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**Time:** 45 Min

**Date:** 26-02-2026

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## ENERGY IMBALANCE AND THE CHANGING DYNAMICS OF EL NIÑO

### Context

- A recent study highlights that the 2022 increase in Earth's energy imbalance was largely driven by a shift from a "triple-dip" La Niña to a warm El Niño, combined with long-term climate change.

### Earth's Energy Imbalance Study

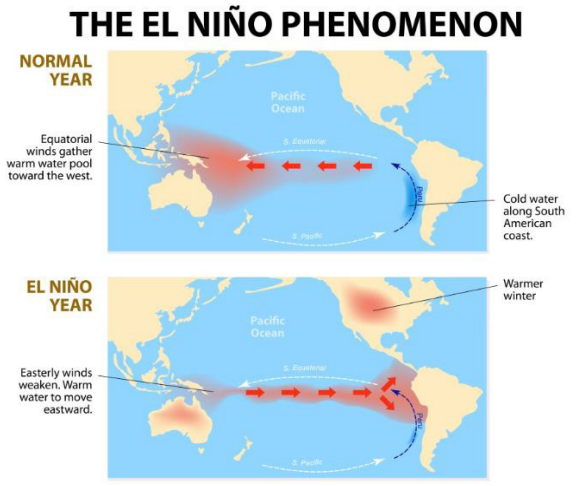
- **Earth's Energy Imbalance (EEI)** refers to the **difference between incoming solar radiation and outgoing heat energy**. When more heat is trapped than emitted, global temperatures rise.
  - The **2022 increase in EEI explains** the sharp global temperature spike since early 2023.
- **The "Triple Dip" Impact:** During a La Niña, **warm water remains deeper in the ocean,** resulting in a **cooler surface that emits less energy back into space**.
  - This unusual three-year cooling cycle acted like a "lid" that, once removed during the transition to El Niño, allowed trapped heat to surge upward.
- During **2020 to 2023**, the world experienced three **consecutive La Niña years** without an intervening El Niño.

### What is ENSO? (El Niño–Southern Oscillation)

- **ENSO is a periodic fluctuation** in sea surface temperatures and atmospheric pressure in the equatorial Pacific Ocean. It has **two opposite phases: El Niño and La Niña.**
- **ENSO influences** Indian Monsoon, cyclone patterns, droughts and floods and global temperature variability.

### What is El Nino?

- El Niño is the **warming of seawater** in the central-east Equatorial Pacific that occurs every few years.




- During El Niño, surface temperatures in the **equatorial Pacific rise,** and trade winds, east-west winds that blow near the Equator, weaken.
- **Impact:** El Niño causes dry, **warm winters in the Northern U.S. and Canada** and increases the risk of flooding in the U.S. gulf coast and southeastern U.S.
  - It also brings drought to Indonesia and Australia.

### What is La Nina?

- La Niña is the opposite of El Niño. La Niña witnesses **cooler than average sea surface temperature (SST)** in the equatorial Pacific region.
  - Trade winds are stronger than usual, pushing warmer water towards Asia.
- **Impact:** This leads to **drier conditions in the Southern U.S.,** and heavy rainfall in Canada. It has also been associated with heavy floods in Australia.

### How does it affect the Indian Monsoon?

- **In El Niño years**, India faces **warmer temperatures and less rainfall**, causing droughts in some regions.
  - This affects agriculture, water resources, and ecosystems.
  - The El Nino phenomenon led to **1.4% decrease** in food grain production for the 2023-24 (July-June) crop year.
- **La Niña** brings cooler sea surface temperatures, leading to increased rainfall in certain parts of India.

## TRAINING OF LARGE LANGUAGE MODELS (LLMS) BY INDIAN FIRMS

### Context

- Bengaluru-based startup Sarvam AI unveiled two indigenous Large Language Models (LLMs), underscoring India's push for sovereign, multilingual, and compute-efficient AI amid global competition.

### Large Language Models (LLMs)

- A large language model (LLM) is a type of artificial intelligence (AI) algorithm that uses **deep learning techniques** and massively large data sets to understand, summarize, generate and predict new content.
- Deep learning involves the **probabilistic analysis of unstructured data**, which eventually enables the deep learning model to recognize distinctions between pieces of content without human intervention.

- It helps to **understand how characters, words, and sentences** function together.

### Indigenous LLM Ecosystem in India

- **Sarvam AI Models:** Focus on efficiency, accuracy, and Indian language capabilities. Intended to be open-source, though broader public scrutiny is ongoing.
- **BharatGen,** incubated at IIT Bombay, trained a multilingual **17-billion-parameter** model for sectors like education and healthcare.
- **Gnani.ai** launched compact speech and text-to-speech models.

### How LLMs Are Trained?

- **GPU Clusters:** LLM training requires massive computational power using clusters of Graphics Processing Units (GPUs). Thousands of GPUs operate simultaneously for weeks or months.
- **Data as the Core Input:** Training relies on enormous datasets, often scraped from the Internet.
- **Model Parameters:** Parameters represent the internal weights through which models learn patterns. Sarvam AI trained models with 35 billion and 105 billion parameters.
  - **Larger parameter** counts improve capability but require more computation.

### Key Training Methodologies Used

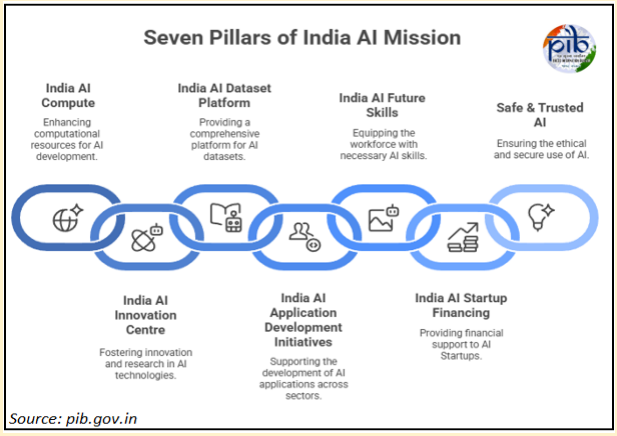
- **Data Curation:** It focuses on **collecting high-quality datasets** in Indian languages.
  - It includes government documents, literature, media, and synthetic data generation.
  - It is critical for improving performance beyond English-centric AI systems.
- **Pre-Training:** The models learn **general language patterns** by predicting the next token in large unlabelled datasets.
  - This stage builds foundational reasoning and grammar capabilities.
- **Fine-Tuning:** Models are adapted for specific tasks using curated datasets.
  - Tools such as **Hugging Face** and **LangChain** support instruction tuning, classification, and domain adaptation.
- **Alignment/RLHF (Reinforcement Learning from Human Feedback):** Human raters rank model outputs to teach it to be safer, more accurate, and better aligned with human intent, discouraging harmful or biased responses.

### Challenges in Training LLMs in India

- **Limited Indian Language Data:** Scarcity of high-quality datasets in Indian languages reduces model performance.
  - Many systems rely on translation into English before processing, increasing token usage and latency. Suboptimal native performance affects adoption among non-English users.
- **High Capital Requirements:** Training frontier models demands substantial financial investment. Startups often lack immediate commercial returns to justify such costs.
- **Infrastructure Constraints:** Access to high-end computing facilities remains limited without government support.

### IndiaAI Mission

- The IndiaAI Mission is the **flagship initiative** to build a comprehensive, sovereign AI ecosystem for India.
- It focuses on developing high-performance computer infrastructure, indigenous foundational models, and safe, ethical AI, under the vision of "Making AI in India and Making AI Work for India".
- India has achieved **38,000 GPUs,** providing affordable access to world-class AI resources.
  - **A GPU or Graphics Processing Unit** is a powerful computer chip that helps machines think faster, process images, run AI programs, and handle complex tasks more efficiently than a regular processor.




**Source: TH**

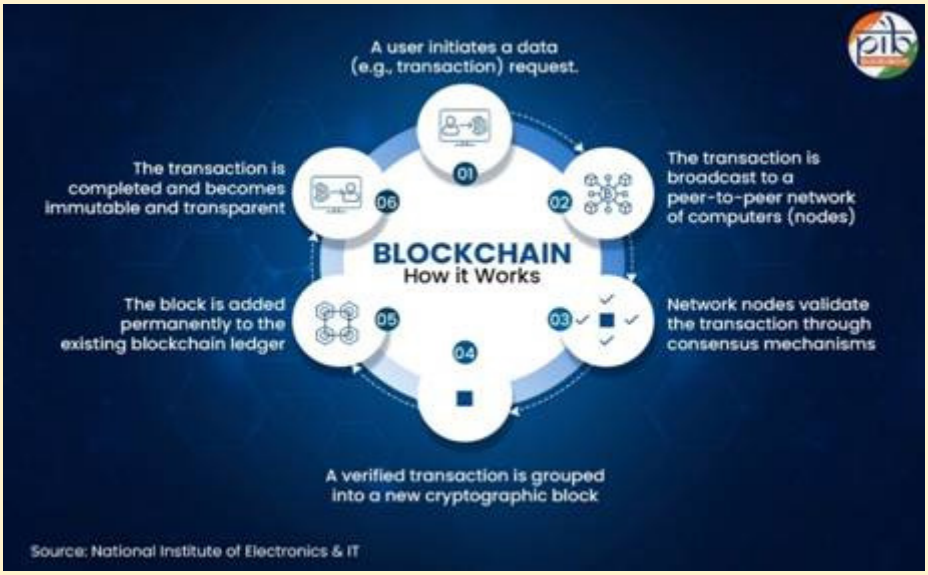
## BLOCKCHAIN BASED DIGITAL GOVERNANCE

### Context

- The **Blockchain India Challenge**, launched by **the Ministry of Electronics & Information Technology (MeitY)** is a **national initiative** aimed at encouraging visionary Indian startups to **pitch & pilot cutting-edge Blockchain-based digital governance solutions.**

**What is Blockchain?**

- Blockchain is a **distributed, transparent, secure, and immutable database** that functions like a **ledger of records or transactions**, resistant to tampering and accessible across a network of computers.
- **Understanding Types of Blockchain:**
  - **Public Blockchain:** In this network, all nodes can access records, verify transactions, perform proof-of-work, and add new blocks.
  - **Private Blockchain:** It is a permissioned blockchain, restricted to selected participants within an organization.
  - **Consortium Blockchain:** In this network, the blockchain is semi-decentralized, governed jointly by multiple organizations for shared data management and validation.
  - **Hybrid Blockchain:** It is a blend of public and private blockchains allowing selective data access.




**Role of Blockchain in Governance**

- **Certificates and Document Chain:** The chain allows secure issuance, storage, and retrieval of documents such as academic certificates, caste, income, ration cards, driving licenses, and birth or death certificates.
- **Logistics Chain:** Provides a tamper-proof and transparent platform to track goods across multiple stakeholders.
  - **Example: Karnataka's Aushada system** tracks medicines from manufacturers to hospitals, verifying quality, expiry, and traceability, reducing the risk of spurious drugs.
- **Land Records & Real Estate:** Ensures transparency in land and property transactions, allowing verification of ownership and rights, minimizing disputes, and expediting resolution processes.
  - **Example:** States like Telangana and Andhra Pradesh have piloted blockchain-based land registries where every transfer is recorded as a block, making illegal encroaching or title-tampering virtually impossible.
- **Judiciary Chain:** Blockchain facilitates electronic delivery of notices, summons, and bail orders, reducing delays and eliminating manual dependencies.
  - **The Inter-operable Criminal Justice System (ICJS)** integrates the criminal justice ecosystem, ensuring a unified digital platform for case records, evidence, and judicial documents.
- **Public Distribution System (PDS) & Supply Chain:** The blockchain would eliminate the diversion of food grains and "leakages" in the subsidy chain.
  - **Example:** By 2026, the World Bank's FundsChain initiative has demonstrated success in tracking project funds globally. In India, blockchain can track a grain sack from a FCI godown to a ration shop.
- **Healthcare Data Integrity:** It will eliminate the problem of fragmented patient records and counterfeit medicines.

- **Example:** Under the Ayushman Bharat Digital Mission, blockchain can allow hospitals to share patient records securely while ensuring patients have absolute control over who views their data.

### National Blockchain Framework (NBF)

- Developed by the **Ministry of Electronics and Information Technology (MeitY),** NBF was launched in **2024** with a budget outlay of **₹64.76 crore.**
- NBF is designed to accelerate the development and deployment of **permissioned blockchain-based applications,** marking a strategic step towards building a secure, transparent, and scalable digital infrastructure for India.

### Key Components of NBF

- **Vishvasya Blockchain Stack:** It is an indigenous and modular platform designed to provide the technical foundation for building and deploying blockchain-based applications for governance. The features of Vishvasya Blockchain Stack are:
  - **Distributed Infrastructure:** The stack is deployed across NIC data centres located in **Bhubaneswar, Pune, and Hyderabad**, ensuring fault tolerance, scalability, and resilience for blockchain-based applications.
  - **Permissioned Blockchain Layer:** The platform is built on a permissioned blockchain, ensuring that only verified and authorized participants can join or validate transactions.
  - **Open APIs and Integration Services:** Vishvasya provides open APIs (Application Programming Interfaces) and integration modules for authentication and data exchange.
- **NBFLite - Blockchain Sandbox for Startups and Academia:** A sandbox environment for startups, academia, and research institutions to prototype blockchain applications in governance.
- **Praamaanik:** It is an innovative solution that leverages blockchain technology to verify the **authenticity and source of mobile applications.**

### Initiatives for Blockchain Adoption in India

- **The Centre of Excellence in Blockchain Technology (NIC) provides** consultancy, training, and support for pilot projects, using platforms such as Hyperledger Fabric, Hyperledger Sawtooth, and Ethereum.
- **RBI is leveraging blockchain** for the Digital Rupee, enabling traceable, secure, and inclusive digital payments.
- **Telecom Regulatory Authority of India (TRAI)** has integrated blockchain-based Distributed Ledger Technology (DLT) to track SMS transmissions for regulatory compliance and consumer protection.
- **The National Securities Depository Limited (NSDL)** has introduced a Distributed Ledger Technology (DLT) based blockchain platform for Debenture Covenant Monitoring, marking a major step in modernizing India's capital markets.

**Source: TH**

## EXPLORATIONS OF CARBON CAPTURE AND UTILISATION (CCU) TECHNOLOGIES FOR INDIA

### In News

- Recently, it has been observed that Carbon Capture and Utilisation (CCU) technologies are essential for achieving India's net-zero emissions targets, particularly for hard-to-abate sectors like cement.

### Carbon Capture and Utilisation (CCU)

- It refers to a set of technologies that capture carbon dioxide emissions from industrial sources or directly from the air and convert them into useful products.
- It removes carbon from the atmosphere and puts it into the economy as inputs for fuels, chemicals, building materials, or polymers.
- Unlike carbon capture and storage, where captured $CO_2$ is permanently stored underground rather than reused, CCU uses up the captured carbon.

#### Global Scenario

- The EU Bioeconomy Strategy and Circular Economy Action Plan explicitly supports CCU as a way to turn $CO_2$ into feedstocks for chemicals, fuels, and materials, linking it to circularity and sustainability targets.
- ArcelorMittal and Mitsubishi Heavy Industries, Ltd. are working with a climate tech company, D-CRBN, to trial a new technology to convert CO2 captured at ArcelorMittal's plant in Gent, Belgium into carbon monoxide which can be used in steel and chemical production.
- The U.S. uses a combination of tax credits and funding to scale CCUs, particularly for CO-derived fuels and chemicals.
- The UAE's Al Reyadah project and planned CO-to-chemicals hubs leverage CCU with green hydrogen.

### Need in India

- India has consistently been the world's third-largest emitter of $CO_2$, with emissions driven largely by power generation, cement, steel, and chemicals.
- While renewable energy may reduce future emissions, many industrial processes are inherently carbon-intensive and difficult to decarbonise.
- CCU offers a pathway to reduce emissions from these "hard-to-abate" sectors while simultaneously creating new industrial value chains.
- It also aligns with India's net-zero target for 2070 and its push to build a circular, low-carbon economy.

### Progress and Initiatives

- India has begun supporting CCU through research funding from the Department of Science and Technology which has created a specific research and development roadmap for these technologies.
- The Union Budget 2026-27 has announced a Rs 20,000-crore scheme to scale up carbon capture, storage and utilisation across five high-emitting industrial sectors.
  - The move aims to move CCUS from pilot projects to policy-backed deployment as part of India's net-zero by 2070 commitment.
- The draft **2030 roadmap for Carbon Utilisation and Storage (CCUS)** presented by the Ministry of Petroleum and Natural gas has identified projects that can be used for CCUS purposes.
- In the private sector, Ambuja Cements (Adani Group) is working on an Indo-Swedish CCU pilot with IIT Bombay to convert captured $CO_2$ into fuels and materials.
- JK Cement is collaborating on a CCU testbed to capture $CO_2$ for applications such as lightweight concrete blocks and olefins.
- Organic Recycling Systems Limited (ORSL) is leading India's first pilot-scale Bio-CCU platform, valorising $CO_2$ from biogas streams into bio-alcohols and specialty chemicals.

### Key risks in scaling CCU (Carbon Capture and Utilization) in India

- **High Costs** – Capturing and converting CO is energy-intensive, making CCU products expensive compared to fossil-based alternatives.
- **Infrastructure Gaps** – Effective CCU requires co-located industrial clusters, $CO_2$ transport networks, and integration with downstream manufacturing, which are unevenly developed.
- **Regulatory and Market Uncertainty** – Lack of standards, certification, and clear market signals discourages investment and limits demand for $CO_2$-derived products.

### Conclusion

- CCUS technologies are essential for hard-to-decarbonize industries like steel and cement, where most $CO_2$ comes from production processes rather than fuel use.
- The ₹20,000 crore budget allocation aims to develop CCUS applications in power, steel, cement, refineries, and chemicals, helping reduce emissions
- India has taken positive steps through the development of roadmaps to achieving CCU, and their appropriate implementation will be necessary for achieving India's goals.

Source :TH

# NEWS IN SHORT

## RAMP PROGRAMME

### Context

- **The 5th National MSME Council** has reviewed the progress of the World **Bank supported RAMP Programme.**

### Raising and Accelerating MSME Performance (RAMP)

- RAMP is a World Bank supported **Central Sector Scheme** aimed at improving access of MSMEs to market, finance and technology upgradation by enhancing the outreach of existing MoMSME schemes.
- **Objective:**
  - Accelerating Centre- State collaboration in MSME promotion and development.
  - Enhancing effectiveness of existing MoMSME schemes for technology upgradation.
  - Strengthening Receivable Financing Market for MSMEs.
  - Enhancing effectiveness of Credit Guarantee Trust for Micro & Small Enterprises (CGTMSE), and promoting guarantee for greening initiatives of MSEs, and women owned MSEs.
  - Reducing incidence of delayed payments to MSEs.
- **Key Benefits:** The RAMP scheme would enhance the performance of MSMEs by promoting technology upgradation, innovation, digitization, market access, credit, greening initiatives, etc through active participation of the State Governments.

**Source: PIB**

## HIM-CONNECT

### Context

- The Ministry of Environment, Forest and Climate Change (MoEFCC) is organising **Him-CONNECT** in New Delhi as part of The Energy and Resources Institute's (TERI) World Sustainable Development Summit (WSDS).

### About

- 'Him-CONNECT' links researchers from the Indian Himalayan Region (IHR) with start-ups, investors and policymakers.
- It will showcase more than 24 technologies and innovations developed under the National Mission on Himalayan Studies (NMHS).
- The platform aims to facilitate commercialisation, on-ground deployment and wider adoption of Himalayan-focused solutions.

**Source: PIB**

## INDIA-SWEDEN AI PARTNERSHIP THROUGH SITAC FRAMEWORK

### Context

- On the sidelines of the **India AI Impact Summit 2026, the IndiaAI Mission and Business Sweden** signed a **Statement of Intent (SoI)** to strengthen bilateral cooperation in the field of Artificial Intelligence (AI).

### About

- It provides a **structured framework** for collaboration on the development, application and deployment of artificial intelligence solutions, with emphasis on real-world industrial and societal outcomes.
- Both countries will jointly develop a dedicated programme titled the **Sweden–India Technology and Artificial Intelligence Corridor (SITAC).**
    - **SITAC** will serve as the **flagship platform** to facilitate structured engagement among **government agencies, industry stakeholders, startups and academic institutions from both countries.**
- The partnership aligns the objectives of the **IndiaAI Mission to build a comprehensive national AI ecosystem** through access to compute, data and talent with Sweden's strengths in industrial innovation, advanced research and development and responsible AI implementation.

**Source: PIB**

## MISSION SUDARSHAN CHAKRA

### In News

- Indian PM visit to Israel boosted defence deal on advanced weapons tech and missile defence under **Mission Sudarshan Chakra**.

### Background and Need of Mission Sudarshan Chakra.

- During Operation Sindoor, India faced drone and missile threats from Pakistan.
- To strengthen national security, the Sudarshan Chakra missile shield—planned for 2035 under Make in India.
- It aims to integrate advanced defensive systems like Iron Dome, Iron Beam, Arrow, David's Sling, along with existing S-400, Barak, and Akash systems, covering India's borders and coastline.
    - The upcoming India-Israel MoU may include both defensive and offensive weapon collaboration.

### Sudarshan Chakra

- It is a multi-layered, home-grown air defence initiative.
- It is named after Lord Krishna's divine disc, designed to protect key sites from missiles, rockets, drones, and swarms.
- It combines long-range systems like S-400 and Project Kusha, medium-range MRSAM/Barak-8, short-range Iron Dome, and future laser-based weapons like Iron Beam and DURGA-II for cost-effective drone and low-altitude threat interception.

### Role of Israel

- Israel is a key partner in Sudarshan Chakra, providing advanced electronics, sensors, and precision tech, with technology transfer for systems like Iron Dome and Iron Beam under a Make in India focus.
- Israeli AI will integrate India's radars and sensors into a unified network for real-time threat detection and response.

Source :FE

## SUJVIKA PORTAL

### Context

- On the 40th Foundation Day of the Department of Biotechnology (DBT), **"SUJVIKA", an AI-driven Biotech Product Data Portal**, was launched highlighting biotechnology as a key driver of India's future economic growth.

### About SUJVIKA Portal

- SUJVIKA is a **Trade Statistics Digital Intelligence Platform** that presents **authenticated biotechnology** product import data in a structured and accessible format.
- The portal provides **sector-wise insights** into biochemical products, industrial enzymes, and other biotechnology imports.
- It **enables researchers, startups, and industry to identify high-value and high-volume imports,** assess import dependency and prioritise indigenisation and R&D efforts.
    - The portal also **supports evidence-based planning and promotes public–private partnerships** for strengthening domestic biomanufacturing.

### Bioeconomy of India

- India's bioeconomy grew from about USD 10 billion in 2014 to **USD 165.7 billion in 2024.**
- Biotechnology is projected to power the next industrial revolution. Biotech startups increased from fewer than 100 in 2014 to over **11,000** at present.
- The country aims to achieve a **USD 1 trillion bioeconomy by 2047** under the Viksit Bharat vision.

**Source: PIB**

## INTERNATIONAL CLIMATE INITIATIVE (IKI)

### In News

- Germany and India have launched a ₹20 million (approximately ₹180 crore) Large Grant project under the **International Climate Initiative (IKI).**

### About International Climate Initiative (IKI)

- Established in 2008, IKI serves as Germany's primary funding mechanism for international climate projects.
- It supports mitigation, adaptation, and biodiversity efforts in over 150 partner countries, with 14 priority nations including India, Brazil, China, South Africa, Indonesia, and Mexico.

### New India-Germany Project: Scope and Targets

- This 20 million project zeroes in on India's high-risk ecosystems, promoting nature-based solutions for long-term resilience.
- Priority regions include Himalayas (glacier melt and landslides), Western Ghats (biodiversity hotspots facing deforestation), North-East India (fragile terrains prone to erosion) & Island ecosystems (e.g., Andaman & Nicobar, vulnerable to sea-level rise).

### Strategic Significance for India and Global Climate Goals

- This initiative bolsters India's climate agenda amid escalating risks, rising temperatures, erratic monsoons, and biodiversity loss.
- It supports NDC targets like 50% non-fossil energy by 2030 and aligns with National Action Plan on Climate Change (NAPCC) missions such as Himalaya and Sustainable Habitat.

**Source: IE**

## CAFE-3 NORMS

### In News

- The Prime Minister's Office (PMO) recently reviewed the **proposed CAFE-3 carbon emission norms** for passenger vehicles, set for 2027, but did not make a final decision.

### CAFE norms

- The norms were introduced by the **Bureau of Energy Efficiency in 2017** to regulate fuel consumption and carbon emissions from passenger vehicles.
- These norms apply to vehicles running on petrol, diesel, liquefied petroleum gas (LPG), compressed natural gas (CNG), hybrids, and electric vehicles (EVs) weighing less than 3,500 kg.
    - The norms were tightened in the beginning of financial year 2022-23, with increased penalties for non-compliance.
- It aims to reduce oil dependency and air pollution by encouraging automakers to lower CO emissions and promote EVs, hybrids, and CNG vehicles, which are less carbon-intensive than conventional fossil-fuel cars.

### Draft Corporate Average Fuel Efficiency (CAFE)-3 Norms

- The CAFE-3 norms introduce concessions for small cars and extend incentives to flex-fuel and strong hybrid vehicles.
- The previous 3.0 g CO/km waiver for light cars weighing upto 909 kg and with engine capacity not exceeding 1200 cc has been removed.
- Automakers can form pools to meet targets, and the emission slope is now flatter, tightening limits for heavier vehicles while easing them for smaller cars.

**Source: TH**

# PEATLANDS

## Context

- **Two large lakes in the Democratic Republic of Congo** are releasing carbon that has been locked away for thousands of years in surrounding **peatlands** posing a **threat to climate stability.**

## Peatlands

- **Peatlands** are **terrestrial wetland ecosystems** in which waterlogged conditions prevent plant material from fully decomposing.
  - Consequently, the production of organic matter exceeds its decomposition, which results in a **net accumulation of peat.**
- **In cool climates,** peatland vegetation is mostly made up of **Sphagnum mosses,** sedges and shrubs, whereas **in warmer climates** graminoids and woody vegetation provide most of the organic matter.
- **Peatlands** occur in every climatic zone and continent and cover 4.23 million km2, which corresponds to 2.84% of the Earth's terrestrial surface.
  - **About 84% of the world's peatlands** are considered to be in natural, or near-natural state.
- Due to the **process of peat accumulation, peatlands** are carbon rich ecosystems that **store and sequester** more carbon than any other type of terrestrial ecosystem.

**Source: DD**

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