

DAILY CURRENT AFFAIRS (DCA)

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INDIA'S FIRST MWH-SCALE VANADIUM FLOW BATTERY

Context

- The Minister of Power and Housing & Urban Affairs inaugurated **India's largest and first MWh-scale Vanadium Redox Flow Battery (VRFB) system of 3 MWh capacity.**
- ♦ This marks a major step towards **long-duration energy storage (LDES) solutions**, enhancing renewable energy integration and grid resilience.

Lithium Ion Batteries and Their Limitations

- Lithium-ion batteries are **rechargeable energy storage devices** that use lithium ions as the charge carriers.
- **They are the dominant battery technology used in:** Electric Vehicles (EVs), Mobile phones, laptops, Renewable energy storage systems.
- **Working Principle:** During discharge, lithium ions move from the anode (usually graphite) to the cathode (lithium metal oxide) through an electrolyte, producing electrical energy.
- **Limitations:**
 - ♦ **Safety Risks:** Prone to thermal runaway, fire, and explosion if overcharged or damaged due to flammable electrolyte.
 - ♦ **Limited Raw Material Supply:** Dependence on lithium, cobalt, and nickel concentrated in a few countries leads to supply chain vulnerability.
 - ♦ **High Cost:** Raw material and manufacturing costs make Li-ion batteries expensive, especially for large-scale energy storage.
 - ♦ **Recycling Challenges:** Recycling technology is complex and expensive; global recycling rates remain below 10%.
 - ♦ **Temperature Sensitivity:** Efficiency drops in extreme cold or heat, affecting EV performance.
 - ♦ **Degradation Over Time:** Repeated charging leads to capacity fading and shorter lifespan.

Next-generation (Next-Gen) Battery Technologies

- Next-generation (Next-Gen) battery technologies refer to **emerging energy-storage systems** that aim **to overcome the limitations of conventional lithium-ion (Li-ion) batteries.**
- **Solid-State and Flow Batteries:**
 - ♦ **Solid-state batteries** use **solid electrolyte solutions**, which don't need a different separator. That makes **them safer** because they are less prone to leakage from damage or swelling in hot temperatures.

- ♦ **Flow batteries**, which are powered by reduction-oxidation (redox) reactions, involve two different liquid electrolytes that pass ions or protons back and forth through a porous membrane.
 - These batteries can store larger amounts of energy—as much as the size of the electrolyte cells can contain—and don't use flammable or polluting materials.

How Next-Generation (Next-Gen) Battery Technologies Are Better Than Lithium-Ion Batteries?

- **Higher Energy Density:** Next-gen batteries (like Solid-State, Li-Sulphur, Metal-Air) offer 2–3 times higher energy density than lithium-ion batteries.
 - ♦ This enables longer EV range, lighter batteries, and better performance.
- **Improved Safety:** Next-gen batteries (especially Solid-State) use non-flammable solid electrolytes, making them safer and more stable.
- **Faster Charging:** Allow rapid ion transfer, enabling faster charging — up to 80% in 10–15 minutes.
- **Longer Lifespan:** Lithium-ion batteries degrade after 500–2,000 cycles. Next-gen batteries can last for 5,000+ cycles with minimal capacity loss.
- **Use of Abundant and Cheaper Materials:** Next-gen batteries use abundant elements such as **sodium, sulphur, zinc, and aluminium**, reducing cost and resource dependency.
- **Environmentally Friendly:** Lithium and cobalt mining causes soil degradation, water stress, and pollution.
 - ♦ Next-gen batteries use eco-friendly materials, are easier to recycle, and have a lower carbon footprint.
- **Better Temperature Tolerance:** Next-gen batteries maintain stable performance across wide temperature ranges which is ideal for Indian climatic conditions.
- **Suitable for Advanced Applications:** Due to compactness, safety, and power efficiency, next-gen batteries can be used in:
 - ♦ Aerospace and defence;
 - ♦ High-performance drones;
 - ♦ Large-scale grid energy storage.

Government Initiatives

- **National Mission on Transformative Mobility and Battery Storage (NMTMBS):** It was launched by NITI Aayog in 2019.
 - ♦ Aims to promote clean, connected, and shared mobility and establish a domestic battery manufacturing ecosystem.

- **Production Linked Incentive (PLI) Scheme for Advanced Chemistry Cells (ACC):** Launched in 2021 to boost domestic manufacturing of next-gen batteries beyond conventional Li-ion.
- **Collaboration with Academia and Startups:** Indian research institutions like IITs, CSIR labs, IISc, and C-MET are actively developing next-gen battery materials.
- **Global Partnerships:** India collaborating with Japan, EU, and the US under frameworks like:
 - ♦ India–Japan Energy Dialogue.
 - ♦ Indo-US Clean Energy Initiative.
 - ♦ EU–India Clean Energy and Climate Partnership.
 - ♦ Focused on technology transfer and joint research in advanced battery chemistries.

Source: PIB

SUPREME COURT ON PRIVILEGED COMMUNICATIONS

In News

- The Supreme Court reaffirmed the vital role of advocates in a constitutional democracy, ruling that lawyers cannot be compelled to disclose client communications unless the legal advice is used to commit or conceal a crime.

Background

- The judgment arose from suo motu proceedings after an Ahmedabad police officer issued a notice under Section 179 of the BNSS, 2023, summoning a defence counsel to reveal case details.

What are privileged communications?

- Privileged communications refer to **confidential exchanges** between certain protected relationships, such as attorney-client and spousal, that the law shields from being disclosed or compelled as evidence in court.
- The **Bharatiya Sakshya Adhiniyam (BSA), 2023**, protects privileged communications from being disclosed in court.
- Sections 128–134 outline these safeguards.
 - ♦ **Section 128** shields marital communications, even post-divorce, unless in cases of inter-spousal crime or litigation.
 - ♦ **Section 129 restricts access to unpublished official records** without departmental approval to protect national interest.
 - ♦ **Section 132 upholds advocate-client confidentiality** by prohibiting disclosure of professional communications.

Latest Observations of Supreme Court

- The Supreme Court ruled that compelling a lawyer to disclose client communications—except under specific exceptions in **Section 132 of the Bharatiya Sakshya Adhiniyam (BSA), 2023**—violates the constitutional right to a fair trial.
- The Court emphasized that **legal professional privilege protects the accused's right to equitable representation and cannot be bypassed by summoning the lawyer** unless the communication involves client consent, illegal purposes, or observed criminal activity.
- By linking this privilege to Article 20(3) (protection against self-incrimination), the Court constitutionalised it as a safeguard for citizens, not a lawyer's privilege.
- It also affirmed that advocates are constitutional actors" vital to the justice system, and forcing them to testify against clients undermines **Articles 14 and 21 by collapsing the boundary between defence and prosecution**.

Importance

- The Supreme Court's verdict reinforces the constitutional right to effective legal representation under Articles 21 and 22(1), citing landmark cases like M.H. Hoskot and Hussainara Khatoon.
- It curbs investigative overreach by affirming that police powers under Section 179 of the BNSS cannot breach lawyer-client confidentiality.
- The ruling restores institutional balance, asserting that professional privilege protects not lawyers, but the citizen's right to fair defence.

Source :TH

EXPORT PROMOTION MISSION

Context

- Amid pressure on **goods exports to the US** due to **high 50% tariffs**, the Union Cabinet has approved a **six-year Export Promotion Mission** with an outlay of Rs 25,060 crore.

Export Promotion Mission

- **In the Union Budget for 2025-26**, the Finance Minister announced an Export Promotion Mission.
 - ♦ It would facilitate easy access to export credit, cross-border factoring support, and support to MSMEs to tackle non-tariff measures in overseas markets.
- **Ministries:** Driven jointly by the Ministries of Commerce and Industry, the Ministry of Micro, Small, and Medium Enterprises, and the Ministry of Finance.

- **Under EPM, priority support** will be extended to sectors impacted by recent global tariff escalations, such as textiles, leather, gems & jewellery, engineering goods, and marine products.
- **The Directorate General of Foreign Trade (DGFT)** will act as the implementing agency, with all processes from application to disbursement.
 - ♦ It will be managed through a dedicated digital platform integrated with existing trade systems.

Major Components of EPM

Financial Support

- **Credit Guarantee Scheme for Exporters (CGSE):** Provides 100% coverage by the National Credit Guarantee Trustee Company Ltd (NCGTC).
 - ♦ For additional credit facilities up to 20,000 crore to eligible exporters (including MSMEs).
 - ♦ Enables collateral-free credit, improving liquidity and competitiveness.
- **Integration of Schemes:** Interest Equalisation Scheme (interest subvention for exporters).
 - ♦ Market Access Initiative (MAI) (support for trade fairs, market promotion).
 - ♦ Both merged under a digitally driven EPM framework.

Non-Financial Support

- **Addressing Non-Tariff Barriers (NTBs):** Funding for compliance, certifications, and technical standards.
- **Market Acquisition & Branding:** Assistance for international exhibitions, packaging, and branding.
- **Logistics Cost Reduction:** Support for supply chain efficiency and trade facilitation.

The Mission is expected to:

- Facilitate access to affordable trade finance for MSMEs.
- Enhance export readiness through compliance and certification support.
- Improve market access and visibility for Indian products.
- Boost exports from non-traditional districts and sectors.
- Generate employment across manufacturing, logistics, and allied services.

Source: IE

DNA SAMPLING

Context

- Investigators are using **DNA profiling** to determine the suspect of the recent deadly **car explosion outside the Red Fort in New Delhi**, highlighting how **genetic analysis** plays a crucial role in forensic investigations.

About DNA Profiling

- It is a set of **molecular techniques** used to identify individuals based on unique genetic markers.
- It remains the most dependable method of identification in cases involving explosions, fires, or mass disasters where bodies are unrecognisable.

Deoxyribonucleic Acid (DNA)

- It is a molecule composed of two strands forming a double helix, carrying genetic instructions used in the growth, development, functioning, and reproduction of all known living organisms.
- Each DNA molecule consists of **four chemical bases**: adenine (A), thymine (T), cytosine (C), and guanine (G).
 - ♦ The sequence of these bases determines genetic information.

Principles of DNA Profiling

- **Short Tandem Repeats (STRs)** as the most widely used markers.
 - ♦ Each person has a distinctive STR pattern.
 - ♦ Children inherit 50% of STR markers from each parent.
 - ♦ A match between the mother's STR profile and that of an unidentified body can confirm identity with high accuracy.
- **Single Nucleotide Polymorphisms (SNPs)** for higher resolution, useful for ancestry and medical applications.
- **Mitochondrial DNA (mtDNA) and Y-chromosome markers** for lineage tracing. If nuclear DNA is too degraded:
 - ♦ mtDNA is used because it survives extreme conditions.
 - ♦ It is inherited only from the mother.
 - ♦ It is crucial for confirming maternal lineage, while it cannot uniquely identify individuals.

Techniques in DNA Profiling

- **Polymerase Chain Reaction (PCR):** It allows amplification of small or degraded DNA, and enables analysis of **STR loci**.
- **Capillary Electrophoresis:** It separates DNA fragments by size to generate STR profiles,

and produces electropherograms used in identification.

- **Next-Generation Sequencing (NGS):** It provides sequence-level variation of STRs and SNPs, and enables deeper resolution in ancestry mapping and complex forensic cases.

Applications of DNA Profiling in Genetic Analysis

- **Forensic Identification:** Crime scene investigation, missing-person cases, mass-disaster victim identification.
- **Medical Genetics:** Detection of hereditary disorders using SNP-based profiling.
 - ♦ Pharmacogenomics: matching drugs to patient genetic profiles.
- **Evolutionary and Population Genetics:** Tracing migrations, genetic drift, founder effects.
 - ♦ Measuring genetic diversity in populations.
- **Ancestry and Genealogy Testing:** Comparing customer DNA to population reference panels.
 - ♦ Use of autosomal SNP arrays and haplogroup analysis.
- **Conservation and Wildlife Biology:** Tracking illegal wildlife trade.
 - ♦ Identifying species, subspecies, and individuals in ecological studies.

How Genetic Analysis Establishes Identity?

- **DNA Extraction:** Samples are taken from biological material — blood, bone, hair, or tissue — from both the unidentified remains and the known relative.
- **PCR Amplification:** PCR is used to amplify specific DNA regions for comparison.
- **STR Profiling:** STRs are highly variable DNA sequences used to create a genetic profile.
- **Kinship Matching:** The suspect's DNA is compared with that of the relative to establish a biological relationship.

Challenges in DNA Identification

- **Degraded DNA:** Heat, chemicals, or environmental exposure can break down genetic material.
- **Contamination:** Poor handling or mixing of samples can compromise results.
- **Insufficient DNA:** Some remains may yield very little biological material.
- **Mixed Profiles:** In explosions, remains of multiple individuals may be intermingled, complicating analysis.

India & DNA Technology

- The **DNA Technology (Use and Application) Regulation Bill, 2019** was aimed to regulate the use of DNA technology for establishing identity in criminal investigations, missing persons cases, and disaster victim identification.
 - ♦ The bill, though not passed, was aimed to:
 - Establish a DNA Regulatory Board;
 - Set standards for DNA laboratories;
 - Ensure privacy and ethical use of genetic data.
- The **Criminal Procedure (Identification) Act, 2022** allows for the collection of DNA samples from arrestees, undertrials, and convicts.
- The **Department of Biotechnology (DBT)** under the Ministry of Science & Technology supports research and infrastructure for DNA-based technologies, including biobanks and genomic studies.

Ethical, Legal, and Social Issues

- Privacy concerns and genetic data protection.
- Risks of genetic discrimination in insurance/employment.
- Debates around national DNA databases.
- Informed consent and data ownership in consumer genetic platforms.

Other Methods of Genetic Analysis

- **Mendelian (Classical) Genetics:**
 - ♦ **Segregation & Independent Assortment Analysis:** Used to determine how traits pass from parents to offspring based on predictable ratios.
 - ♦ **Linkage & Recombination Mapping:** Measures how frequently alleles recombine during meiosis to infer physical proximity on chromosomes.
- **Cytogenetic Methods:**
 - ♦ **Karyotyping:** Examines whole chromosome structures to detect aneuploidies and gross chromosomal changes.
 - ♦ **Fluorescence In Situ Hybridization (FISH):** Uses fluorescent probes to detect specific DNA sequences on chromosomes.
 - ♦ **Comparative Genomic Hybridization (CGH):** Identifies chromosomal gains and losses without requiring cell culture.

- **Functional Genetic Analysis:**
 - ♦ **Gene Knockout/Knock-in (CRISPR, TALEN, ZFN):** Used to study gene function by disrupting or altering gene sequences.
 - ♦ **RNA Interference (RNAi):** Silences gene expression to observe phenotypic changes.
 - ♦ **Overexpression Systems:** Increase gene expression to determine function.
- **Epigenetic Analysis:**
 - ♦ **Bisulfite Sequencing:** Maps DNA methylation.
 - ♦ **ChIP-seq:** Identifies protein–DNA interactions and histone modifications.
 - ♦ **ATAC-seq:** Profiles chromatin accessibility.

Source: IE

INDIA, BOTSWANA CHEETAH TRANSLOCATION PACT

In News

- India and Botswana formally announced the translocation of eight Cheetahs to India as a part of 'Project Cheetah'.

About

- India declared the **cheetah extinct in 1952**, after decades of over-hunting, habitat fragmentation, and depletion of prey species.
- The launch of Project Cheetah in 2022 and the arrival of cheetahs from Namibia and South Africa created the world's first intercontinental relocation programme for a large carnivore.
- And, **Botswana, a landlocked country** with nearly 70% of its landmass covered by the **Kalahari Desert**, holds one of the world's largest wild cheetah populations.

Project Cheetah

- **Overview:** Project Cheetah is India's ambitious attempt to reintroduce the cheetah in suitable open forest and grassland ecosystems.
- **Launched By:** National Tiger Conservation Authority (NTCA), a statutory body under the Wildlife (Protection) Act, 1972 (amended 2006).
- **Objective:** To reintroduce cheetahs into India's grassland ecosystems and establish a viable, free-ranging cheetah population.
- **Global First:** It is the world's first intercontinental translocation of a large wild carnivore.

Translocations So Far:

- ♦ 8 cheetahs from Namibia in 2022
- ♦ 12 cheetahs from South Africa in 2023
- ♦ 8 cheetahs from Botswana (2025 announcement)

Significance of Reintroducing the Cheetah

- **Ecological Restoration:** Cheetahs, as apex predators, help regulate prey populations and maintain the health of grassland and open forest ecosystems. Their reintroduction is expected to restore ecological balance and revive degraded grassland biomes.
- **Biodiversity Conservation:** The cheetah serves as a flagship and umbrella species, helping conserve not only its prey-base but also other endangered species in grassland and semi-arid ecosystems.
- **Sustainable Livelihoods:** The project aims to boost ecotourism and create economic opportunities for local communities through eco-development and conservation-driven activities.
- **Global Conservation:** Project Cheetah contributes to the global effort to conserve the cheetah species, especially the vulnerable African cheetah and the critically endangered Asiatic cheetah.

Concerns and Challenges

- **Habitat Suitability:** Kuno is relatively small for a long-term, self-sustaining cheetah population.
- **High Mortality:** Several deaths (disease, conflict, heat stress) have been recorded since 2023 have raised questions about preparedness, disease screening, and enclosure design.
- **Human–Wildlife Conflict:** Cheetahs may venture into farmland due to porous boundaries. India lacks a historical memory of living with cheetahs, creating management gaps.
- **Climate and Ecological Mismatch:** African cheetahs are adapted to open savannahs; India's landscapes are patchier. India's prey density still needs improvement in some sites.

About the Cheetah

- The **cheetah (Acinonyx jubatus)** is the world's fastest mammal and the only large carnivore to have gone extinct in India (1952).
- Unlike other big cats, cheetahs do not roar.
- There are **two main species:** the **African cheetah (Vulnerable)** and the **Asiatic cheetah (Critically Endangered)**, found only in eastern Iran and parts of Africa.

Source: TH

NEWS IN SHORT

SC ASKED HCS TO UPLOAD DETAILS OF TIME TAKEN BY JUDGES TO DELIVER VERDICTS

Context

- **The Supreme Court** said **all High Courts** should put out in the public domain the time taken by their judges to pronounce verdicts in pending cases.

About

- There are **no specific timelines** within which judges have to deliver judgments.
- The convention is that the judiciary ought to pronounce judgments **within a reasonable time, from two to six months**, of reserving cases.
- However, judges, including in the Supreme Court and the High Courts, have in practice **reserved judgments for well over a year before delivering them**.
 - ♦ This may be due to the complexity of the question of law involved or the burden of work.

Recommendations by SC

- There ought to be a dashboard on High Court websites, exclusively focussing on the **reservation and pronouncement of judgments**.
 - ♦ This will show the **transparency and accountability** of the judiciary to the people.
- State High Courts to **file reports on their existing mechanisms** to bring into the **public domain**:
 - ♦ the dates when pending judgments were reserved,
 - ♦ the time taken between the reservation of judgments and their pronouncement,
 - ♦ and when a pronounced judgment is actually uploaded on their official websites.

Significance

- Promotes judicial transparency and public trust.
- Helps in monitoring judicial efficiency and reducing delays in pronouncing judgments.
- Strengthens accountability mechanisms within the judiciary.

Judiciary in India

- **Supreme Court:** The highest court in India, with the authority to interpret the Constitution, adjudicate disputes between states and the center, and oversee the legality of laws and government actions.

- **High Court:** Each state or group of states has a High Court, which handles appeals from lower courts and issues related to state-level legal matters.
- **District Courts** handle civil and criminal cases at the district level, and various specialized courts such as family courts, consumer courts, and labor courts.
- **Each branch operates independently** but is designed to work in harmony with the others, providing a system of **checks and balances** to ensure fair governance and adherence to the Constitution.

Source: TH

GI TAG FEE CUT

In News

- Recently, the Government announced a reduction in the **GI tag application fee** from **₹5,000 to ₹1,000**, encouraging tribal artisans to protect traditional crafts.

More About the News

- GI tag certificates distributed for crafts and products like Kannadippaya (Kerala), Apatani textile (Arunachal), Marthandam honey (Tamil Nadu), Lepcha Tungbuk (Sikkim), Bodo Aronai (Assam), Ambaji Marble (Gujarat), and Badri cow ghee (Uttarakhand).

Geographical Indications (GIs)

- They are a form of industrial property that identify products as originating from a specific place, where their quality or reputation is linked to that origin.
- They are recognized under the **Paris Convention and TRIPS Agreement (Articles 22–24)**.
- GIs are part of **international intellectual property rights**. India, as a WTO member, enacted the **Geographical Indications of Goods (Registration & Protection) Act, 1999**, which came into effect on 15 September 2003.
 - ♦ The first product in India to be accorded with GI tag was Darjeeling tea in the year 2004-05.
- **Benefits:** Legal protection to the products
 - ♦ Prevents unauthorised use of GI tag products by others
 - ♦ It helps consumers to get quality products of desired traits and is assured of authenticity
 - ♦ Promotes the economic prosperity of producers of GI tag goods by enhancing their demand in national and international markets

Source :TH

QUANTUM DIAMOND MICROSCOPE

In News

- India has developed its first **indigenous Quantum Diamond Microscope (QDM)** for dynamic magnetic field imaging, marking a major milestone in the field of quantum sensing.

About

- The technology allows for **three-dimensional magnetic field imaging** at the nanoscale, offering widefield visualization of dynamic magnetic activity similar to an optical microscope.
- This innovation holds immense potential in neuroscience, materials research, and the non-destructive testing of semiconductor chips, where it can map buried current paths and multilayer structures in 3D.
- QDM offers a transformative solution for high-resolution, 3D magnetic mapping across integrated circuits, microelectronics, and energy storage systems.

Source: DD News

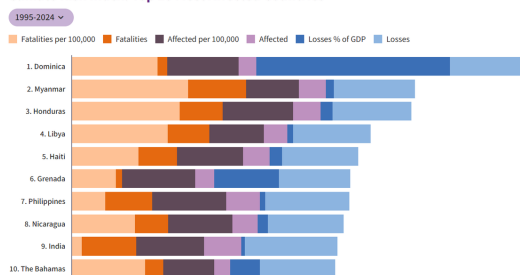
CLIMATE RISK INDEX (CRI) 2026

Context

- The new **Climate Risk Index (CRI) 2026** report has been released by **Germanwatch**.
 - The analysis was presented at the ongoing COP30 in Belem, Brazil.

Key Findings

Climate Risk Index: Top 10 Most Affected Countries



- India was ninth on the list of countries most affected by **extreme weather events between 1995 and 2024**.
 - In the last three decades, India faced around 430 extreme weather events which resulted in inflation-adjusted losses of around \$170 billion.
- Most People Affected:** India ranked third behind Bangladesh and the Philippines.
- Continuous Threat Category:** It has placed India, along with the Philippines, Nicaragua, and Haiti in the "continuous threats" category,
 - This means that these countries are exposed to repeated and frequent extreme weather events.

Recommendations

- Global emissions have to be reduced immediately.
- Adaptation efforts must be accelerated.
- Effective solutions for loss and damage must be implemented, and adequate climate finance must be provided.

- The **CRI** is calculated based on the **economic and human effects of extreme weather events**.
 - Higher the rank, the worse a country** has been affected by extreme weather events.
 - The index, however, **only analyses rapid onset events** like storms, extreme temperatures, wildfires, glacial lake outbursts, and floods.
 - It does not include slow onset events** like rising mean temperatures, sea level rise, ocean acidification, glacial retreat, etc.

Source: TH

