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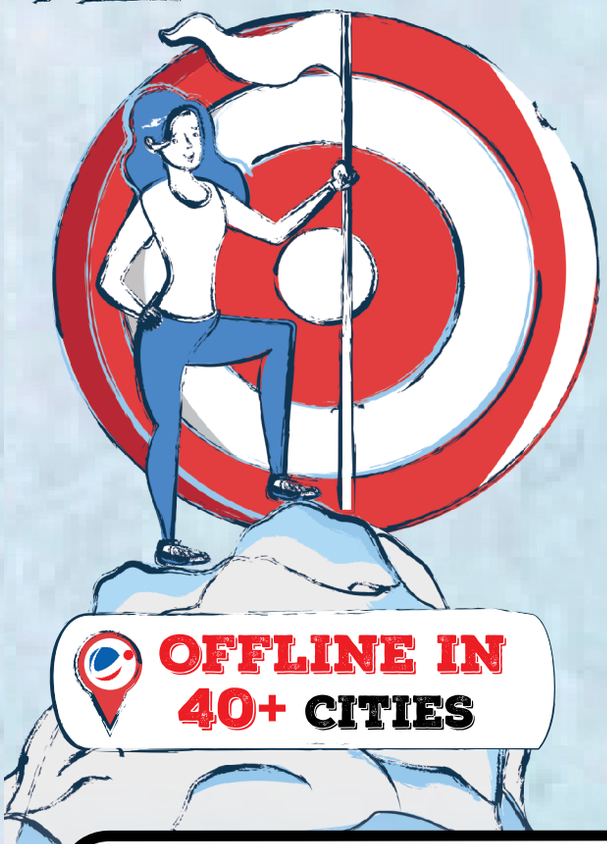
MAINS 365

SUMMARY
SCIENCE & TECHNOLOGY

AHMEDABAD BENGALURU BHOPAL CHANDIGARH DELHI GUWAHATI HYDERABAD JAIPUR JODHPUR LUCKNOW PRAYAGRAJ PUNE RANCHI



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Dear Students,

In the competitive landscape of the UPSC Mains examination, the **significance of integrating data, facts, examples and government initiatives** into your answers cannot be overstated.

These elements serve as the backbone of a compelling and persuasive response, **elevating your answer from a generic narrative to a well-substantiated argument.**

To support you, we have **distilled essential information from the VisionIAS Mains 365 resources** which are renowned for their comprehensive coverage of current affairs. This document pr**ovides a concentrated source of high-quality data, facts, examples and government initiatives.**

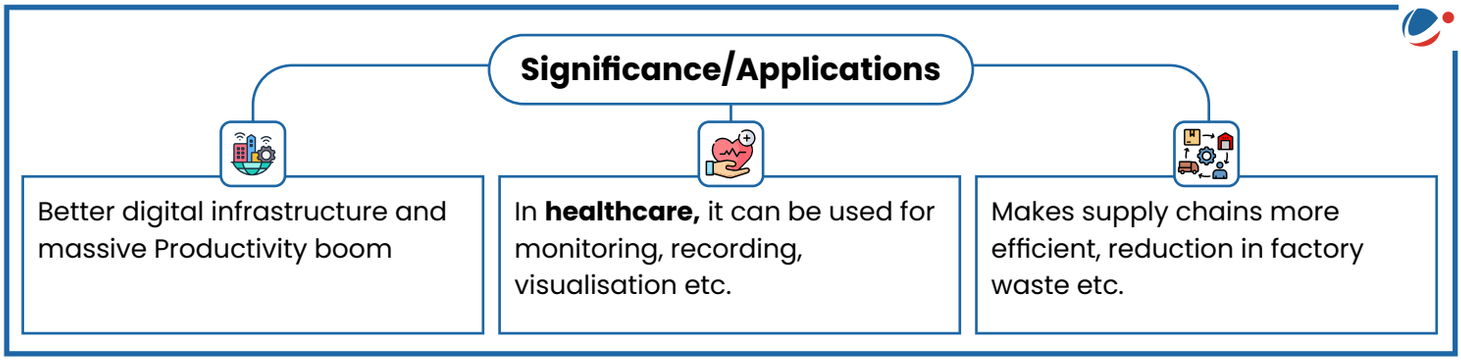
The layout of this document is designed for **quick reference and easy integration into your answer.**

Leveraging this distilled information will help you **craft comprehensive, informative, and compelling answers** essential for securing higher marks.

1. IT, Computer and Robotics

1.1. Fourth Industrial revolution (4IR)

- **Definition:** Refers to **digital transformation** of the manufacturing industry by new technologies such as AI, AM/3D Printing, augmented/virtual reality, and the **Internet of Things (IoT).**



- **Key Initiatives:**
  - Centre for the Fourth Industrial Revolution (India) in Maharashtra,
  - Smart Advanced Manufacturing and Rapid Transformation Hub (SAMARTH) - Udyog Bharat 4.0, etc.

Challenges/Concerns	Way Forward
◇ Increased **digital environment footprint.** ◇ **Cyber security challenges** include privacy issue, etc. ◇ **Other: Lack of skilled workforce,** etc.	◇ Enhancing **regulatory framework** ◇ **Developing ethical guidelines** ◇ **Investing in up skilling** and **reskilling**

1.2. Artificial Intelligence (AI) Technology

- **Definition:** Enables computers to **simulate human intelligence** and **problem-solving capabilities.** It includes learning, reasoning, problem-solving, and language understanding.

Key Applications	
Sphere	**Applications**
Agriculture	◇ **Intelligent crop planning** and **precision agriculture:** E.g. SENSAGRI, Sensor-based Smart Agriculture ◇ **Farmgate-to-fork:** E.g. Market-based intelligence, traceability and quality of logistics, etc.

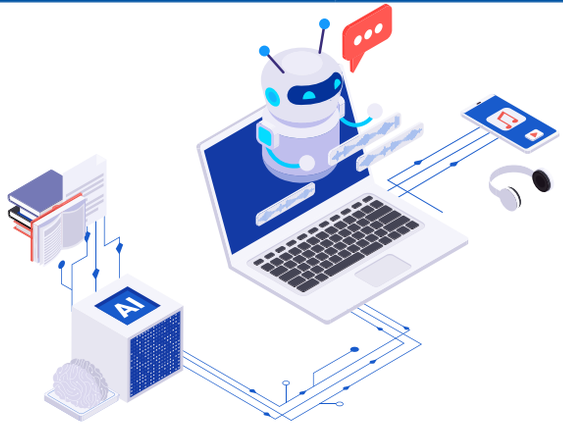
Health Care	◇ **Diagnosis** and **Treatment Planning:** E.g. S.A.R.A.H. Smart AI Resource Assistant, developed by WHO ◇ **Clinical research and discovery:** E.g. ProteinSGM, a Generative AI model from the University of Toronto is used for protein designing.
Defence	◇ **Border Security:** Detects border intrusions, target classification, etc. » **AI-based technologies** can be used for, logistics, UAV, advanced military weaponry, etc. ◇ **Warfare systems:** E.g. **Vista,** AI-controlled F-16 **(Fourth generation fighter jet** of the USA)

Key Initiatives

- India AI Mission
- **National Strategy on Artificial Intelligence (NSAI),** by NITI Aayog
- **National Artificial Intelligence Portal**

◇ **Key Measures for Regulation:** European Union's AI Act is world's first comprehensive AI law, Bletchley Declaration, Hiroshima AI Process (HAP) by G7, GPAI, etc.

Challenges/Concerns	Way Forward
◇ Internal workings of AI Based model are not known by users (black boxes) ◇ Lack of clear **regulations** and **guidelines** for applications. ◇ Infringing **Intellectual property rights**	◇ International Cooperation to establish basic global standards. ◇ Increased transparency by private actors ◇ **Better Design** to reduce degree and impact of bias ◇ Adopting **Asilomar AI Principles**



1.2.1. IndiaAI Mission

- **Aim:**
  - Establish an ecosystem for AI innovation through **public-private partnerships.**
  - Deploying over **10,000 Graphics processing units (GPUs)** for advanced AI computing infrastructure.
  - Driving **responsible, inclusive growth of India's AI ecosystem** through democratization, data quality improvement, and indigenous AI capabilities development.
- **Nodal Ministry:** Ministry of Electronics and Information Technology (MeitY).
- **Funding:** Over **5 years** through a public-private partnership model.
- **Implementing agency:** 'IndiaAI' Independent Business Division under Digital India Corporation.
- **Components:** Compute Capacity, Innovation Centre, Datasets Platform etc.
- **Pillars of IndiaAI and Related Schemes**
  - **AI in Governance:** BHASHa INterface for India, India Stack and AI
  - **AI Computer & Systems:** AIRAWAT, National Supercomputing Mission
  - **Data for AI:** Data Management Office, India Datasets Program and India Data Platform
  - **AI, intellectual property (IP) & Innovation:** Centre of Excellence for Artificial Intelligence
  - **Skilling in AI:** Future Skills Prime
  - **AI Ethics & Governance:** RAISE: Responsible AI for Social Empowerment, by MeitY

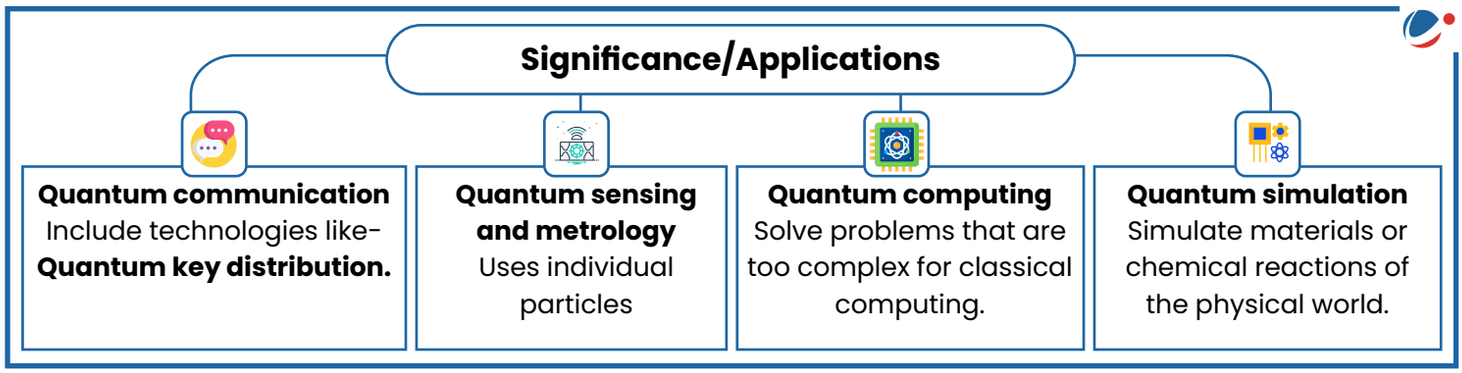
1.2.2. Deepfakes

- **Definition:** Refers to a video/image that has been **edited** using an **algorithm** to replace a person in the original video/image with someone else, in a way that makes the video look authentic.
- **Regulatory measures:** No specific legal provisions
  - However, some laws indirectly address deepfake, viz., **Section 66E and 66D** of the IT Act of 2000, **Indian Copyright Act of 1957** etc.

Challenges/Concerns	Way Forward
◇ **Damaging content (breach of personal data)** ◇ **Weaponization against Women** (Women form about **90% of the victims)** ◇ **Crisis of Authenticity** (Misinformation and Disinformation), ◇ **Lack of Regulation** etc.	◇ **Establish** and **update laws and regulations** ◇ Ensuring **responsibility** and **Accountability** of **social media platforms** ◇ **International Cooperation** (for shared standards and protocols) ◇ **Invest in Research and Development** (detection methods) etc.

1.3. Quantum Technology

- **Definition:** An emerging field powered by the principles defined by quantum mechanics, a subfield of physics that explains the nature and behaviour of matter and energy on the atomic and subatomic level.

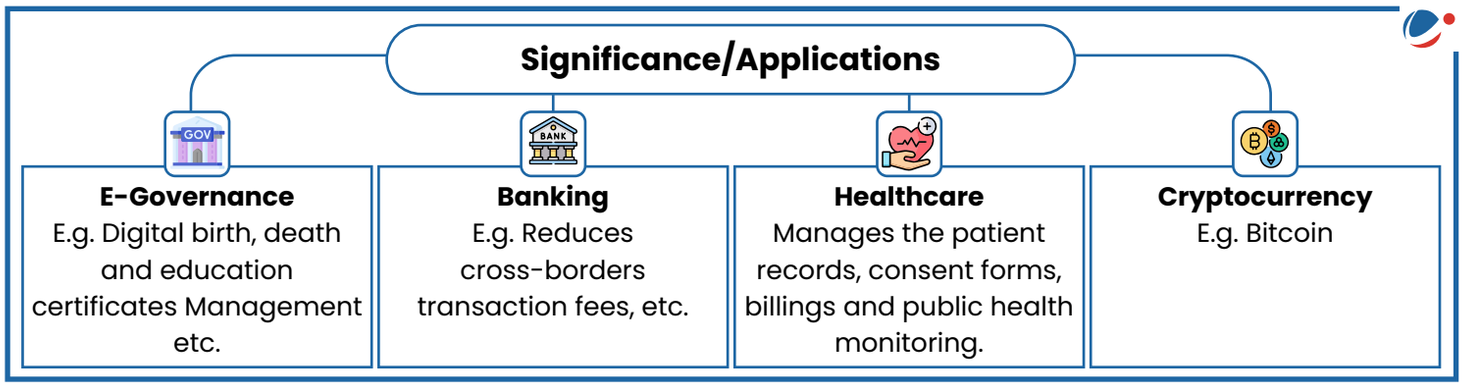


- **Key Initiative:**
  - National Quantum Mission
  - National Mission on Quantum Technologies & Applications (NMQTA)
  - Quantum Frontier Mission of PM-STIAC etc.

Challenges/Concerns	Way Forward
◇ Difficulty in achieving and maintaining quantum **superposition** and **entanglement.** ◇ **Absence of indigenous development** of critical quantum components. ◇ Spending on R&D is about 0.64 % of GDP.	◇ Establishing **dedicated centres** for research ◇ Setting priorities to **safeguard national security** such as investing in post-quantum cryptography. ◇ Promoting **domestic manufacturing facilities**

1.4. Blockchain Technology

- **Definition:** Blockchain is a shared, **immutable ledger** that facilitates the process of **recording transactions** and tracking assets in a business network.

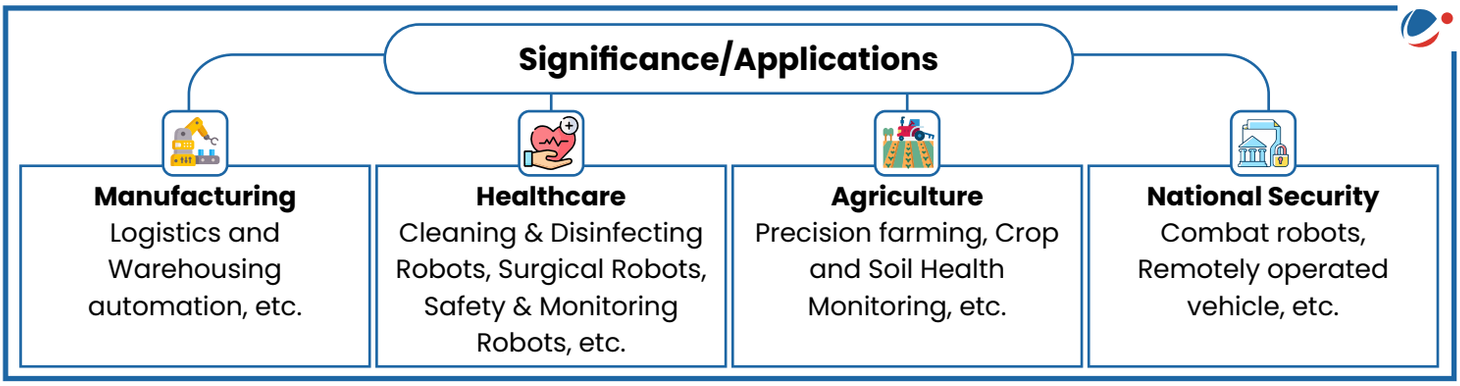


- **Key Initiatives:**
  - **National Strategy on Blockchain,** 2021 (by MeitY)
  - India's first Blockchain District has been conceptualized in Telangana, etc.

Challenges/Concerns	Way Forward (National Strategy on Blockchain)
◇ Variable requirements for processing power, etc. affect their **scalability.** ◇ Decentralized storage on every node creates privacy challenges. ◇ **Localization hurdles** as data redundancies are stored across all nodes	◇ A **National Level Blockchain Framework (NLBF)** ◇ Integration of **National Level Services** to Blockchain such as eSign, etc. ◇ Capacity building by conducting short term courses

1.5. Robotic Technology

- **Status:** In terms of annual industrial installations, India ranks 10th globally as per the World Robotics Report, 2022 **(Draft National Strategy for Robotics (NSR)).**

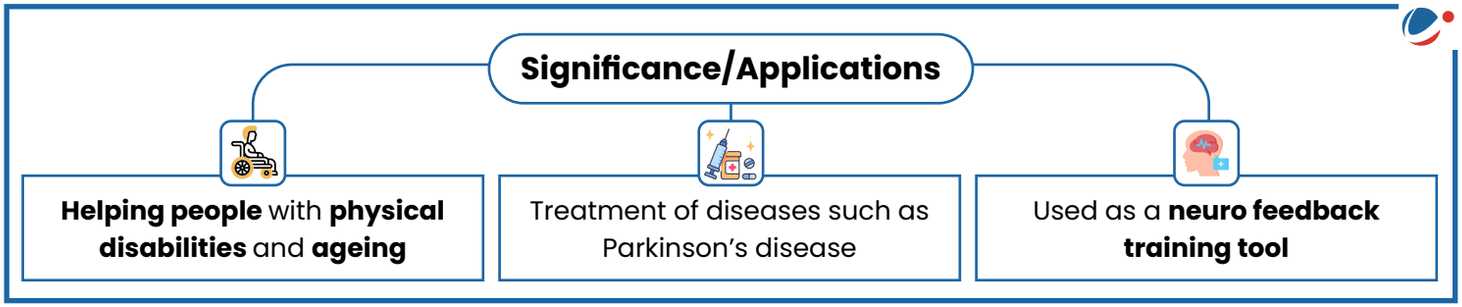


- **Key Initiatives: Draft National Strategy for Robotics (NSR),** by MeitY; Center for Advanced Manufacturing for Robotics and Autonomous Systems (CAMRAS), etc.

Challenges/Concerns	Way Forward (National Strategy on Blockchain)
◇ Difficult to replicate **human-like sensory perception** ◇ **Limited Governance Mechanisms** (Absence of separate robotics legislation) ◇ Lack of **reliable & continuous** access to **foundational infrastructure**	◇ Setting up and managing the **Robotics Innovation Unit (RIU)** network ◇ **Develop demonstrations** and test platforms. ◇ Undertake exploratory research through mission mode **moonshot projects**

1.6. Brain–Computer Interface (BCI)

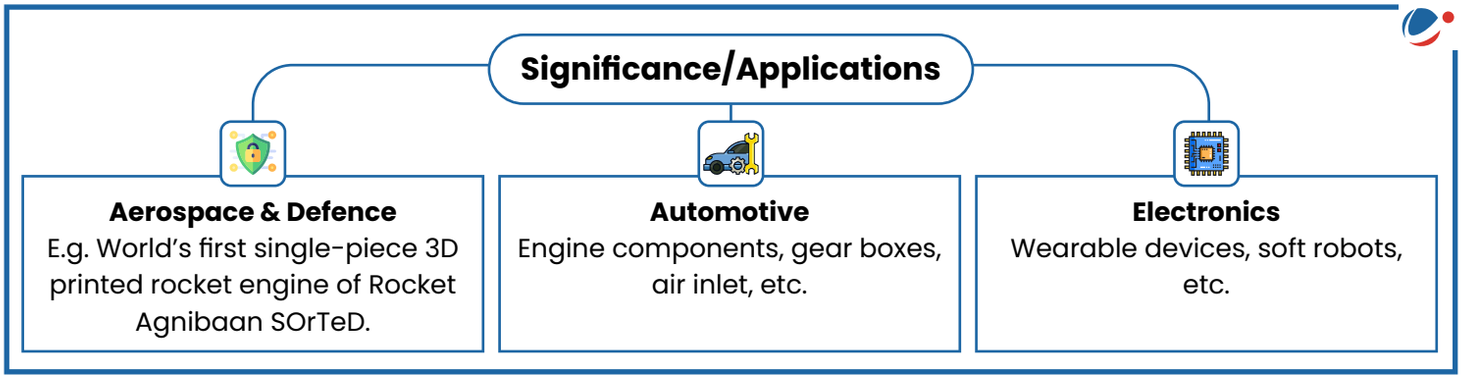
- **Definition:** A system that determines **functional intent -** the desire to change, move, control, or interact with something in our environment - directly from brain activity.
  - » BCIs allow controlling an application or a device using only our mind.



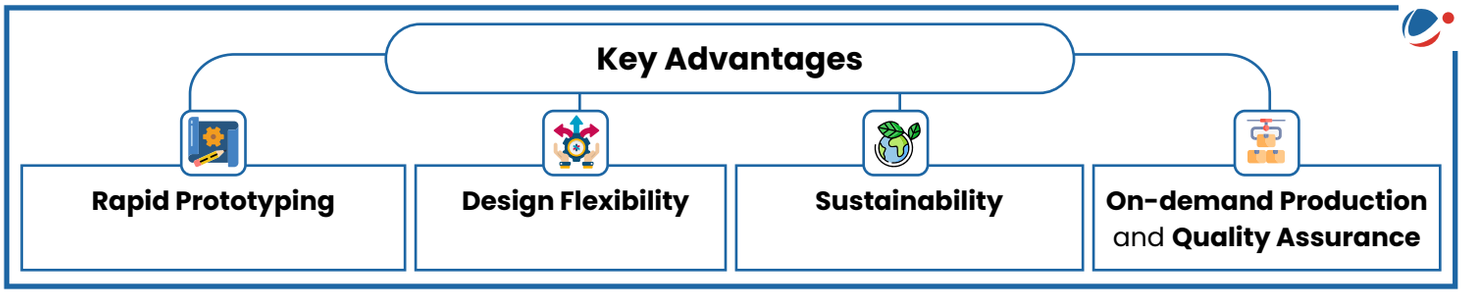
- **Concerns:** Fear of **inaccurate mapping,** Vulnerable to **cyberattacks,** may influence other brain functions, or cause any unwanted side effects such as seizures, headaches, etc.
- **Conclusion:** BCI will play significant role in in dealing with many health related issues which are not being tackled at present time. However, it needs to be implemented after assessing it side-effects.

1.7. 3D Printing Technology

- **Definition:** 3D Printing Technology or Additive manufacturing (AM) is the technology that constructs a **three-dimensional object** from a digital 3D model by **adding material layer by layer.**



- **Key Initiatives:**
  - » **National Strategy for Additive Manufacturing, 2022** by MeitY,
  - » **National Centre for Additive Manufacturing,** set up by MeitY in collaboration with the Telangana, etc.

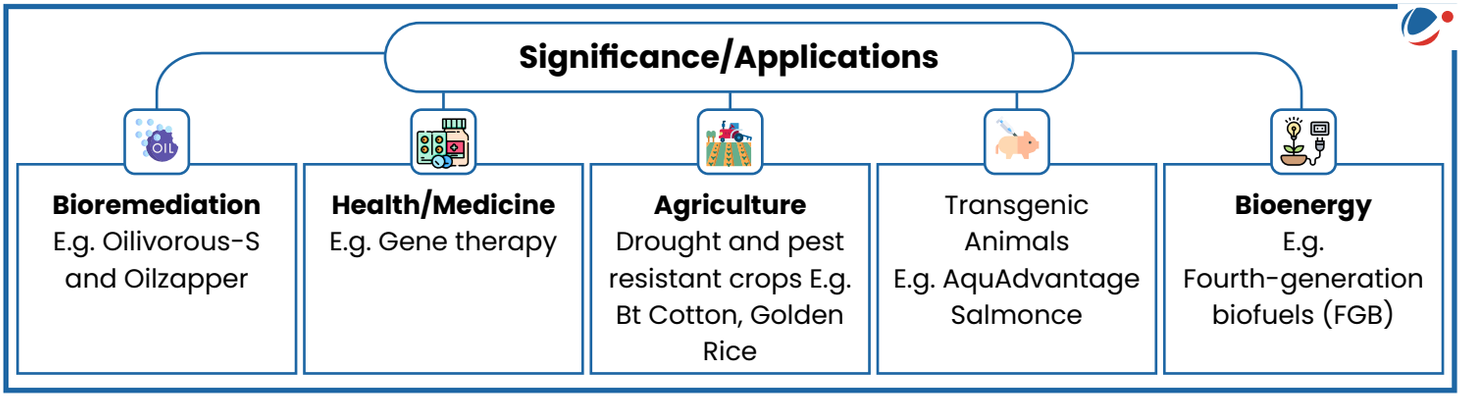


- **Challenges/Concerns:** Limited Materials, Initial investment in equipment is substantial, Layers can delaminate under stress etc.
- **Way Forward**
  - Promoting linkage between research institute and enterprises.
  - **Adopting governance mechanism** to define standards

2. Biotechnology, Nanotechnology and Issues Relating to Intellectual Property Rights

2.1. Biotechnology

- **Definition:** Area of Biology that uses **living processes, organism** or **systems** to manufacture products intended to improve quality of human life.

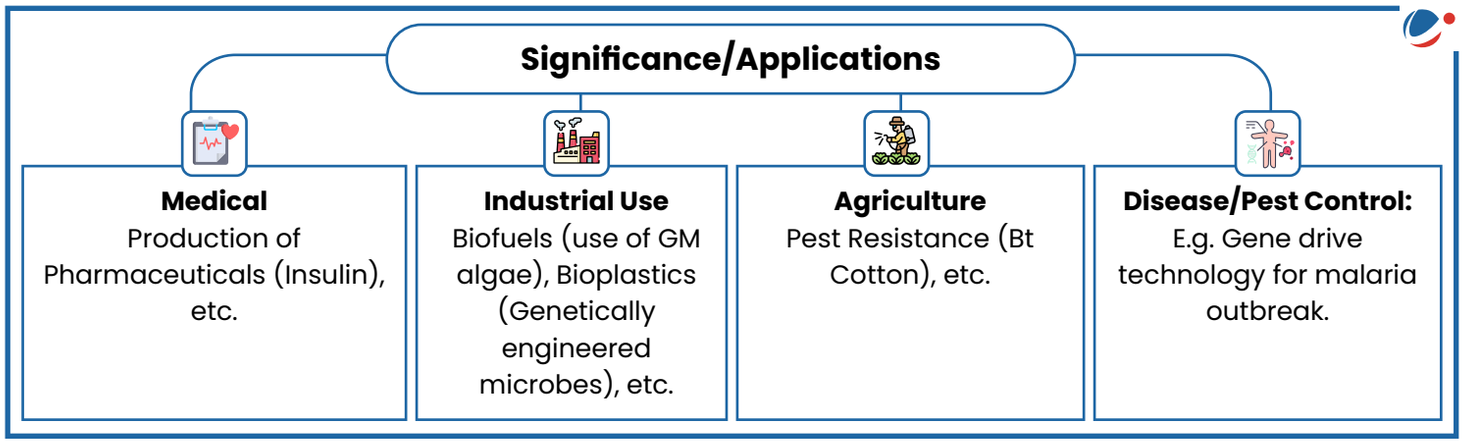


- **Key Initiatives:** Biotechnology Industry Research Assistance (BIRAC), a PSU of DBT; National Biopharma Mission (NBM); Biological Research Regulatory Approval Portal (BioRRAP); etc.

Challenges/Concerns	Way Forward
◇ Lack of **Regulatory Mechanism** ◇ **Ethical Issues:** E.g. Bio piracy, Designer Babies, Human clinical trials, safety issues of GMO ◇ **Environmental Issues:** Unintended consequences on environment and genetic variability.	◇ **Increase in investment** towards R&D ◇ **Building capacities** both human resource and infrastructure to cater to the current needs ◇ **Collaboration between government and industry** for improving IP regime.

2.1.1. Genetically Modified Organism

- **Definition:** A genetically modified organism (GMO) is any living organism whose genetic material has been modified to include certain desirable techniques.

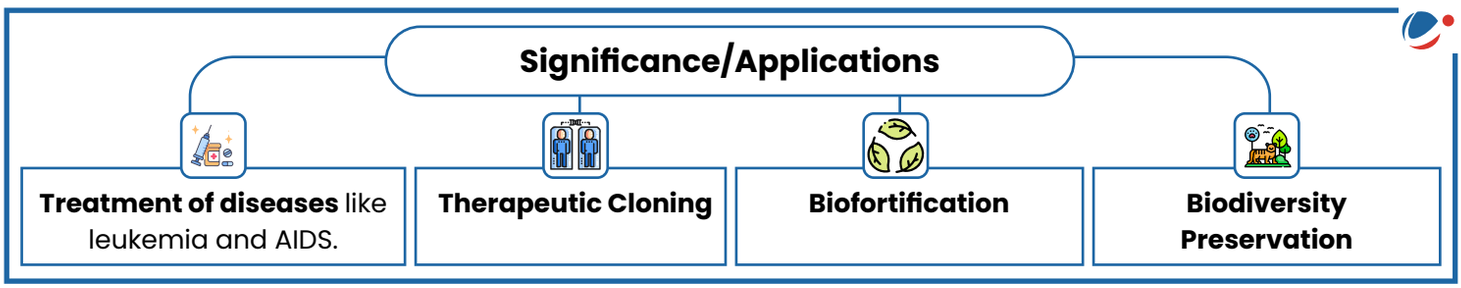


- **Regulation**
  - Environment Protection Act 1986 (EPA)
  - Genetic Engineering Appraisal Committee
  - Biological Diversity Act, 2002
  - Codex Alimentarius Commission (Codex)
  - Cartagena Protocol on Biosafety

Challenges/Concerns	Way Forward
◇ GMOs can potentially **outcompete** or **crossbreed** ◇ Introduction of **new allergens** or **toxins** into the food supply ◇ **Regulation** differs in each country.	◇ **Conduct** field **demonstration** studies ◇ **Following Bioethics, environmental ethics** & **Research ethics** ◇ **Risk assessments** to determine the possible consequences of their use.

2.2. Gene Editing

- **Definition:** It is a way of making **specific changes to the DNA of a cell or organism.** This allows genetic material to be added, removed, or altered at particular locations in the genome.

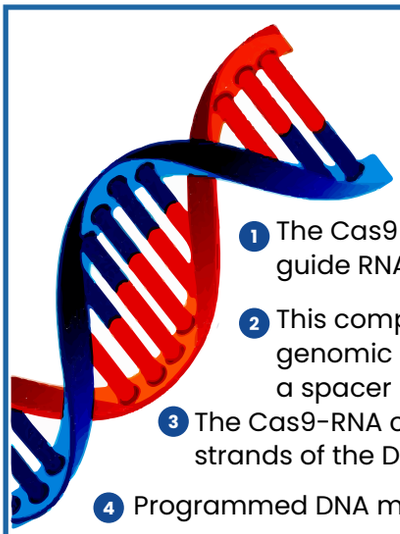


Challenges/Concerns	Way Forward
◇ **Ethical Dilemma** (rise of designer babies, etc.) ◇ **Safety concerns** ◇ **Potential loss to diversity** ◇ **Health risks** (could cause allergic reactions)	◇ Promoting **Altruistic Science** ◇ Human germline editing should be permitted only when there is no reasonable alternative ◇ **Robust policy framework** to ensuring accountability and self-regulation

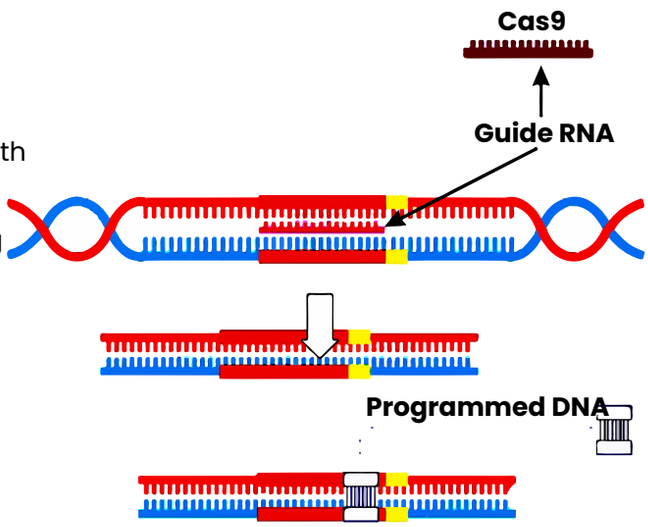
2.2.1. CRISPR-Cas9

- **Definition: CRISPR (Clustered Regularly Interspaced Short Palindromic Repeats)/Cas9** is used to modify gene function, to change genetic code or edit DNA at particular locations.
- **Applications of CRISPR:** Edit genes in human embryo; **Change genetic codes of crops** to improve crop resilience; creating new therapies for **Cancer treatment & sickle cell diseases** etc.

How CRISPR works



1. The Cas9 protein forms a complex with guide RNA in a cell
2. This complex attaches to a matching genomic DNA sequence adjacent to a spacer (Yellow Segment).
3. The Cas9-RNA complex cuts the double strands of the DNA
4. Programmed DNA may be inserted at the cut



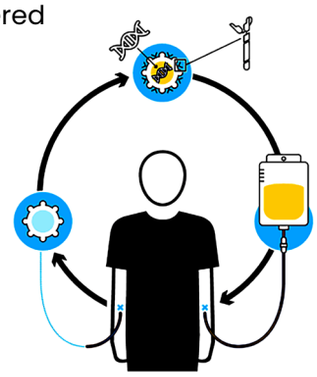
2.2.2. CAR-T cell therapy

- **Definition:** A type of **cellular immunotherapy treatment** that uses T cells that are genetically altered in a lab to enable them to locate and destroy cancer cells more effectively.
  - **NexCAR19 (Actalycabtagene autoleucel)** is India's first indigenous CAR-T cell therapy.

How CAR-T Works

2. The T cells are genetically engineered in a laboratory by introducing proteins called **chimeric antigen receptors (CARS).**

1. Blood is drawn from the patient to extract a **type of white blood cell**-the body's natural disease destroyer-called **T cells.**



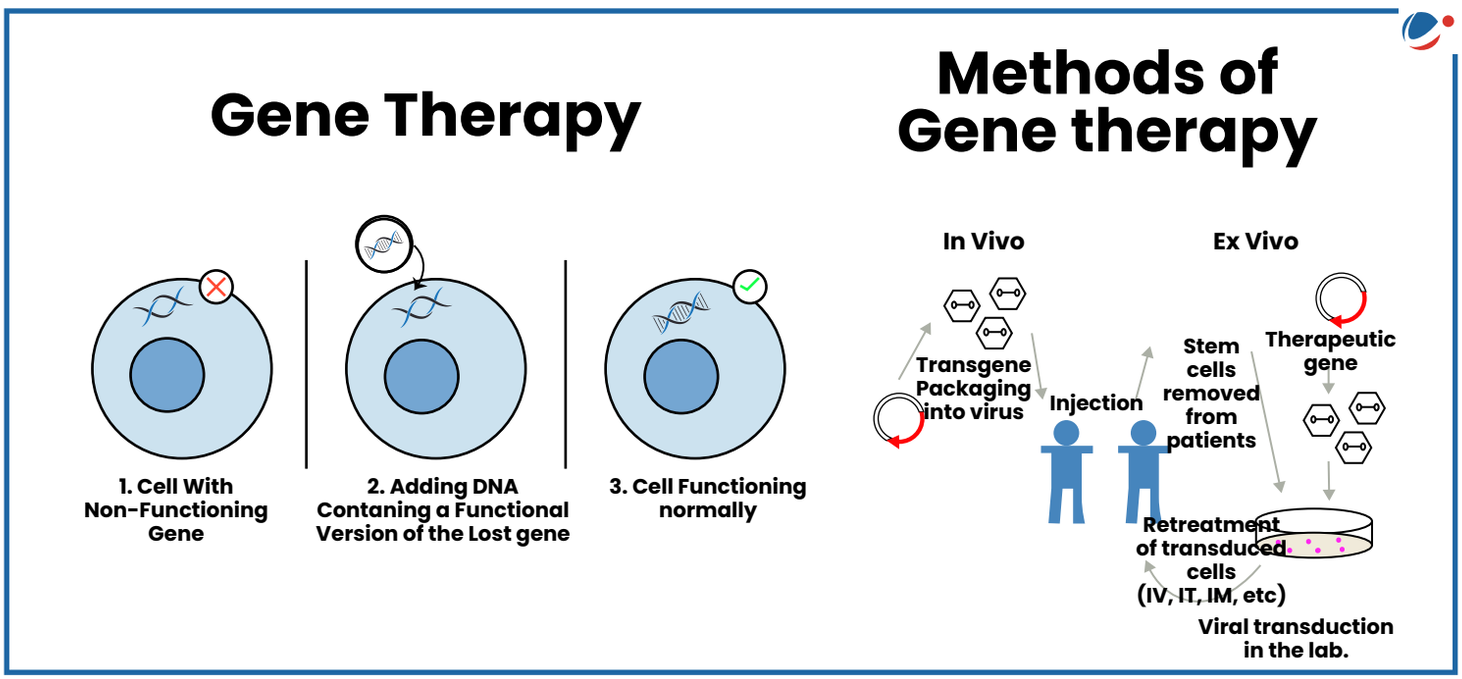
3. The **engineered CAR-T cells** can now identify and home in on cancer cells. They latch on & are triggered to destroy the cancer cells.

4. The **CAR-T cells** are multiplied in the lab and infused into the patient by the millions to attack cancer.

- **Key Challenges/Concerns:**
  - **Cytokine Release Syndrome (CRS)**
  - **Neurological Toxicity** leading to confusion, seizures, or other neurological issues.
  - **Patient Eligibility** factors such as age, overall health can impact eligibility
  - **Other issues:** high cost, Limited Applicability etc.
- **Conclusion:** There is need for enhanced safety profiles for minimizing severe side effects such as cytokine release syndrome and increased accessibility by intregating it in healthcare system.

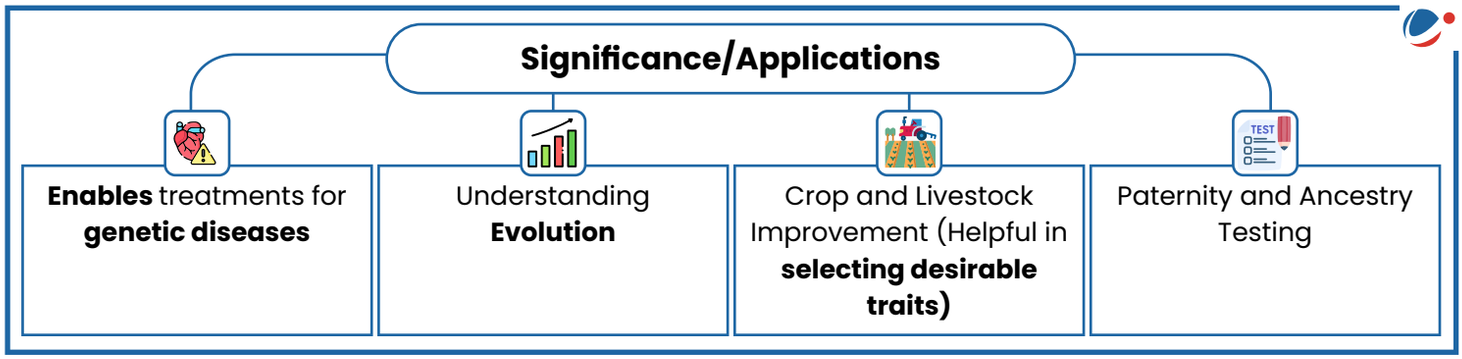
2.2.3. Gene Therapy

- **Definition:** A technique that **uses a gene(s) to treat, prevent, or cure a disease** or medical disorder.
  - In most gene therapy, a **normal gene is inserted into the genome** to supplement an abnormal disease-causing gene and **restore target cell to a normal state.**
- **Application:** Both **inherited genetic diseases** (e.g., haemophilia and sickle cell disease) and **acquired disorders** (e.g., leukaemia) could be **treated** with gene therapy.



2.3. Genome Sequencing

- **Definition:** Determining the exact order of base pairs in a strand of DNA in an individual.

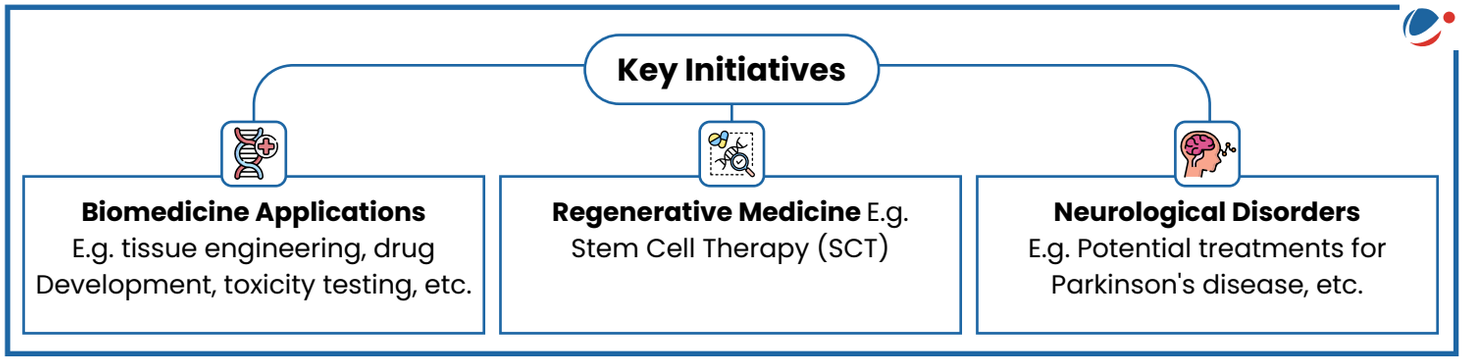


- **Key Initiatives:**
  - **GenomeIndia Project,** inspired by **Human Genome Project (1990) and** launched by DBT.
  - **IndiGen programme,** whole genome sequencing of diverse ethnic groups from India, funded by CSIR.
  - **Global Alliance for Genomics and Health (GA4GH)**

Challenges/Concerns	Way Forward
◇ **Lack** of **regulatory framework** ◇ **Fragmentation of genetic data** ◇ **Privacy and data issues** (sensitive information such as personal data, medical and family history) ◇ Cyber threats, Problems of sample contamination and viable run quality etc.	◇ Establish **clear regulations** ◇ **Prioritize genomic research funding** and establish centralized sequencing facilities ◇ **Develop advanced training programs** for researchers ◇ Improved access of up-to-date genomic data and **open access publication models.**

2.4. Stem Cell

- **Definition:** Stem cells are **special human cells** that are able to **develop into many different cell types** such as muscle cells, blood cells, and brain cells.



Challenges/Concerns	Way Forward
◇ Immune rejection of donor cells by host immune system ◇ Use of embryos for human embryonic stem cell ◇ **Limited technology:** To generate large quantities of stem cells.	◇ **Better regulation** for **basic, clinical research** and product development ◇ **Informed consent** for trials ◇ **Addressing ethical dilemma** by **developing guidelines** (like India's **National Guidelines for Stem Cell Research**)

2.5. Nanotechnology

◇ **Definition:** Refers to the design, characterization, production and application of structures, devices and systems by controlling shape and size at the nanoscale.

Key Applications	
Sphere	**Applications**
Agriculture	◇ **Nanofertilizers** and **Nanopesticides:** E.g., **Nano Silver** ◇ **Nanobiosensors** ◇ **Crop Protection:** E.g. **Silica nanoparticles**
Health Care	◇ **Clinical investigation,** e.g., **Gold nanoparticle** ◇ **Better imaging tools** ◇ **Drug delivery,** hydrophobic and hydrophilic drugs
Environment	◇ **Sustainable Production:** Green chemistry; ◇ **Pollutant sensing:** detects contaminations ◇ **Water treatment:** Graphene filters ◇ **Reduced energy Consumption**
Defence	◇ **Nano-Enhanced Sensors:** Detect chemical and biological weapons. ◇ **Body Armour:** Silicon dioxide nanoparticles ◇ Supports **Nano medicines** ◇ **Advanced weapon/ equipment**

◇ **Key Initiatives:**

» **Nano Science and Technology Initiative (NSTI),** 2002

» **Mission on Nano Science and Technology (Nano Mission),** 2007

» **Nano-electronics Innovation Council** set up by MeitY

Challenges/Concerns	Way Forward
◇ Nano particles may easily **enter the lungs.** ◇ Nanoparticles can form new form of non-**biodegradable pollutants.** ◇ **Ethical Concern** (Nano particles may be used in warfare, invade people's privacy etc.)	◇ **Promoting Academy** and **Industry Linkage** ◇ **Coordination** with **various international/ inter-governmental organizations** ◇ Increasing funding of **Nano Mission** and establishing more dedicated institutes.

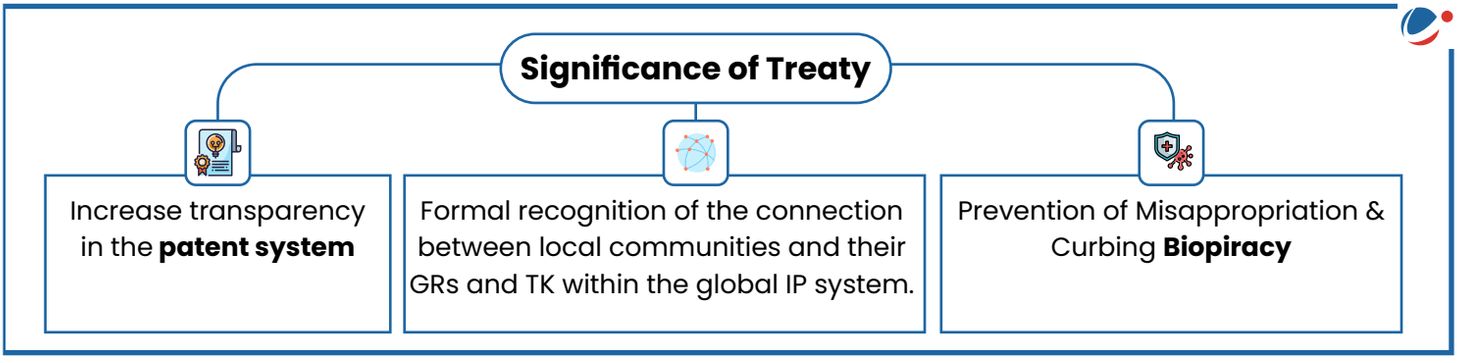
2.6. Traditional Knowledge and Genetic Resources (GRs) in India at a Glance

- **Definition:** Knowledge system held by indigenous communities
- **Measures:** Traditional Knowledge Digital Library (TKDL), India's Patent Act, 1970, Biological Diversity Act, 2002 (in line with Convention of Biodiversity), Forest Rights Act 2006, Ministry of AYUSH

Concern	Way Forward
◇ **Biopiracy** ◇ **Lack** of **Documentation** ◇ Inadequate **Global Legal Framework** ◇ Insufficient **Conservation of biodiversity**	◇ **Establishing agricultural research programmes** and **centres** ◇ **Setting up** or **promoting herbal gardens** ◇ **Curriculum for schools,** universities

2.6.1. Treaty on Intellectual Property, Genetic Resources and Associated Traditional Knowledge

- **Key provisions of Treaty:** Mandatory Patent Disclosure Requirements (PDRs), Mandatory legal, administrative, and/or policy Framework at national level, Establishment of information systems.



3. AWARENESS IN THE FIELD OF SPACE

3.1. India's Race to Space

- **Definition: Space race** is an outgrowth of mid-20th-century Cold War over who could conquer space exploration first.

Emerging trends of Indian space sector	Implication of India's enhanced role
◇ **Growing commercialization:** E.g. Agnikul Cosmos and Skyroot ◇ **Increasing international collaborations: 381 Foreign satellite** launched from 1999- 2022. ◇ **Focus on challenging missions:** Mangalyaan Mission and Soft land on lunar's south pole. ◇ **Development of new technologies:** Reusable launch vehicles	◇ **Geopolitical significance:** India's rising capabilities to support a commercial space ◇ **India as a space start-up hub:** Home to almost 190 registered space-tech start-ups ◇ **Leading nation for satellite launches:** With a success rate of almost 95%, ◇ **Outer Space use for national security:** ASAT capability

3.2. Indian Space Policy – 2023

- **Vision of Space Policy 2023:** To augment space capabilities; Develop a flourishing commercial presence in space; use space as a driver of technology development; etc.

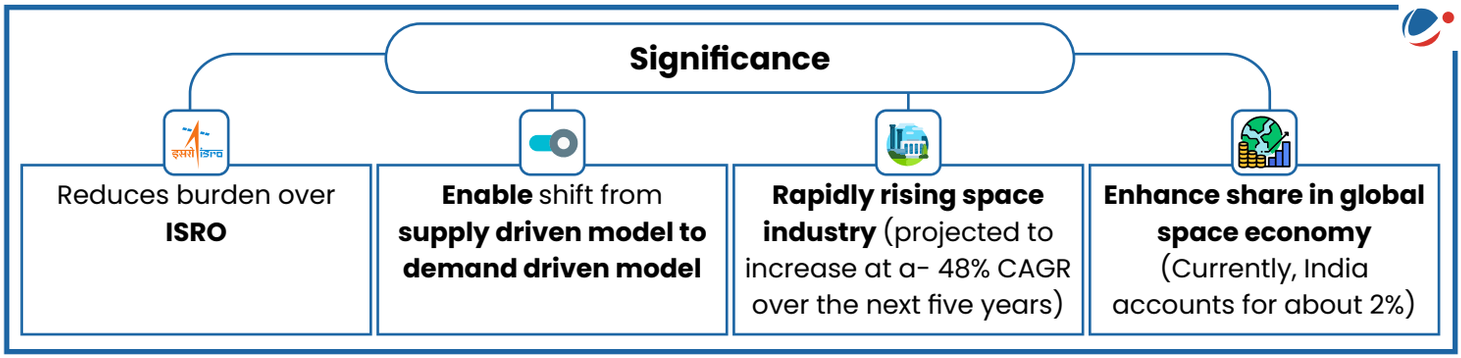
Stakeholder	Role
Government	◇ **Research & Development** and **predictable regulatory framework.**
Non-Governmental Entities (NGEs)	◇ Offer national and international **space-based communication services.** ◇ Establish and **operate Ground facilities for space object** operations, e.g. Satellite Control Centres (SCCs), Remote sensing satellite systems.
Department of Space (DOS)	◇ **Nodal department** for implementation of the Indian Space Policy-2023.
ISRO	◇ Focus **research and development, Share technologies** with NGEs
IN-SPACe-	◇ **single window agency** for the authorisation of space activities by govt
NSIL	◇ **Commercializing space technologies and platforms**

Significance of Space Policy 2023:

- **Delineates specific roles for major stakeholders**
- Collaborate globally in **addressing global challenges**
- Sets stage for India's expanded **participation in global space arena**
- **Facilitating technology transfers**

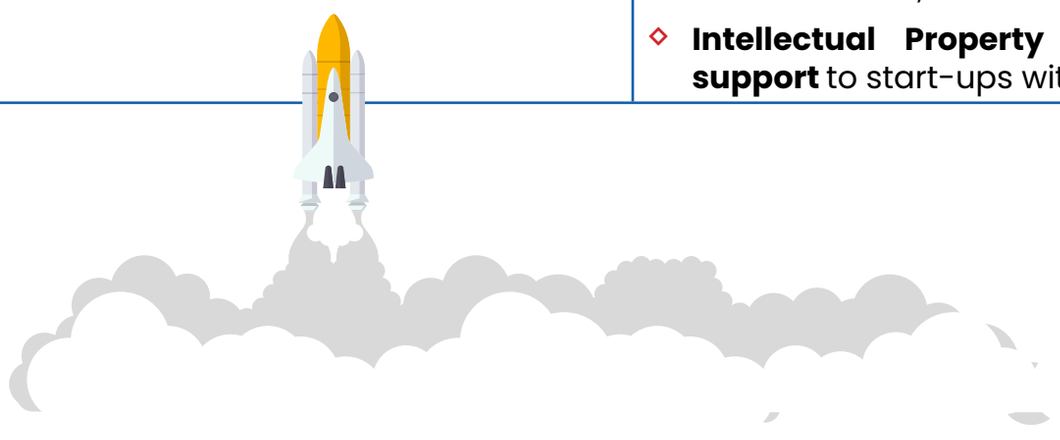
3.3. Private Sector in Space

- Space Start-ups increased to **nearly 200 in 2024 from 1 in 2022. (Economic survey 2023-2024)**



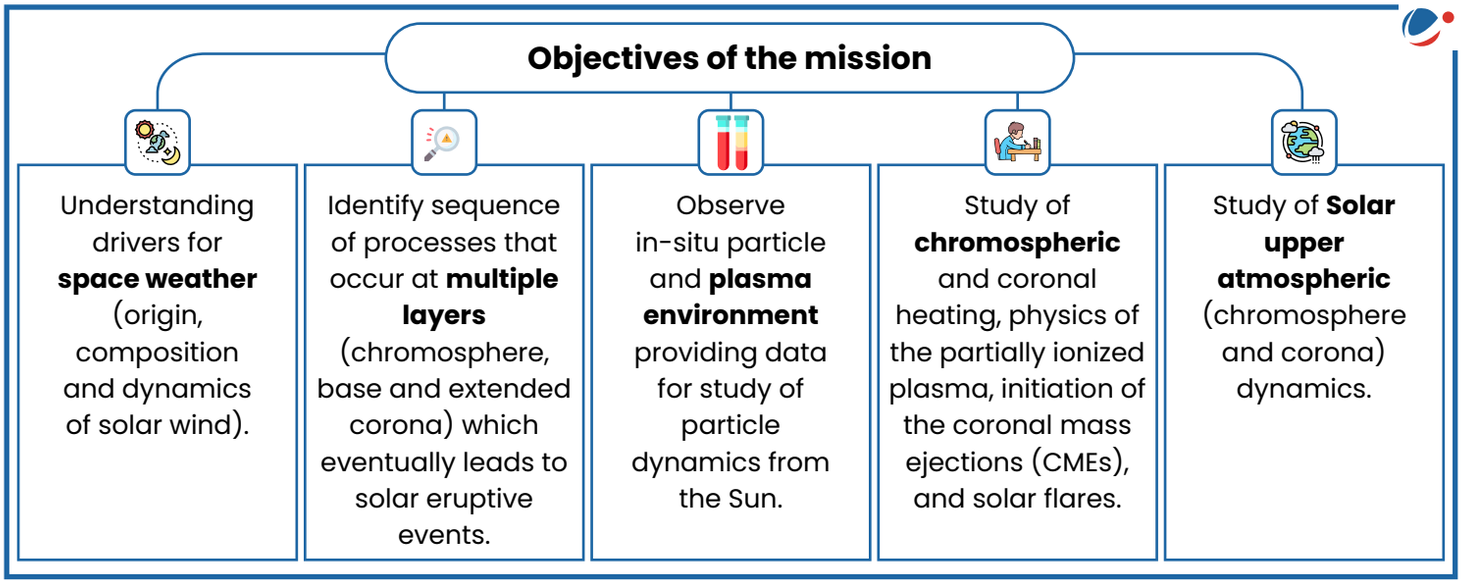
- **Initiatives:** Indian Space Policy 2023, IN-SPACe, New Space India Limited, Budget 2024–25 announced Rs 1,000 crore venture capital fund.

Challenges/Concerns	Way Forward
◇ **Multiplicity of regulations:** approvals needed from Department of Space, ISRO, Antrix etc. ◇ **Increase in space debris:** 26,000 are pieces of debris that are larger than 10 cm in size. ◇ **Security and strategic concern:** possible leak of confidential information.	◇ **Regulatory clarity:** To remove barriers for private firms and better synergies with ISRO. ◇ **Promoting satellite manufacturing:** PLI scheme for satellite manufacturing. ◇ **Handhold private sector:** ISRO can act as an enabler by technology transfer, collaborations, ◇ **Intellectual Property (IP) protections, support** to start-ups with critical items



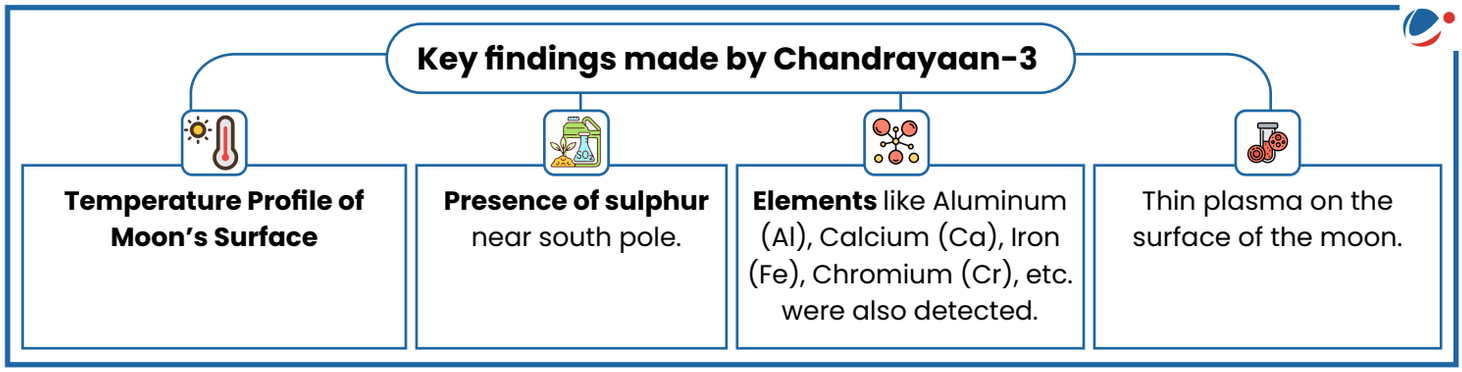
3.4. Aditya-L1

- **About: Aditya – L1 carries 7 payloads** (5 by ISRO and 2 by Indian Academic institutes)
- Out of 7, four of will carry out remote sensing of the Sun and three will do in-situ observation.
  - **Remote sensing payloads:** VELC, SUIT, SoLEXS, HEL1OS
  - **In-situ payloads:** ASPEX, PAPA, Advanced Tri-axial High Resolution Digital Magnetometer



3.5. Chandrayaan-3

- **Chandrayaan-3 objectives:** Demonstration of a Safe and Soft Landing on the Lunar Surface, **Demonstration of Rover roving** on the moon & Conduct **in-situ scientific experiments.**

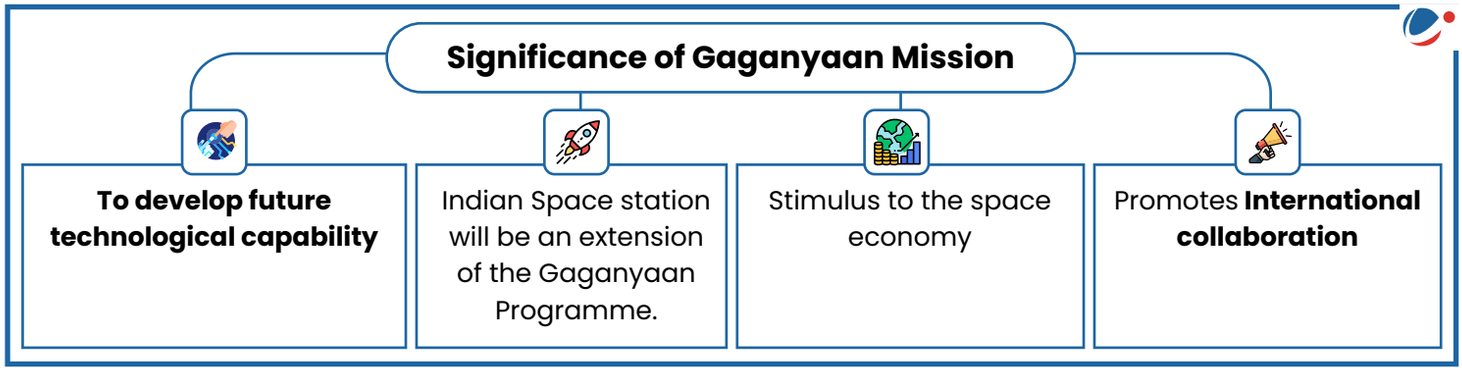


Implications of Findings

- Presence of a volatile substance like water ice and could prove **critical for lunar habitation.**
- **Measurements of Lunar Plasma** potentially assist in mitigating noise that lunar plasma introduces into radio wave communication.

3.6. Gaganyaan Mission

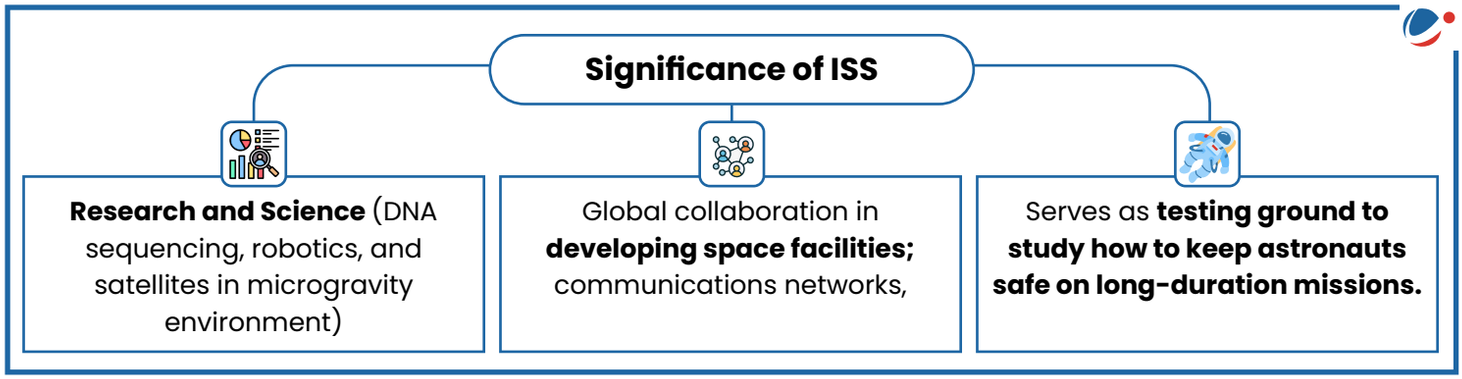
- **Objective:** Demonstration of human spaceflight capability **(3 member crew to orbit of 400 km for 3-day mission)** and bringing them back safely to earth, by landing in Indian sea waters.



- **Challenges:** Development of Indigenous technology, Human health and safety, Training of astronauts, Budget constraints.

3.7. International Space Stations (ISS)

- **About: Habitable artificial satellite,** in low Earth orbit (at an altitude of between 370–460 km).
  - **Key partners for ISS:** European Space Agency, NASA, Japan Aerospace Exploration Agency, Canadian Space Agency, Roscosmos



About Bharatiya Antariksha Station: India's own Space Station

- **First tests of the proposed Bharatiya Space Station in 2025** and talks are on with the industry to **manufacture, test and launch its first module by 2028.**
- **Benefits:** Advancing scientific knowledge, enhancing the nation's prestige, promoting global co-operation & peace etc.
- **Challenges regarding Indian space station:**
  - **Station building is costly endeavor:** India's R&D expenditure-GDP ratio is low (0.7%).

- **Need of expertise in human spaceflight:** India will have to train a team of astronauts and ensure their safety and well-being in space.
- **Upgrade needed in ISRO's technological infrastructure**

3.8. Developmental Role of ISRO

Food security and Agriculture	◇ **E.g. Resourcesat-2 Sattelite** ◇ **FASAL Project** & **CHAMAN Project**
Rural Development	◇ **Village Resource Centers (VRCs),** IWMP, **GeoMGNREGA** etc.
Urban Development	◇ **e.g. Use of geospatial data in AMRUT scheme.**
Water Management	◇ **Satellite with ARGOS and ALTIKA (SARAL)**
Railways	◇ **Navigation with Indian Constellation (NavIC) and Bhuvan**
Weather Forecasting	◇ **INSAT and earth observation satellites, IMD**
Disaster Management	◇ Development of **Flood Early Warning System (FLEWS) in Assam**

3.9. Space Habitation

◇ **Definition:** It refers to **setting up of habitation for humans beyond earth** such as on Moon, Mars etc.

Benefits from Space Habitation

Scientific
- We might find **answer to** the question on existence of extraterrestrial life.
- **Inspiration to scientific community as well as kids** to generate interest in science and future space exploration.

Economic
- **Raw materials** such as gold, silver, platinum, etc. could be harnessed from space bodies.
- **Development of habitation technology** opens up new sectors such as life support, radiation shields, etc. which can generate employment opprotnuities.

Address global challenges
- Enhanced global partnerships and exploration capabilities may help advance **international preparedness for protecting the Earth from catastrophic** events such as some asteroid strikes.
- Advancing collaborative research on **space weather and protecting spacecraft by developing new means for space debris removal.**

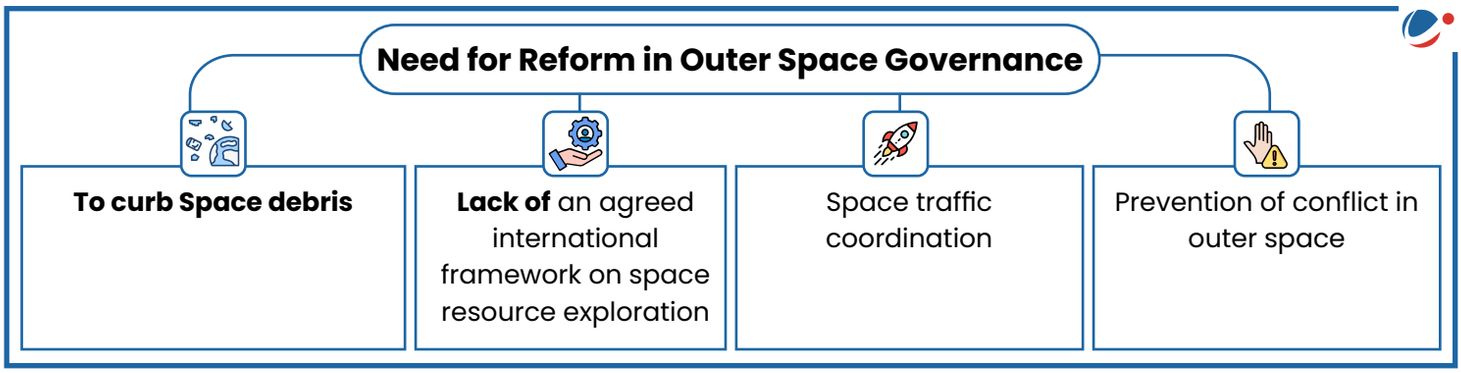
Spinoff benefits
- **Inventions of new materials** for space habitation can help people in other aspects of life (eg. Nitinol used for satellites are being used by orthodontists now)

- **Issues associated:**
  - Enormous Costs, Managing oxygen, food, medical supplies etc.,
  - **Health Implications:** Cosmic radiation, lack of a breathable atmosphere etc.,
  - **Environmental Modification:** possibility of triggering the **Kessler syndrome,**
  - Lack of Legal Regulation and ethical concerns (such as Damage to the value of alien planets, afforded by limited people, etc.), etc.

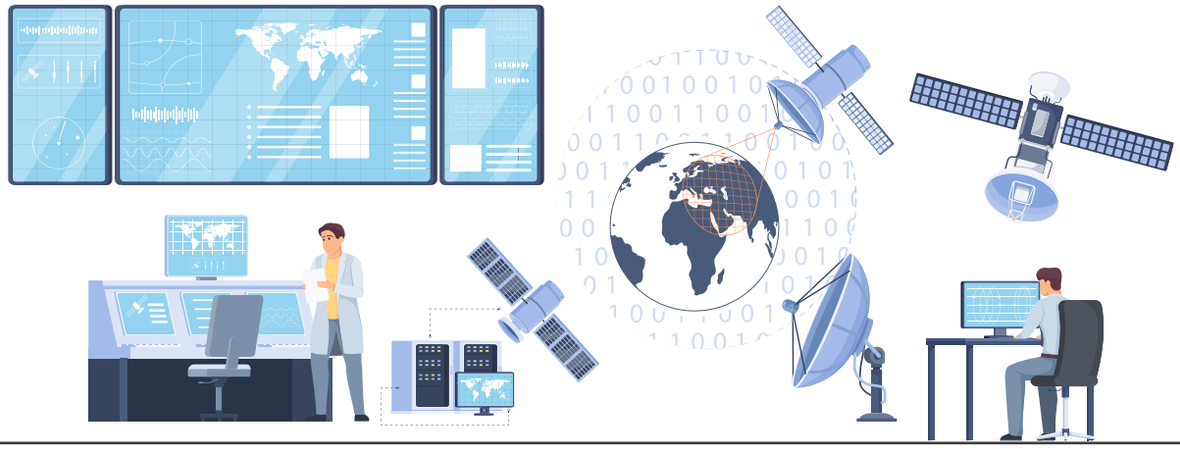
3.10. Outer Space Governance

Existing Outer Space Governance Framework

- **Outer Space Treaty 1967:** Principles Governing Outer Space,
- **Rescue Agreement 1968:** Agreement on t Rescue of Astronauts, Return of Astronauts.
- **Liability Convention 1972**
- **Registration Convention 1976**
- **Moon Agreement 1979:** Agreement Governing Activities of States on Moon and Other Celestial Bodies.
  - India is **signatory to all five treaties but** India has **not ratified Moon agreement.**



- **Conclusion:** United Nations in its policy brief document titled **'For All Humanity – the Future of Outer Space Governance'** recommended measures to improve outer space governance such as develop norms and principles for space debris removal, enacting new treaty to ensure peace, security, and the prevention of an arms race, etc.



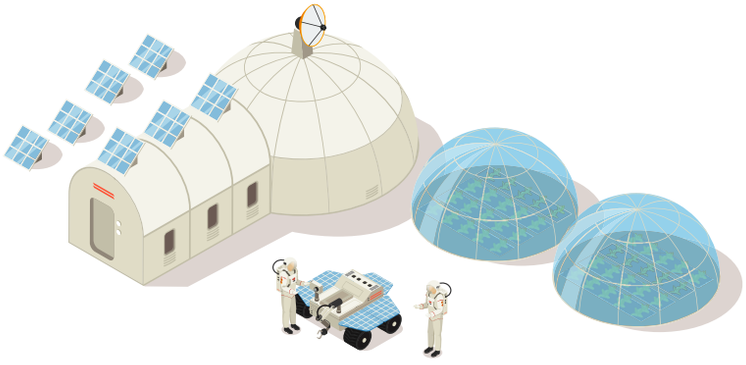
3.11. Space Debris (Space Junk)

- **Definition:** Defined as all **non-functional, artificial objects, including fragments and elements** thereof, in Earth orbit or re-entering into Earth's atmosphere.
- **Concerns/Risks Associated with Space Debris**
  - Harm to operational spacecraft and satellites **resulting into Kessler Syndrome.**
  - Current and future space-based explorations and operations **pose a safety risk to astronauts.**
  - Debris can re-enter atmosphere in uncontrolled way can **create risk to population** on ground.

Initiatives for mitigating Space Debris	
Indian initiatives	**Global initiatives and international partnerships**
◇ **Debris Free Space Missions (DFSM) 2030:** ◇ **ISRO System for Safe and Sustainable Operations Management (IS4OM):** ◇ **Space Situational Awareness Control Centre (SSACC)** ◇ **Project Network for Space Object Tracking and Analysis (NETRA) by** ISRO	◇ **Inter-Agency Debris Coordination Committee (IADC):** ◇ **UN Space Debris Mitigation Guidelines:** ◇ **Zero Debris Charter:** Signed by **12 countries** » guiding principles and jointly defined targets to become **debris neutral by 2030.**

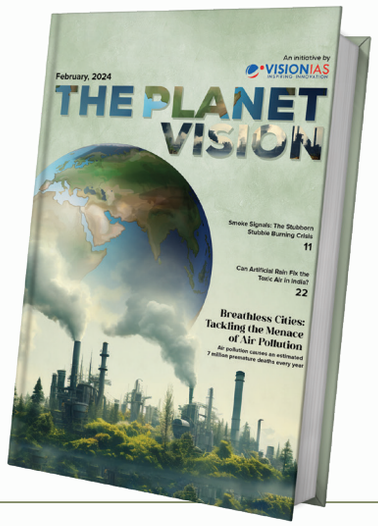
Way Forward

- Ensure safe **disposal of space objects** through atmospheric reentry or re-orbiting to a safe altitude
- **Satellite health monitoring** must be improved
- Robust passivation techniques implemented to prevent satellites breaking up from within



VISIONIAS
INSPIRING INNOVATION

THE PLANET VISION



In a world facing unprecedented environmental challenges, staying informed and empowered is more crucial than ever. VisionIAS brings you **'The Planet Vision'**, a simplified, informative, and interactive magazine to delve into the complexities of the environment.

With the belief, that individual efforts and awareness are the key to a sustainable future, the magazine seeks to inspire and educate people to **develop a deeper understanding and appreciation for the environment, nature & planet.**

Objectives of 'The Planet Vision'

- **Sensitise the young generation:** Highlighting pressing environmental issues and their multifaceted impacts.
- **Inspire Action and Promote Sustainable Lifestyle:** Inspiring stories and case studies to motivate readers to make environmentally conscious choices.
- **Bridge Environmental Science and Public Understanding:** Presenting complex scientific concepts in a simple and interactive manner.
- **Showcase Solutions:** Spotlight innovative technologies, projects, and initiatives that offer solutions to environmental challenges.
- **Highlight Local Efforts:** Showcase local conservation efforts, community initiatives, and grassroots projects that make a positive impact on the environment.

Who is the magazine for?

The Magazine is designed for students, eco-conscious individuals, educators, environmentalists, and anyone who cares about the health of our planet.

Key elements of the 'The Planet Vision'

- **Cover Stories:** Thought-provoking articles about a critical ongoing environmental issue, along with the mitigation strategies adopted at the national and international levels.
- **Briefing and Developments:** Stay informed about the latest environmental news, trends, and solutions.
- **Protect and Preserve:** Inspirational stories of local conversation efforts.
- **Environment and You:** Illustrating ways to make environmentally conscious choices in everyday life.
- **Green Tech:** New and emerging technologies in the field of environment.
- **Interactive elements:**
  - **Snapshot:** Telling a story through capturing images.
  - **Quizzes and crosswords:** To test your understanding and knowledge as a reader.

> "Look deep into nature, and then you will understand everything better."
>
> -Albert Einstein

Scan the QR code, to download and read the Magazine:

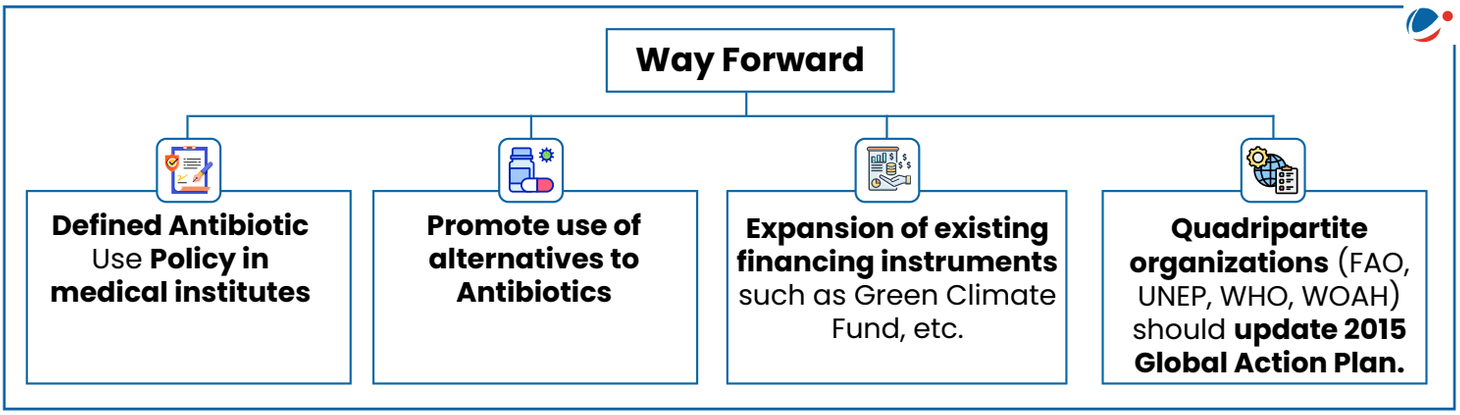
4. HEALTH

4.1. Antimicrobial Resistance

- **Definition:** AMR occurs when **microbes** (bacteria, fungi, parasites and viruses) evolve so that **antimicrobial drugs** against them are **no longer effective.**
  - It is among **top 10 public health threat (WHO).**

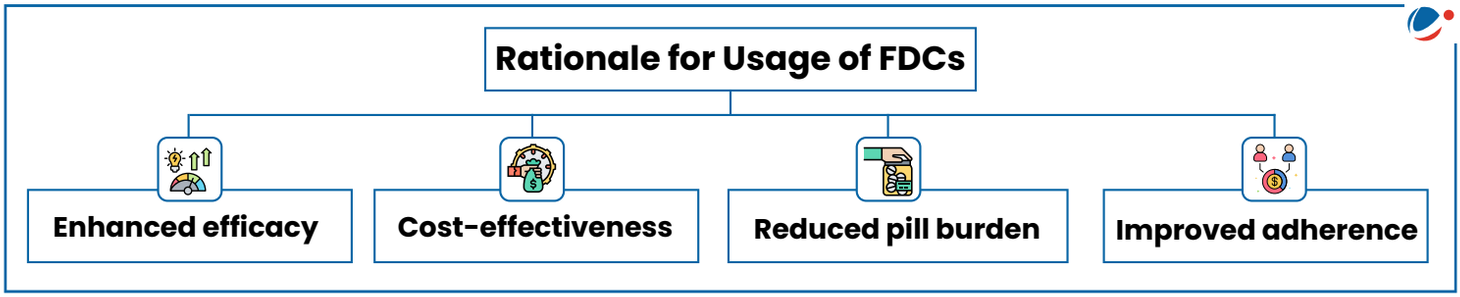
Reasons behind AMR	Implications of AMR
◇ **Overuse and misuse of antimicrobials** ◇ **Poor infection prevention** and **control practices** in healthcare settings ◇ **Effluents discharge from hospitals, industries,** and **urban settlements**	◇ **Increased mortality and morbidity,** and prolonged illness.(1.27 million deaths in 2019) ◇ Longer hospital stays, additional diagnostic tests etc. ◇ **Economic impact (US$ 1 trillion to 3.4 trillion annual losses to GDP** by 2030)

- **Initiatives**
  - **National**
    - **National Program** on **AMR containment**
    - **National Action Plan on AMR (NAP – AMR), 2017**
    - **National AMR surveillance network of state medical college labs (NARS-Net)**
    - **Drugs and Cosmetics Rules, 1945**
  - **Global**
    - **Global Action Plan on AMR (by WHO), GLASS,** 2015



4.2. Fixed-Dose combinations (FDCs) Drugs

- **Definition:** Refers to **products containing two or more active ingredients** used for a particular indication(s) (as per Drugs & Cosmetics Rule 1945)



Issues associated with FDCs	Way Forward
◇ **Lack** of **individual dose flexibility** ◇ **Unapproved** and **Banned FDCs** ◇ **Increased** risk of ◇ **Reduced transparency and affordability concerns** ◇ **Limited choice** for **patients**	◇ Require robust **scientific evidence** of FDC efficacy and safety ◇ Vigilant **market monitoring mechanisms** ◇ Harmonize export policies with domestic regulations ◇ CDSCO should enforce stringent guidelines for FDC approval

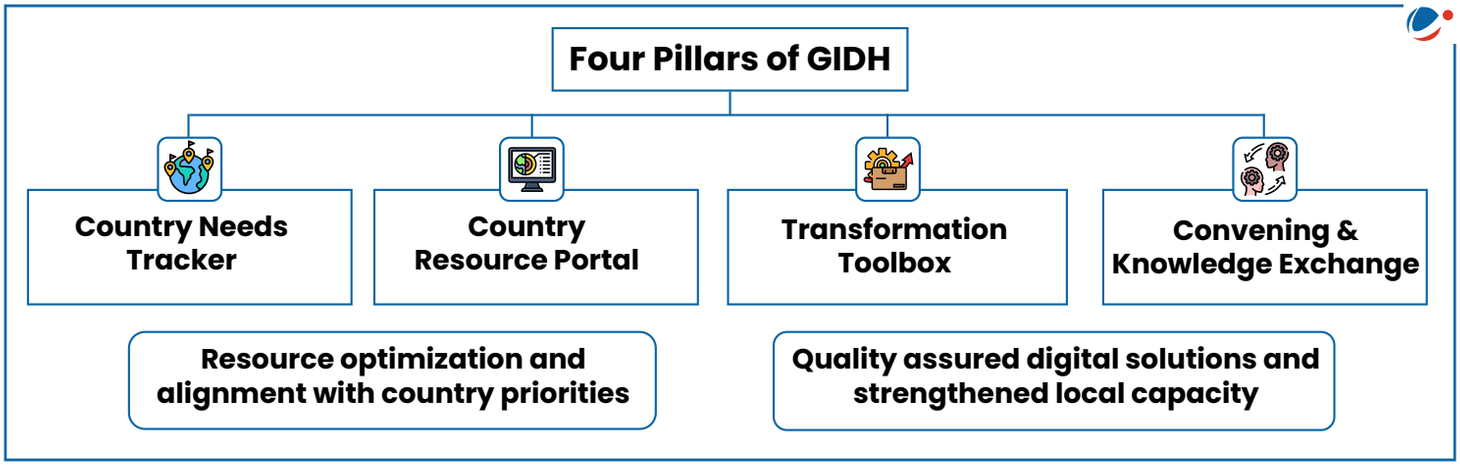
4.3. Organ and Tissue Transplantation

- **Definition:**
  - » **Organ Transplantation:** Includes kidney, liver, heart, lung, pancreas, and intestine etc.
  - » **Tissue Transplantation:** Involves corneas (eye), skin, bone, heart valves, and blood vessels etc.
- **Legal Framework:** Governed under the **"Transplantation of Human Organs Act 1994"**, later **"Transplantation of Human Organs & Tissues Act (THOTA) 2011.**

Challenges in Organ Transplantation in India	Way Forward
◇ **Low Donation: 0.52 donors per million** population (in **Spain it is 49.61 per million**). ◇ **Slow progress: 6,916 in 2014 to about 16,041 in 2022** (Ministry of Health and Family Welfare (MoHFW)). ◇ **Supply-demand Mismatch:** Only **8,000 out of 1.5-2 lakh** people obtain a kidney transplant ◇ **Other:** Organ trafficking, **Lack of male donor participation** (70%-75% of donors are female), etc.	◇ Adopting an **opt-out model of organ donation system** ◇ Kerala, first State to formulate well-defined **clinical protocols for brain death certification.** ◇ Creation of **digital registry** on organ transplantation ◇ **Streamline transportation process**

4.4 Digital Health

- World Health Organization (WHO) and Indian government **launched Global Initiative on Digital Health (GIDH).**

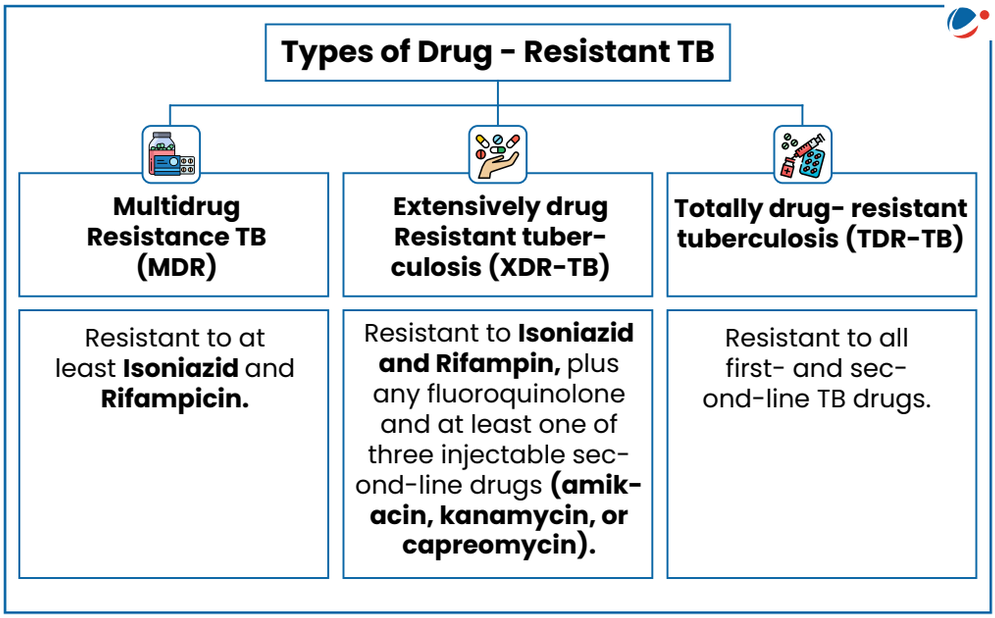


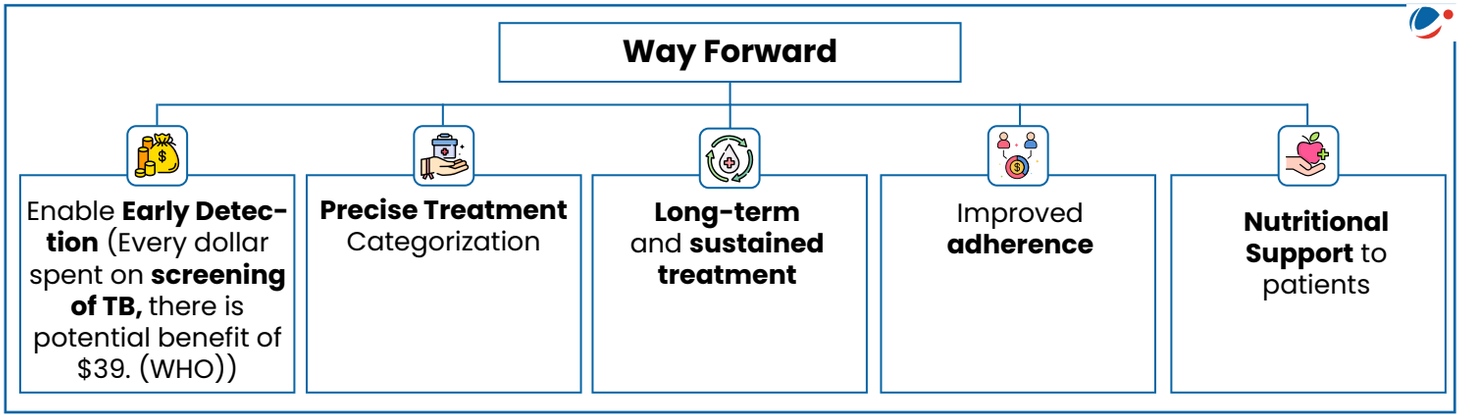
- **About Digital Health:** Refers to **use of digital technologies for healthcare purposes.**
- **Significance**
  - **Early diagnosis of critical alterations in the disease progression,**
  - **Decreased healthcare costs,**
  - improved patient health outcomes through personalised **treatment plans,**
  - **Increase quality and reduce the administrative workload,**
  - **Enhanced accessibility** through initiatives like telemedicine.
- **Initiatives: Ayushman Bharat Digital Mission (ABDM), eSanjeevani,Telemental Health Assistance and Networking Across States (Tele-MANAS), Nikshay 2.0 portal,**

Concerns	Way Forward
Data consent concerns: Patients are reluctant to share their data due to security reasons. **Data Processing** (Vast data generated at hospitals, clinics, etc.),**Quality Concern** **Other: Lack of Infrastructure** (such as digital connectivity in rural areas and hilly terrain), Ensuring **accountability or liability** in case of device failure, lack of **Digital Illiteracy** etc.	**Connect** global and regional collaboration, digital infrastructure and health information gaps, etc. **Establishing digital health governance,** instead of focusing exclusively on digital health interventions. **Data protection:** Focusing on **ethical and regulatory oversight,** etc. **AI** should be utilised to process data collected by healthcare professionals

4.5. Tuberculosis (TB)

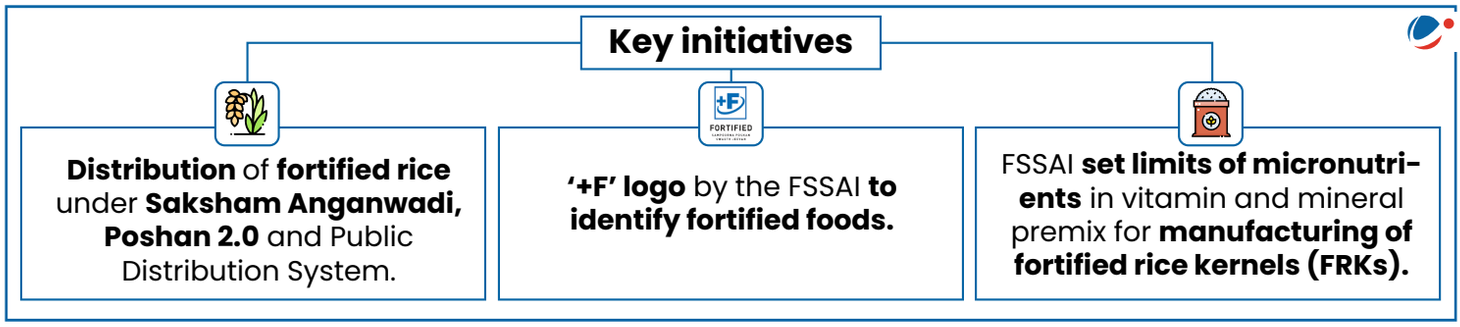
- **Definition:** An infectious disease caused by bacillus **Mycobacterium tuberculosis bacteria** which most often **affects lungs** and is known as **pulmonary TB.**
  - **Extrapulmonary TB** affects **other areas of the body. (e.g.** gastrointestinal TB, skeletal TB, liver TB)
- **Challenges**
  - Social **Stigma** and **Taboo**
  - Poor Healthcare Infrastructure
  - Poverty and **Malnutrition**
  - **Comorbidities** (with HIV, diabetes)
  - High **Treatment Costs** & **High- dropout rates**
- **Initiative**
  - **India's Initiatives: National Tuberculosis Elimination Programme (NTEP),Pradhan Mantri TB Mukt Bharat Abhiyan, Nikshay Poshan Yojana, ,Mission Indradhanush, BPaL regimen trial.**
  - **Global Initiative:** WHO Initiative: **#ENDTB Strategy,TB vaccine accelerator Council**





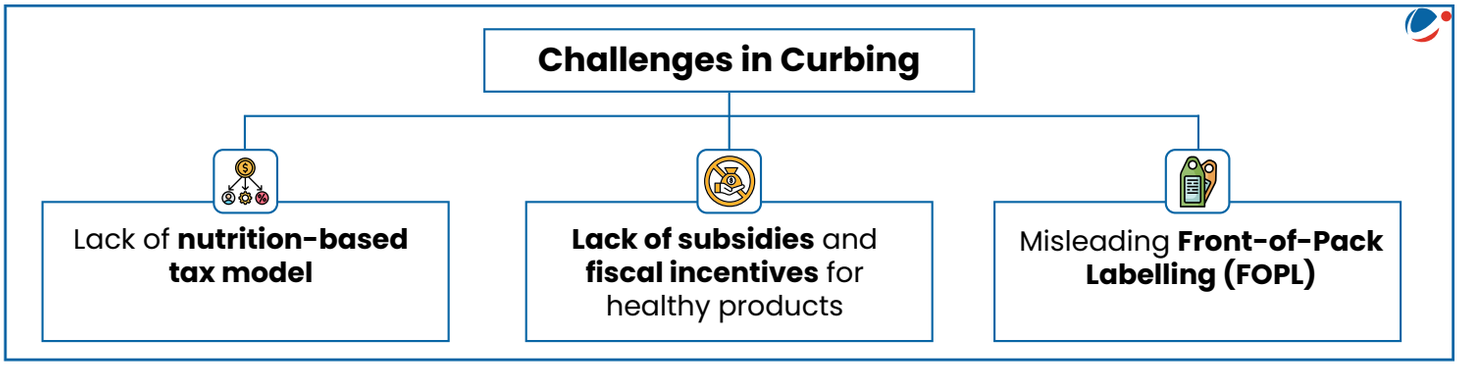
4.6. Food Fortification

- **Fortification:** Addition of **key vitamins and minerals** to staple foods such as rice, wheat, oil, milk and salt **to improve their nutritional content.**
- **Key issues:** Fortified rice could be **harmful to people suffering from thalassemia** and **sickle cell anaemia.**

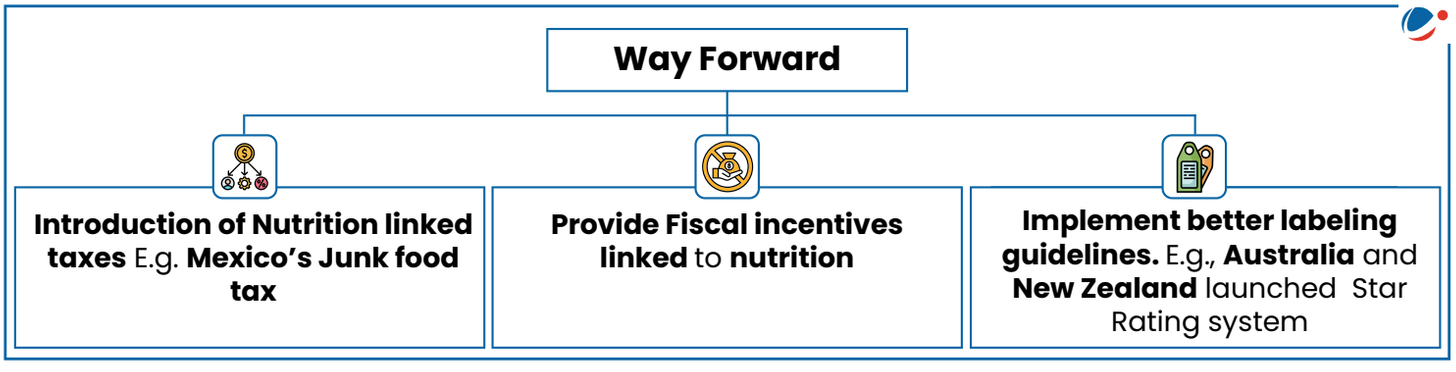


4.7. Ultra-processed Food (UPF)

- **Concern: Diets high in UPF, fats and sugars** drove a **hidden cost of over $7 trillion a year** on our health and environment.



- **Initiatives to curtail Ultra-Processed food**
  - **2% cap on trans-fatty acids** in food products
  - **Food Safety and Standards (Advertising and Claims) Regulations, 2018** aims to hold food businesses accountable for their claims/advertisements.
  - Ban on advertisements of UPF in school canteens or within 50 metres of school campuses
  - **FSSAI** campaigns like **'Eat Right India' movement, 'Aaj Se Thoda Kam'**
  - Aerated beverages in India are taxed at 28% GST and additional 12% compensation cess.
  - **ICMR** has released revised dietary guidelines, 2024.



5. ACHIEVEMENTS OF INDIANS IN SCIENCE & TECHNOLOGY; INDIGENIZATION OF TECHNOLOGY AND DEVELOPING NEW TECHNOLOGY

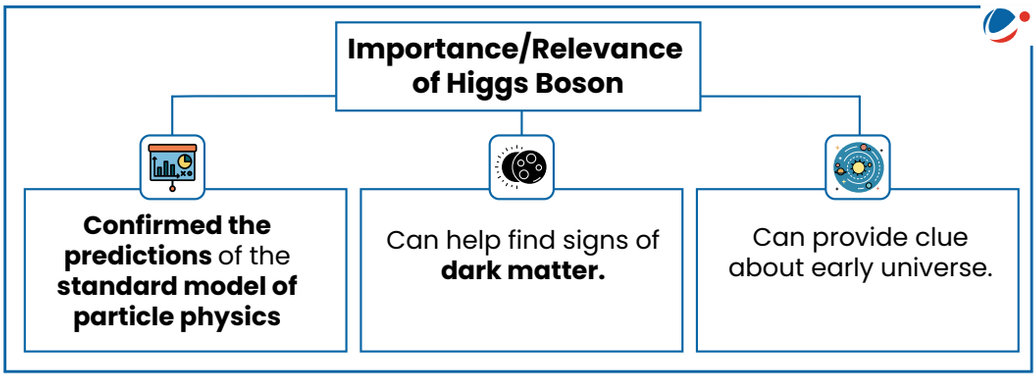
5.1. Satyendra Nath Bose

- Popularly known as **"Father of the God Particle"**
- **Fundamental particle 'Bosons'** are named after him

Scientific Contributions	
Bose-Einstein Condensates (BEC)	◇ **Fifth State of matter,** created when particles are **cooled to near absolute zero** (-273.15 degrees Celsius/0 Kelvin). ◇ **Properties of BEC: Super fluidity, Super conductivity, Coherence** of quantum state **and** wave function.
Bose-Einstein Statistics	◇ **Statistical procedure** for counting possible states of a quantum system.
Other:	◇ **X-ray diffraction cameras** ◇ **Deduced Planck's Black body radiation** law without any reference to classical electrodynamics.

5.1.1. Higgs Boson

- **Definition: Elementary particle** with a very short life, aka **God particle.**
  - » It is a type of **boson,** a force-carrying subatomic particle.
  - » **Gets its mass** just like other particles—from its interactions with the Higgs field.

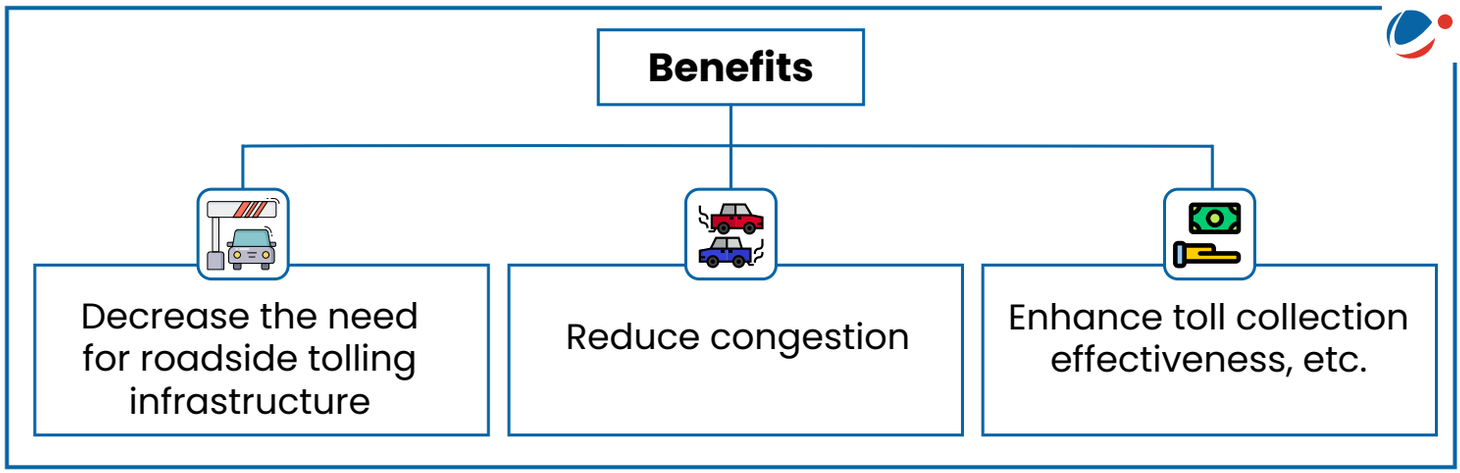


  - » **Physicist Peter Higgs who** passed away recently **proposed it as a new fundamental particle.**
- **Higgs Field**
  - » Particles do not have a mass of their own; they get their mass by interacting with the Higgs field.

» **Intensity** of **interaction** between the field and the particle decides the quantity of mass of the particle

5.2. Satellite-Based Toll Collection System

◇ **About:** Uses GNSS-based imaging to track the position of the vehicle and collect tolls based on the distance travelled.

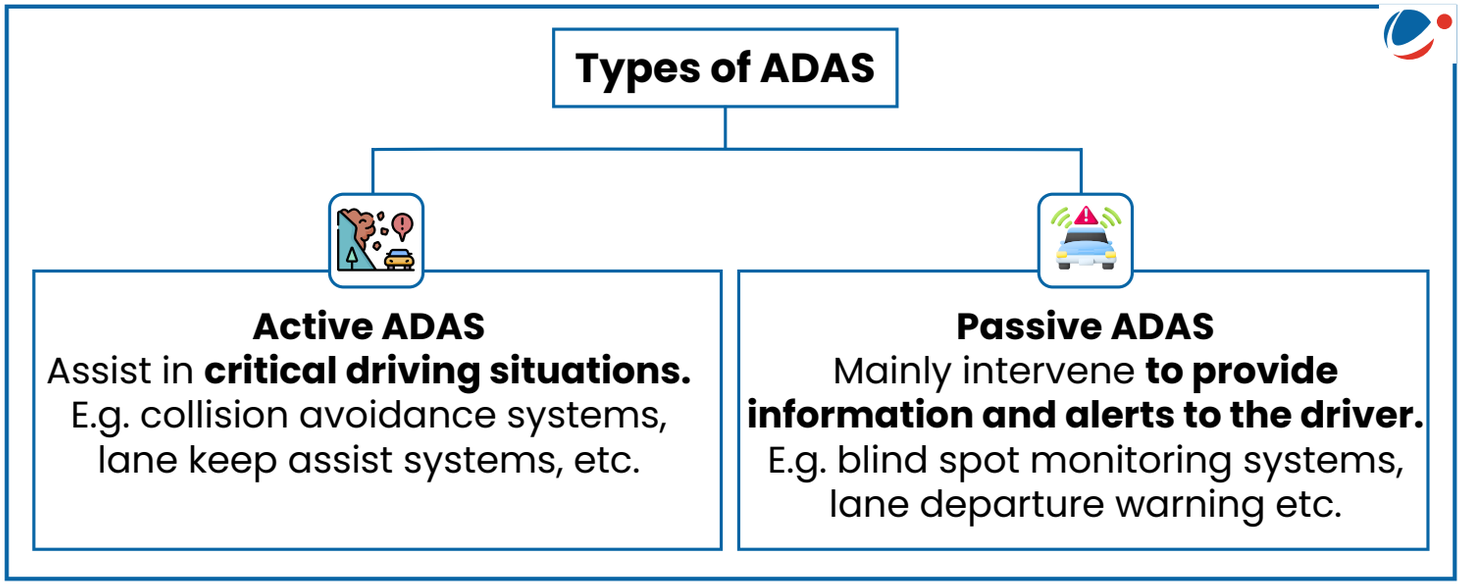


◇ **Challenges:** Signal interference or inaccurate readings; Privacy Concerns; need to equip older vehicles with GNSS technology etc.

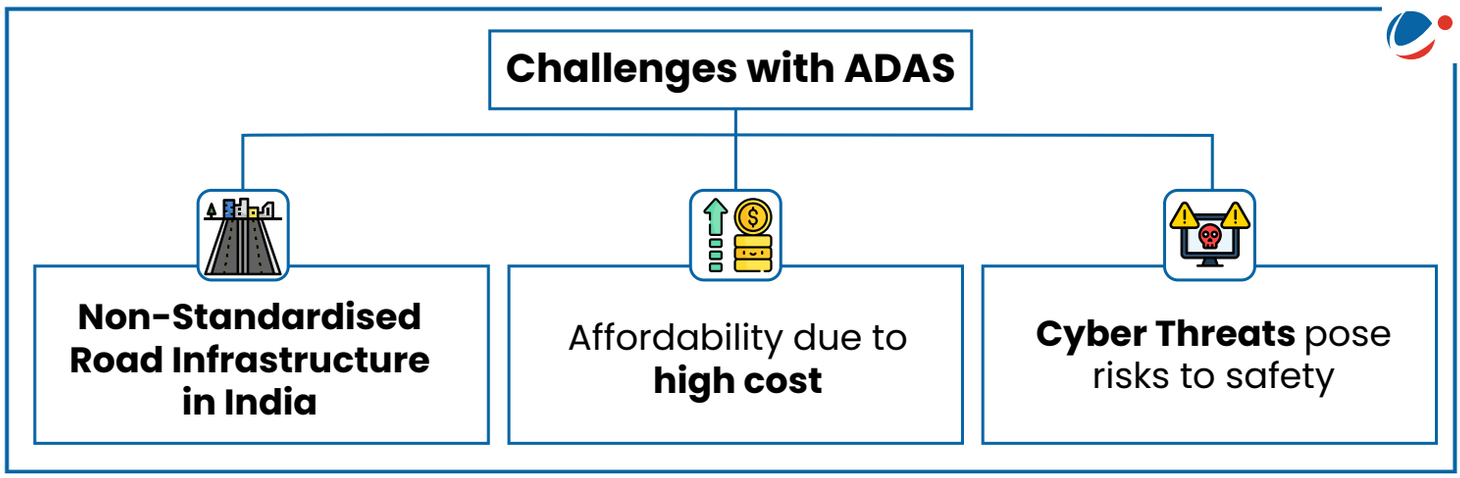
Difference between FASTags & Satellite-based toll collection		
Parameters	**FASTags**	**GNSS-based Toll collection**
Technology	**Radio Frequency Identification(RFID)**	**Satellite-based imaging** and **ANPR cameras**
Equipment needed in Vehicles	**RFID** Tag **on windscreen**	**OBU** with **GNSS connectivity**
Calculation of Toll tax	**Fixed rates**	Based **on real-time vehicle movement data**
Requirement of Toll Plazas	Required for scanning **FASTag**	**Not required**

5.3. Advanced Driver Assistance Systems

- **About:** It is a **set of electronic systems which are integrated into vehicles** to enhance driver safety, improve vehicle performance, and provide convenience.



- **Benefits of ADAS:** Reduces accidents, Optimise **traffic flow,** increases ease of driving, **reduces fuel consumption** and greenhouse gas emissions through optimization in driving patterns.

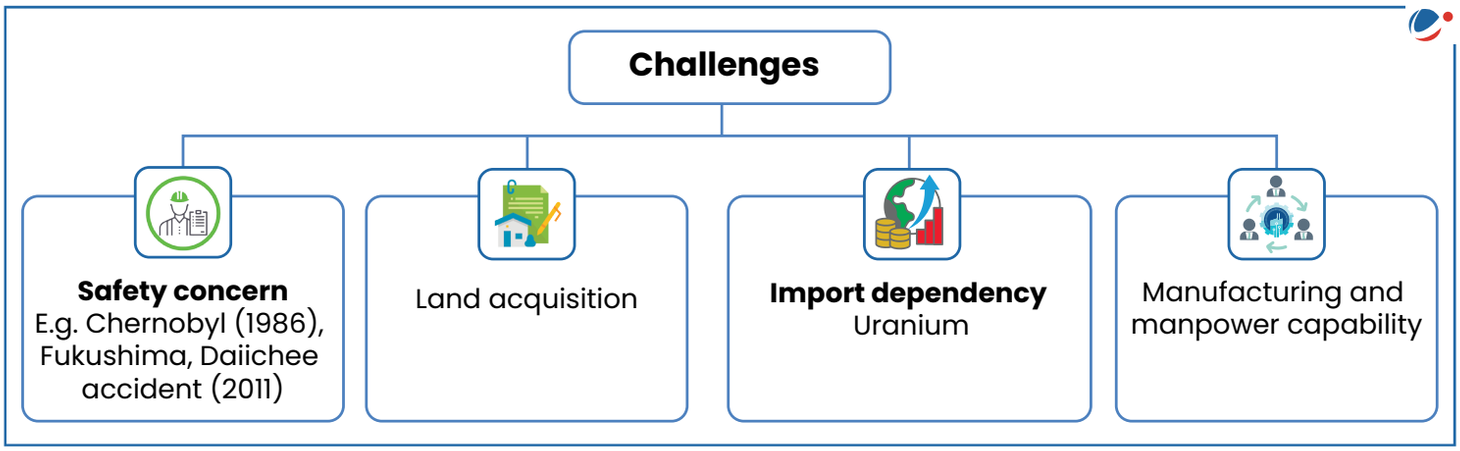


- **Conclusion:** The adoption of ADAS can be facilitated by establishing effective regulations and standards for ADAS implementation.

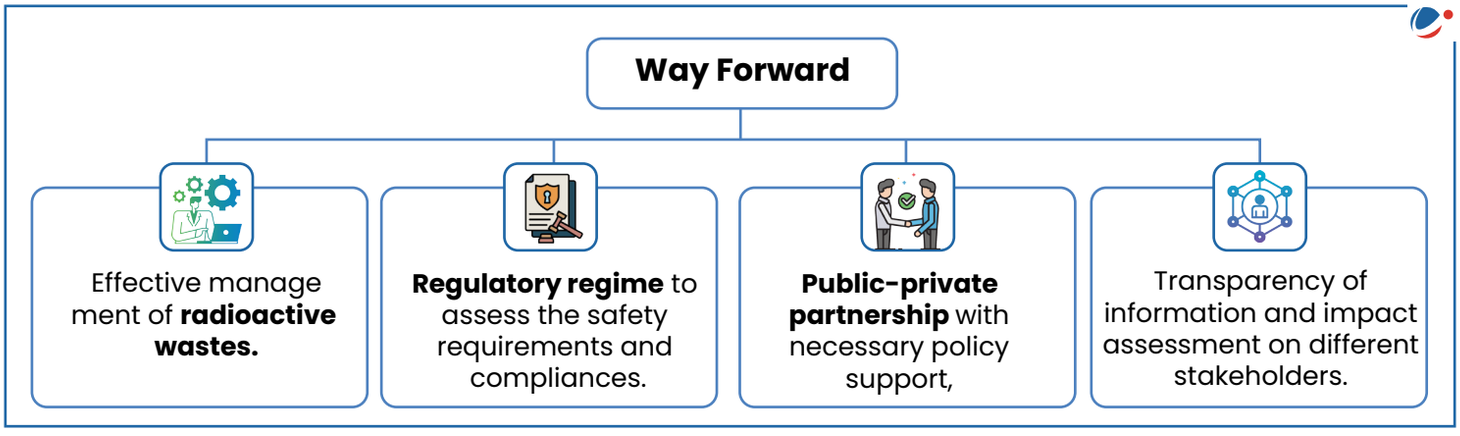
6. Miscellaneous

6.1. Nuclear Energy in India

- **Status:** Installed capacity of 8180 MW will become 22480 MW by 2031-32, which is about 1.8% of total electricity generation.(Ministry of power)
- **Significance**
  - Clean, cost-efficient, generation of pink hydrogen, thus facilitating transition to net zero economy.
  - Promote peaceful use of nuclear technologies.

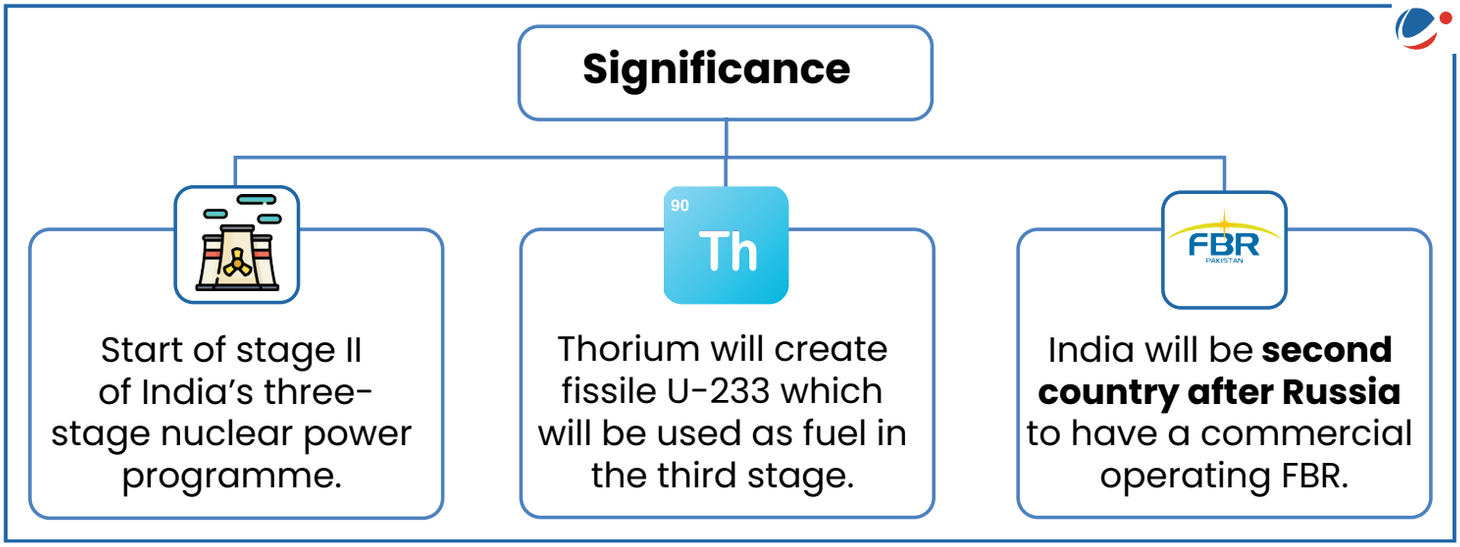


- **Initiative**
  - Supply contracts under IAEA.
  - Resolution of issues related to Civil Liability for Nuclear Damage (CLND) Act & Creation of Indian Nuclear Insurance Pool.
  - Enabling Joint Ventures of Public Sector Companies to set up nuclear power projects.
  - Monitoring through **PRAGATI Platform.**
  - Global Centre for Nuclear Energy Partnership for training.

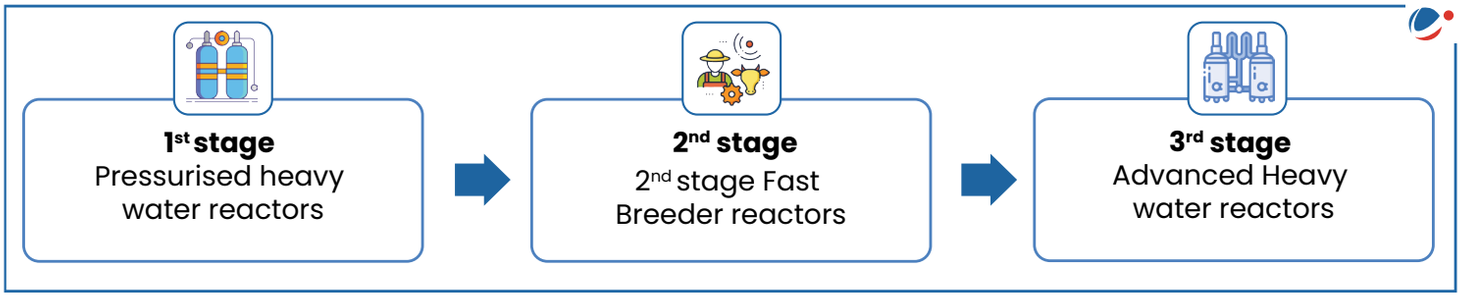


6.2. Fast Breeder Reactor

- **Definition:** FBR is a nuclear reactor that uses fast neutron to **generate more nuclear fuel than they consume** while generating power.
  - **Uranium-Plutonium Mixed Oxide** (MOX) fuel.
  - The **Uranium-238 "blanket"** surrounding the fuel core to **produce more fuel.**
- **Core-loading**
  - **Core loading** is the process of **placing nuclear fuel assemblies inside the core** of a nuclear reactor.
  - It has started in the **indigenous Prototype Fast Breeder Reactor** (PFBR) was initiated at Kalpakkam, TN.

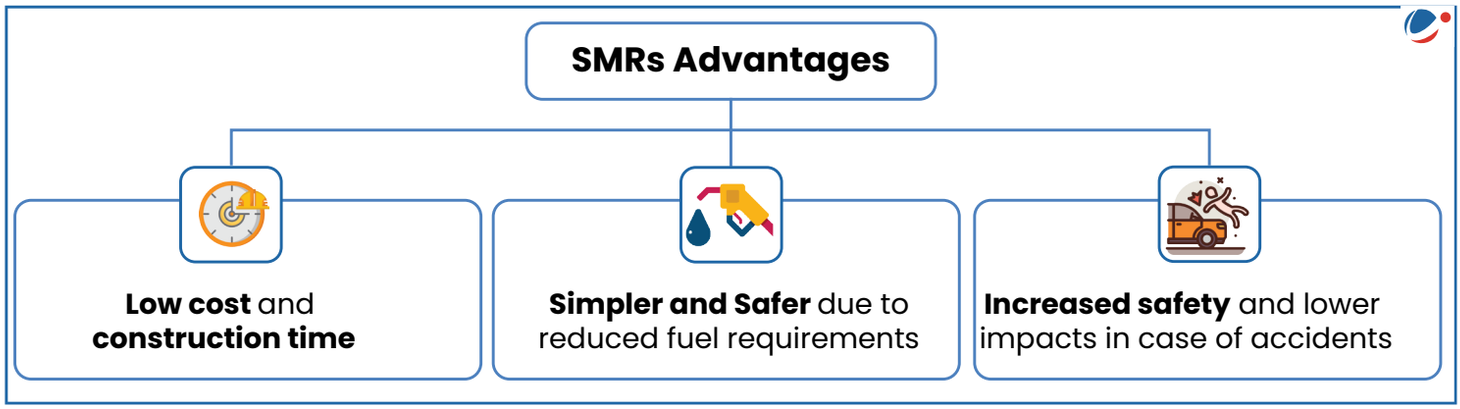


- **India's 3 stage Nuclear Power Program:**
  - **Dr Homi J Bhabha,** devised **this program in 1950s** to make the most of India's abundant thorium reserves.



6.3. Small Modular Reactor (SMR)

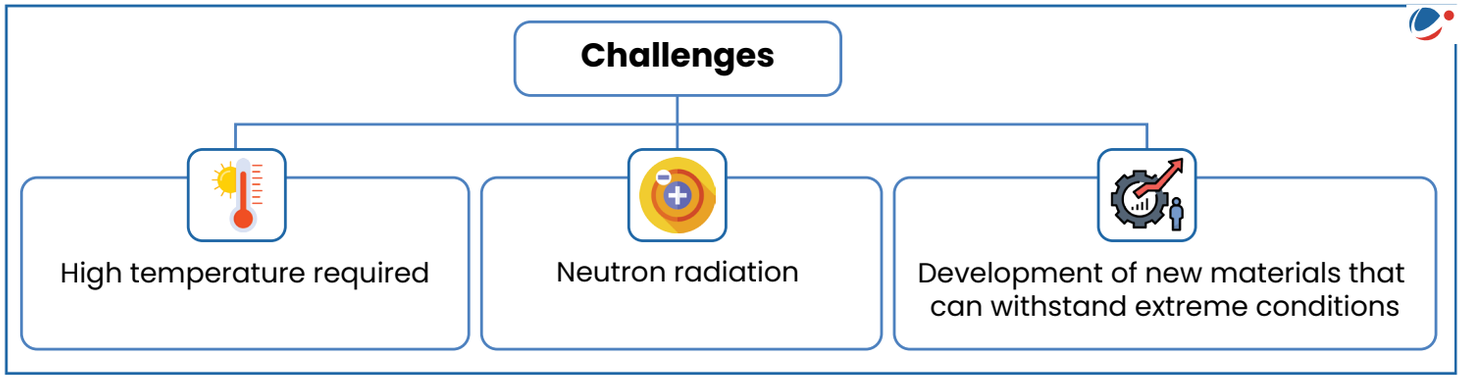
- **Definition:** Advanced nuclear reactors, with up to 300 MW per unit, are factory-assembled and transported for installation, reducing size compared to conventional reactors.



- **Bharat Small Reactors (BSRs):** In **Budget 2024-25,** government has announced to partner with private sector to develop **Bharat Small Reactors (BSRs).**
  - Unlike **SMRs, BSRs** are based on India's **existing PHWR technology.**

6.4. Nuclear Fusion

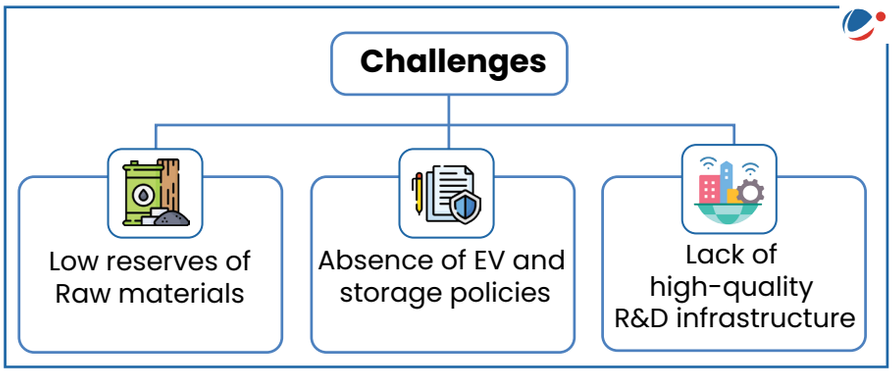
- **Definition:** Process by which two light atomic nuclei combine to form a single heavier one while releasing massive amounts of energy.
- **Advantages:** Abundant fuels (Deuterium from water), safer as amounts of fuel used is less



- **Initiatives**
  - India joined International Thermonuclear Experimental Reactor (ITER), collaboration of 35 nations to build the world's largest tokamak.
  - ITER-India, Institute for Plasma Research
  - Indigenous tokamak ADITYA and semi-indigenous Steady State Superconducting Tokamak (SST-1).

6.5. Battery Energy Storage System (BESS)

- **Definition:** BESS are type of **electrochemical storage** system which uses different **electrochemical reactions to store electricity.**
- **Initiatives undertaken for BESS**
  - **Legal status for ESS**
  - **Bidding Guidelines for BESS**
  - **National Framework for Promoting Energy Storage Systems** unveiled by the Ministry of Power in 2023.
  - **Battery Waste Management Rules, 2022** to promote circular economy in BESS sector.
  - **Scheme for Viability Gap Funding (VGF)**



- **Way Forward**
  - **Soft loan facility** for Discoms/transmission companies for BESS
  - **Phased manufacturing programme**
  - **Re-design GST rates** to discourage imports
  - **Recycling and sustainability**

6.5.1. Sodium Ion Battery

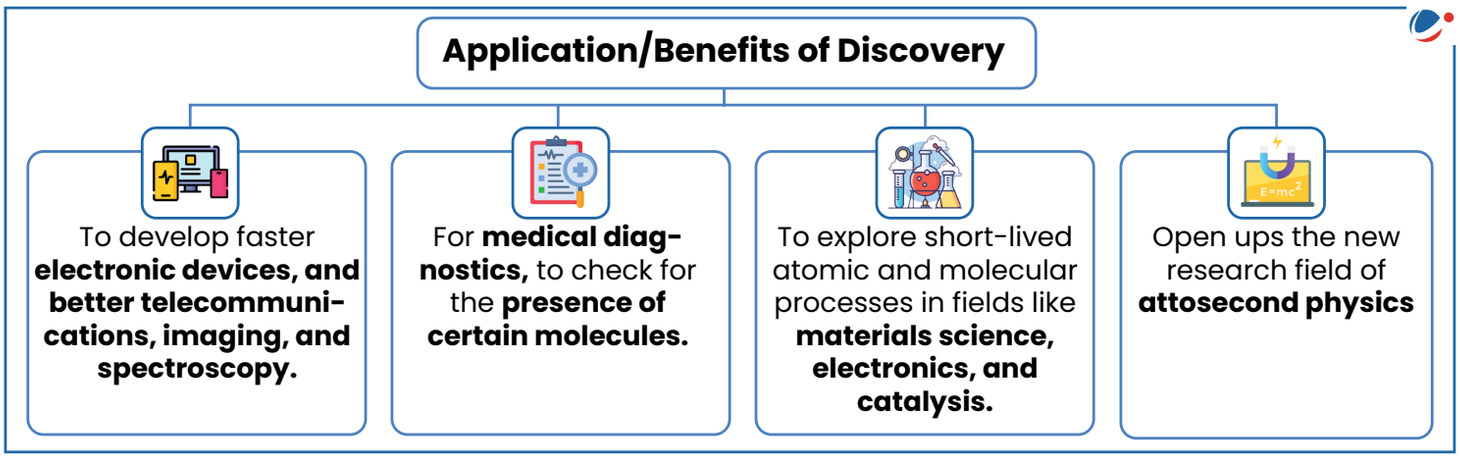
- **About:** An **electrochemical energy storage device** that utilizes **sodium ions as charge carriers** to **store and release electrical energy.**

Sphere	Sodium Ion Battery	Lithium-Ion Battery
Occurrence	Sodium more abundant	Lithium limited to few countries.
Charging	Charges faster	Slow charging
Safety	Safer, less prone to explosion or fire	Less safe, prone to catching fire or exploding
Use	Extreme temperatures	Lower temperature range
Applicability	Large-scale storage systems	Portable devices

6.6. Nobel Prizes

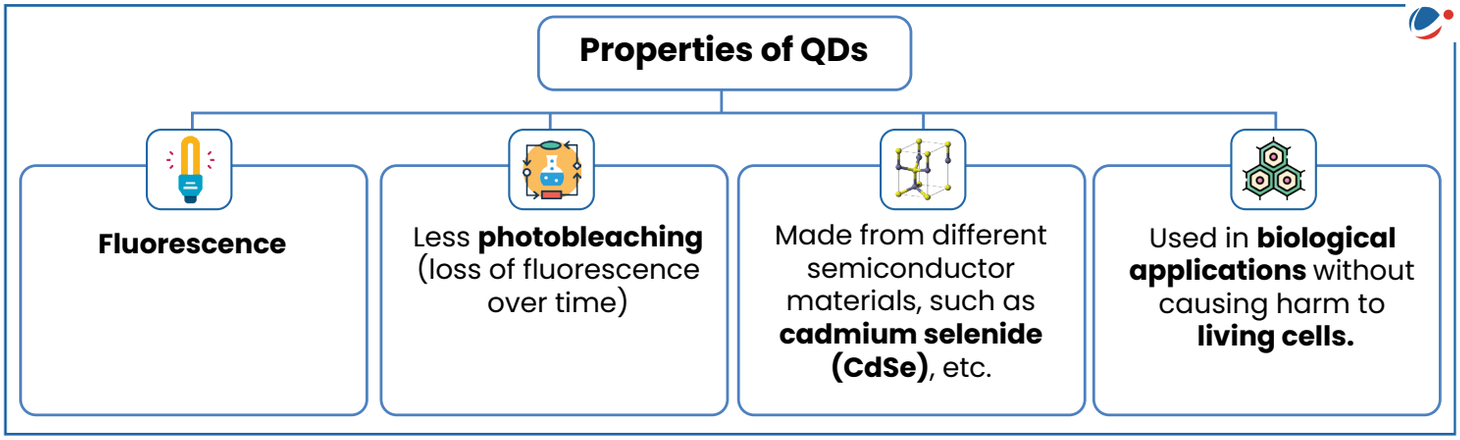
6.6.1. Nobel Prize in Physics 2023

- **Prize awarded for:** Generation of **attosecond pulses of light** for the study of **electron dynamics in matter.**
- **Awardees:** Pierre Agostini, Ferenc Krausz, and Anne L'Huillier
- **Electron dynamics** refers to the behaviour **and movement** of electrons within **atoms and molecules.**
- **Attoseconds pulses** can be **used to provide images** of the processes inside atoms and molecules (including electron dynamics).



6.6.2. Nobel Prize in Chemistry 2023

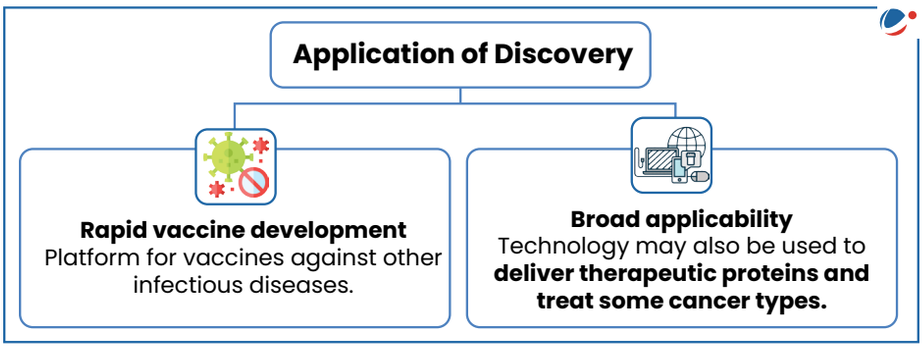
- **Prize awarded for:** The discovery and development of **quantum dots.**
- **Awardees: Moungi G. Bawendi, Louis E. Brus and Aleksey Yekimov.**
- **Definition: Quantum dots** are **man-made semiconductor particles,** whose sizes are normally not more than **10 nanometers.**
  - » Their properties can be changed by changing their size, for example they have different colours depending on their size.
  - » **Quantum confinement (electrons are confined in small regions),** leads to many unique optical and transport properties.



- **Applications of Quantum Dots**
  - **Electronics** screens, for targeted drug delivery, Nano medicine
  - **Other potential uses:** In quantum computing, thinner solar cells, flexible electronics, tiny sensors, and encrypted quantum communication

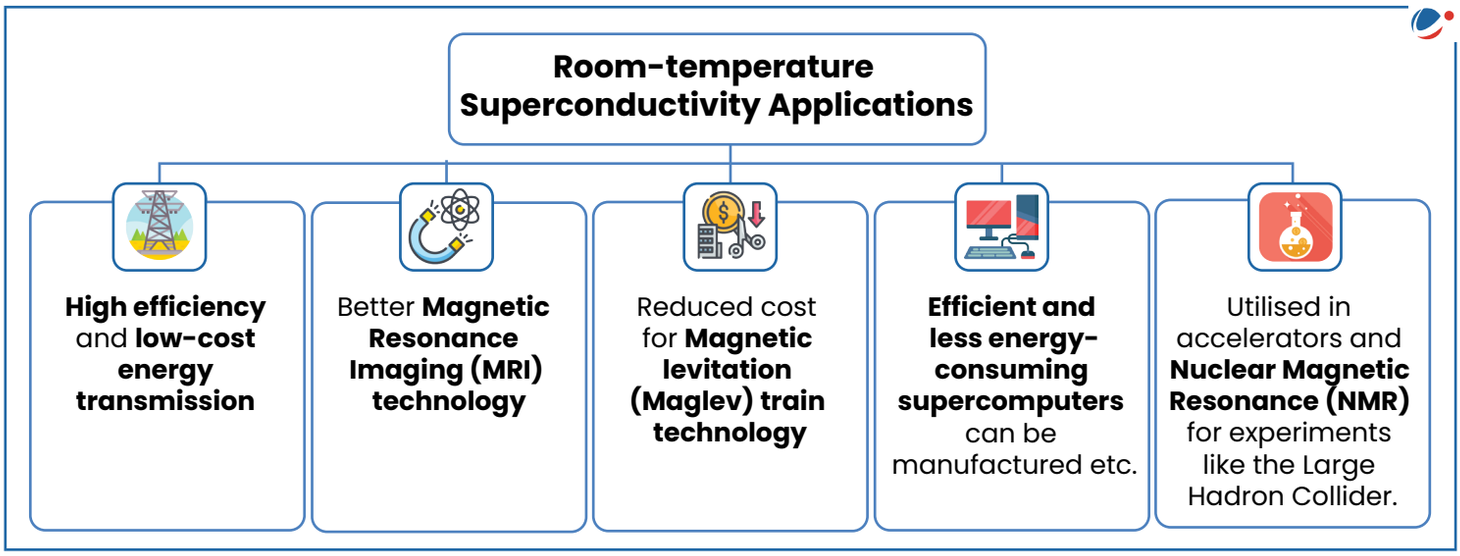
6.6.3. Nobel Prize in Physiology or Medicine 2023

- **Prize awarded for:** Discoveries concerning nucleoside base modifications that enabled the development of **effective mRNA vaccines against COVID-19.**
- **Awardees: Katalin Karikó** and **Drew Weissman.**
- **Concerns with mRNA vaccines**
  - **Issues with In vitro transcribed mRNA vaccines:**
    - **Instability** and **challenging to deliver,** requiring the **sophisticated infra.**
    - **Inflammatory reactions**
    - **Inefficient protein production in cells and tissues.**
  - They questioned why this **synthetic mRNA was considered to be a foreign substance** while mRNA from mammalian cells did not give rise to the same reaction.
- **Breakthrough by Nobel Laureates**
  - **Hypothesis:** They hypothesised that the **absence of altered bases** in the in vitro transcribed RNA could explain the **unwanted inflammatory reaction.**
  - **Testing:** On testing, they produced different variants of mRNA, each with unique **chemical alterations in their bases,** which they delivered to **dendritic cells.**
  - **Result: Inflammatory response was almost abolished** when base modifications were included in the mRNA.



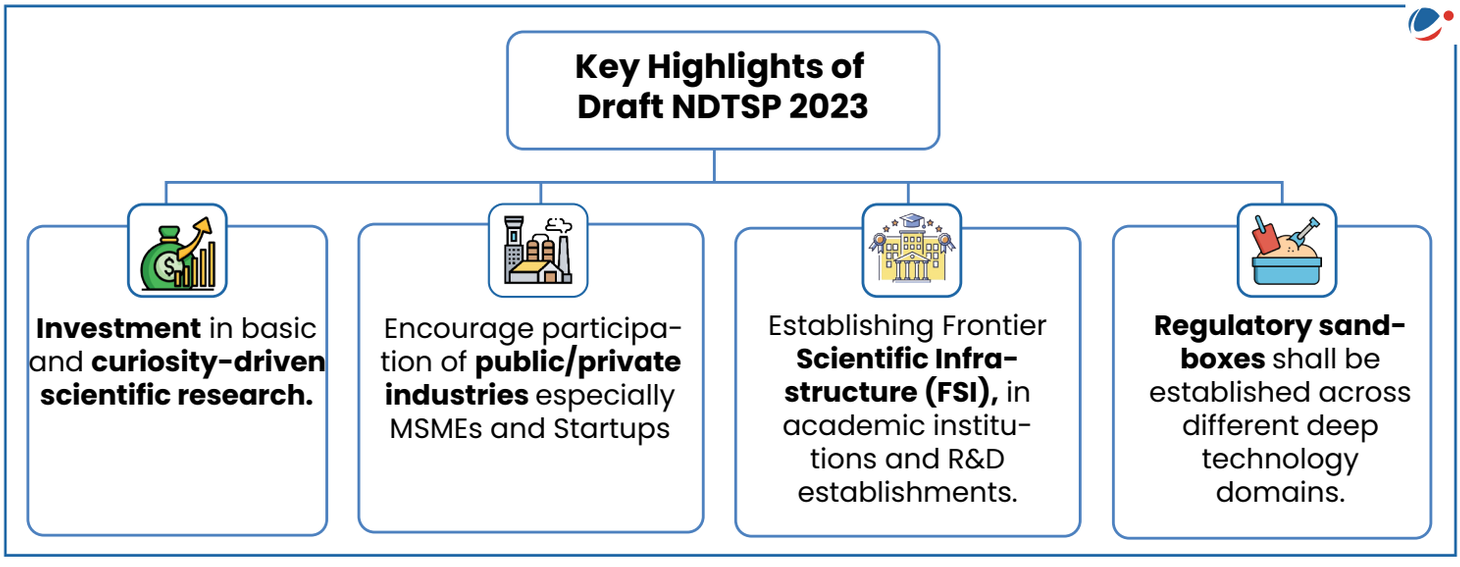
6.7. Superconductivity

- **Definition:** A phenomenon in which **certain materials exhibit zero electrical resistance** and the **expulsion of magnetic fields** when **cooled below a critical temperature (Tc).**
- Discovered by **Heike Kamerlingh Onnes** in 1911.
- Currently, **superconductivity** can be achieved only at very low temperatures, **more than 250 degrees Celsius below zero.**
  - **Materials like Mercury, Lead, Aluminum, Tin, Niobium,** etc., become superconducting at Tc.



6.8. Deep Tech Startups

- **Definition:** A startup that typically produces a solution along an unexplored pathway based on **new knowledge** within a **scientific or engineering** discipline or by **combining knowledge from multiple disciplines.**



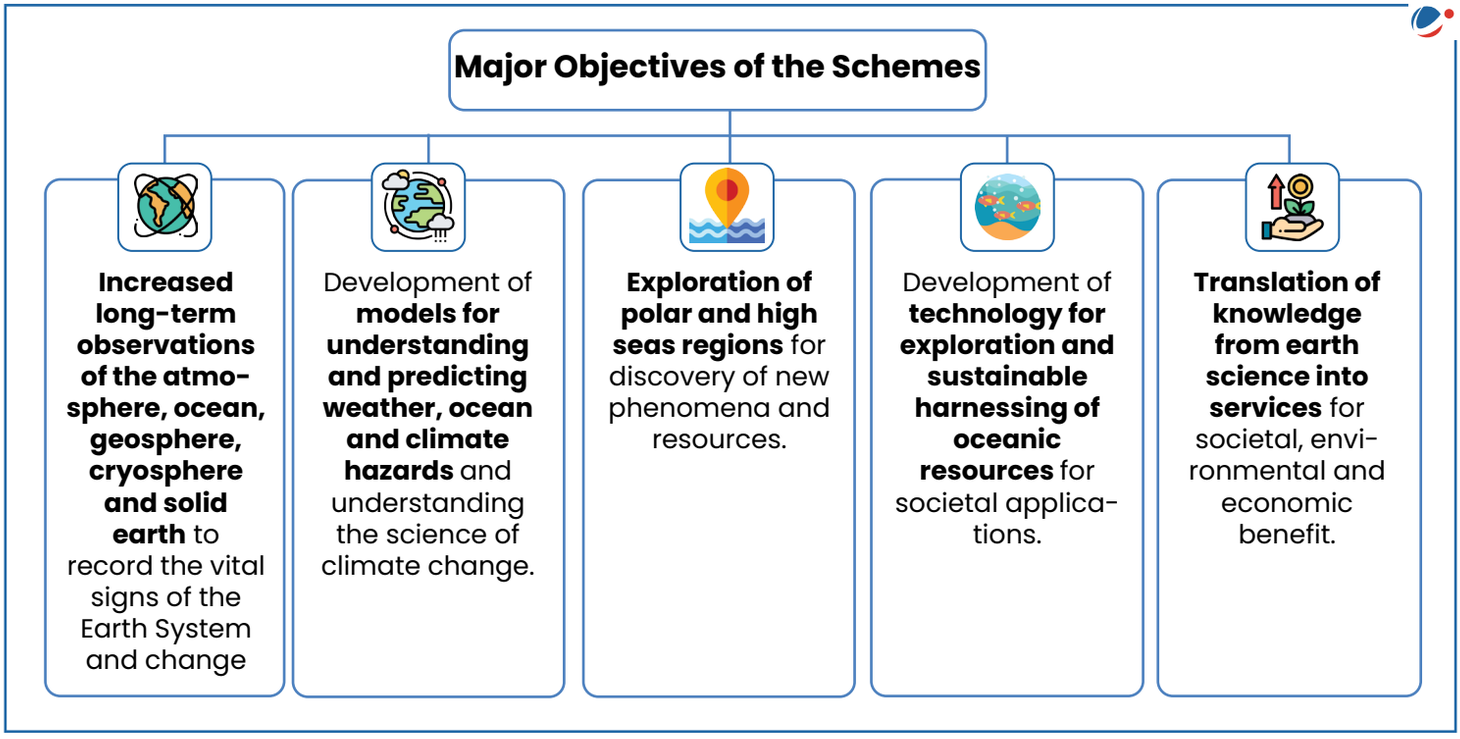
6.9. PRITHvi VIgyan (PRITHVI) Scheme

- Union Cabinet approved the overarching scheme **PRITHvi VIgyan (PRITHVI).**
- **About PRITHvi VIgyan (PRITHVI)**
  - **Ministry:** Ministry of Earth Sciences (MoES)
  - **Tenure:** 2021-26
  - Encompasses **five ongoing sub-schemes:**

- **ACROSS** (Atmosphere & Climate Research-Modelling Observing Systems & Services)
- **O-SMART** (Ocean Services, Modelling Application, Resources and Technology)
- **PACER** (Polar Science and Cryosphere Research)
- **SAGE** (Seismology and Geosciences)
- **REACHOUT** (Research, Education, Training, and Outreach)

◇ **Significance of integrated R&D efforts under PRITHVI**

- **Improve** understating of the **Earth System sciences.**
- **Enable development** of **integrated multi-disciplinary earth science research.**
- **Address challenges** of weather and climate, ocean, cryosphere, seismological science and services.
- **Convert research into practical solutions for future disasters** arising from Climate change, etc.
- **Understand** and **predict weather accurately** due to increased cross-disciplinary coordination.



VISIONIAS
INSPIRING INNOVATION

Building Mental Resilience for UPSC CSE with VisionIAS Student Wellness Cell

The UPSC Civil Services Examination is one of the most prestigious exams in the country, bringing immense professional and personal satisfaction. However, the journey often involves overcoming loneliness, intense competition pressure, anxiety, and other psychological challenges. These issues can impact both your preparation and overall well-being.

At **VisionIAS**, we recognize the multifaceted nature of this journey. To support our students comprehensively, we have established a dedicated Student Wellness Cell. Since April 2024, our highly professional psychologists and experienced professionals have provided confidential and mindful support as per student needs.

From Stress Management to Academic Excellence

Enhancing Academic Performance: Effective stress management contributes to better academic outcomes.

Comprehensive Wellness Cell: Addressing various issues impacting mental health and academic performance.

Professional Mental Health Support: Seeking professional help is crucial for success in UPSC preparation.

Safe and Non-Judgmental Environment: A space for students to discuss issues and receive personalized support.

Well-Supported Mind for Excellence: Mental well-being is essential for achieving success in UPSC exams.

Confidential and Structured Support: Multiple, structured sessions based on the severity of the issues.

Common Issues and Our Approach

Our counseling services have addressed a variety of issues, including:

Anxiety and Hopelessness: Using Cognitive Behavioural Therapy (CBT) to promote positive thinking.

Lack of Motivation and Focus: Introducing time management strategies and SMART goal-setting.

Emotional Struggles: Providing a safe space for expression and techniques such as journaling and progressive muscle relaxation.

Social Isolation and Loneliness: Encouraging healthy social interactions and setting personal boundaries.

Family and Personal Issues: Offering advice on coping with family dynamics, personal loss, and significant life stressors.

Scan the QR code for more details

To support the larger student community, **VisionIAS** is now extending our counseling and wellness support to all students preparing for UPSC CSE, regardless of their coaching institute affiliation. Schedule a session by visiting our office at Apsara Arcade near Karol Bagh Metro Station or emailing ***student.wellness@visionias.in.***

Remember, seeking help is a sign of strength, not weakness.

Heartiest Congratulations
to all Successful Candidates

Aditya Srivastava

16 in **TOP 20** Selections in **CSE 2023**
from various programs of **Vision IAS**

Animesh Pradhan

Ruhani

Srishti Dabas

Anmol

Nausheen

Aishwaryam Prajapati

39 Selections in **TOP 50** in **CSE 2022**

Ishita Kishore

Garima Lohia

Uma Harathi N

SHUBHAM KUMAR
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