levels and reduce reliance on imported helium.

But the honest way to read those gaps is as the agenda for the mission's second half, not as caveats that diminish its first. The pattern established between October 2024 and mid-2026 is one of compounding: prior programmes seeded the labs, the labs seeded the startups, the startups delivered the milestones, the milestones attracted the capital, and the capital is now funding the next round of components, qubits and kilometres.

THE COMPOUNDING FLYWHEEL … NT SUSTAINS ITSELF

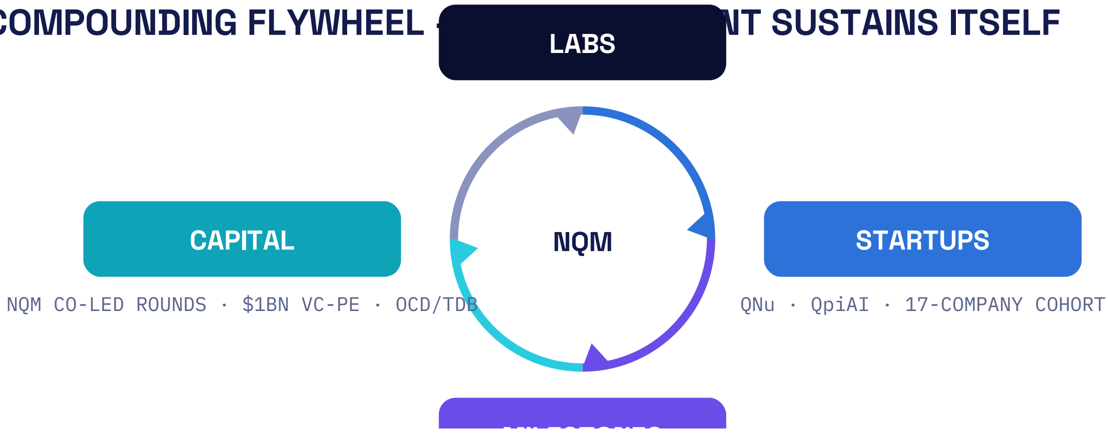


FIG. 12 Labs seed startups; startups deliver milestones; milestones attract capital; capital funds the next round of components, qubits and kilometres.

> *"Countries that fall behind in these technologies risk falling behind in both development and security."*
>
> DR JITENDRA SINGH, UNION MINISTER FOR SCIENCE & TECHNOLOGY · JUNE 2026, ANNOUNCING THE MISSION HAD CROSSED ITS HALFWAY MARK IN THREE YEARS

QpiAI's 128-qubit Ganges processor is targeted for early 2027; the Amaravati machine is now expected to be commissioned by September 2026; the IISER Pune ion-trap system lands by year-end; and the 2,000-kilometre backbone — the target the mission was given until 2031 to reach — is now a this-year objective.

Three years ago, India entered the quantum race as the seventh nation to declare one. The declaration was unremarkable; national quantum strategies had become table stakes. What was not table stakes — what remains genuinely rare in the global landscape — is a mission that publishes an eight-year roadmap and then runs ahead of it, with the receipts independently verified. On current evidence, falling behind is not India's problem. Keeping up with itself is.

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Sources: Department of Science & Technology / Office of the PSA (NQM official), PIB, Quantum Computing Report, The Quantum Insider, Swarajya, Qureca Global Quantum Initiatives 2026, ECIPE, McKinsey (via press reporting), NITI Aayog.