

# PrepAlpine

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**First Edition: January 2026**

Printed and published by PrepAlpine

# DAILY CURRENT AFFAIRS DATED 04.02.2026

## GS Paper II: Current Affairs

### 1. India's Industrial Transition

#### a. Introduction

For more than a century, industrial growth across the world has been powered by the direct burning of fuels such as coal, oil, gas and biomass. These fuels—often described as “molecules”—have traditionally driven factories, furnaces, kilns, engines and transport systems. Industrial expansion was therefore closely tied to the availability, extraction and combustion of physical fuels.

The emerging phase of industrial transformation, however, is increasingly centred on “electrons,” that is, electricity. Modern industries are progressively shifting away from fuel-based combustion processes towards electricity-driven systems. This transition is not merely technological; it reshapes efficiency levels, cost structures, competitiveness, and environmental outcomes.

For India, the transition from molecules to electrons is not simply an environmental preference. It represents a structural economic necessity that will decisively influence industrial competitiveness, export viability and long-term energy security.

#### Industrial Energy Transition: Molecules vs Electrons

MOLECULES (Fuel-based)	ELECTRONS (Electricity-based)
 Coal / Oil / Gas / Biomass	 Grid / Renewables / Captive power
 Direct combustion	 Motors, EAFs, induction heating
 Boilers, furnaces, kilns	 90% efficiency
 30~35% efficiency	 Precise digital control
 High heat loss	 Low emissions (with green grid)
 High CO <sub>2</sub> + pollutants	 Automation-ready
 Volatile supply chains	

*Industrial competitiveness increasingly depends on electrons, not molecules.*

#### b. Conceptual Framework: Molecules and Electrons in Industry

##### i. Molecules: Fuel-Based Industrial Energy

Molecules refer to conventional fuels such as coal, oil, natural gas, liquefied petroleum gas and biofuels. These fuels are primarily utilised through direct combustion in industrial processes such as boilers, furnaces, kilns and internal combustion engines.

Fuel-based industrial systems suffer from several structural limitations:

- Low conversion efficiency, with a large share of energy lost as waste heat
- High greenhouse gas and local pollutant emissions
- Dependence on complex and volatile fuel supply chains

- Limited scope for automation, precision control and digital integration

As a result, fuel-driven industries face rising operational costs and growing regulatory pressures in a carbon-constrained global economy.

## **ii. Electrons: Electricity-Based Industrial Energy**

Electrons refer to electricity supplied through power grids, captive power plants or renewable energy systems. Electricity is used in electric motors, induction heating, electric arc furnaces, electrified kilns and digitally controlled manufacturing systems.

Electricity-based industrial processes offer several advantages:

- Much higher energy efficiency
- Precise digital control and automation
- Ease of integration with renewable energy sources
- Lower emissions as electricity grids decarbonise

The central insight is simple but powerful: industrial competitiveness increasingly depends on how much productive work is performed using electricity rather than fuel combustion.

## **c. Why Electrification Enhances Industrial Efficiency**

Electric motors typically convert over 90 percent of input energy into useful mechanical work. In contrast, fuel-based engines and boilers often convert less than 30–35 percent of energy into productive output, with the remainder lost as heat.

In practical terms, this means that:

- One unit of electricity can replace multiple units of fuel
- Operating costs decline even before accounting for environmental benefits
- Reliability, precision and productivity improve significantly

Thus, electrification is not only environmentally desirable but also economically rational, especially in energy-intensive industries.

## **d. Global Patterns of Industrial Electrification**

Across advanced economies, overall electrification levels in industry typically lie in the range of 30–35 percent. However, the decisive difference lies not in aggregate numbers, but in how electricity is deployed within industrial systems.

China, for instance, uses nearly half of its industrial energy in the form of electricity, whereas India remains overwhelmingly dependent on fuel-based processes. This divergence is not driven by resource constraints but by deliberate strategic choices.

China has consciously channelled electricity into manufacturing and heavy industry, while India's industrial sector continues to rely largely on combustion-driven technologies.

## **e. China's Electron-First Industrial Strategy**

China's industrial electrification has been intentional, coordinated and policy-driven, resting on three interlinked pillars:

- Massive expansion of electricity generation capacity
- Strong transmission, storage and grid infrastructure
- Redesign of industrial processes to operate primarily on electricity

Sectoral examples illustrate this approach clearly:

- **Steel:** Aggressive expansion of Electric Arc Furnaces (EAFs), supported by scrap recycling ecosystems, favourable electricity pricing and reliable power supply
- **Cement:** Extensive electrification of grinding and material handling, complemented by waste heat recovery and digital energy management
- **Hard-to-abate emissions:** Pilot projects on carbon capture for residual emissions that cannot be eliminated through electrification

This strategy has given China a decisive advantage in global markets where carbon intensity, traceability and environmental compliance increasingly shape trade outcomes.

## **f. India's Present Industrial Energy Profile**

India possesses several enabling strengths:

- Rapid expansion of renewable energy capacity, especially solar
- Partial electrification in sectors such as steel
- Growing digital infrastructure for power management

However, major structural limitations persist:

- Industrial systems—especially in micro, small and medium enterprises (MSMEs)—remain heavily dependent on coal boilers and diesel generators
- Power reliability concerns discourage firms from designing fully electric processes
- Policy focus has largely emphasised electricity generation, rather than transforming industrial energy consumption patterns

Consequently, India's industrial electricity usage remains low, and the share of green electricity in industry is particularly limited.

## **g. Why the Molecule-to-Electron Transition Is Crucial for India**

### **i. Industrial Competitiveness**

Global buyers increasingly demand low-carbon and traceable products. Carbon intensity now affects pricing, export access and long-term contracts. Electrified industries are structurally better positioned to meet these expectations.

### **ii. Trade and Carbon Regulations**

Mechanisms such as the European Union's Carbon Border Adjustment Mechanism (CBAM) impose additional costs on carbon-intensive production. Fuel-based industries therefore face rising trade barriers and declining competitiveness.

### **iii. Energy Security**

Electricity can be generated domestically from renewable and non-fossil sources. This reduces dependence on imported oil and gas, strengthens macroeconomic stability and shields industry from global fuel price volatility.

### **iv. Structural Transformation**

Electrification enables automation, digital manufacturing and innovation-led growth, supporting a shift towards a modern, technology-intensive industrial structure.

## **h. Sector-Specific Pathways for India**

Key sectoral priorities include:

- **Steel:** Expansion of Electric Arc Furnaces, supported by improved scrap availability and assured access to renewable electricity
- **Cement:** Greater electrification of grinding and transport, combined with large-scale waste heat recovery and preparedness for carbon capture
- **MSMEs:** Replacement of coal boilers and diesel generators with electric boilers and induction furnaces, supported by concessional finance, technical assistance and shared renewable procurement models

Future industrial clusters should be designed as all-electric by default, integrating smart grids, demand-response systems and digital energy monitoring from inception.

### **i. The Way Forward: Towards an Electron-First Industrial Economy**

India requires a dedicated National Mission on Industrial Electrification. Policy focus must shift from installed power capacity to actual electricity usage in industry.

Key priorities include:

- Improving power quality and reliability for manufacturing
- Prioritising green electricity allocation for industrial consumers
- Rapid conversion of all industrial processes where electrification technologies are already mature

Such a strategy would lay the foundation for low-carbon industrialisation, export resilience and long-term competitiveness.

### **Conclusion**

The future of industrial success will not be determined by how much fuel a country burns, but by how efficiently it uses electricity. Electrons deliver higher efficiency, cleaner production and stronger integration with global value chains.

For India, the transition from molecules to electrons is essential to sustain industrial growth, protect export markets, enhance energy security and align with a low-carbon global economy. The next phase of India's industrialisation must therefore be decisively electron-led rather than fuel-led.

## **GS Paper III: Environment**

### **2. Solid Waste Management (SWM) Rules, 2026**

#### **a. Introduction**

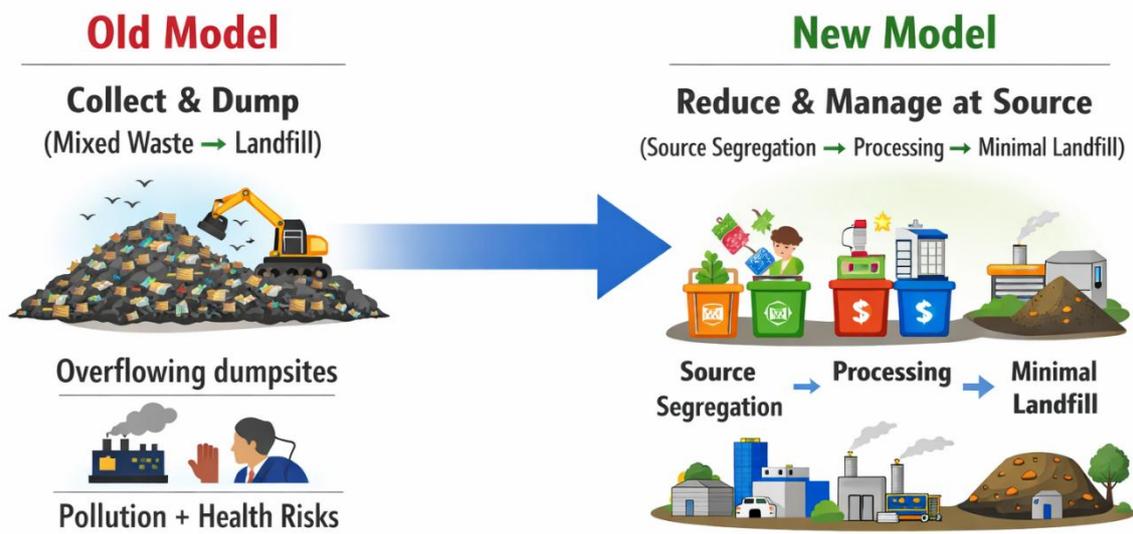
Union Ministry of Environment, Forest and Climate Change (MoEFCC) has notified the Solid Waste Management (SWM) Rules, 2026, which will come into force from April 1, 2026. These new rules replace the SWM Rules, 2016 and mark a significant policy shift in India's approach to waste management. Given India's mounting solid waste problem (1.85 lakh tonnes generated daily) and the visibility of urban landfill "mountains", the notification of these rules has major environmental, urban governance, and public health implications.

Solid waste management refers to the systematic collection, segregation, treatment, processing and disposal of waste generated by households, commercial establishments, institutions and industries. In India, rapid urbanisation, population growth, rising incomes and changing consumption patterns—especially increased use of packaged and disposable goods—have sharply increased both the quantity and complexity of solid waste.

Historically, most Indian cities followed a "collect and dump" model, where mixed waste was transported to landfills located on urban fringes. This approach has resulted in overflowing dumpsites, environmental degradation, public health hazards and loss of valuable recyclable

materials. Recognising these failures, India's waste management framework is now undergoing a conceptual shift from end-stage disposal to waste reduction and management at the point of generation itself.

## India's Shift in Solid Waste Management Approach



### b. Why Solid Waste Management Has Become a Critical Urban Challenge

India generates an extremely large volume of municipal solid waste every day, yet systems for handling it remain inadequate. Waste is frequently collected without segregation, processing infrastructure is insufficient, and a substantial share of waste continues to be dumped untreated.

The consequences have been severe:

- Overflowing landfill mounds near cities, contaminating soil and groundwater through leachate
- Methane emissions from decomposing organic waste, contributing to climate change
- Serious health risks for communities living near dumpsites
- Permanent loss of recyclable materials that could have generated economic value

These outcomes underline the need for a fundamental change in how waste is perceived, generated and managed, rather than incremental improvements in disposal practices.

### c. From Disposal to Prevention: A Shift in Perspective

Contemporary waste management frameworks emphasise that waste should be prevented or minimised before disposal is even considered. This represents a decisive break from landfill-centric thinking.

The new approach focuses on:

- Reducing waste generation at source
- Extending product life cycles through reuse
- Recovering value from waste through recycling and processing

The overarching goal is to ensure that only minimal, inert and non-recoverable waste reaches landfills.

#### **d. Waste Hierarchy as the Guiding Framework**

The waste hierarchy provides a structured framework by ranking waste management practices according to their environmental desirability.

The hierarchy progresses as follows:

- Prevention – avoiding waste generation altogether
- Reduction – minimising the quantity of waste generated
- Reuse – extending the life of products
- Recycling – converting waste into new materials
- Recovery – extracting energy or materials from waste
- Disposal – landfilling or incineration, treated as a last resort

Practices placed higher in the hierarchy conserve more resources and cause less environmental harm. As such, the hierarchy forms the normative backbone of sustainable solid waste management.

#### **e. Centrality of Segregation at Source**

Segregation at source refers to separating waste at the point where it is generated—such as homes, offices, markets and institutions. It is the cornerstone of effective solid waste management.

Waste is broadly categorised into:

- Wet waste – biodegradable kitchen and food waste
- Dry waste – paper, plastic, metal and glass
- Sanitary waste – diapers, sanitary napkins
- Special-care waste – medicines, bulbs, chemicals, paint containers

Source segregation is critical because it:

- Enables efficient composting and recycling
- Prevents contamination of recyclable materials
- Reduces occupational health hazards for sanitation workers
- Significantly lowers the volume of waste sent to landfills

When waste is mixed, even valuable recyclables lose their utility, making downstream processing ineffective.

#### **f. Role of Bulk Waste Generators**

Bulk waste generators are entities that produce large quantities of waste regularly, such as:

- Large residential complexes
- Hotels and restaurants
- Shopping malls
- Educational institutions
- Office complexes

Focusing on bulk generators is strategic because a disproportionately large share of urban waste originates from a relatively small number of sources.

Bulk waste generators are expected to:

- Ensure segregation at source
- Process biodegradable waste on-site through composting or similar methods
- Channel recyclable materials to authorised recyclers

This decentralised approach reduces pressure on municipal systems and reflects the principle of shared responsibility.

### **g. Polluter Pays Principle in Solid Waste Management**

The polluter pays principle holds that those who generate pollution must bear the cost of managing it. In solid waste management, this principle is operationalised through:

- Higher user charges for unsegregated waste
- Penalties for improper disposal
- Financial disincentives for dumping waste in landfills

By internalising environmental costs, the principle:

- Encourages responsible waste behaviour
- Enhances accountability
- Discourages wasteful consumption patterns

### **h. Role of Households and Residential Communities**

Households and residential societies are increasingly recognised as active participants rather than passive waste producers.

Their role includes:

- Segregating waste at home
- Reducing unnecessary consumption
- Composting biodegradable waste where feasible
- Cooperating with local authorities and authorised processors

This decentralised approach acknowledges that sustainable waste management begins at the household level, not at landfills.

### **i. Technology and Waste Tracking Systems**

Digital technologies are being integrated into waste management systems to improve governance and accountability. Waste tracking systems monitor waste movement from generation to processing or disposal.

Such systems help to:

- Prevent illegal dumping
- Improve planning and route optimisation
- Ensure regulatory compliance
- Enhance transparency among stakeholders

Technology thus plays a critical role in strengthening institutional capacity and enforcement mechanisms.

### **j. Reconsidering the Role of Landfills**

Landfills pose serious environmental challenges:

- Occupation of vast land areas
- Air, water and soil pollution
- Methane emissions
- Long-term ecological and health costs

As a result, landfills are increasingly treated as a last-resort option. Contemporary strategies focus on:

- Reducing fresh waste reaching landfills
- Scientifically reclaiming legacy dumpsites

Methods such as bioremediation (microbial decomposition of waste) and biomining (recovery of reusable materials from old dumps) are being adopted to restore degraded land.

## **k. Environmental and Social Benefits of Improved Waste Management**

Effective solid waste management delivers multiple benefits:

- Cleaner and healthier urban environments
- Reduction in greenhouse gas emissions
- Conservation of natural resources through recycling
- Safer working conditions for sanitation workers

At a systemic level, these practices support the transition towards a circular economy, where waste is treated as a resource rather than a burden.

## **1. Persistent Implementation Challenges**

Despite policy progress, several challenges persist:

- Uneven public awareness and behavioural change
- Capacity and financial constraints of urban local bodies
- Weak monitoring and enforcement mechanisms
- Limited technical expertise and infrastructure

These constraints hinder uniform and large-scale implementation across cities.

## **m. Way Forward**

The path ahead requires:

- Strengthening public awareness and behavioural change campaigns
- Promoting decentralised waste processing systems
- Enhancing financial and technical capacity of urban local bodies
- Integrating informal waste pickers into formal municipal systems
- Ensuring consistent enforcement of waste management rules

Long-term institutional commitment is essential to sustain progress.

## **Conclusion**

Solid waste management in India is gradually shifting from a landfill-dependent model to a source-based, prevention-oriented system. Waste reduction, segregation at source and shared responsibility among households, institutions and authorities form the foundation of this transition.

If implemented effectively, this approach can deliver cleaner cities, environmental sustainability and a significantly improved quality of urban life, while aligning India's urban development with principles of resource efficiency and circular economy.

## GS Paper III: Security

### 3. Why India Is Increasing Capital Spending in the Defence Sector

#### a. Introduction

India's defence expenditure has historically been shaped by the imperative of sustaining a large standing force. A substantial share of the budget was devoted to salaries, pensions, fuel, and routine maintenance, ensuring operational continuity but leaving limited fiscal space for modernisation and technological upgradation.

In recent years, however, a clear policy shift has emerged towards increasing capital expenditure in the defence sector. This transition reflects changing security realities, lessons from contemporary warfare, and India's long-term strategic objective of building technologically advanced and self-reliant armed forces. Defence spending is thus moving away from mere force sustenance towards future-oriented military preparedness.



#### b. Understanding Defence Capital Spending

Defence expenditure is broadly divided into two components:

##### i. Revenue Expenditure

Revenue expenditure covers recurring and operational costs such as:

- Salaries and pensions
- Fuel and logistics
- Routine maintenance and repairs

While essential for day-to-day functioning, revenue expenditure does not create long-term military assets.

##### ii. Capital Expenditure

Capital expenditure is directed towards asset creation and long-term capability development. It includes:

- Acquisition of weapons, ammunition, and platforms (aircraft, ships, submarines, tanks)
- Missiles, drones, surveillance and communication systems
- Investments in defence research and development

Capital spending therefore determines the modernisation level, technological edge, and future readiness of the armed forces.

### **c. The Traditional Problem in India's Defence Budget**

For decades, India's defence budget suffered from a structural imbalance.

#### **i. Dominance of Revenue Expenditure**

A large proportion of allocations was absorbed by salaries and pensions, steadily reducing the share available for capital acquisition.

#### **ii. Burden of Committed Liabilities**

Much of the capital budget itself was pre-empted by payments for contracts signed in earlier years, known as committed liabilities. This left little room for initiating fresh procurement projects.

#### **iii. Consequences of the Imbalance**

As a result:

- Ageing platforms remained in service beyond their intended life
- Induction of new technologies was delayed
- Capability gaps emerged despite adequate troop strength

India thus faced a paradox of being operationally sustained but insufficiently modernised.

### **d. Why Capital Spending Is Now Being Increased**

#### **i. Shift from Manpower-Centric to Technology-Centric Warfare**

Modern warfare is no longer decided by numerical strength alone. Contemporary conflicts increasingly depend on:

- Precision-guided munitions
- Long-range missiles and air defence systems
- Unmanned platforms and drones
- Electronic, cyber, and space-based capabilities
- Real-time intelligence, surveillance, and reconnaissance

Such capabilities require high upfront capital investment, not recurring personnel expenditure. India's increased capital spending reflects this transformation in the character of warfare.

#### **ii. Lessons from Recent Military Engagements**

Recent conflicts across the world have highlighted:

- The critical importance of ammunition stockpiles
- The decisive role of precision weapons
- Vulnerabilities arising from inadequate war wastage reserves

These experiences reinforce the understanding that military preparedness is rooted in technological superiority and logistical depth, both of which are outcomes of sustained capital investment.

#### **iii. Breaking the Constraint of Committed Liabilities**

Historically, past contracts crowded out new acquisitions. By significantly expanding overall capital allocations, the government has created fiscal space to:

- Service existing commitments without stagnation
- Approve new projects for aircraft, submarines, naval platforms, and missiles
- Invest in emerging and disruptive technologies

Higher capital spending thus allows the defence budget to look forward rather than remain anchored to past obligations.

#### **iv. Supporting Aatmanirbhar Bharat in Defence**

Rising defence capital expenditure is closely linked with the goal of self-reliance.

- A growing share of capital acquisitions is reserved for domestic industry
- Priority is given to Indigenously Designed, Developed and Manufactured (IDDM) systems
- Assured demand encourages private sector participation, start-ups, and MSMEs

Defence capital spending therefore functions not only as a security instrument but also as an industrial and technological policy tool.

#### **v. Structural Correction in Budget Composition**

Recent reforms aim to moderate the growth of revenue expenditure over the medium term, particularly pension-related outgo. As revenue expenditure stabilises:

- The capital-to-revenue balance improves
- Greater resources flow towards asset creation
- Capability enhancement replaces mere operational maintenance

This marks a long-term structural correction in India's defence budgeting philosophy.

### **e. Strategic Importance of Higher Defence Capital Expenditure**

#### **i. National Security and Deterrence**

Higher capital spending:

- Improves preparedness for multi-front challenges
- Enhances deterrence through credible capability display
- Enables rapid response in short, high-intensity conflicts

#### **ii. Military Modernisation**

It facilitates:

- Replacement of obsolete platforms
- Induction of next-generation systems
- Integration of artificial intelligence, cyber, space, and unmanned domains

#### **iii. Economic and Technological Spillovers**

Sustained capital expenditure:

- Strengthens the domestic defence industrial base
- Generates skilled employment
- Promotes technology spillovers into aerospace, electronics, and advanced manufacturing

### **f. Challenges Associated with Higher Capital Spending**

Despite its strategic rationale, several constraints persist:

- Limited absorption capacity in defence public sector enterprises
- Delays in indigenous production and testing

- Tension between urgent operational needs and long-term indigenisation
- Weaknesses in project management and time-bound execution

Unless addressed, these challenges can dilute the effectiveness of higher allocations.

### **g. Way Forward**

To maximise returns on increased capital spending, India must:

- Strengthen domestic manufacturing and supply chains
- Streamline procurement and contract management procedures
- Improve project execution timelines and accountability
- Maintain a balanced approach between speed of induction and indigenisation
- Ensure predictable and stable defence spending aligned with long-term capability plans

### **Conclusion**

The rising emphasis on defence capital expenditure represents a decisive shift in India's strategic thinking—from maintaining existing forces to preparing for future wars. By prioritising modernisation, stockpiling, and indigenous capability creation, India is strengthening both its national security and strategic autonomy.

The success of this transition, however, will ultimately depend on institutional efficiency, timely implementation, and the ability to translate higher spending into real combat capability.

## Reader's Note — About This Current Affairs Compilation

Dear Aspirant,

This document is part of the PrepAlpine Current Affairs Series — designed to bring clarity, structure, and precision to your daily UPSC learning.

While every effort has been made to balance depth with brevity, please keep the following in mind:

### 1. Orientation & Purpose

This compilation is curated primarily from the UPSC Mains perspective — with emphasis on conceptual clarity, analytical depth, and interlinkages across GS papers.

However, the PrepAlpine team is simultaneously developing a dedicated Prelims-focused Current Affairs Series, designed for:

- factual coverage
- data recall
- Prelims-style MCQs
- objective pattern analysis

This Prelims Edition will be released separately as a standalone publication.

### 2. Content Length

Some sections may feel shorter or longer depending on topic relevance and news density. To fit your personal preference, you may freely resize or summarize sections using any LLM tool (ChatGPT, Gemini, Claude, etc.) at your convenience.

### 3. Format Flexibility

The formatting combines:

- paragraphs
- lists
- tables
- visual cues

—all optimised for retention.

If you prefer a specific style (lists → paras, paras → tables, etc.), feel free to convert using any free LLM.

### 4. Monthly Current Affairs Release

The complete Monthly Current Affairs Module will be released soon, optimized to a compact 100–150 pages — comprehensive yet concise, exam-ready, and revision-efficient.

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