REPORT ON GREEN & CLEAN TECHNOLOGIES INDIA – MARCH'26

Covering Market trends, key policy initiatives, growth drivers, challenges and Standardization activities in India

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Contents

1. Executive Summary

In the recent year's India has emerged as one of the fastest growing economies with a sustained annual growth rate of approximately 6–7%. In 2023, it surpassed China and became the world's most populous country, ranking third globally in terms of gross domestic product (GDP) based on purchasing power parity (PPP). India is also the third-largest energy consumer globally, accounting for nearly 7% of total global energy demand, following China (27%) and the United States (14%).

India's status as a rapidly growing and energy-intensive economy has accelerated its transition toward clean and green technologies in recent years. This shift reflects a broader **twin transition**, combining the move toward sustainable energy systems with increasing digitalization, aimed at enhancing efficiency, reducing emissions, and supporting long-term economic growth.

Green and Clean technologies are critical enablers for climate mitigation and sustainable development, as they reduce greenhouse gas emissions, support resource efficiency, and limit environmental degradation.

Recognizing the urgency of climate action, India has committed to achieving net-zero emissions by 2070. In addition to its long-term net-zero objective, India has announced the following key targets for 2030:

- 50% of energy requirements to be met through renewable energy
- 500 GW non-fossil fuel-based installed power capacity
- Reduction of carbon emissions by 1 billion tonnes
- Reduction of carbon intensity of GDP by 45% below 2005 levels

This report presents India's progress and ecosystem developments across key green and clean technology domains including clean energy, smart grids, green hydrogen, energy storage, critical raw materials, energy efficiency, and climate action mechanisms.

Clean and Green technologies can be broadly divided into two main categories: **Clean Energy production** and **Energy & Resource efficiency**. Clean energy production refers to technologies that generate energy with little or no emissions, such as solar, wind, hydropower, and green hydrogen. These helps reduce dependence on fossil fuels by making the energy supply cleaner. On the other hand, energy & resource efficiency focuses on using energy and materials more effectively across sectors like industry, transport, and buildings. This includes solutions such as energy-efficient equipment, electric vehicles, smart grids, and recycling practices. While the first category makes energy cleaner, the second reduces how much energy and resources are needed. Together, they support a more sustainable and low-carbon economy.

The rapid expansion of solar and wind capacity has firmly established India as a global leader in renewable energy deployment. India currently ranks 4th globally in total installed renewable energy capacity, with over 50% of its total installed electricity capacity derived from non-fossil fuel sources. Notably, India has achieved one of its key COP26 "Panchamrit" commitments—having 50% of installed electricity capacity from non-fossil fuel sources—five years ahead of the 2030 target. This achievement underscores India's ability to scale clean energy while maintaining grid stability and reliability. **Green hydrogen** is also emerging as a key pillar of India's decarbonization strategy, especially for hard-to-abate sectors like industry and transport. Under the **National Green Hydrogen Mission (2023)**, India aims to produce **5 MMT annually by 2030**, supported by significant investments, R&D, and policy incentives.

One of the most important and pressing infrastructure requirement for transitioning from fossil fuels to Renewable Energy Sources are large utility scale Energy Storage Systems (ESS). Energy storage with Pumped Hydro Storage Plants (PSP) and Battery Energy Storage Systems (BESS) enhances grid stability, reliability, and renewable integration. Government incentives, policy changes, and technology diversification are crucial for large-scale ESS adoption to meet the net zero target.

The deployment of Smart Grids and Smart Meters is playing a critical role in modernizing India's electricity system. With over **224 million smart meters approved**, these technologies are improving efficiency, reducing losses, and enabling better energy management and consumer participation. The electric vehicle (EV) sector in India is also expanding rapidly, supported by initiatives such as **FAME II and PM E-Drive**, alongside incentives for domestic manufacturing. Rising consumer demand and declining battery costs are expected to accelerate EV adoption.

Circular economy and Resource efficiency are a critical component of Clean and Green Technologies. Resource and Energy Efficiency and productivity ensure that materials are used efficiently at all stages of their lifecycle (extraction, transport, manufacturing, consumption, recovery and disposal) and throughout the supply chain. Moving towards a resource-efficient and circular economy is critical from both supply security and environmental perspectives and provides the basis for a sustainable and competitive economy. India is transitioning toward a circular economy model to reduce waste, improve resource efficiency, and create economic value estimated at **over $2 trillion by 2050**. Key policy measures include Extended Producer Responsibility (EPR), the Right to Repair(R2R) initiative, and the establishment of a Circular Economy Cell under India's think tank - NITI Aayog.

Appropriate policy and regulatory measures are being implemented to ensure circularity in energy intense sectors such as telecom, manufacturing, transport, construction etc. A vision document for circularity in Telecom sector is currently being prepared by the Telecom Engineering Centre, Ministry of Communications.

India's transition to clean energy relies not only on scaling up renewable capacity but also on ensuring access to critical minerals such as lithium, cobalt, and nickel. Recovering these materials from e-waste and used batteries can help lower import dependence while strengthening a resilient and self-sufficient supply chain for the future. Recognizing this, the Union Cabinet approved the National Critical Minerals Mission (NCMM) in January 2025, with a government outlay of Rs.16,300 crore and an expected investment of Rs.18,000 crore by PSUs, etc.

Clean and green technologies have emerged as a central pillar of the expanding EU–India partnership, underpinning cooperation in areas such as sustainable energy, climate action, and technological innovation. Europe's advanced technological expertise and regulatory frameworks with India's rapidly growing market and renewable energy ambitions, both partners are fostering innovation in areas such as solar and wind energy, green hydrogen, energy efficiency, and circular economy practices. This cooperation not only supports global efforts to address climate change but also promotes sustainable economic growth, job creation, and resilience in both regions, highlighting the importance of international partnerships in achieving a low-carbon future.

2. Clean / Smart Energy Including Electric Vehicles

India's clean energy transition is being driven by rapid expansion of renewable energy capacity, policy-led market reforms, and grid modernization initiatives aimed at enabling high renewable penetration. India is currently the **third-largest energy consumer in the world**, ranking behind China and the United States. As of 2025-2026, India is the fastest-growing major energy consumer, with its energy demand expected to rise by nearly 35% by 2035.

India's electric vehicle (EV) sector is experiencing rapid growth, fuelled by government incentives, rising environmental concerns, and technological advancements. With initiatives like the Faster Adoption and Manufacturing of Hybrid and Electric Vehicles (FAME) scheme, India aims to significantly increase EV adoption, revolutionizing its transportation landscape towards sustainability and innovation.

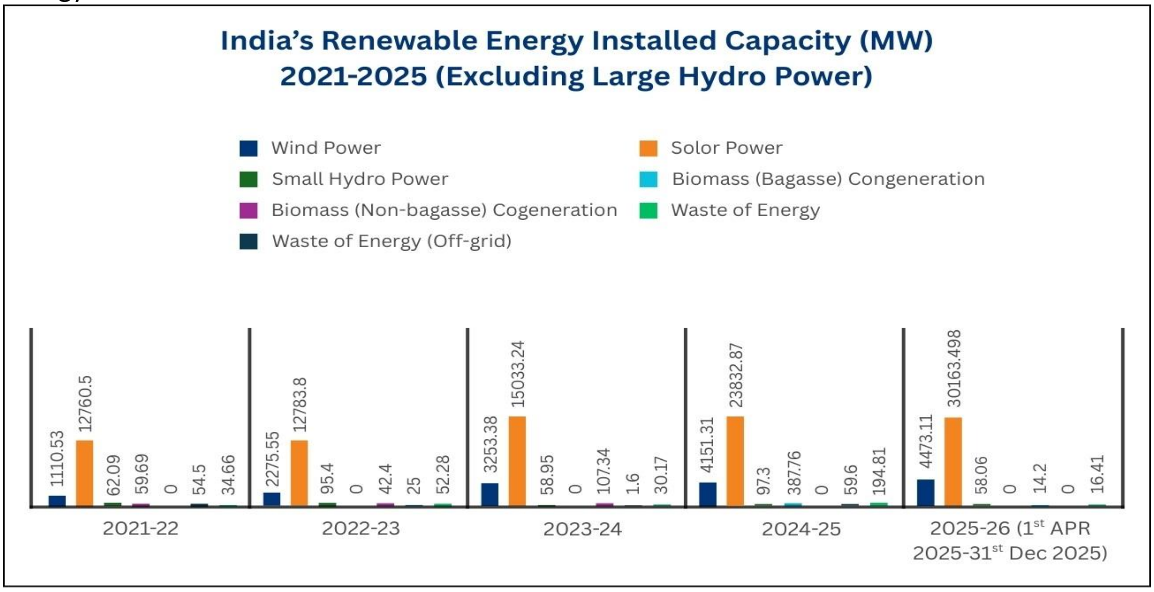
2.1 Renewable Energy

As on December 2025, the country's total installed generation capacity has reached 5,13,729 MW (513.72 GW), comprising of 2,46,941.62 MW (246.94 GW) of fossil-fuel sources and 2,66,788 MW (266.78 GW) of non-fossil fuel sources (including 2,58,008 MW (258 GW) from renewable energy sources). The details of country's current composition of installed generation capacity, indicating the share of renewable and non-fossil fuel sources are given below.

- Solar power – 135.80 GW
- Wind power – 54.51 GW
- Hydro: 50.91 GW
- BM Power/Cogen.: 10.75 GW
- Small Hydro Power: 5.15 GW
- Waste to Energy: 856.62 W

Sector Installed RE Capacity (Capacities in MW)	FY 2025-26 Achievements (1st April 2025-31st Dec 2025)	Cumulative Achievements (as on 31st Dec 2025)
Solar Power*	30163.48	135809.94
Wind Power	4473.11	54510.93
Biomass (Bagasse) Cogeneration	0.00	9821.32
Biomass(non-bagasse) Cogeneration	14.20	935.99
Waste to Energy	0.00	309.34
Waste to Energy (off grid)	16.41	547.28
Small Hydro Power	58.06	5158.61
Sub Total (Exc. Large Hydro)	**34725.26**	**207093.41**
Large Hydro^	3186.50	50914.67
Total RE	**37911.76**	**258008.08**
Nuclear Power#	700.00	8780.00
Total non-Fossil	**38611.76**	**266788.08**

Over the past decade, India's renewable energy capacity has increased more than fivefold, rising from 35.84 GW in March 2014 to over 207.09 GW (including large hydropower) by December 2025. This remarkable growth reflects the effectiveness of supportive policy frameworks, large-scale project deployment, and strong private sector participation in accelerating the country's clean energy transition.



Source: CEA

i. Policy Initiatives

India has introduced a wide range of policy measures and flagship programmes to boost electricity generation and ensure clean and reliable power. Key initiatives include, inter alia, the following:

a) Electricity Act of 2003

Electricity Act of 2003 paved the way for private participation and encouraged competition in the power sector, from generation to distribution. This was complemented by the National Electricity Policy (NEP), providing a roadmap for affordable electricity access and sustainable development[1].

b) National Electricity Tariff Policy (2006, amended in 2016)

Further promoted renewable energy integration by requiring distribution utilities to source a portion of their power from renewable sources.

c) National Solar Mission (NSM)

Launched in 2010, the NSM is a flagship programme aimed at scaling up solar power generation in India. While the initial target was 100 GW of solar capacity by 2022, the mission has since been aligned with India's broader ambition of achieving 450 GW of renewable energy capacity by 2030.

d) PM Surya Ghar: Muft Bijli Yojana

Launched in 2024, this flagship rooftop solar initiative aims to cover **one crore (10 million) households** by enabling residential solar PV installations. Beneficiaries can receive up to 300 units

[1] https://niti.gov.in/sites/default/files/2026-02/Scenarios-Towards-Viksit-Bharat-and-Net-Zero-Sectoral-Insights-Power.pdf

of free electricity per month through direct benefit transfers, significantly expanding distributed solar generation and consumer participation.

e) National Offshore Wind Energy Policy (2016)

Focuses on exploring and developing offshore wind energy potential within India's Exclusive Economic Zone. It lays down a framework for resource assessment, leasing of offshore areas, and project development, contributing to India's target of expanding its non-fossil fuel capacity (MNRE, 2015).

f) The **National Wind-Solar Hybrid Policy (2018)**

Aims to promote large-scale hybrid renewable energy projects by combining wind and solar technologies at a single site. This helps in better utilisation of land and transmission infrastructure while ensuring more stable power supply (MNRE, 2018).

g) Scheme for setting up of Solar Parks and Ultra Mega Solar

This scheme supports the establishment of large-scale solar parks with plug-and-play infrastructure, including land acquisition, transmission connectivity, and common facilities. It has played a critical role in reducing project development risks and enabling rapid deployment of utility-scale solar capacity.

h) Production Linked Incentive (PLI) Scheme for Solar Manufacturing

This scheme provides financial incentives to boost domestic manufacturing of solar PV modules and components, strengthening local supply chains, reducing import dependence, and generating employment.

i) Green Energy Corridors (GEC)

The Green Energy Corridors programme supports the development of dedicated transmission infrastructure for the evacuation and integration of renewable energy. Central Financial Assistance (CFA) is being provided to states to strengthen intra-state and inter-state transmission systems, ensuring grid stability amid rising renewable penetration.

j) Green Energy Open Access (GEOA) Rules, 2022

These rules enable consumers with a connected load of 100 kW and above to procure renewable electricity directly from generators through open access or bilateral arrangements. GEOA has significantly facilitated corporate renewable power procurement, captive generation, and the adoption of clean power across commercial and industrial sectors.

k) Renewable Purchase Obligations (RPO)

RPOs mandate distribution companies (DISCOMs), open-access consumers, and captive power producers to procure a specified share of electricity from renewable sources. This regulatory mechanism creates sustained market demand and underpins long-term growth of the renewable energy sector.

l) Viability Gap Funding (VGF) and Support for Emerging Technologies

The Government has introduced financial support measures for emerging renewable energy technologies such as offshore wind, floating solar, and energy storage, including VGF-based models and pilot projects to enable early-stage deployment.

ii. Growth Drivers

- **Strong Policy Support and Government Targets:** India has set ambitious renewable energy targets, including 500 GW of non-fossil fuel capacity by 2030. Policy initiatives such as the National Solar Mission, Renewable Purchase Obligations (RPOs), and production-linked incentives (PLI) are accelerating renewable deployment.

- **Energy Security and Reduced Import Dependence:** India's dependence on imported fossil fuels has strengthened the push toward renewables. Expanding domestic renewable capacity supports energy independence and improves long-term energy security.

- **Corporate Renewable Procurement and ESG Commitments:** A surge in **Net-Zero commitments** from the private sector is driving demand. Through "Open Access" and captive power projects, industries are bypassing traditional utilities to secure cheaper, greener energy directly.

- **Grid Modernization & Storage Integration:** Massive investments in **Green Energy Corridors** and Battery Energy Storage Systems (BESS) are solving the "intermittency" problem, ensuring the grid can handle a high percentage of variable renewable power.

iii. Challenges

Despite rapid progress, India faces persistent challenges including:

- Land acquisition delays and high project development costs
- Transmission and evacuation bottlenecks
- Limited grid flexibility due to intermittency of RE
- Financing constraints for storage and hybrid systems

The Economic Survey highlights that India will require stronger grid planning and accelerated deployment of **Battery Energy Storage Systems (BESS)** and **Pumped Storage Projects (PSP)** to ensure reliable renewable integration[2].

iv. Standardisation

India's renewable energy standardization framework, led by the Bureau of Indian Standards (BIS), is largely aligned with International Electrotechnical Commission (IEC) standards. BIS technical committees actively mirror IEC work through adoption or adaptation of international standards, ensuring safety, performance, interoperability, and global market access.

- **ETD 11 (Secondary Cells and Batteries)**: responsible for developing standards for all rechargeable cells and batteries (starter batteries, stationary batteries, traction batteries etc.)

[2] https://www.indiabudget.gov.in/economicsurvey/doc/echapter.pdf

- **ETD 28 (Solar Photovoltaic Energy Systems):** responsible for developing standards for systems of photovoltaic conversion of solar energy into electrical energy and for all the elements in the entire photovoltaic energy systems. In this context, the concept photovoltaic energy systems include the entire field from light input to solar cell and include the interface with the electrical system(s) to which energy is supplied.

- **ETD 42 (Wind Turbines):** responsible for developing Indian standards for wind turbines that convert wind energy into electrical energy. These standards address design requirements, engineering integrity, measurement techniques and test procedures. Their purpose is to provide a basis for design, quality assurance and certification. The standards are concerned with all subsystems of wind turbines, such as mechanical and internal electrical systems, support structures and control and protection systems. They are intended to be used together with appropriate Indian Standards.

- **ETD 54 (Marine Energy Conversion Systems):** responsible for preparing standards for marine energy conversion systems. The primary focus will be on the conversion of wave, tidal and other water current energy into electrical energy, although other conversion methods, systems and products are included. a) terminology; b) management plans for technology and project development; c) performance measurements of marine energy converters; d) resource assessments; e) design and safety including re liability and survivability; f) deployment, commissioning, operation, maintenance, retrieval and decommissioning; g) electrical interface, including array integration and / or grid integration; h) testing laboratory, manufacturing and factory acceptance; i) additional measurement methodologies and processes.

2.2 Green Hydrogen

In line with India's commitment to achieve net-zero emissions by 2070 and to become an energy-independent nation by 2047, green hydrogen is expected to play a pivotal role as an alternative to petroleum and other fossil-based fuels.

Green Hydrogen is produced by the process of electrolysis, where water is split into hydrogen and oxygen using electricity generated from renewable sources like solar, wind, or hydropower. This process results in a clean and emission-free fuel that has immense potential to replace fossil fuels and reduce carbon emissions. Another method of producing Green Hydrogen is from biomass, which involves the gasification of biomass to produce hydrogen. Both these production methods are clean and sustainable, making Green Hydrogen an attractive option for the transition to a low-carbon future.

In 2020, India's hydrogen demand stood at 6 million tonnes (MT) per year. According to **NITI Aayog** report titled "**Harnessing Green Hydrogen**" the demand for hydrogen is expected to see more than fourfold jump to 29 MT by 2050. Almost 94% of hydrogen demand in 2050 can be met by green hydrogen, up from 16% in 2030. The cumulative value of the green hydrogen market in India could be $8 billion (approx. €6.84 billion) by 2030 and $340 billion (€296 billion) by 2050.

i. Policy Initiatives

Indian Government has established following several policies and guidelines to promote green hydrogen.

a) National Green Hydrogen Mission 2023

Ministry of New and Renewable Energy (MNRE), Government of India launched the National Green Hydrogen Mission on 4th January 2023.

The initial outlay for the Mission will be INR 19,744 crore (approx. €1.85 billion), including an outlay of INR 17,490 crore (approx. €1.64 billion) for the **Strategic Interventions for Green Hydrogen Transition' (SIGHT) programme**, INR 1,466 crore (approx. €137 million) for **pilot projects**, INR 400 crore (approx. €37.4 million) for **R&D**, and INR 388 crore (approx. €36.3 million) towards other Mission components.

The Mission focuses on four key pillars, including **policy and regulatory framework, demand creation, research and development & innovation, and enabling infrastructure and ecosystem development** — aimed at positioning India as a global hub for green hydrogen production, use, and export.

Expected outcomes of the mission by 2030:

- Development of green hydrogen production capacity of at least 5 MMT (Million Metric Tonne) per annum with an associated renewable energy capacity addition of about 125 GW in the country
- Over INR 8 lakh crore (approx. €74.9 billion) in total investments
- Creation of over 6 lakh (0.6 million) jobs
- Cumulative reduction in fossil fuel imports over Rs. 1 lakh crore (approx. €9.36 billion)
- Reduction of nearly 50 MMT of annual greenhouse gas emissions

All concerned Ministries, departments, agencies, and institutions of the Central and State Governments will undertake focussed and coordinated steps to ensure successful achievement of the Mission objectives. Ministry of New & Renewable Energy will be responsible for overall coordination and implementation of the Mission.

Implementation Progress:

- **Under the incentive scheme for Electrolyser Manufacturing**, 15 companies have been awarded a total manufacturing capacity of 3,000 MW per annum. The total incentive awarded is Rs. 4440 crores (approx. €415.6 million).
- **Under the incentive scheme for Green Hydrogen production**, 18 companies have been awarded a cumulative production capacity of 8,62,000 tonnes per annum.
- **Under the incentive scheme for procurement of Green Hydrogen for refineries**, 2 companies have been awarded a total capacity of 20,000 tonnes per annum.
- Prices have been discovered by Solar Energy Corporation of India for the production and supply of 7,24,000 tonnes per annum of Green Ammonia (a derivative of Green Hydrogen) to 13 fertilizer units across India.
- **Government has launched various pilot projects in steel, mobility and shipping sectors.**
- In July 2025, MNRE has released revised guidelines for setting up Hydrogen Valley Innovation Clusters (HVICs) and green hydrogen hubs in India under NGHM. These clusters are designed to act as test beds and living labs, supporting business innovation, linking hydrogen producers to off-takers, and building local hydrogen value chains. Four HVICs will be set up with an allocation of Rs 1.72 billion (approx. €16.1 million). Each HVIC must arrange for its own land, as no funding is provided for land acquisition. Hydrogen hubs, as larger ecosystems, will require a minimum planned capacity of 100,000 metric tonnes per annum

of green hydrogen and will pool resources from central and state governments, local authorities, and industry stakeholders.

- In August 2025, MNRE has issued revised guidelines for implementing pilot projects aimed at producing and utilising Green Hydrogen through innovative methods. The scheme targets applications in residential, commercial, and decentralised sectors that were previously left out of earlier Mission initiatives.
- In October 2025, MNRE has announced the recognition of three major ports Deendayal Port Authority (Gujarat), V.O. Chidambaranar Port Authority (Tamil Nadu), and Paradip Port Authority (Odisha) as **Green Hydrogen Hubs** under the NGHM. These coastal gateways will serve as integrated centres for production, consumption, and future export

The above incentives ensure stable and predictable demand for green hydrogen by securing long - term offtake agreements and integration of green hydrogen for industrial decarbonisation[3].

b) R&D Roadmap for Green Hydrogen ecosystem in India

The Ministry of New and Renewable Energy (MNRE), on October 13, 2023, has unveiled a R&D roadmap for Green Hydrogen ecosystem in India. The roadmap is outlining the research and development (R&D) priorities for manufacturing and storing green hydrogen. The roadmap aims to promote efficient, safe, and cost-effective hydrogen storage, paving the way for its widespread adoption as a clean energy source.

The key objectives include:

- Steep reduction in electrolyser capital and operational expenditure.
- Enhance operational capacity and efficiency, keeping in mind durability and reliability, especially when operating dynamically.
- Decrease carbon footprint by increasing current density.
- Showcase the benefits of adding electrolysers to the power system through their ability to seamlessly integrate higher concentrations of renewables while providing flexibility.
- Reducing the life-cycle carbon footprint of electrolysers by ensuring circularity of material employed as well as for the production process.
- Design and develop large-scale (MW) Electrolyser systems, including Stack and BOP.
- Build capacity and keep stock of material and critical components of Electrolyser stacks.
- Deployment rates to be increased.
- Reengineer and improve manufacturing for both water and steam electrolysis.

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c) Green Hydrogen Standard for India

To support the effective implementation of the **National Green Hydrogen Mission**, the Ministry of New and Renewable Energy (MNRE) notified the '**Green Hydrogen Standard for India** in August 2023, outlining the emission thresholds for production of hydrogen that can be classified as '**green**'. Government has specified following:

[3] https://www.pib.gov.in/Pressreleaseshare.aspx?PRID=2222471&reg=3&lang=2

- **Green Hydrogen** shall mean Hydrogen produced using renewable energy, including, but not limited to, production through electrolysis or conversion of biomass. Renewable energy also includes such electricity generated from renewable sources which is stored in an energy storage system or banked with the grid in accordance with applicable regulations.

- **Whereas, for Green Hydrogen produced through electrolysis:** The non-biogenic greenhouse gas emissions arising from water treatment, electrolysis, gas purification and drying and compression of hydrogen shall not be greater than 2 kilogram of carbon dioxide equivalent per kilogram of Hydrogen (kg CO_2 eq/kg Hydrogen), taken as an average over last 12-month period.

- **Whereas, for Green Hydrogen produced through conversion of biomass:** The non-biogenic greenhouse gas emissions arising from biomass processing, heat/steam generation, conversion of biomass to hydrogen, gas purification and drying and compression of hydrogen shall not be greater than 2 kilogram of carbon dioxide equivalent per kilogram of Hydrogen (kg CO_2 eq/kg Hydrogen) taken as an average over last 12-month period.

In order to assess compliance to this standard, MNRE has formulated the Green Hydrogen Certification Scheme of India (GHCI) **in April 2025** that provides a national framework to certify hydrogen as "green" by assessing its greenhouse gas emissions across the entire production cycle. The scheme ensures that only hydrogen produced using renewable energy, and within the prescribed emission limits, can be officially labeled as Green Hydrogen. It provides transparency, traceability, and credibility for producers, buyers, and export markets. Under the GHCI, obtaining a 'Final Certificate' is mandatory for any green hydrogen production facility in India that (a) receives subsidies or incentives from the central or state governments, or (b) sells or uses the hydrogen domestically (in India).

Bureau of Energy Efficiency (BEE) shall be the Nodal Authority for accreditation of agencies for the monitoring, verification, and certification for Green Hydrogen production projects.

d) Green Hydrogen/Green Ammonia policy 2022

Ministry of Power (MoP), Government of India notified "Green Hydrogen/ Green Ammonia Policy" in February 2022.

The policy provides as follows:

- Green Hydrogen / Ammonia manufacturers may purchase renewable power from the power exchange or set up renewable energy capacity themselves or through any other, developer, anywhere.
- Open access will be granted within 15 days of receipt of application.
- The Green Hydrogen / Ammonia manufacturer can bank unconsumed renewable power, up to 30 days, with distribution company and take it back when required.
- Distribution licensees can also procure and supply Renewable Energy to the manufacturers of Green Hydrogen / Green Ammonia in their States at concessional prices which will only include the cost of procurement, wheeling charges and a small margin as determined by the State Commission.
- Waiver of inter-state transmission charges for a period of 25 years will be allowed to the manufacturers of Green Hydrogen and Green Ammonia for the projects commissioned before 30th June 2025.

- The manufacturers of Green Hydrogen / Ammonia and the renewable energy plant shall be given connectivity to the grid on priority basis to avoid any procedural delays.
- The benefit of Renewable Purchase Obligation (RPO) will be granted incentive to the hydrogen/Ammonia manufacturer and the Distribution licensee for consumption of renewable power.
- To ensure ease of doing business a single portal for carrying out all the activities including statutory clearances in a time bound manner will be set up by MNRE.
- Connectivity, at the generation end and the Green Hydrogen / Green Ammonia manufacturing end, to the ISTS for Renewable Energy capacity set up for the purpose of manufacturing Green Hydrogen / Green Ammonia shall be granted on priority.
- Manufacturers of Green Hydrogen / Green Ammonia shall be allowed to set up bunkers near Ports for storage of Green Ammonia for export / use by shipping. The land for the storage for this purpose shall be provided by the respective Port Authorities at applicable charges.

The implementation of this policy will provide clean fuel to the common people of the country. This will reduce dependence on fossil fuel and reduce crude oil imports. The objective also is for India to emerge as an export Hub for Green Hydrogen and Green Ammonia.

The policy promotes Renewable Energy (RE) generation as RE will be the basic ingredient in making green hydrogen. This in turn will help in meeting the international commitments for clean energy. Read more/Download>>

e) Green Ammonia and Green Methanol Standards

The Ministry of New and Renewable Energy (MNRE) announced standards of Green Ammonia and Green Methanol Standards on 27th February 2026, outlines the emission thresholds and eligibility conditions that must be compiled in order for ammonia & methanol produced to be classified as 'Green', i.e., produced using Green Hydrogen derived from renewable sources.

- Green Ammonia shall have a **total non-biogenic greenhouse gas emission**, arising from Green Hydrogen production, ammonia synthesis, purification, compression, and on-site storage, of **not more than 0.38 kg CO_2 equivalent per kg of ammonia (kg CO_2 eq/kg NH_3)**, calculated as an average over the preceding 12-month period.

- Green Methanol shall have a **total non-biogenic greenhouse gas emission**, arising from Green Hydrogen production, methanol synthesis, purification, and on-site storage, of **not more than 0.44 kg CO_2 equivalent per kg of methanol (kg CO_2 eq/kg CH_3OH)**, calculated as an average over the preceding 12-month period.

ii. Growth Drivers

- **Climate Goals:** India's commitment to reducing greenhouse gas emissions and transitioning to a low-carbon economy under the Paris Agreement is a significant driver for exploring green hydrogen as a clean energy source.

- **Renewable Energy Potential:** India has abundant renewable energy resources, including solar and wind, which can be harnessed to produce green hydrogen through water electrolysis using renewable electricity.

- **Government Support:** The Indian government has recognized the potential of green hydrogen and has introduced policies and initiatives such as National Green Hydrogen Mission, Green Hydrogen Policy etc. to support its development.

- **International Collaborations:** India has also been actively engaging in international collaborations to promote green hydrogen. It has joined the International Partnership for Hydrogen and Fuel Cells in the Economy (IPHE) and has signed agreements with countries like Australia and Japan to explore opportunities for collaboration in the hydrogen sector. India has also forged important partnerships with the European Union, Germany, Japan, Gulf Countries and others.

- **Decarbonizing Sectors:** Sectors such as industry, transportation, and power generation that are difficult to decarbonize directly can use green hydrogen as a clean alternative to fossil fuels.

iii. Challenges

- **High cost**: Currently, the production cost of green hydrogen from renewable energy is higher compared to hydrogen derived from fossil fuels. High production costs hinder widespread adoption. To reduce Green Hydrogen (GH2) costs, India needs consistent and low-cost renewable energy.

- **Lack of investment and insufficient infrastructure**: Establishment of necessary infrastructure for producing, transporting, storing, and distributing green hydrogen requires significant investment.

- **Availability of water:** Green hydrogen production requires plenty of water, and India is already facing water scarcity in many regions. Therefore, the availability of water for green hydrogen production could be a significant challenge in India.

- **Lack of harmonised standards and regulations:** A robust ecosystem of harmonized standards and regulations is necessary to enable safe and rapid scaling up of projects for production, delivery, storage, and use of green hydrogen.

iv. Standardisation

In India, standards related to the Green Hydrogen value chain are developed or adopted by five entities– the Bureau of Indian Standards (BIS), which is the National Standards Body of India, the Oil Industry Safety Directorate (OISD), the Petroleum and Explosives Safety Organization (PESO), the Petroleum and Natural Gas Regulatory Board (PNGRB) and the Ministry of Road Transport and Highways (MoRTH).

Standards related to the green hydrogen value chain are broadly divided into four categories: Mobility, Production and Use, storage and transportation, and general requirement. As per National Green Hydrogen Mission (NGHM portal), list of standards & regulation have been made available across these categories[4].

[4] https://nghm.mnre.gov.in/regulations?cat=21&language=en

MNRE with CEEW as a knowledge partner, have also published a report titled "Green Hydrogen Standards and Approval Systems in India" that describes the various dimensions of regulatory frameworks, standards, testing infrastructure and permissions required for setting up green hydrogen projects in India. It offers insights into the current status quo and identifies actionable steps for implementing the National Green Hydrogen Mission (NGHM). Report also summarises that, out of the total 201 standards assessed, 87 standards have already been adopted or developed in India, 59 are under development by various issuing bodies, and 52 could be considered for adoption as these are potential gaps that are not assessed by issuing bodies. In three instances, there were no Indian or international standards available for value chain categories. Within each component of the value chain, the number of standards assessed are as follows – 8 in production, 102 in storage and transport, 52 in end-use applications and 39 in general safety. In this many EN Standards such as EN13458, CEN-EN 12245, EN135302:2002/A1:2 004, EN 17339, EN-14585-1 have been adopted by Petroleum and Explosives Safety Organisation (PESO) and is also in the process of adopting many other ENs such as EN13807, EN 720-1, EN 17649: 2022 etc. for Gas infrastructure. Many Other EN 17127, EN 303-3, EN 15502-22: 2014, EN 437 are under study for BIS adoption

Following BIS Technical Committees are relevant, as they are actively working in this domains:

- **MED1: Boilers And Pressure Vessels -** a) Formulation of standards for terminology, acceptance tests layout of boilers and other aspects not covered under the Indian Boilers Regulations. b) Preparation of code for Unfired Pressure Vessels c) Co-ordination of work with ISO/TC 11 Boilers and Pressure Vessels.
- **MED16: Gas Cylinders -** Formulation of standards on gas cylinders for permanent, high pressure liquefiable low pressure liquefiable and dissolved gases; fittings of gas cylinder, namely valve fittings, pressure regulators; pipelines conveying gases; identification colours of gas cylinders; acetylene generators; filling ratios and developed pressures for different gases.
- **MED23: Domestic And Commercial Gas Burning Appliances -** Domestic and commercial gas burning appliances (pressure type) such as gas stoves, oven, cooking ranges and water heaters, including gobar gas stoves
- **MED38: MECHANICAL EQUIPMENT USED IN REFUELING STATIONS FOR PETROLEUM AND GASEOUS FUEL:** Formulation of standards in the field of mechanical equipment used in refueling stations for petroleum and gaseous fuels
- **CHD6: Industrial Gases -** a) To formulate Indian Standards for terminology; methods of sampling and test; codes of practice and specifications for industrial gases including high purity speciality gases and gas mixtures other than LPG. b) To liaise with i) ISO/TC 158 Analysis of gases

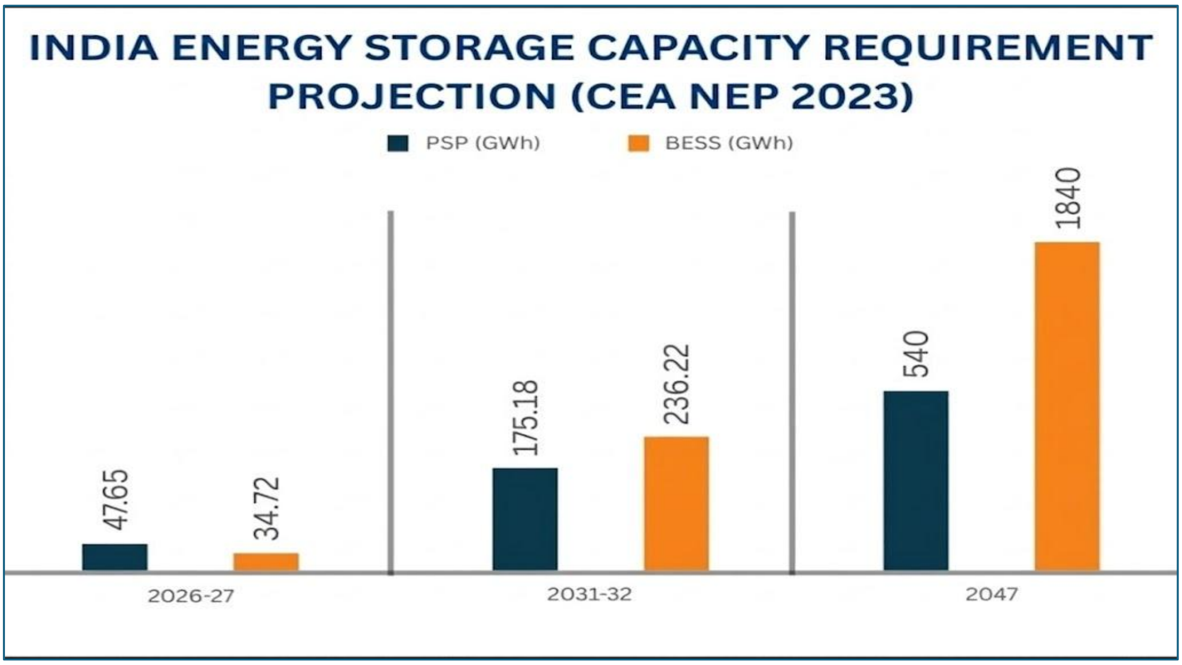
2.3 Energy Storage Systems (ESS)

In a bid to meet the surging energy demands and integrate renewable energy sources effectively, India needs to bolster its energy storage infrastructure significantly. Use of energy storage systems by residential, commercial, or industrial consumers, in conjunction with renewable energy has potential to improve power quality and reliability for such consumers. This would also allow for minimization of diesel consumption from back-up power applications.2

As per National Electricity Plan (NEP) 2023 of Central Electricity Authority (CEA), the energy storage capacity requirement is projected to be 82.37 GWh (47.65 GWh from Pumped Storage Plants (PSP) and 34.72 GWh from Battery Energy Storage System (BESS) in year 2026-27. This requirement is further expected to increase to 411.4 GWh (175.18 GWh from PSP and 236.22 GWh from BESS) in year 2031-32.

Further, CEA has also projected that by the year 2047, the requirement of energy storage is expected to increase to 2380 GWh (540 GWh from PSP and 1840 GWh from BESS), due to the addition of a larger amount of renewable energy considering the net zero emissions targets set for 2070[5].

To ensure that India meets its BESS targets, government has approved **viability gap funding (VGF) to cover up to 40% of the total capital cost for the establishment of a 4,000 MWh** battery energy storage system (BESS) in the country.



i. Policy Initiatives

The government of India has taken various steps to speed up the development and adoption of energy storage systems in India.

a) National Framework for promoting Energy Storage Systems

In August 2023, the Ministry of Power (MoP) has released comprehensive guidelines aimed at promoting energy storage adoption in India.

Objectives of the ESS framework:

- To have 24×7 dispatchable RE power i.e., RE-RTC (Renewable Energy- Round the Clock)
- To reduce greenhouse gas emissions and reduce overall costs of energy by incentivizing the deployment of ESS and reducing the need for fossil fuel power plants.
- To support the development and deployment of ESS through policy and regulatory measures, financial and fiscal incentives, and performance-based incentives.
- To redesign energy markets to incentivize participation of ESS in the markets and to establish market mechanisms through introduction of products, and compensation methods for storage services.

[5] https://mnre.gov.in/en/energy-storage-systemsess-overview/?utm_source=chatgpt.com

- To improve grid stability and reliability through deployment of ESS that provides grid services such as frequency regulation, voltage support, ramping, and other ancillary support services.
- To promote energy independence and resiliency through deployment of ESS in remote or islanded communities.
- To foster innovation and research for improving the performance, safety, and cost effectiveness of energy storage technologies and development of new energy storage technologies.
- To develop technical standards for ESS to ensure safety, reliability, and interoperability with the grid.
- To promote equitable access to energy storage by all segments of the population regardless of income, location, or other factors.
- To monitor and evaluate the performance and impact of ESS, and to provide feedback for making policy and investment decisions.

For more information please click here>>

b) Guidelines for Procurement and Utilization of Battery Energy Storage Systems (BESS)

In March 2022, Ministry of Power issued detailed guidelines for procurement and utilization of BESS as part of generation, transmission, or distribution assets, or along with ancillary services. These guidelines, inter alia, provide standardization and uniformity in procurement of BESS and a risk-sharing framework between various stakeholders, involved in the energy storage and storage capacity procurement, thereby encouraging competition and enhanced bankability of these projects.

These guidelines would ensure transparency and fairness in procurement processes and provide for a framework for an Intermediary Procurer as an Aggregator/Trading licensees/ Implementing Agency for the inter-state/intra-state sale-purchase of power.

For more information, please click here>>

c) Viability Gap Funding (VGF) Scheme

In March 2024, government has approved a Viability Gap Funding (VGF) Scheme for the development of large-scale Battery Energy Storage Systems (BESS), with an outlay of INR 3,760 crore (approx. €351.94 million) for development of 13220 MWh at VGF of Rs 27 lakhs/MWh.

In June 2025 the Government has approved another VGF scheme of 30 GWh, funded through INR 5,400 crore (approx. €505.44 million) from the power system development fund (PSDF) at VGF of Rs 18 lakhs/MWh[6].

d) National Programme on ACC Battery Storage

The Ministry of Heavy Industries (MHI), Govt. of India notified the Production Linked Incentive (PLI) scheme, 'National Programme on Advanced Chemistry Cell (ACC) Battery Storage' in 2021 for

[6] https://www.pib.gov.in/Pressreleaseshare.aspx?PRID=2222473&reg=3&lang=2

implementation of giga–watthour scale ACC manufacturing facilities in India with a budgetary outlay of INR 18,100 crore (approx. €1.693 billion).

The scheme envisaged the setting up a cumulative ACC manufacturing capacity of 50 GWh and an additional cumulative capacity of 5 GWh for Niche ACC Technologies. The incentive structure is designed to encourage the industry to promote fresh investments in indigenous supply chains and deep localization for ACC battery manufacturing in the country. For more information, please click here>>

ii. Growth Drivers

- **Renewable Energy Integration:** India is rapidly expanding its renewable energy portfolio, primarily through solar and wind power. Energy storage systems are essential for managing the intermittent nature of these sources, ensuring a stable and reliable power supply.

- **Grid Stability and Reliability:** Energy storage systems contribute to grid stability by providing ancillary services such as frequency regulation and voltage control. In a country like India with an evolving grid infrastructure, these services are crucial for maintaining a reliable electricity supply.

- **Rising Adoption of Electric Vehicles (EVs):** The growing EV market in India is significantly boosting demand for advanced battery technologies, especially lithium-ion batteries. This expansion is also supporting domestic battery manufacturing and driving innovation, with spillover benefits for stationary energy storage applications such as grid-scale and residential storage solutions.

iii. Challenges

- **High Initial Capital Costs:** The upfront costs of energy storage systems, particularly advanced technologies like lithium-ion batteries, are high. This makes it challenging for many consumers, businesses, and utilities to invest in energy storage infrastructure.

- **Limited Availability of Raw Materials**: India faces constraints in securing critical raw materials such as lithium, cobalt, nickel, and copper, which are essential for battery manufacturing. Dependence on imports and global supply chain volatility further increases cost and supply risks.

- **Grid Integration Challenges:** Integrating energy storage systems into the existing grid infrastructure can be complex. Issues related to grid compatibility, standardization, and seamless operation need to be addressed for widespread deployment.

- **Evolving Regulatory and Policy Framework:** Although policy attention on storage is increasing, the regulatory ecosystem is still developing. Uncertainty around tariffs, grid interconnection procedures, ownership models, and safety compliance requirements can delay investment decisions and slow deployment.

- **Financing and Access to Capital**: Many stakeholders, particularly startups and smaller project developers, face difficulties in accessing affordable financing. The lack of dedicated financial instruments, risk mitigation mechanisms, and long-term revenue certainty reduces bankability of storage projects.

iv. Standardization

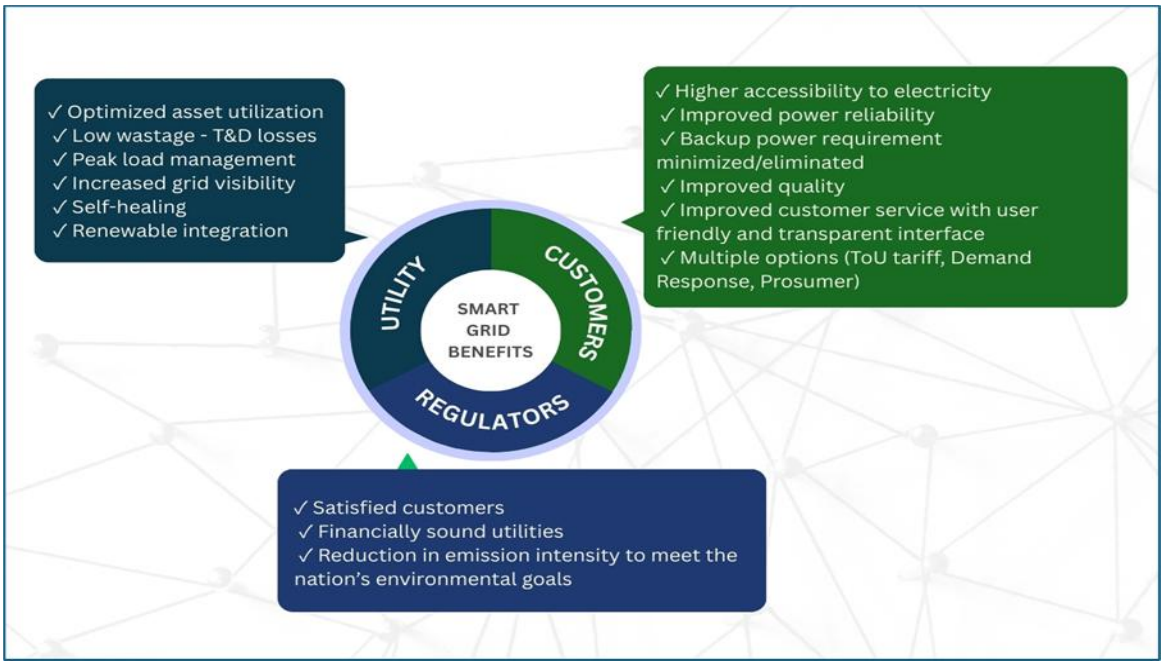
- **ETD 52 (Electrical Energy Storage Systems) at BIS is** responsible for Standardization in the field of grid integrated Electrical Energy Storage Systems. The Sectional Committee to focus on system aspects on EES Systems rather than energy storage devices and shall prepare Indian Standards dealing with the system aspects of electrical energy storage. EES to include any type of grid-connected energy storages, which can both store electrical energy from a grid or any other source and provide electrical energy to a grid. The Sectional Committee to include Chemical ES as one of the ESS. Thermal storage to be included in the scope, only from the electricity exchange point of view. Unidirectional energy storages such as UPS not to be included in the scope of the sectional Committee. Following Standards have been published by BIS:

  - **IS 17092:2019**- Electrical energy storage systems: safety requirements
  - **IS 17067 (Part 5/Sec 2):2021 (IEC TS 62933-5-2:201)-** Electrical energy storage EES systems Part 5 Safety requirements for grid integrated EES systems Section 2 electrochemical based systems
  - **IS 17387:2020**- General Safety and Performance Requirements of Battery Management Systems

2.4 Smart Grid/Meter

India's energy sector is undergoing a major transformation driven by the need for energy security, efficiency, and decarbonization. The development of Smart Grids and Smart Meters is crucial to modernizing India's power sector and enabling a responsive and resilient electricity network.

The implementation of smart grid technology is the need of the hour to meet consumer requirements for secure, reliable, and affordable supply as well as to balance the electricity grid with the increasing penetration of renewable energy sources. Smart Grids can be achieved by implementing efficient transmission & distribution systems, system operations, consumer integration and renewable integration. Smart grid solutions help to monitor, measure and control power flows in real time that can contribute to identification of losses and thereby appropriate technical and managerial actions can be taken to arrest the losses.



Source: NSGM

Smart grid solutions can contribute to reduction of T&D losses, peak load management, improved quality of service, increased reliability, better asset management, renewable integration, better accessibility to electricity etc. and lead to self-healing grids.

Smart meters also offer numerous benefits for both consumers and utility providers. For consumers, they provide accurate billing, real-time consumption monitoring, and the ability to manage energy usage more effectively, potentially leading to cost savings and reduced environmental impact. For utilities, smart meters improve grid management, reduce losses (including theft) and enhance customer services.

According to the National Smart Grid Mission as of January 2026 , a total of 224.2 million smart consumer meters have been sanctioned on a pan-India basis, of which, orders for over 171.3 million meters have been awarded so far. A total of 52.8 million smart meters has been installed so far. These smart metering projects were sanctioned under RDSS (Revamped Distribution Sector Scheme), DDUGYJ (Deen Dayal Upadhyaya Gram Jyoti Yojana), IPDS (Integrated Power Development Scheme), NSGM (National Smart Grid Mission), SG Pilot, PMDP (Prime Minister Development Package) scheme, and under the utility ownership model[7].

Smart grids and smart meters in India are driven by the Ministry of Power, the Central Electricity Authority (CEA), and the Bureau of Energy Efficiency (BEE), with utilities and EESL implementing nationwide programs. Industry associations such as the India Smart Grid Forum (ISGF) and the India Energy Storage Alliance (IESA) play a key role in industry engagement. Standards are developed by BIS (ETD 13, ETD 46, ETD 50, and LITD 10) and TEC, while research contributions come from CPRI, IITs, and IISc.

Government Ministries / Departments	Ministry of Power- Central Electricity Authority (CEA); Bureau of Energy Efficiency (BEE); Central Electricity Regulatory Commission (CERC); Power Grid Corporation of India Limited (POWERGRID); Energy Efficiency Services Ltd
Industry Associations	India Smart Grid Forum (ISGF); India Energy Storage Alliance (IESA)
Standard Development Organizations	• BIS: ETD 13, ETD 46, ETD 50 and LITD 10 • TEC
R&D Organizations	Central Power Research Institute (CPRI); IITs; IISc

i. Policy Initiatives

India's smart metering journey has been shaped by over a decade of policy evolution and institutional capacity building. The initial momentum was set in motion with the establishment of the India Smart Grid Task Force and the India Smart Grid Forum in 2010.

This was followed by following policy initiatives to implement smart Grid/Meter:

a) Smart Grid Vision and Road map for India

In 2013, India took its first steps towards outlining a documented vision and roadmap for ushering in smart grids in India through the Smart Grid Vision and Road map for India released by Ministry of Power (MoP). The roadmap offers a series of time-framed, specific, target driven measures, across these different areas, with which to enable the development of an Indian Smart grid model. The roadmap had been prepared by the India Smart Grid Task Force (ISGTF) and India Smart Grid Forum (ISGF), and covers the 12th, 13th, and 14th 5-year plan periods from 2012 to 2027. Read more about SG Vision and Roadmap for India>>

b) National Smart Grid Mission (NSGM)

Ministry of Power (MoP) launched National Smart Grid Mission in 2015 with aims to accelerate Smart Grid deployment in India. NSGM has its own resources, authority, functional & financial

[7] https://www.nsgm.gov.in/en/sm-stats-all

autonomy to plan and monitor implementation of the policies and programs related to Smart Grids in the country.

NSGM functions with three tier hierarchical structure: 1st Level – Governing Council (GC), headed by Minister of Power, 2nd Level – Empowered Committee (EC), headed by Secretary (Power), Supportive Level – Technical Committee (TC), headed by Chairperson CEA, 3rd Level – NSGM Project Management Unit (NPMU).

There are 11 Smart Grid pilot projects have been sanctioned and are under implementation under NSGM so far, adopting the functionalities such as Advanced metering infrastructure, Peak Load Management, Cybersecurity, Distributed generation, Micro grid, Power quality measurement, Smart City Control Center, Smart homes, Advanced IT infrastructure, Renewable Energy Integration, EV with charging infra, home energy management center, AMI (Smart Metering), Outage management system, Customer engagement social media for utility.
Read more about NSGM here>>

c) Revamped Distribution Sector Scheme (RDSS)

Government of India launched Revamped Distribution Sector Scheme (RDSS) with the objective of improving the quality and reliability of supply to consumers through a financially sustainable and operationally efficient distribution sector. The scheme aims to reduce the AT&C losses and ACS-ARR gap at pan-India level. The scheme has a duration of 5 years i.e., from (FY 2021-22 to FY 2025-26).

The Scheme allows States to adopt customised reform measures and plan infrastructure works to meet the specific needs of the States. All Distribution Utilities i.e., all Distribution companies (DISCOMs) and State /UT Power Departments, excluding private sector DISCOMs are eligible for financial assistance under this Scheme. The scheme consists of two parts:

- Part A- Financial support for prepaid smart consumer metering, smart/ communicable system metering & upgradation of the distribution infrastructure.
- Part B - Training, Capacity Building etc.

ii. Growth Drivers

Here are some of the key growth drivers for smart grid/meter in India:

- **Energy Efficiency:** Smart grids and meters enable more efficient energy distribution and consumption. They allow utilities to monitor and manage energy flow in real-time, reducing losses during transmission and distribution. This can help India address its energy efficiency challenges and reduce energy wastage.

- **Integration of Renewable Energy and Grid Flexibility**: India's target of achieving 500 GW of non-fossil fuel-based capacity by 2030 requires greater grid flexibility to manage intermittency from solar and wind generation. Smart grids enable better forecasting, automated load balancing, demand response, and integration of distributed renewable energy resources, making the grid more stable and resilient.

- **Rising Electricity Demand and Urbanization:** Rapid urbanization, industrial growth, and increasing electrification of households are driving higher electricity demand. Smart grid infrastructure helps manage peak loads more efficiently, improves reliability, and supports future-ready distribution networks.

- **Government Policy Support and Large-Scale Programmes**: Strong policy backing through national schemes has significantly accelerated deployment. Key initiatives include the Revamped Distribution Sector Scheme (RDSS), National Smart Grid Mission (NSGM), Deen Dayal Upadhyaya Gram Jyoti Yojana (DDUGJY), and the Integrated Power Development Scheme (IPDS), which provide funding support and implementation frameworks for smart metering and grid modernization.

- **Environmental and Climate Commitments**: Growing concerns over air pollution and climate change are driving India's focus on cleaner and more efficient energy systems. Smart grids contribute by enabling renewable energy integration, reducing losses, improving demand-side management, and supporting energy conservation measures.

iii. Challenges

Here are some of the key challenges for implementing smart grids and meters in India:

- **Data Security and Privacy:** Smart meters and grids collect a vast amount of data about energy consumption patterns. Ensuring the security and privacy of this data is critical to prevent unauthorized access and potential misuse.

- **Cybersecurity**: Smart grids and meters also pose significant cybersecurity risks, as they can be targeted by hackers, malicious insiders, or state actors to disrupt the power grid, steal sensitive information, or manipulate billing and pricing. Robust cybersecurity measures are necessary to protect these systems.

  - In October 2021, the Ministry of Power (MoP) and Central Authority of Electricity (CEA) has released the guidelines for cybersecurity in the power sector to be adhered by all Power Sector utilities to create cyber secure eco system.

- **High capital investment:** Substantial upfront investment is required for the deployment/implementation of smart grid infrastructure and the installation of smart meters. Many utilities in India face financial constraints, which can impede their ability to make these investments.

- **Lack of Interoperability Standards:** Ensuring that different components of smart grids and meters from various manufacturers can work seamlessly together is essential. Lack of interoperability standards can lead to compatibility issues and hinder the scalability of the technology.

iv. Standardization

a) Bureau of Indian Standards (BIS)

Bureau of Indian Standards (BIS) has following technical committees which are developing standards in support of smart grid/meter:

- **ETD-13: Equipment for Electrical Energy Measurement and Load Control (Smart Meter)**: ETD 13 is responsible for preparing standards for equipment for electrical energy measurement, tariff - and load control, customer information, payment, local and/or remote data exchange, using electromechanical and/or electronic, technologies for applications ranging from electrical energy generation to residential. The standards may include requirements and test methods to cover mechanical, environmental, electrical, safety, metrology dependability aspects as well as functional requirements and data models. It is a mirror technical committee of IEC TC-13 (P): Electrical energy measurement and control.

- ✓ IS 15959 (Part 2): 2016: Data exchange for electricity meter reading tariff and load control - Companion specification Part 2 smart meter
- ✓ IS 15959 (Part 3): 2017: Data exchange for electricity meter reading tariff and load control - Companion specification Part 3 smart meter Transformer Operated KWh and KVarh Class 0 2 S 0 5 S And 1 0 S
- ✓ IS 16444: 2015: AC static direct connected watthour smart meter class 1 and 2 – Specification
- ✓ IS 16444 (Part 2): 2017: AC static transformer operated watthour and var - Hour smart meters class 0 2 S 0 5 S and 1 0 S Part 2 specification transformer operated smart meters.

- **ETD 46: Grid Integration of Renewables**: ETD 46 is responsible for preparing standards in the field of Grid Integration comprising of LT (ON Grid, Off Grid and Hybrid with and without storage), HT and EHT for all capacities.

  - ✓ IS 18968:2025: Interconnection and Interoperability of Distributed Energy Resources with Associated Electric Power Systems Interfaces
  - ✓ IS 18969:2025: Conformance Test Procedures for Equipment Interconnecting Distributed Energy Resources with Electric Power Systems and Associated Interfaces

- **ETD 50: LVDC Power Distribution Systems:** ETD 50 is responsible for preparing standards on: a) LVDC System Requirements, Safety, and Installation Guidelines b) LVDC products including electrical wiring accessories and Applications c) Integration of DC Infrastructure d) Non-Traditional Distribution Networks/**Microgrids.**

- **LITD 10: Power system Control and associated Communications**: To prepare Indian Standards relating to: a) Power system control equipment and systems including EMS (Energy Management System) b) DMS (Distribution Management System) c) SCADA (Supervisory Control and Data Acquisition) d) Distribution automation, Smart Grid, tele-protection, and associated communications used in planning, operation, and maintenance of power systems.

  - ✓ IS/IEC 62488-1: 2012: Power line communication systems for power utility applications Part 1: Planning of analogue and digital power line carrier systems operating over EHVHVMV electricity grids.

b) Telecommunication Engineering Centre (TEC)

TEC has also developed Essential Requirements (ERs) for "Smart Electricity Meter" under the Mandatory Testing & Certification of Telecom Equipment (MTCTE)- phase 3. This ER covers Smart Electricity Meter working on wired or wireless (cellular/ non cellular) communication technologies.

Please note that if Smart Electricity Meter is tested as per IS 16444 from the BIS recognized lab, then no separate EMI/EMC & Safety testing is required for MTCTE Certification.

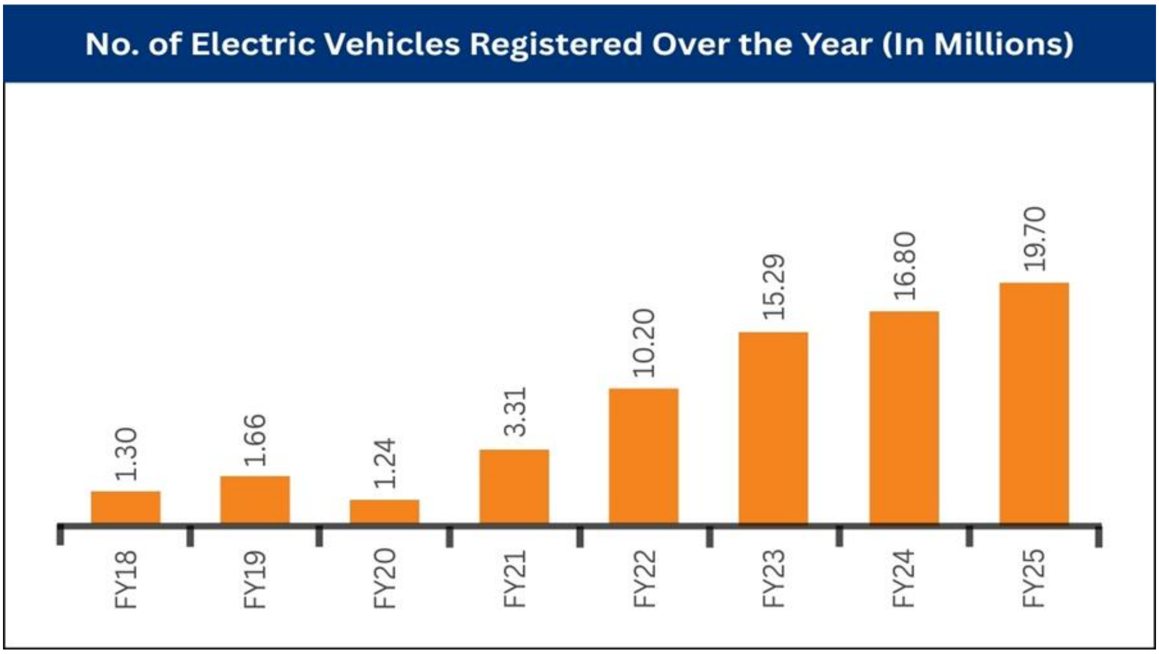
2.5 Electric Vehicle (EV)

India's transport sector is a major source of greenhouse gases, contributing approximately 10–14% of the country's total emissions. Road transport dominates this, accounting for over 90% of these emissions, driven by rapid urbanization, increased private vehicle ownership, and reliance on fossil fuels. Emissions are projected to grow, necessitating urgent decarbonization to meet 2070 net-zero goals.

The **transport or vehicle sector** is considered highly energy-intensive, requiring a continuous and substantial input of energy. Most vehicles still operate on **internal combustion engines**, which are inherently inefficient, converting only a small portion of fuel energy into useful mechanical work while the rest is lost as heat.

The concept of **Electric Vehicles (EVs)** was introduced to address the growing challenges of **fossil fuel depletion, environmental pollution, and energy security** associated with conventional internal combustion engine vehicles.

India's electric vehicle (EV) sector is experiencing rapid growth, fuelled by government incentives, rising environmental concerns, and technological advancements. With initiatives like the Faster Adoption and Manufacturing of Hybrid and Electric Vehicles (FAME) scheme, India aims to significantly increase EV adoption, revolutionizing its transportation landscape towards sustainability and innovation. The country has set an ambitious target to elevate EV sales to 30% of private cars, 70% of commercial vehicles, 40% of buses, and 80% of two- and three-wheelers by 2030, translating to approximately 80 million EVs on Indian roads, alongside a focus on complete domestic EV production through the 'Make in India' initiative.



Source:IBEF

The Indian EV market, valued at US$ 2.36 billion (approx. €2.04 billion) in 2024, is projected to grow to US$ 164.42 billion (approx. €142.1 billion) by 2033, registering a remarkable CAGR of 57.23%, while the Indian EV battery market is expected to expand from US$ 2.22 billion (approx. €1.92 billion) in 2024 to US$ 13.89 billion (approx. €12.0 billion) by 2033 at a CAGR of 22.6%. As of Q2 FY26, India’s EV sales reached 5,80,664 units, representing 9.98% penetration of total automotive sales with 2W and 3W making up nearly 90% of EV volumes, e-goods carriers posting the highest

YoY growth of 158.92%, and EV penetration rising across 2W, 3W passenger and 4W segments QoQ. In October 2025, electric car sales surged to 17,783 units, 56% jump from 11,444 units a year ago and a 9% MoM growth. The overall passenger vehicle market saw record dispatches of over 5,00,000 units in October 2025.

i. Policy Initiatives

The Government of Indian has taken following measures to promote Electric Vehicles (EVs) in the country: -

a) National Electric Mobility Mission Plan (NEMMP) 2020

Government of India launched the **National Electric Mobility Mission Plan (NEMMP)** in year 2013, laying the foundation for a cleaner, greener transport future. As part of this mission, the **FAME India Scheme (Faster Adoption and Manufacturing of Hybrid and Electric Vehicles)** was implemented to encourage electric and hybrid vehicle purchase by providing financial support and also by way of establishing a necessary charging Infrastructure for electric vehicles. Its first phase ran for four years until 2019.

The second phase (FAME II) commenced on April 1, 2019, for a period of three years, which was further extended for a period of two years up to March 31, 2024. The scheme provided demand incentive for e-2Ws, e-3Ws, e-4Ws and grant for e-buses and setting up of EV public charging stations (EV PCS). FAME-II has supported the sale of approximately 16.71 lakh electric vehicles including e-2Ws, e-3Ws and e-4Ws and 6,862 e-buses were sanctioned for various cities out of which 5,195 e-buses have been deployed as of January 2026.

b) PM Electric Drive Revolution in Innovative Vehicle Enhancement (PM E-DRIVE) Scheme

This PM E-DRIVE scheme with an outlay of Rs.10,900 crore (approx. €1.02 billion) has been notified on September 29, 2024. This scheme supports incentivization of approximately 28.27 lakh electric vehicles (EVs) including e-2W, e-3W, e-Trucks, e-buses and e-Ambulances. Further, EV public charging stations (EV PCS) and upgradation of testing agencies are also included in this scheme. An allocation of Rs.4,391 crore (approx. €411 million) has been made under the scheme for deployment of 14,028 e-buses out of which 13,800 e-buses have been allocated in seven cities having four million plus population including Delhi, Bengaluru, Hyderabad, Mumbai, Ahmedabad, Pune and Surat[8].

In September 2025, The Ministry of Heavy Industries released the operational guidelines for setting up electric vehicle public charging infrastructure under the PM E-Drive scheme. The Rs 10,000 crore (approx. €936 million) scheme has set aside Rs 2,000 crore (approx. €187.2 million) to subsidise charging infrastructure, including up to 72,300 new public EV charging stations, battery swapping stations, and battery charging stations.

c) Scheme for Promotion of Manufacturing of Electric Passenger Cars in India (SPMEPCI)

The Scheme notified on 15th March, 2024 aims to promote the manufacturing of electric cars in India. This requires applicants to invest a minimum of Rs.4,150 crore (approx. €388.44 million) and to achieve a minimum Domestic Value Addition (DVA) of 25% at the end of the third year and DVA of 50% at the end of the fifth year.

[8] https://www.pib.gov.in/PressReleaseIframePage.aspx?PRID=2222604&reg=3&lang=2

d) Guidelines for Installation and Operation of Electric Vehicle Charging Infrastructure-2024

Ministry of Power issued revised "Charging Infrastructure for Electric Vehicles — Guidelines and Standards" in September 2024. The objectives are as:

- To drive EV adoption by making charging stations safe, reliable and accessible.
- To develop a robust charging network across the Nation initially prioritising the essential locations.
- To increase the viability of charging stations by facilitating public land at promotional rates, expeditious approval of electricity connections and standardising pricing of power supply.
- To encourage charging of EVs during solar hours.
- To prepare the electricity grid to handle the increased demand from EV charging.

e) Guidelines for Installation and Operation of Battery Swapping and Battery Charging Stations

In January 2025, the ministry of power has issued comprehensive guidelines to promote battery swapping and charging infrastructure for electric vehicles (EVs) across the country. The initiative aims to establish a robust framework for battery swapping, enhancing the efficiency and convenience of EV operations and supporting India's transition to sustainable mobility.

The guidelines, titled "Guidelines for Installation and Operation of Battery Swapping and Battery Charging Stations", provide a structured approach to implementing battery swapping infrastructure, addressing safety protocols, operational standards, and regulatory requirements. These guidelines are applicable to all swappable battery providers and operators of Battery Charging Stations (BCS) and Battery Swapping Stations (BSS).

f) Production Linked Incentive (PLI) Scheme for Automobile and Auto Component Industry in India (PLI-Auto)

Union Cabinet approved the PLI-Auto Scheme in September 2021, with budgetary outlay of INR 25,938 crore (approx. €2.43 billion) for a period of 5 years (FY2022-23 to FY2026-27). The PLI-AUTO Scheme will boost manufacturing of Advanced Automotive Technology (AAT) Products. This scheme will also help to facilitate and promote deep localization for AAT products and enable creation of domestic as well as global supply chain.

The Scheme is focused on Zero Emission Vehicles (ZEVs) i.e. Battery Electric Vehicle and Hydrogen Fuel Cell Vehicle. The incentive under the scheme is applicable from FY 2022-23 to FY 2026-27 (5 years' period) and the disbursement is applicable in the subsequent financial year i.e. from FY 2023-24 to FY 2027-28.

g) Production Linked Incentive (PLI) Scheme for National Programme on Advanced Chemistry Cell (ACC) Battery Storage

In June 2021, Government notified the PLI Scheme for manufacturing of ACC in the country with a budgetary outlay of Rs.18,100 crore (approx. €1.693 billion). The scheme aims to establish a competitive domestic manufacturing ecosystem for 50 GWh of ACC batteries.

ii. Growth Drivers

- **Growing Demand**: Demand for electric vehicles (EVs) in India is rising steadily, driven by increasing environmental awareness—particularly among younger consumers—and the sharp increase in petrol and diesel prices. As the market looks for viable alternatives to conventional vehicles, this presents a strong opportunity for domestic manufacturers to expand their market presence and capture a larger share of EV adoption.

- **Government Support**: The Government of India has played a key role in accelerating EV adoption through supportive policies and financial incentives. Significant investments are being made in charging infrastructure, along with subsidies for EV buyers and reduced road tax in several states. India's broader commitment to reducing carbon emissions and addressing climate change has further strengthened policy momentum, creating a favorable environment for growth of the EV ecosystem.

- **Low-Cost Manufacturing Advantage**: India has strong manufacturing capabilities and is well-positioned to produce cost-effective, high-quality EVs and components. The availability of a large skilled and semi-skilled workforce, along with an established industrial base, supports low-cost production. These factors have encouraged several multinational companies to set up manufacturing operations in India. With increasing economies of scale, India can further reduce production costs and strengthen its competitiveness in global EV supply chains.

- **Declining Battery Costs**: Falling battery prices are one of the most important drivers of EV growth in India. Batteries account for a major share of an EV's total cost and have historically been a key barrier to affordability. However, improvements in battery technology, higher production volumes, and supply chain expansion are gradually reducing costs. As innovation and domestic manufacturing scale up, EV prices are expected to become increasingly competitive, enabling wider adoption across consumer segments.

iii. Challenges

To successfully meet its goal of having 30% electric vehicle fleet on road by 2030, there are multiple challenges to be resolved. These include the following:

- **Limited charging Infrastructure:** In India, the charging infrastructure is still relatively inadequate, particularly in non-metro cities and rural areas. The lack of proper electric vehicle charging infrastructure poses one of the greatest obstacles for adoption of electric vehicles in the country.

- **Shortage of Battery Raw Material:** India falls extremely behind in the lithium and cobalt reserves. It needs to speed up in securing lithium and cobalt.

- **Long charging time:** The mass adoption of electric vehicles mandates a robust charging infrastructure. the charging process of EVs can take anywhere from 30 minutes (in case of fast charging) up to 24 hours, depending on the capacity of the battery and motors. Most, however, take around four to six hours to be fully charged, which is several times longer than the time it takes to refuel a petrol/diesel car.

- **Lack of Consumer awareness and price sensitivity:** Indian consumer is extremely price sensitive and would be hesitant to invest in environmentally friendly products that are too expensive. Unless the battery and other electro-mobility parts are economically at par with the established ICE engine market, it is difficult for EVs to make a dent in the Indian market. EVs are expensive primarily due to their costly batteries which are mostly imported.

- **Lack of Standardization and interoperability**: The lack of standardization and interoperability between different charging networks also poses challenges for EV owners. The government, in collaboration with EV ecosystem players and auto OEMs, should prioritize establishing standardization protocols, ensuring interoperability, and promoting the development of fast-charging technologies.

iv. Standardization

a) **Bureau of Indian Standards (BIS)**

Within BIS the following two technical committees are responsible for developing standards related to Electric vehicle safety and charging infrastructure.

- **TED 27 on Electric and Hybrid Vehicles** is responsible for standardization of Electric and Hybrid vehicles and their components. It is national mirror technical committee of ISO/ TC 22/SC 37 and IEC/ TC 69.

- **ETD 51 on Electrotechnology in mobility** is responsible for standardization of electrotechnical aspects of totally or partly electrically propelled road vehicles.

For more information about BIS standards for Electric vehicle charging, please visit https://e-amrit.niti.gov.in/bis-standard

b) Automotive Research Association of India (ARAI)

ARAI, the leading automotive Research and Development organization of India, is one of the prime Testing and Certification agencies notified by the Government of India under Rule 126 of Central Motor Vehicle Rules, 1989. ARAI has set some Standards for Electric Vehicles & Chargers which are as follows:

- **AIS-138 Part1, Part2 / IS 17017** standard applies for charging infrastructure.

- **AIS-038 – Electric Power Train Vehicles-Construction and Functional Safety Requirements:** It includes requirements of a vehicle with regards to specific requirements for the electric power train and requirements of a vehicle Rechargeable Electrical Energy Storage System concerning its safety.

- **AIS-039 – Electric Power Train Vehicles–Measurement of Electrical Energy Consumption:** It helps in measuring the consumption of electric energy by electric vehicles.

- **AIS-040 – Electric Power Train Vehicles – Method of Measuring the Range:** It is a range test for the electric vehicles.

- **AIS-041 – Electric Power Train Vehicles – Measurement of Net Power and The Maximum 30 Minute Power:** It helps in the measurement of the net power of the electric vehicle and explains the working and benefits of the maximum 30-minute power.

- **AIS-049 – Electric Power Train Vehicles – CMVR Type Approval for Electric Power Train Vehicles:** It is a test of grade-ability for electric vehicles.

- **AIS-131** type-approval procedure for electric and hybrid electric vehicles introduced in the market for pilot/demonstration projects intended for a government scheme.

- **AIS-123** on CMVR Type Approval of Hybrid Electric System Intended for Retro-fitment.

- **AIS-102 (Part 1 & 2)** on CMVR Type Approval for Hybrid Electric Vehicles[9].

For more information, please visit https://www.araiindia.com/downloads

[9] https://e-vehicleinfo.com/electric-vehicles-in-india-arai-standards-and-regulation/

3. Circular Economy including Resource & Energy Efficiency

A **Circular Economy** is an economic system designed to minimize waste and maximize the use of resources by promoting recycling, reuse, repair, remanufacturing, and sustainable product design. Instead of discarding materials after use, the circular economy keeps products and materials in circulation for as long as possible.

India is actively transitioning from a linear "take-make-dispose" model to a circular economy to reduce waste and pollution, aiming for over $2 trillion (approx. €1.73 trillion) in market value and 10 million jobs by 2050.

Energy, resource efficiency and waste management are integral and interconnected components of a circular economy, serving as key strategies to decouple economic growth from resource consumption. While resource efficiency focuses on reducing material usage, and energy efficiency targets reduced energy consumption, waste management ensures that waste materials are properly collected, treated, recycled, or recovered. Instead of disposing of waste in landfills, circular systems encourage recycling, composting, and converting waste into useful resources such as energy or raw materials for new products.

Each of these are essential for "designing out waste" and keeping products at their highest value. Estimates suggest that the circular economy could grow into a multi-billion-dollar market by 2030, driven by innovations in recycling, waste management technologies, sustainable manufacturing, and resource efficiency solutions. Over the long term, circular economy practices are expected to generate substantial economic savings across sectors such as agriculture, construction, mobility, electronics, and materials management while creating new business models and employment opportunities. As India accelerates its transition towards sustainable and climate-resilient growth, circular economy approaches are expected to play a central role in shaping future industrial, environmental, and technological development.

i. Policy Initiatives

a) Circular Economy Cell- NITI Aayog

Circular Economy Cell (CE Cell) was constituted in NITI Aayog in September 2022 as a dedicated unit to work around Circular Economy. 10 sectoral Circular Economy action plans were finalized in NITI Aayog for implementation by stakeholder Ministries/Departments. The primary activities encompass coordinating among stakeholder Ministries/Departments in implementing the Circular Economy action plans. Among other initiatives, CE Cell worked in coordination with MoRTH to operationalize the Vehicle Scrapping programme and developing a strategy for scrapping the fleet of unfit and old Central & State government vehicles. The envisioned activities for the upcoming financial year comprise preparation of a comprehensive Mission Document for Circular Economy, development of an interactive Dashboard elaborating the progress in different domains of Circular Economy and furthering engagement with States.

b) Draft National Resource Efficiency Policy, 2019

The Draft National Resource Efficiency Policy (NREP) 2019, released by India's Ministry of Environment, Forest and Climate Change, aims to streamline the efficient use of these resources with minimum negative impact on environment.

The policy seeks to steer India towards a circular economy by encouraging sustainable and efficient material use, based on the principles of 6R and Green Public Procurement (GPP). The **6R framework** includes **Reduce, Reuse, Recycle, Redesign, Remanufacture, and Refurbish**. In parallel, **Green Public Procurement** promotes the purchase of products with lower environmental footprints, such as those made from secondary raw materials and locally sourced materials.

c) Mission LiFE (Lifestyle for Environment)

Mission LiFE (Lifestyle for Environment) was launched by Prime Minister Narendra Modi at COP26 in 2021 as a global initiative promoting behavioural change and sustainable consumption.

Mission LiFE encourages individuals and communities to adopt environmentally conscious practices such as reducing waste, conserving energy and water, minimizing plastic usage, and promoting sustainable lifestyles. It aims to shift the focus from high-consumption patterns toward responsible and nature-aligned living.

To take ahead the 'LiFE' - 'Lifestyle for Environment' movement, the Ministry of Environment, Forest and Climate Change has introduced two pioneering initiatives that indicate the country's pro-active approach to climate change, sustainability and promotion eco-conscious practices. These initiatives, the **Green Credit Program (GCP)** and the **Ecomark Scheme**, seek to encourage environmentally friendly practices rooted in tradition and conservation, reflecting the ideas of LiFE concept.

- **Green Credit Program (GCP):** GCP is an innovative market-based mechanism designed to incentivize voluntary environmental actions across diverse sectors, by various stakeholders like individuals, communities, private sector industries, and companies.

- **Ecomark Scheme:** It provides accreditation and labelling for household and consumer products that meet specific environmental criteria while maintaining quality standards as per Indian norms. Products accredited under the Ecomark Scheme will adhere to specific environmental criteria, ensuring minimal environmental impact. It will build consumer awareness of environmental issues and encourage eco-conscious choices. It will also motivate manufacturers to shift towards environmentally friendly production. The scheme seeks to ensure accurate labelling and prevent misleading information about products.

The Central Pollution Control Board administers the Ecomark Scheme in partnership with Bureau of Indian Standards (BIS).

d) TEC: Vision, Strategy, and Action Plan for Circular Economy in Telecom Sector

The DoT is finalizing a "Vision, Strategy, and Action Plan for Circular Economy in Telecom Sector" to create a structured approach to waste management and resource efficiency.

e) Right to Repair Framework

The Ministry of Consumer Affairs launched the **Right to Repair Portal**, empowering consumers to repair, reuse, and maintain products via accessible manuals, spare parts, and third-party services. Aimed at boosting the circular economy and reducing e-waste, it forces manufacturers to share product details, reducing dependence on brand services. It also incorporates R3 concept i.e. Reduce, Reuse (repair) and recycle.

Below are the key details regarding the Ministry of Consumer Affairs' initiative on Repair, Reuse, and Recycle:

Key Features of the Right to Repair Framework:

- **Official Portal:** The initiative is cantered around the Right to Repair Portal India, serving as a single platform for repair information.
- **Core Objective:** To move from a "use-and-dispose" to a "circular economy" by increasing product lifespan, usability, and recyclability.
- **Key Sectors Covered:** Mobile and Electronics, Automobile, Consumer Durables, and Farming Equipment.
- **Manufacturer Mandate:** Companies must provide access to:
  - User manuals and DIY repair videos.
  - Information on spare part pricing, warranty, and availability.
  - Details of authorized service centers and recognized third-party repairers.

The initiative aligns with the **Mission LiFE (Lifestyle for the Environment)** movement, promoting sustainable consumption.

f) Carbon Credit Trading System (CCTS)

The Carbon Credit Trading System (CCTC) notified by the Government of India in 2023 provides an overall framework for the functioning of the Indian Carbon Market (ICM). The objective of CCTS is to reduce or avoid greenhouse gas emissions from various sectors of Indian economy by pricing the emissions through a carbon credit certificate trading mechanism.

The CCTS operates through two mechanisms: the Compliance Mechanism and the Offset Mechanism. Under the Compliance Mechanism, emission-intensive industries designated as Obligated Entities are required to meet assigned Greenhouse Gas Emission Intensity (GEI) targets. Obligated Entities that outperform their targets are eligible to receive Carbon Credit Certificates which they can trade with obligated entities which are unable to meet their targets.

Under CCTS 2023, Government has notified Greenhouse Gas Emission Intensity Targets for 490 industrial entities across eight high-emission sectors

- Government of India first notified Greenhouse Gas Emission Intensity (GEI) targets in October 2025 for the Aluminium, Cement, Chlor-Alkali, and Pulp & Paper sectors covering 282 obligated entities.

- Targets for Aluminium (2.8%–7.06% reduction), Cement (4.7%–7.6%), Chlor-alkali (3.3%–11%), and Pulp & Paper (up to 15%).

- In January 2026, Government notified GEI targets for additional carbon-intensive sectors including Petroleum Refineries, Petrochemicals, Textiles and Secondary Aluminium covering 208 obligated entities.

These targets have been notified under the Greenhouse Gases Emission Intensity Target (Amendment) Rules, 2025 establishing the first structured compliance-based carbon trading framework in India.

g) Waste Management Policies and Initiatives

India's rapid urbanisation, economic growth, and rising consumption have significantly increased municipal solid waste (MSW) generation, making India one of the world's largest waste producers. Recent government estimates suggest municipal waste generation has crossed 160 million tonnes (MT) per year and is expected to rise further. Despite improvements in collection and processing, a large share of waste remains untreated or ends up in landfills, highlighting the need for more efficient and technology-driven waste management systems.

At the same time, waste streams are becoming more complex, with increasing plastic waste, e-waste, battery waste, and hazardous waste. This has intensified environmental challenges and strengthened the need for integrated waste management and circular resource use.

Government has been actively formulating policies and promoting projects to drive the country towards a circular economy.

- **Waste Management Rules:** Government has notified several rules/regulations to reduce waste generation and promote recycling and resource recovery.

- **Solid Waste Management Rules (2016)**
- **Plastic Waste Management Rules** with mandatory **Extended Producer Responsibility (EPR)**
- **E-Waste Management Rules (2022)** enabling structured recycling and EPR obligations
- **Battery Waste Management Rules (2022)** focusing on EV batteries and recycling targets
- Construction and Demolition Waste Management Rules, 2025
- **hazardous waste management regulations**
- **Environment Protection (End-of-Life Vehicles) Rules, 2025**

ii. Growth Drivers

- **Resource Scarcity:** India's growing population and economy have put pressure on natural resources. The circular economy offers a way to reduce resource depletion by maximizing the use of existing resources.

- **Environmental Concerns:** Increasing awareness of environmental degradation, pollution, and waste management issues has led to a greater focus on sustainable practices like circular economy principles.

- **Consumer Awareness:** As consumers become more environmentally conscious, there's an increasing demand for sustainable products and services, which can drive adoption of circular economy practices.

- **Economic Opportunities:** The Circular Economy can create new business models, jobs, and economic growth by promoting recycling, remanufacturing, and value-added services.

- **Government Support:** Government policies, such as extended producer responsibility (EPR) regulations and waste management rules, drive businesses to adopt circular practices and reduce waste.

iii. Challenges

The implementation of a circular economy in India faces several challenges. Some of the key challenges include:

- **Lack of awareness and understanding of circular economy concepts among businesses and consumers**: The government needs to create awareness campaigns and education programs to promote the adoption of circular economy practices and encourage consumers to adopt sustainable consumption patterns.

- **Inadequate waste collection and segregation**: India generates a vast amount of waste every day, and a large proportion of it is not adequately collected or segregated, leading to environmental and health hazards. India needs to improve waste collection and segregation systems to enable the efficient and effective processing of waste.

- **Lack of infrastructure and recycling technologies**: India's infrastructure is not well-suited to support a circular economy. For example, there is a lack of recycling facilities, which makes it difficult to recycle and reuse materials. This would require significant public and private sector investment in setting up recycling facilities and developing and deploying recycling technologies.

- **Lack of support and incentives from Government:** Industries are reluctant in adopting the circular economy model due to lack of government support and incentives to invest in waste collection, reusing, recycling, re-manufacturing processes and setting up recycling facilities. The high cost of effective waste treatment and remanufacturing for industries also impedes their efforts in this area.

- **Lack of research and development in adopting Circular Economy:** The transition to a circular economy requires a fundamental shift in the way we design, produce, consume, and dispose of goods and services. This shift requires innovation and new approaches to address the challenges of resource depletion, waste, and environmental degradation. However, the lack of research and development in this field can limit the knowledge and expertise needed to develop circular business models, technologies, and products. Without R&D, businesses may not have the resources to develop and implement innovative circular solutions[10].

iv. Standardization

Bureau of Indian Standards (BIS) through various technical committees has developed standards for recycled products that can be used to promote resource efficiency in the economy.

- **PCD 12: Plastics**: To formulate Indian Standards for specifications for thermosetting and thermoplastic resins-bonded and moulding materials; natural and synthetic polymers, synthetic resin bonded laminates thermoplastic films and sheets, plasticizers cellular plastics, finished plastic articles, composites and reinforced plastics (excluding sanitary wares and

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[10] https://eacpm.gov.in/wp-content/uploads/2023/07/17-Indias-Tryst-with-a-Circular-Economy.pdf

plastic pipes for water supply and plastic packaging containers) safety of toys, and natural and synthetic adhesives (excluding for plywood industry and electrical tapes).

- **EED-1: Environmental management**- responsible for standardization in the field of Environment Management systems, Life Cycle Assessment, General Management of Green House Gases, Climate Change Management, Environmental Labelling, Sustainability at Organizational Level

- **EED-5: Environmental Services-** responsible for standardization in the field of various environmental services including sewage services, refuse disposal, sanitation and similar services, reducing emissions, noise abatement services, nature and landscape protection services and other environmental services including standardization in areas dealing with provisions of raw material and energy used to produce goods and services using verifiable and relevant criteria to ensure less stress on the environment by products and services." Excluded: Standardization in the field of Biodiversity Coordination with i) ISO/TC 207/SC 2 - Environmental auditing and related environmental investigations ii) ISO/TC 207/SC 5 – Life cycle assessment

- **EED-7: Sustainability in built environment-** Standardization in the field of sustainability in new and existing buildings/constructions, responding to current and emerging concerns pertaining to climate change, environment toxicity and ecological disruption. Perceiving sustainability involves examining the built environment, and its various features/functionalities, for its role in reviving, restoring and sustaining societal and planetary wellness. Environmental, economic, and social concerns of sustainability, inducing emerging paradigms

- **EED-8: Waste Management-** To formulate Indian Standards on: i) Terminology, methods of sampling, method of test, characterization and categorization of waste (Excluding Nuclear waste); ii) Handling and management of wastes including waste audits and data collection (Excluding Nuclear waste); iii) Plant machinery and equipment related to waste management; iv) Services related to waste management.

- **EED-9: Circular Economy-** responsible for Indian Standards on: Circularity framework, guidance, supporting tools and requirements; Circularity in design; Recovered critical materials / resources of national importance. Excluding: Aspects of Circular Economy already covered by other sectional committees. Liaison - ISO/TC 323 - Circular economy - Participating (P)

- **EED-10: Carbon dioxide Capture, Transportation, Utilization and Storage:** EED-10 is responsible for developing standards in the field of design, construction, operation, environmental planning and management, risk management, quantification, monitoring and verification, and related activities in the field of carbon dioxide capture, utilisation, transportation, and storage.

- **ETD 43: Standardization of Environmental Aspects for Electrical and Electronic Products:** To prepare the necessary guidelines, basic standards, in the environmental area, in close cooperation with product committees, which remain autonomous in dealing with the environmental aspects relevant to their products; To liaise with product committees in the elaboration of environmental requirements of product standards in order to foster common technical approaches and solutions for similar problems and thus assure consistency in standards.

Telecommunication Engineering Centre (TEC):

The National Working Group (NWG)-5 in TEC corresponding to ITU-T Study Group-5 (SG5): Environment, Climate Action, Circular Economy and Electromagnetic Fields, comprises members from industry, academia, start-ups, research organizations and government organizations, under the Chairpersonship of DDG (Radio), TEC. The standards / recommendations / technical reports of ITU-T SG5 address environmental sustainability, climate action, circular economy aspects, and electromagnetic field (EMF) related issues in the ICT sector.

3.1 Telecom Circularity

India is the second-largest telecom market in the world, contributing around **1.16% to India's Gross Value Added (GVA)**. The sector is supported by an extensive infrastructure network that includes **approximately 42.36 lakh kilometers of optical fibre cables (OFCs)** and **about 8.46 lakh telecom towers** across the country. India currently has around **1.232 billion telecom subscribers**, of which **1.185 billion are wireless users** and **47 million are wireline users**. Broadband connectivity has also expanded rapidly, with **about 1 billion broadband subscribers**, including **955 million wireless broadband users and 45 million wireline users**.

It is imperative to align this significant sector with circular economy principles to ensure resource efficiency, extend product lifecycles, and reduce environmental impacts across digital infrastructure.

i. Policy Initiatives

The Electronics and Electrical Equipment (EEE) Committee under MEITY, in association with NITI Aayog, finalized and released the Action Plan in Electronic and Electrical sector in November 2021.

The Draft National Telecom Policy 2025 (NTP-25) in India aims to establish a sustainable, circular economy by 2030, targeting a 30% reduction in the sector's carbon footprint. Key measures include enforcing electronic waste (e-waste) recycling mandates for manufacturers, encouraging the use of refurbished equipment, and implementing product stewardship frameworks to promote sustainability and resource optimization.

The Department of Telecommunication, under the Ministry of Communications has been entrusted with the directive to prepare a Vision, Strategy, & Action Plan for Circular Economy in the Indian Telecommunications (Telecom) Sector, which is currently under draft stage.

Several other important steps have been taken to reduce the carbon emissions and the E-waste from the electronic equipment used in the telecom sector.

a) **E-Waste Management Rules 2022**

India's E-Waste (Management) Rules, 2022, effective from April 1, 2023, mandate strict Extended Producer Responsibility (EPR) for electronic equipment, including telecom and network hardware. Producers must register on a CPCB portal to manage collection, recycling, and safe disposal, aiming for a 70% to 80% collection rate by 2023-2024 onwards. These rules promote a circular economy, enforcing authorized, environmentally sound disposal.

b) **Voluntary Code of Practice for Sustainable Telecom**

In October 2017, Telecom Regulatory had released recommendations on Approach towards Sustainable Telecommunications with aims to reduce carbon footprint of telecom sector. TRAI has recommended 40% reduction in carbon emissions in telecom networks by 2022-23 considering 2011-12 as the base year to make telecom sector greener. The paper also suggested a formula to calculate carbon footprint.

As a further step towards sustainable telecommunications, In January 2018, Department of Telecommunications (DoT) has issued a notification "Approach towards Sustainable Telecommunications" to implement it as a Voluntary Code of Practice. Telecom Engineering Centre (TEC) has finalized a document on "**Voluntary Code of Practice (VCP)**" to be adopted by Telecom Service Provider (TSP) for reduction in the Carbon Footprint**".**

The National Working Group (NWG)-5 in the Telecom Engineering Centre (TEC), corresponding to ITU-T Study Group-5 (SG5) is responsible for standardisation for circularity in Telecom Sector. https://www.tec.gov.in/nwg-5

3.2 Recycling of Critical Raw Materials

Critical minerals are essential raw materials required for modern technologies, renewable energy systems, electric vehicles, electronics, telecommunications, and defense equipment. These include minerals such as **lithium, cobalt, nickel, copper, rare earth elements (REEs), and graphite**. As the global demand for clean energy technologies and digital infrastructure grows, securing sustainable supplies of these minerals has become a strategic priority for many countries.

India relies heavily on imports for most critical minerals. Recycling of these minerals from secondary sources—such as **electronic waste (e-waste), spent lithium-ion batteries, and industrial scrap**—is therefore becoming an important strategy to reduce import dependence, strengthen supply chains, and support a circular economy.

India is taking decisive steps toward **self-reliance in critical materials** by establishing a domestic ecosystem for Rare Earth Permanent Magnets (REPMs) - high-performance magnets essential for electric vehicles, wind turbines, electronics, aerospace, and defence. To support this goal, the government approved a **₹7,280 crore (approx. €681.4 million) scheme** to develop **6,000 MTPA of integrated REPM manufacturing capacity** in November 2025, covering the full value chain from rare-earth oxides to finished magnets.

Major investments are emerging, such as Attero planning ₹100 crore (approx, €9.36 million) for rare earth magnet recycling. The government and PSUs are aiming for a total investment outlay exceeding ₹34,000 crore (approx. €3.182 billion) between 2025-31 for critical minerals.

i. Policy Initiatives

a) National Critical Mineral Mission (NCMM)

The Government of India launched the **National Critical Mineral Mission (NCMM)** in 2025 for a period of seven years from 2024-25 to 2030-31, with a proposed expenditure of Rs.16,300 crore (approx. €1.53 billion) and an expected investment of Rs.18,000 crore (approx. €1.685 billion) by Public Sector Undertakings (PSUs) and other stakeholders. It aims to establish a robust framework for self-reliance in the critical mineral sector.

- Under this mission, the **Geological Survey of India (GSI)** has been tasked with conducting **1,200 exploration projects** from 2024-25 to 2030-31.
- NCMM targets 1,000 patents by 2030, with the creation of 7 Centres of Excellence to drive breakthroughs in exploration and extraction.
- In May 2025, 21 patents were filed in India within the critical mineral's ecosystem, followed by 41 more in June.
- Guidelines for setting up a Centre of Excellence on Critical Minerals (CECM) under NCMM to work on the critical minerals value and aim to synergise R&D and innovation with the national objectives.
- As part of NCMM, the Union Cabinet approved a **INR 1,500 crore (approx. €140.4 million) Incentive Scheme** to boost **domestic recycling** of critical minerals from sources like e-waste and battery scrap, offering 20% Capex subsidies and Opex support for 6 years (FY2025-26 to FY2030-31) to create a self-reliant supply chain, expecting significant investment, job creation, and new recycling capacity.

b) The Geological Survey of India (GSI)

Under the Ministry of Mines, follows the United Nations Framework Classification (UNFC) classification and Minerals (Evidence of Mineral Contents) (MEMC) Rules, 2015, to carry out exploration activities for critical minerals.

- Ministry of Mines has **withdrawn Quality Control Orders (QCOs) on seven key non-ferrous metals and alloys** that are classified as critical minerals. The decision, made in November 2025, reverses a previous policy that mandated Bureau of Indian Standards (BIS) certification for these imported materials.
- The withdrawn QCOs cover the following critical materials: **Aluminium & Aluminium Alloys, Copper, Nickel, Primary Lead, Refined Zinc, Refined Nickel, Tin Ingot**

c) Rare Earth Permanent Magnet (REPM) Manufacturing Scheme

The **Union Budget of India 2026–27** has placed strong emphasis on building India's self-reliance in critical materials by complementing the recently approved **Rare Earth Permanent Magnet (REPM) Manufacturing Scheme** with new corridor-based initiatives. Together, these measures create a comprehensive framework for strengthening domestic capacity, reducing import dependence, and positioning India as a global leader in advanced materials.

Government on 26th November 2025, approved a major scheme for **Rare Earth Permanent Magnets (REPMs)**. This initiative provides financial support and incentives to build a fully integrated domestic manufacturing ecosystem for high-value magnets. It also seeks to create 6,000 metric tonnes per annum capacity that spans the entire value chain from rare-earth oxides to finished magnets. These oxides serve as the primary raw material for downstream rare-earth industries, including permanent magnet manufacturing[11].

[11] https://www.pib.gov.in/PressNoteDetails.aspx?NoteId=157165&ModuleId=3&reg=3&lang=1

ii. Growth Drivers

- **Growing demand from clean energy and electric vehicles:** India's rapid transition towards renewable energy and electric mobility is increasing the demand for critical minerals such as lithium, cobalt, nickel, and rare earth elements. Recycling of end-of-life batteries, electronic devices, and renewable energy components provides an alternative and sustainable source of these materials, helping to meet the rising demand while reducing reliance on primary mining.

- **Import dependence and supply chain security:** India currently depends heavily on imports for most critical minerals required for advanced technologies and manufacturing. Recycling offers an opportunity to reduce this dependency by recovering valuable materials from domestic waste streams.

- **Increasing generation of e-waste and battery waste:** The rapid growth of electronic consumption and the adoption of electric vehicles are leading to a significant increase in e-waste and spent batteries in India. These waste streams contain valuable critical raw materials that can be recovered through advanced recycling processes. Harnessing this growing waste stream can create a sustainable source of secondary raw materials.

- **Regulatory frameworks and extended producer responsibility (EPR):** India has introduced regulatory mechanisms such as Extended Producer Responsibility (EPR) for e-waste and batteries, requiring manufacturers to ensure proper collection and recycling of their products at the end of their lifecycle.

- **Circular economy and sustainability goals:** Recycling critical raw materials aligns with India's broader sustainability and circular economy goals. As India pursues greener growth and climate commitments, recycling is becoming an essential component of sustainable resource management.

iii. Challenges

- **Limited recycling infrastructure and technology:** India currently lacks sufficient advanced recycling facilities and sophisticated technologies required for extracting high-value critical minerals. This technological gap limits the efficiency and scalability of CRM recycling in the country.

- **Dominance of the informal recycling sector:** A large portion of India's e-waste recycling is handled by the informal sector. Due to lack of proper safety standards, traceability, and advanced recovery techniques results in the loss of valuable critical minerals and environmental risks.

- **Inefficient collection and segregation systems:** The collection and segregation of end-of-life electronics, batteries, and other products containing critical minerals remain weak and fragmented, making it difficult to ensure a consistent supply of recyclable materials for formal recycling facilities.

- **Economic viability and high processing costs:** Recycling critical raw materials requires significant investment in technology, infrastructure, and skilled labour. The cost of recycling can sometimes be higher than importing raw materials, especially when global mineral prices are low.

- **Lack of awareness and skilled workforce:** The recycling industry faces a shortage of skilled professionals trained in advanced material recovery technologies. This knowledge gap slows the development of a modern and efficient recycling ecosystem.

iv. Standardization

The key organizations involved are:

- **Bureau of Indian Standards (BIS):** The National Standards Body of India, BIS is responsible for formulating Indian Standards (IS) for the quality and safety of recycled materials, particularly through its Chemical department (CHD), Petroleum, Coal and Related Products department (PCD). Under the new EPR framework for non-ferrous metals, BIS is specifically tasked with revising and issuing standards for recycled material quality. Bureau of Indian Standards (BIS), through various metal-specific technical committees has published over 400 standards. Dashboard of BIS Standards for Non-ferrous metals and their alloys

- **Ministry of Environment, Forest and Climate Change (MoEFCC):** The nodal ministry for environmental regulations, which notifies the Rules for E-Waste (Management) Rules, 2022, Battery Waste Management Rules, 2022, and Hazardous and Other Wastes Rules, 2016.

- **Central Pollution Control Board (CPCB):** Responsible for developing technical guidelines, Standard Operating Procedures (SOPs), and managing the Extended Producer Responsibility (EPR) portal, which acts as the single point for registration of recyclers.

- **Ministry of Mines (MoM):** Through the NCMM, this ministry is the lead agency for securing critical mineral supplies, including establishing an incentive scheme for recycling secondary sources (tailings, fly ash, red mud) and providing guidelines for Centers of Excellence (CoE) in critical minerals. Click Here for the list of Standards published and defined Scope under ministry of mines department for Minerals.

4. EU-India Cooperation

Collaboration between the European Union and India on clean and green technologies has emerged as a key pillar of their strategic partnership, driven by shared commitments to sustainability, climate action, and energy security. Both regions are working together to foster innovation in areas such as solar and wind energy, green hydrogen, energy efficiency, and circular economy practices.

This collaboration is ably supported by **high-level policy dialogue**, **set of a structured framework, instruments, funding mechanisms, and platforms**. These operate at policy, financial, technological, and research levels. Here are the key announcements, collaborations and instruments:

4.1 Towards 2030: A Joint India-European Union Comprehensive Strategic Agenda

This Joint India-EU Comprehensive Strategic Agenda, endorsed at the 16th India-EU Summit held on 27 January 2026 in New Delhi, aims to further reinforce the strategic partnership by broadening, deepening and better coordinating EU-India cooperation to deliver mutually beneficial, concrete and transformative outcomes for both partners and for the wider world.

The strategic agenda covers key areas: **prosperity and sustainability**, **technology and innovation, security and defence, connectivity and global issues**, reinforced by enablers across pillars. Building on more than 20 years of strategic partnership, it is a forward-looking action plan that reflects the commitment of both sides to work together in an increasingly complex geopolitical environment as trusted, predictable and like-minded partners.

- **Advancing the clean transition and resilience[12]:** Strengthen cooperation under the **India-EU Clean Energy and Climate Partnership**, including through energy technologies, smart grids, storage, electricity sector regulation, energy and climate diplomacy.
- Reactivate the Joint Working Group on Energy Security under the India-EU Energy Panel which would inter-alia focus on dialogue on diversifying reliable and affordable energy sources and strengthen co-operation to promote energy efficiency improvement across sectors.
- Organise an **India-EU Wind Business Summit** to foster business and expert exchanges on wind energy technologies, know-how, auction design, tendering, investment and financing, research and innovation, and testing and demonstration facilities.
- Operationalise the **India-EU Task Force on Green Hydrogen** to foster cooperation on hydrogen production, storage, and distribution to support efforts to decarbonise hard-to-abate sectors.
- Explore further cooperation in sustainable mobility including Sustainable Aviation Fuels (SAF), Compressed Biogas (CBG), as well as on vehicles' energy certification methodologies, **e-mobility, and electric vehicle charging standards**.
- Deepen cooperation under the **India-EU Partnership on Smart and Sustainable Urbanisation** including by furthering city-to-city cooperation and exchanges as well as investments.
- Advance collaboration on sustainable finance instruments and corporate sustainability, including under the EU's Global Green Bonds Initiative.

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[12] https://www.mea.gov.in/bilateral-documents.htm?dtl/40616/Towards+2030+A+Joint+IndiaEuropean+Union+Comprehensive+Strategic+Agenda

- Work together to make power markets stronger, using tools such as contracts for difference, smart meter insights, and offtake agreements. Team up to make offtake deals easier and share know-how on technologies like electrolysers, fuel cells, and energy storage.
- Cooperate on efforts towards industrial decarbonisation of heavy hard to abate energy intensive industries, including through exchanging best practices on low-carbon materials definitions such as steel and cement, while ensuring a level playing field.
- Work towards sharing experiences on the design and implementation of **India's Carbon Credit Trading Scheme (CCTS), and the EU's Emissions Trading Scheme (ETS)** and exploring further cooperation.
- Deepen collaboration on water resilience and security within the India–EU Water Partnership through organisation of regular EU-India Joint Working Group on Water Cooperation.
- Reinforce the **Resource Efficiency & Circular Economy Partnership**, including by establishing an India-EU Joint Working Group on Circular Economy.

4.2 India - EU TTC Working Group 2 (WG2) on "Green & Clean Energy Technologies"

Within the framework of the India-EU Trade and Technology Council (TTC), Working Group 2 (WG2) focuses on green and clean technologies, including investment and standards, with emphasis on research and innovation (R&I), identifying areas of mutual interest for collaboration and implementation (e.g. clean energy, waste management, circular economy, plastic and litter in the ocean), cooperation between EU and Indian incubators, SMEs and start-ups working in these areas and building human resource capability and capacity in such technologies.

The second meeting of the India-EU TTC held in New Delhi (February 28, 2025). During the meeting:

- Both sides agreed on joint research cooperation through exceptional coordinated calls on **recycling of batteries for electric vehicles (EVs), marine plastic litter, and waste-to-hydrogen**. The estimated total joint budget will be about EUR 60 million from the Horizon Europe programme and from matching Indian contributions. On recycling of batteries for EVs, the focus will be on battery circularity through different kinds of flexible/low cost/easy to recycle batteries. In marine plastic litter, the focus will be on developing technologies for detection, measurement and analysis of aquatic litter and for mitigation of the cumulative impact of pollution on the marine environment. On waste-to-hydrogen, the focus will be on developing technologies with greater efficiency to produce hydrogen from biogenic wastes.

- Both sides agreed to explore **cooperation on harmonising standards for EV charging infrastructure**, including cooperative, pre-normative research for harmonised testing solutions and knowledge exchange in the domain of e-mobility. They also agreed to explore how to enhance collaboration in the field of hydrogen-related safety standards, the science of standards as well as the market uptake of wastewater treatment technologies as outcomes of previous jointly conducted research projects.

Recent developments/announcements:

- **Waste to Hydrogen:** A ₹90 crore (approx. €8.42 million) joint call for proposals was launched in 2025 to develop technologies converting biogenic waste into renewable hydrogen, supporting the National Green Hydrogen Mission.
- **Marine Plastic Pollution:** The India-EU Ideathon promoted innovative solutions for ocean cleanup, with winners receiving incubation support.

- **Energy Transition:** Cooperation focuses on offshore wind, battery recycling technologies, and smart grid integration to foster clean energy adoption.
- **Start-up Exchange:** Matchmaking events connect Indian and EU startups and SMEs to boost innovation in cleantech and electric vehicle (EV) battery recycling.
- **Regulatory & Research Support:** Both sides are collaborating on standard-setting for green technologies and increasing research & innovation (R&I) to meet 2050/2070 net-zero targets.

These efforts, part of the broader **EU-India Clean Energy and Climate Partnership (CECP)**, aim to create a sustainable, resilient green economy through collaborative, technology-driven solution.

4.3 The India-EU Clean Energy and Climate Partnership (CECP)

The India-EU Clean Energy and Climate Partnership (CECP), launched in 2016 and currently in its third phase (2025–2028), is a strategic framework aiming to accelerate renewable energy integration, green hydrogen development, and grid stabilization. Key objectives include supporting India's 2070 net-zero goal, strengthening energy security, and promoting joint research.

An energy panel meets annually at senior official level to agree on the CECP work programme and future priorities. Several joint working groups reporting to the energy panel are actively working on various sectors such as renewable energy, energy efficiency, regional connectivity and energy security. In addition, energy cooperation takes place through conferences, study tours, exchanges, business meetings, joint research and other activities within the energy sector.

During the 16th EU-India Summit held in January 2026, a **Green Hydrogen Task Force** was launched in the framework of the EU-India Clean Energy and Climate Partnership.

4.4 Global Gateway and the EU-India Connectivity Partnership

The EU Global Gateway Strategy in India aims to mobilize sustainable investments for high-quality infrastructure in digital, energy, transport, and health sectors by 2027, complementing the 2021 EU-India Connectivity Partnership. It acts as a democratic, transparent alternative to competing connectivity initiatives, focusing on green transition, 2024 Sustainable Urbanization initiatives.

4.5 India-Middle East-Europe Economic Corridor (IMEC)

The India-Middle East-Europe Economic Corridor (IMEC) is a visionary initiative reshaping global trade, connectivity, and cooperation across three continents. Designed to foster robust infrastructure development, seamless logistics, and sustainable growth, IMEC stands as a testament to the commitment of partner nations towards a more interconnected future.

Key Pillars of IMEC

- **Infrastructure Development**: Building state-of-the-art transport networks, digital infrastructure, and logistics hubs to ensure smooth and efficient trade across regions.
- **Sustainability**: IMEC is committed to integrating green technologies, renewable energy sources, and eco-friendly infrastructure to reduce environmental impact and promote sustainable growth.
- **Innovation**: Leveraging the latest advancements in digital technology, AI, and data analytics, we aim to drive smart solutions that enhance the flow of goods and services.

IMEC aims to connect three of the world's fastest-growing economic regions—India, the Middle East, and Europe—through enhanced infrastructure and advanced trade mechanisms. By building a robust corridor for goods, services, and ideas, we help businesses access new markets, streamline operations, and reduce trade barriers[13].

5. Conclusion

India is making steady progress in building a strong green technology ecosystem, supported by policy initiatives, market forces, and international collaboration. Significant progress has been made across key sectors, including renewable energy deployment, green hydrogen development, energy storage, electric mobility, and circular economy initiatives.

The dual focus on **clean energy production** and **energy and resource efficiency** provides a comprehensive pathway for decarbonization while supporting economic growth. This report provides overview of the policies, key growth drivers, standardisation efforts and challenges being faced by India achieving its goals of climate protection, Net zero emissions and energy production from renewable energy sources.

In this context, partnerships such as the EU–India collaboration play a crucial role in facilitating technology transfer, investment, and regulatory convergence. Clean and Green technologies is a priority topic for the Project SESEI (Seconded European Standardisation Expert in India), contributing significantly towards various clean tech issues e.g. Telecom Circularity, Smart Grid and Smart Meters, Battery Charging Ecosystem for EV's, etc.

Overall, India is well-positioned to emerge as a leader in clean and green technologies, provided that sustained policy support, innovation, and coordinated action across stakeholders.

6. Glossary

S. No.	Acronym	Expansion
1	ACC	Advanced Chemistry Cell
2	AI	Artificial Intelligence
3	ARAI	Automotive Research Association of India
4	BCS	Battery Charging Stations
5	BEE	Bureau of Energy Efficiency
6	BESS	Battery Energy Storage Systems
7	BIS	Bureau of Indian Standards
8	CCTS	Carbon Credit Trading System
9	CEA	Central Electricity Authority
10	CECP	Clean Energy and Climate Partnership
11	CERC	Central Electricity Regulatory Commission
12	CMVR	Central Motor Vehicles Rules
13	CO2	Carbon Dioxide
14	COP26	Conference of the Parties
15	CPRI	Central Power Research Institute
16	DoT	Department of Telecommunications

[13] https://www.imec.international/

17	EED	Environment and Ecology Department
18	EPR	Extended Producer Responsibility
19	ESG	Environmental, Social, and Governance
20	ETD	Electrotechnical Department
21	EV	Electric Vehicle
22	FAME	Faster Adoption and Manufacturing of Hybrid and Electric Vehicles
23	FICCI	Federation of Indian Chambers of Commerce & Industry
24	GDP	Gross Domestic Product
25	GEC	Green Energy Corridors
26	GEOA	Green Energy Open Access
27	GH2	Green Hydrogen
28	GHCI	Green Hydrogen Certification Scheme of India
29	GW	Gigawatt
30	HVICs	Hydrogen Valley Innovation Clusters
31	IEC	International Electrotechnical Commission
32	IMEC	India-Middle East-Europe Economic Corridor
33	ISGF	India Smart Grid Forum
34	ISO	International Organization for Standardization
35	ITU	International Telecommunication Union
36	LiFE	Lifestyle for Environment
37	LITD	Electronics and Information Technology Department
38	LVDC	Low Voltage Direct Current
39	MEITY	Ministry of Electronics and Information Technology
40	MHI	Ministry of Heavy Industries
41	MNRE	Ministry of New and Renewable Energy
42	MoEFCC	Ministry of Environment, Forest and Climate Change
43	MoP	Ministry of Power
44	MT	Million Tonnes
45	MTCTE	Mandatory Testing & Certification of Telecom Equipment
46	MW	Megawatt
47	NCMM	National Critical Mineral Mission
48	NEP	National Electricity Policy
49	NGHM	National Green Hydrogen Mission
50	NSGM	National Smart Grid Mission
51	NSM	National Solar Mission
52	PCD	Petroleum, Coal and Related Products Department
53	PCS	Public Charging Stations
54	PLI	Production Linked Incentive
55	PSP	Pumped Storage Projects
56	QCOs	Quality Control Orders
57	R&I	Research and Innovation
58	RDSS	Revamped Distribution Sector Scheme
59	RE	Renewable Energy
60	RPO	Renewable Purchase Obligations
61	TEC	Telecommunication Engineering Centre
62	TED	Transport Engineering Department
63	TTC	Trade and Technology Council
64	VGF	Viability Gap Funding

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