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# India's Quantum Leap: Amaravati Quantum Valley and the National Quantum Mission

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# India's Quantum Leap: Amaravati Quantum Valley and the National Quantum Mission

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## WHY IN NEWS

On June 19, 2026, an indigenous dilution refrigerator at the Quantum Reference Facility of Amaravati Quantum Valley was successfully cooled to 4 Kelvin, equivalent to minus 269 degrees Celsius. The milestone marks a significant step in building the hardware backbone of India's National Quantum Mission (<https://ujyari.com/schemes/nqm/>).

## BACKGROUND: THE NATIONAL QUANTUM MISSION

The National Quantum Mission (NQM) was approved in April 2023 with an outlay of **Rs 6,003.65 crore** for the period 2023 to 2031, with the Department of Science and Technology (DST) as the nodal agency. It seeks to make India one of the few nations with advanced quantum capabilities.

PARAMETER	DETAIL
Approved	April 2023
Outlay	Rs 6,003.65 crore
Period	2023 to 2031 (eight years)
Nodal agency	Department of Science and Technology (DST)
Qubit target	50 to 1,000 physical qubits over eight years

## The Four Verticals

The Mission is organised around four thematic verticals, each anchored by Thematic Hubs in leading institutions:

VERTICAL	FOCUS
Quantum Computing ( <a href="https://ujivari.com/terms/quantum-computing-term/">https://ujivari.com/terms/quantum-computing-term/</a> )	Building qubit-based processors
Quantum Communication	Secure quantum key distribution and satellite links
Quantum Sensing and Metrology	Ultra-precise sensors and atomic clocks
Quantum Materials and Devices	Novel materials, superconductors and devices

### WHY A DILUTION REFRIGERATOR MATTERS

Superconducting (<https://ujivari.com/vocab/superconducting/>) qubits, a leading approach to quantum computing, are extraordinarily fragile. Any heat or stray energy causes **decoherence**, destroying the quantum information. To stay coherent, the qubits must be kept at temperatures close to absolute zero.

A **dilution refrigerator** is the specialised machine that achieves these milli-Kelvin temperatures, using a mixture of helium isotopes. Reaching 4 Kelvin with an indigenous unit demonstrates that India can build a critical, hitherto import-dependent piece of quantum hardware domestically. Absolute zero is 0 Kelvin (minus 273.15 degrees Celsius); 4 Kelvin is an intermediate cooling stage on the path to the much colder operating temperatures of qubits.

### Amaravati Quantum Valley

Amaravati Quantum Valley, in Andhra Pradesh, is being developed as a hub for quantum research, industry and skilling. The Quantum Reference Facility there hosts the refrigerator milestone, and a **second reference facility** is being established at SRM University AP.

### ANALYSIS: STRATEGIC SIGNIFICANCE

#### Why quantum matters for India

- **Strategic autonomy** (<https://ujivari.com/terms/strategic-autonomy/>): Quantum computing can break or secure encryption, with profound implications for national security and finance.
- **Self-reliance**: Indigenous dilution refrigerators reduce dependence on a handful of foreign suppliers.

- **Economic potential:** Applications span drug discovery, materials, logistics optimisation, weather modelling and secure communication.
- **Global race:** The United States, China and the EU are investing heavily; the NQM keeps India competitive.

### Challenges

- Quantum hardware is expensive and technically demanding.
- Shortage of trained quantum scientists and engineers.
- Long timelines before practical, error-corrected machines emerge.
- Need for a domestic supply chain of cryogenics, lasers and control electronics.

### WAY FORWARD

- Sustain long-term funding and patient investment across the eight-year horizon.
- Build human capital through dedicated quantum curricula and fellowships.
- Foster academia-industry-startup partnerships around the Thematic Hubs.
- Develop an indigenous supply chain for cryogenics and quantum components.

### UPSC RELEVANCE

**Prelims:** National Quantum Mission (year approved, outlay, nodal DST); four verticals; qubit target; dilution refrigerator and absolute zero; Amaravati Quantum Valley.

**Mains (GS3):** “Quantum technology is the next frontier of strategic and economic competition. Examine India’s preparedness through the National Quantum Mission.” Discuss the applications and challenges of quantum computing for India.

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NQM: National Quantum Mission approved April 2023; outlay Rs 6,003.65 crore; period 2023-31; nodal DST.

Target: 50 to 1,000 physical qubits over eight years.

Verticals: Quantum computing, communication, sensing and metrology, and materials and devices.

Milestone: Indigenous dilution refrigerator cooled to 4 Kelvin (minus 269 degrees Celsius) on June 19, 2026.

Absolute zero: 0 Kelvin equals minus 273.15 degrees Celsius.

Facilities: Quantum Reference Facility at Amaravati Quantum Valley; second facility at SRM University AP.

Sources: *Department of Science and Technology* (<https://dst.gov.in>), *Press Information Bureau* (<https://pib.gov.in>)

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