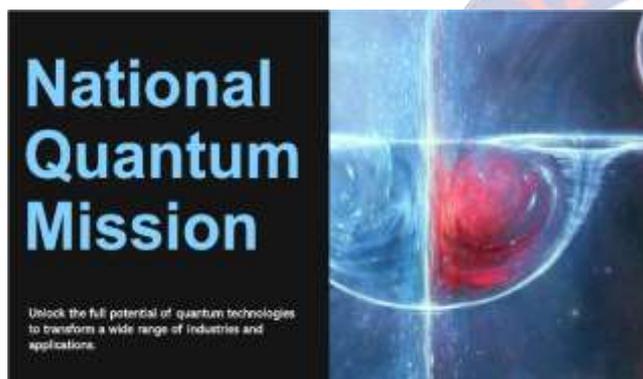


**PRELIMS EDGE 2025****07-11-2025****NATIONAL QUANTUM MISSION**

Context: A startup supported under National Quantum Mission - QNu Labs Pvt. Ltd. - has demonstrated India's first 500 km Quantum Key Distribution (QKD) network.

**National Quantum Mission (NQM):**

- Implemented by **DST from 2023-2031** to nurture, and scale up scientific and industrial R&D and create a vibrant & innovative ecosystem in quantum technology.
- India is the **7th country to have a quantum mission** after USA, Austria, Finland, France, Canada and China.

Objectives of NQM:

- Developing **intermediate scale quantum computers** with **50-100 physical qubits in 5 years** and **50-1000 physical qubits in 8 years**.

- **Help develop magnetometers** with high sensitivity for precision timing, communications, and navigation.
- Support **design and synthesis of quantum materials** such as superconductors and materials for fabrication of quantum devices.

What is Quantum Computing ?

- It is a rapidly-emerging technology that harnesses the **laws of quantum mechanics to solve problems too complex for classical computers**.
- While today's classical computers store information as binary 0 and 1 states, they **carry out calculations using quantum bits (qubits)**.
- Unlike a bit that has to be a 0 or a 1, a **qubit can be in a combination of states** – this allows for exponentially larger calculations and gives them the potential to solve complex problems which even the most powerful supercomputers are not capable of.

About Quantum Satellites:

- In Dec 2024, the Mission Governing Board of the National Quantum Mission, stated that India plans to launch a quantum satellite in 2-3 years for quantum communications.
- Quantum satellites **use principles of quantum mechanics, such as quantum entanglement & quantum key**

distribution (QKD), to establish secure communication channels.

- Quantum satellites use QKD, a secure communication method that applies the principles of quantum mechanics to share encryption keys. These **satellites generate and transmit quantum particles, such as photons, which encode the encryption keys.**
- Through QKD, the encryption keys are distributed securely as any **attempt to intercept the particles alters their quantum state**, immediately signalling a breach.
- The benefits of using quantum satellites include **enhanced cybersecurity**, as they are immune to traditional hacking; enabling **global-scale quantum networks**; facilitating **growth of quantum communication research**; and potential applications in **military and financial sectors** where data security is paramount.

About Quantum Hubs:

- Quantum Hubs, also called Thematic Hubs (T-Hubs), are **research centres established under the NQM**. They aim to drive innovation, research, and development in different aspects of quantum technology. **4 T-Hubs have been created** in major institutions.
 - Quantum Computing (IISc Bengaluru).
 - Quantum Communication (IIT Bombay).
 - Quantum Sensing & Metrology (IIT Delhi).
 - Quantum Materials & Devices (IIT Madras).

- **IIT Kanpur serves as the central coordinating institution**, overseeing administration and funding allocation.



Quantum Technology is a field that deals with principles of quantum mechanics (study of behaviour of matter and energy at atomic and subatomic levels). Quantum Key Distribution is a secure communication technology that uses the laws of quantum physics to generate and exchange encryption keys between two parties. Unlike traditional encryption, it ensures that any attempt to intercept or observe the key instantly alters the system, making intrusion detectable.

Terms related to Quantum Computing

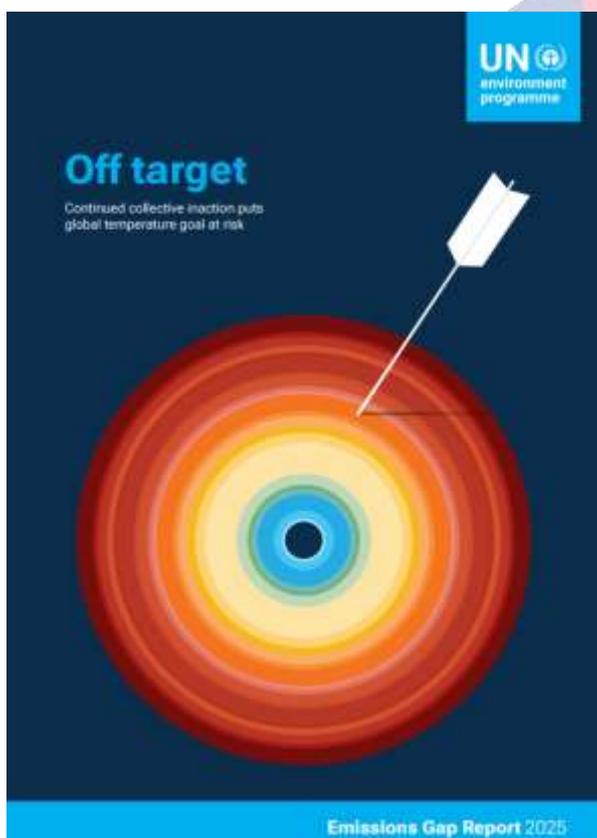
- **Qubit:** The basic unit of quantum information, analogous to a classical binary bit but capable of representing both 0 and 1 at the same time due to superposition.
- **Superposition:** Feature of quantum mechanics where quantum system can exist in multiple states at once until it is measured.
- **Entanglement:** A phenomenon where two or more quantum particles become interconnected, such that state of one particle always influences state of the other, regardless of their distance.
- **Decoherence:** Process by which a quantum system loses its quantum properties, such as superposition and entanglement, due to interactions with its environment.
- **Quantum Supremacy:** The point at which a quantum computer can perform

a calculation or solve a problem that is infeasible for classical computers to achieve.

Source: Startup supported by DST under NQM demonstrates 500 km Quantum-Safe Network (PIB)

EMISSIONS GAP REPORT 2025

Context: The UNEP Emissions Gap Report 2025 warns that despite climate pledges, the world remains on course for 2.3–2.5°C warming, far exceeding Paris Agreement goals.



About Emissions Gap Report 2025:

- It is the 16th edition of the **United Nations Environment Programme (UNEP)** annual assessment that measures the “gap”

between projected emissions and the levels needed to limit global warming.

- It aims to evaluate countries’ Nationally Determined Contributions (NDCs), analyze global temperature trajectory, and recommend actions for **aligning with the 1.5°C and 2°C warming (Paris targets)**.

Key Global Trends in the 2025 Report:

- **Temperature projections:** World is on track for 2.3–2.5°C warming with NDCs, and 2.8°C under current policies, far exceeding the Paris limits.
- **Limited progress:** Adjustments in calculation methods and the U.S. withdrawal from the Paris Agreement offset whatever minor gains made.
- **Emissions gap:** To align with the Paris goals, global emissions must fall by 35% (2°C) or 55% (1.5°C) from 2019 levels by 2035.
- **Overshoot risk:** The 1.5°C ceiling will be breached by 2035, necessitating rapid negative emissions and technological interventions.
- **Sectoral emissions:** Energy, industry, transport, and agriculture sectors continue to dominate emissions.
- **Technology readiness:** Solar, wind, and battery technologies are cheaper and scalable, but their deployment in low-income nations is low.
- **Geopolitical challenge:** Rising debt, weak climate finance, and fragmented cooperation among countries are slowing the pace of decarbonization.

Successes Highlighted:

- **Falling temperature projections:** Global temperature projections have dropped

from 3–3.5°C (2015) to ~2.4°C, proving gradual progress.

- **Technology availability:** The world now witnesses unprecedented expansion in renewables, electric vehicles, and battery storage.
- **Increased NDC coverage:** Nearly 90% of global emissions are now included in national climate pledges.

Limitations:

- **Insufficient ambition:** The latest NDC updates reduce projected warming by 0.1°C, keeping global temperatures at 2.3–2.5°C, far from the Paris targets.
- **Finance gap:** Global climate finance flows need to triple by 2030 to meet mitigation goals, yet only one-third of this funding is currently mobilized.
- **Implementation deficit:** Only nine G20 members are currently on track to meet their existing NDCs.
- **Unproven carbon removals:** It warns against overreliance on Carbon Dioxide Removal (CDR) and Direct Air Capture (DAC) technologies, which remain expensive & untested at scale.
- **Geopolitical instability:** Conflicts and energy crises post-2022 have caused reinvestment in fossil fuels, with global subsidies of \$1.3 trillion.

UNEP Recommendations:

- **Near-term emission cuts:** Annual global emissions must fall by 35% for 2°C and 55% for 1.5°C by 2035, requiring phasing out of coal and oil.
- **Mobilize climate finance:** Restructuring international financial systems, including

debt swaps and concessional financing, to unlock private investment in green sectors.

- **Enhance international cooperation:** Operationalizing the Loss and Damage Fund and enhancing technology sharing frameworks.
- **Mainstream adaptation & resilience:** Integrate climate adaptation into budgets and sectoral planning to protect communities and ecosystems.
- **Phase out fossil fuel subsidies:** Redirect fossil fuel subsidies toward renewable sources of energy.
- **Focus on poorer economies:** Focus on access to clean energy innovation funds & capacity-building initiatives.
- **Strengthen monitoring:** Develop a unified global tracking mechanism for emissions and finance to ensure transparency & accountability.

Source: World on track to dangerous warming as emissions hit record high: U.N. (The Hindu)

CENSUS OF INDIA

Context: Registrar General and Census Commissioner of India has released two mobile apps in preparation for the trial phases of India's first Digital Census in 2027.



About Census:

- Population Census is the total process of collecting, compiling, analyzing and disseminating demographic, economic and social data pertaining, at a specific time, of all persons in a country or a well-defined part of a country.
- The census was first started under British Viceroy **Lord Mayo in 1872**.
- The first **synchronous and decadal census was taken in 1881**, by W.C. Plowden, Census Commissioner of India. Since then, censuses have been undertaken uninterruptedly once every ten years.
- The last census was undertaken in 2011.
- The **Census of India Act of 1948** provides the legal framework for carrying out the Census - however, it does not mention its timing or periodicity.
- Hence, a census is legally mandated in India but there is **no constitutional or legal requirement that it needs to be conducted decennially**.
- In India, the census is conducted by the Office of the **Registrar General and Census Commissioner under the Ministry of Home Affairs**.

- In March 2020, the Ministry of Home Affairs (MHA) amended the Census Rules framed in 1990 – in order to capture and store the Census data in an electronic form and enabled self-enumeration by respondents.
- Until 1951, the Census Organisation was set up on an ad-hoc basis for each Census.

National Population Register (NPR):

- NPR is a database containing a list of all usual residents of the country.
- A usual resident is a person who has **resided in a place for six months or more and intends to reside there for another six months** or more.
- It is generated through house-to-house enumeration during the “house-listing” phase of the Census.
- NPR was **first collected in 2010**. It was updated in 2015 and already has details of 119 crore residents.
- The NPR is **prepared under the provisions of the Citizenship Act 1955** and the Citizenship (Registration of Citizens and Issue of National Identity Cards) Rules, 2003.
- It is mandatory for every “usual resident of India” to register in NPR.

National Register of Citizens (NRC):

- The NRC is a record containing the names of genuine Indian citizens residing in the country.
- It aims to identify and deport illegal immigrants as mandated by the Citizenship Act of 1955, Foreigners Act of 1946 and Passport (Entry into India) Act, 1920.

- The **only nation-wide NRC** was created in **1951**, after 1951 Census. At present, **only Assam has an NRC**.
- The nodal agency for the NRC is the Registrar General and Census Commissioner.

NRC in Assam

- ✓ It aims to **identify genuine citizens** who were residing in Assam as of **March 24, 1971** & thereby address immigration concerns.
- ✓ Over the years, Assam witnessed major illegal migration, estimated at around **6 million out of its 26 million population** – which led to socio-political complexities.
- ✓ In 1978, the All Assam Students Union (AASU) started the **Assam Movement** demanding detection & deportation of illegal immigrants.
- ✓ The **Assam Accord was signed in 1985** between PM Rajiv Gandhi and AASU leaders, promising to identify illegal immigrants who arrived after March 24, 1971.
- ✓ After much delay, the NRC process in Assam began in 2013 due to an order of the Supreme Court.
- ✓ The NRC updating in Assam was carried out under the Citizenship Act of 1955 and the Assam Accord of 1985 to identify illegal Bangladeshi migration.



According to UN data, India surpassed China to become the world's most populous country in April 2023.

Source: Two census apps, test portal for self-enumeration go live (The Hindu)

TERMS IN NEWS

Operation White Cauldron



- **Directorate of Revenue Intelligence (DRI)** busted a clandestine factory in Valsad, Gujarat, manufacturing the **psychotropic drug Alprazolam**, seizing drugs worth ₹22 crore and arresting four people under “Operation White Cauldron.”
- It is a **nationwide anti-narcotics operation** led by the DRI targeting clandestine drug manufacturing units involved in producing psychotropic substances and drugs.
- It aims to dismantle inter-state synthetic drug networks, curb illegal trade of chemical precursors, and **support India's Nasha Mukta Bharat Abhiyaan**.

INS Ikshak



- It is the third vessel of the **Survey Vessel (Large) [SVL] class** and the first to be based at the Southern Naval Command.
- It is 3rd in its series, following **INS Sandhayak and INS Nirdeshak**, replacing older Sandhayak-class vessels.
- It was constructed by Garden Reach Shipbuilders & Engineers (GRSE) Ltd., Kolkata, under Aatmanirbhar Bharat, with **over 80% indigenous content** sourced from Indian MSMEs.
- Its name means '**Guide**' in **Sanskrit** – symbolizing its role in charting unexplored waters and strengthening maritime safety in Indian Ocean Region.
- It is designed primarily for **hydrographic surveys** but also configured for Humanitarian Assistance and Disaster Relief (**HADR**) operations and can serve as a **hospital ship** during crises.

Starlink



- Maharashtra has become the first Indian state to sign an agreement with Starlink Satellite Communications Pvt. Ltd. to deliver satellite-based internet services across government institutions and remote rural areas of state.
- In June 2025, **Elon Musk-owned 'Starlink'** received a licence to operate in India - nearly three years after first applying for one.
- Starlink is the name of a satellite network developed by **SpaceX** to provide high-speed internet access anywhere on the planet through a **constellation of satellites in Low Earth Orbit (LEO)**.
- Starlink aims to provide broadband services that are **faster, cheaper, and more reliable** than existing options, particularly in rural and **remote areas** where connectivity is limited.
- Starlink delivers internet services using a vast network of satellites to maximize connection speed between the satellites and the ground.
- Currently, internet services are being **provided to over 60 countries** on a limited scale and many countries are in talks with Elon Musk.

- Unlike traditional internet, which relies on a single geostationary satellite that orbits 35,786 km above the Earth, Starlink satellites fly much closer to the surface, at about **550 km, reducing the latency and increasing the bandwidth** of the connection.
- The satellites are launched in groups of 60. **SpaceX hopes to eventually have as many as 42,000 satellites** to cover the entire globe and offer **truly universal internet access**.

species such as the Lesser Adjutant Stork, Black-necked Stork, and Smooth-coated Otter.

- It provides **ecosystem services** such as flood mitigation, groundwater recharge, carbon storage, and climate regulation, contributing to the Gangetic ecosystem's stability.

PLACES IN NEWS

Gogabeel Lake



- Gogabeel Lake, in **Katihar district, Bihar**, has been designated as India's **94th Ramsar Site** and 6th from Bihar.
- It is an oxbow lake situated within the Trans-Gangetic Plains, between the **Ganga and Mahananda rivers**.
- It connects to both rivers during monsoon floods, functioning as a dynamic floodplain wetland.
- It had been declared as **Bihar's first community reserve, co-managed by local communities & the forest dept.**
- It serves as a key habitat for **migratory birds** and a breeding site for vulnerable

Kunar River



- India has announced support for **Afghanistan's plan to build a dam** on the Kunar River, marking a major geopolitical shift that could intensify Pakistan's water scarcity.
- The Kunar River, known as the **Chitral River in Pakistan**, is a transboundary river flowing through the **Hindu Kush mountains**, crucial for irrigation, drinking water, and hydropower.
- It rises from the **Chiantar Glacier** near the Pakistan-Afghanistan border in Gilgit-Baltistan. It flows east to west, originating in Pakistan's Chitral region, entering Afghanistan's Kunar and Nangarhar provinces, and re-entering Pakistan.

- It merges with the **Kabul River** near Jalalabad (Afghanistan), and this combined flow **joins the Indus River** near Attock (Pakistan).
- It forms a key part of the Indus basin, helping **agriculture and energy needs in northwestern Pakistan**.

PRACTICE QUESTIONS

Q1. Consider the following statements regarding India's "National Quantum Mission":

1. India is the first country in the world to have a dedicated mission for quantum technology.
2. Development of quantum computing will be aided by the National Supercomputing Mission.
3. Its implementation is overseen by the Ministry of Electronics and Information Technology (MEITY).

How many of the above statements are correct ?

- (a) Only one
- (b) Only two
- (c) All three
- (d) None

Q2. Consider the following Ramsar Sites of India and the states where they are located:

1. Gogabeel Lake: Bihar
2. Khecheopalli Lake: Assam
3. Aghanashini Estuary: Tamil Nadu
4. Yashwant Sagar: Maharashtra

How many of the above pairs are correctly matched ?

- (a) Only one
- (b) Only two

- (c) Only three
- (d) All four

Q3. The "Emissions Gap Report" is released annually by:

- (a) World Meteorological Organization (WMO)
- (b) United Nations Environment Programme (UNEP)
- (c) Intergovernmental Panel on Climate Change (IPCC)
- (d) Food and Agriculture Organization (FAO)

Q4. Consider the following rivers that are part of the Indus river basin:

1. Nubra
2. Kabul
3. Jhelum
4. Zaskar
5. Kunar
6. Chenab
7. Shyok

Which of the above rivers directly join the master stream of the Indus ?

- (a) 1, 3, 5 and 6
- (b) 2, 3, 6 and 7
- (c) 2, 4, 6 and 7
- (d) 1, 4, 5 and 6

Q5. Consider the following statements regarding India's population census:

1. The Census of India Act of 1948 mandates that a population census be held once every ten years.
2. The census is conducted by the Office of the Registrar General and Census Commissioner under the Ministry of Home Affairs.

Which of the above statements are correct ?

- (a) Only statement 1
- (b) Only statement 2
- (c) Both of the statements
- (d) None of the statements

Answers:

1. D
2. A
3. B
4. C
5. B

