विद्युत मंत्रालय
MINISTRY OF
POWER

सत्यमेव जयते

INDIA ENERGY SCENARIO

FOR THE YEAR 2024-25

EDITION III

BEE@25

Bureau of Energy Efficiency

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कृष्ण चन्द्र पाणिग्राही
महानिदेशक
KRUSHNA CHANDRA PANIGRAHY
Director General

सत्यमेव जयते

Azadi Ka Amrit Mahotsav

ऊर्जा दक्षता ब्यूरो
(विद्युत मंत्रालय, भारत सरकार)
BUREAU OF ENERGY EFFICIENCY
(Ministry of Power, Government of India)

FOREWORD

The Bureau of Energy Efficiency (BEE), under the aegis of the Ministry of Power, has established the Energy Data Management Unit (EDMU) to compile, manage, and publish reliable data on energy supply and consumption in the country. With the collaborative efforts of various Line Ministries / Departments, the latest edition of the report titled "India Energy Scenario 2024–25" has been prepared. The present edition of the report also incorporates several value additions aimed at further strengthening the comprehensiveness, consistency, and usability of India's national energy data.

This publication has been made possible with the support of the Energy Conservation Division of the Ministry of Power, Shri Dhiraj Kumar Srivastava, Chief Engineer (EC, ET & EV) and the Energy Data Management Unit team of BEE (Arijit Sengupta, Deepshikha Wadhwa, Abhishek Kumar Yadav and Anju R Singh). Further appreciation is extended to NITI Aayog, Ministry of Statistics and Programme Implementation (MoSPI), Ministry of Petroleum and Natural Gas (MoPNG), Ministry of Coal (MoC), Ministry of New and Renewable Energy (MNRE), Central Electricity Authority (CEA), and Petroleum Planning and Analysis Cell (PPAC) for their valuable feedback and support.

The Energy and Resources Institute (TERI) team is also sincerely acknowledged for their valuable support in the estimation of biofuel consumption across sectors. I hope this publication will provide valuable information to strengthen India's energy data management system.

(Krushna Chandra Panigrahy)

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स्वच्छ भारत एक कदम स्वच्छता की ओर

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Abbreviations

ATF	Aviation Turbine Fuel
ATUFS	Amended TUFS
BCM	Billion Cubic Metres
BEE	Bureau of Energy Efficiency
BG	Broad Gauge
BU	Billion Units
CAGR	Compounded Annual Growth Rate
CEA	Central Electricity Authority
CIL	Coal India Limited
CNG	Compressed Natural Gas
CO_2	Carbon Dioxide
CPPRI	Central Pulp & Paper Research Institute
DAP	Di-Ammonium Phosphate
DBTL	Direct Benefit Transfer of LPG
DCPC	Department of Chemicals and Petrochemicals
DCs	Designated Consumers
DDUGJY	Deen Dayal Upadhyaya Gram Jyoti Yojana
DG	Diesel Generator
DGCA	Directorate General of Civil Aviation
DISCOMs	Distribution Companies
DPIIT	Department for Promotion of Industry and Internal Trade
ECBC	Energy Conservation Building Code
ECSBC	Energy Conservation and Sustainable Building Code
EE	Energy Efficiency
EESL	Energy Efficiency Services Limited
EPI	Energy Performance Index
EV	Electric Vehicles
FAME	Faster Adoption and Manufacturing of (Hybrid &) Electric Vehicle
FDI	Foreign Direct Investment
FO	Furnace Oil
GDP	Gross Domestic Product
GEF	Global Environment Facility
GHG	Greenhouse Gas
GJ	Gigajoules
GoI	Government of India
GRIHA	Green Rating for Integrated Habitat Assessment
GVA	Gross Value Added
GW	Giga-Watt
HSD	High-Speed Diesel
ICED	India Climate Energy Dashboard
IR	Indian Railways
kWh	kilo-Watt hour
LDO	Light Speed Diesel Oil
LNG	Liquefied Natural Gas

LPG	Liquefied Petroleum Gas
LSHS	Low Sulphur Heavy Stock
MMSCM	Million Standard Cubic Metres
MNRE	Ministry of New & Renewable Energy
MoC&I	Ministry of Commerce and Industry
MoC	Ministry of Coal
MoEFCC	Ministry of Environment, Forest, and Climate Change
MoH&FW	Ministry of Health and Family Welfare
MoPNG	Ministry of Petroleum and Natural Gas
MoRTH	Ministry of Road Transport & Highways
MoSPI	Ministry of Statistics and Program Implementation
MSME	Micro, Small & Medium Enterprises
MT	Million Tonnes
$MTCO_2e$	Metric tons of carbon dioxide equivalent
Mtoe	Million Tonnes of Oil equivalent
NITI	National Institution for Transforming India
NO_x	Nitrogen Oxides
NPP	National Power Portal
PAT	Perform, Achieve and Trade
PAT Cycle I	Perform, Achieve and Trade Cycle- I (from 2012-13 to 2014-15)
PAT Cycle II	Perform, Achieve and Trade Cycle- II (from 2015-16 to 2018-19)
PAT Cycle III	Perform, Achieve and Trade Cycle- III (from 2016-17 to 2019-20)
PAT Cycle IV	Perform, Achieve and Trade Cycle- IV (from 2017-18 to 2021-22)
PAT Cycle V	Perform, Achieve and Trade Cycle- V (from 2018-19 to 2021-22)
PAT Cycle VI	Perform, Achieve and Trade Cycle- VI (from 2019-20 to 2022-23)
PAT Cycle VII	Perform, Achieve and Trade Cycle- VII (from 2021-22 to 2024-25)
PAT Cycle VIII	Perform, Achieve and Trade Cycle VIII (from 2022-23 to 2025-26)
PIB	Press Information Bureau
PLI	Production-Linked Incentive
PM	Particulate Matter
PMAY	Pradhan Mantri Awas Yojana
PM-KUSUM	Pradhan Mantri Kisan Urja Suraksha evam Utthaan Mahabhiyan
PMUY	Pradhan Mantri Ujjwala Yojana
PPAC	Petroleum Planning and Analysis Cell
RBI	Reserve Bank of India
RES	Renewable Energy Sources
RTS	Roof-top solar
S&L	Standards and Labelling
SAF	Sustainable Aviation Fuel
SAUBHAGYA	Sahaj Bijli Har Ghar Yojana
SME	Small and Medium Enterprises
SO_x	Sulphur Oxide
T/tcs	Tonnes per tonne of crude steel
TCDS	Textile Cluster Development Scheme
tCO_2e	Tonnes of carbon dioxide equivalent
TMT	Thousand Metric Tonnes
TUFS	Technology Upgradation Fund Scheme

TWh	Terawatt hours
UDAY	Ujwal DISCOM Assurance Yojana
UJALA	Unnat Jyoti by Affordable Light-emitting diodes for All
UNIDO	United Nations Industrial Development Organization
US	United States
WB	World Bank

Executive Summary

As India progresses in line with the Viksit Bharat 2047 vision, sustained economic growth across sectors such as industry, transport, urban infrastructure, and buildings is expected to significantly increase the demand for energy services. Expanding manufacturing activity, rising mobility needs, rapid urbanisation, and improved access to modern energy for households will place growing pressure on energy supply systems. Ensuring the availability of affordable, reliable, and sustainable energy is therefore central to supporting India's long-term economic development.

Energy services are essential for economic development. Today, India stands at a stage where rising energy requirements need to be balanced with ambitious climate goals, while also improving the overall efficiency of the economy. Over the years, India has taken several important steps to move in this direction, particularly by increasing the share of clean energy in its total installed power capacity and by reducing the emissions intensity of its GDP.

As on December 2025, non-fossil fuel sources account for more than 50 percent of India's total installed electricity capacity, a target originally set for 2030 under India's updated Nationally Determined Contributions in 2022. Additionally, India had already reduced the emissions intensity of its GDP by about 36 percent between 2005 and 2020, and continues to work towards achieving a 45 percent reduction by 2030. These developments reflect India's ongoing efforts to align economic growth with climate action, while ensuring access to clean, reliable, and affordable energy for all citizens.

However, India's energy system continues to be largely dominated by fossil fuels, with the energy sector contributing about 75.66 percent of total greenhouse gas emissions. This underscores the urgent need to transform energy production and the consumption patterns to achieve net-zero emissions by 2070 and effectively mitigate the climate change impacts. India plans to implement a multi-layered strategy in order to achieve its ambitious climate targets, through a combination of conducive policy environments, improved data regimes, and greater collaboration amongst stakeholders. India has launched and strengthened several policy measures to support the clean energy transition.

These include ambitious renewable energy targets to accelerate low-carbon electricity deployment; comprehensive energy efficiency programmes such as the Perform, Achieve and Trade (PAT) and Standards & Labelling schemes, along with the National Bioenergy Programme; sector-specific efficiency measures including the Energy Conservation and Sustainable Building Code (ECSBC), and Corporate Average Fuel Efficiency (CAFE) standards for the transport sector; and the Carbon Credit Trading Scheme (CCTS), which builds on the experience of PAT to incentivise greenhouse gas emission reductions through a domestic carbon market. In addition, other market-based mechanisms such as competitive bidding and emerging instruments like Virtual Power Purchase Agreements are being promoted to facilitate clean power procurement, alongside long-term initiatives including the National Green Hydrogen Mission to guide technology expansion and future energy pathways.

The transition to cleaner energy sources is therefore central to India's long-term energy strategy. While coal and oil continue to dominate the energy mix, there is a growing and deliberate shift toward renewable energy sources (RES) such as solar, wind, and biomass, supported by battery energy storage systems and emerging technologies including green hydrogen and green ammonia. Policy measures aimed at tripling renewable

energy capacity and doubling energy efficiency, alongside technological innovation, market transformation, and targeted investment incentives, are critical to accelerating this transition and greening India's energy mix.

However, the energy transition isn't just about replacing fossil fuels with cleaner options. It's a fundamental shift in our understanding of how energy interacts with the economy, society and systems. This interconnectedness demands a holistic approach in technology, policy, finance and most importantly, data. The role of accurate and timely energy data is instrumental in formulating informed policies to support energy transition in the country. Robust data facilitates evidence-based decision-making, aids in monitoring progress towards climate goals, and enhances transparency in energy governance. Addressing the gaps in data and strengthening data management frameworks are essential steps towards optimising energy planning.

India's approach to climate change is guided by the principle of Common but Differentiated Responsibilities and Respective Capabilities (CBDR-RC)**,** as recognised under the UNFCCC, which acknowledges differing national circumstances and development priorities. In this context, India views the energy transition not only as a mitigation pathway, but also as a means to build resilience and support adaptation through more robust, decentralised and climate-resilient energy infrastructure. The country's strategy, therefore, integrates renewable and low-carbon energy sources, energy efficiency, demand-side electrification, circularity, and adaptive frameworks to support an inclusive transition for developing economies. India has consistently sought to balance economic growth with climate responsibility, ensuring that the transition remains equitable, inclusive, and sustainable.

The third edition of the India Energy Scenario Report serves as a comprehensive reference, bringing together critical data and insights on India's evolving energy landscape. It offers detailed insights into India's landscape of energy across supply and demand side sectors while filling some of the sectoral data gaps identified in last edition of India Energy Scenario. The report also attempts to provide certain value additions from the last version with more focus on reducing the gap for non-specified total final energy consumption by identifying the sectoral energy consumption and updated energy balance for 2024-25. The energy balance has been prepared by converting commodities from their physical forms (e.g., tonnes) to energy unit, Million Tonnes of Oil Equivalent (MTOE), to align energy supply and demand.

Based on the conventional energy balance (excluding biomass and biofuels), India's total primary energy supply (TPES) in 2024-25 stood at 932 Mtoe, with 59.5 percent from coal, 27.9 percent from oil, 7.1 percent from gas, and 5.4 percent from non-fossil energy sources including nuclear. The final energy consumption was 603 Mtoe, with industry at 50.1 percent, transport at 22.3 percent, residential buildings at 12.1 percent, commercial buildings at 2.8 percent, agriculture at 4.6 percent, non-specified (other) sector at 4.3 percent and non-energy use accounting for around 3.9 percent.

When biofuels and biomass are also taken into account, India's total primary energy supply in 2024-25 increases to about 1,061.4 Mtoe. In this expanded energy mix, coal remains the dominant source, contributing nearly 52 percent, followed by oil (25 percent), natural gas (6 percent), and renewable energy sources including nuclear (5 percent), while biofuels and biomass contribute around 12 percent of total primary energy supply. Correspondingly, total final energy consumption including biomass and biofuels is estimated at 722.4 Mtoe, with industry accounting for about 48 percent, followed by buildings (22 percent), and transport (19.2 percent). Agriculture**,** non-energy use**,** and other sectors together account for the remaining 11 percent of final energy consumption. The estimates of biofuels and biomass used in *India Energy Scenario 2024–25* are

based on a study jointly conducted by TERI and MNRE under the Expert Committee on Energy Statistics constituted by the Ministry of Statistics and Programme Implementation (MoSPI).

On the demand side, this report presents a detailed assessment of energy consumption across major end-use sectors, including industry, buildings, transport, and agriculture. Industrial energy use is analysed using sector-wise data and information from energy efficiency programmes such as the Perform, Achieve and Trade (PAT) scheme, enabling improved disaggregation of fuel and electricity consumption across energy-intensive industries. Energy consumption patterns in residential and commercial buildings, including appliance-wise electricity consumption in residential buildings and typology-wise energy consumption in commercial buildings, are captured through surveys. The report also analyses fuel and electricity consumption in the transport and agriculture sectors, providing a comprehensive view of final energy use across the economy.

Coverage and Value Addition

Taken together, this report brings together a consolidated assessment of India's energy system, covering both supply and demand-side dimensions. It combines updated data, sector-wise analysis, and methodological refinements to present a coherent picture of energy production, consumption, and transformation across the economy. The key areas of coverage and analytical enhancements in the current edition are outlined below-

Energy balance for the year 2024-25

- Use of energy efficiency schemes (such as PAT) to improve sectoral disaggregation of industrial energy consumption and reduce the share of energy reported under non-specified industries.
- Disaggregated building energy consumption based on survey based analysis.
- Significant reduction in energy reported under non-specified and "other" categories—from about 18 percent in the previous edition to nearly 4 percent-through improved mapping of fuels to end-use sectors.
- Enhanced disaggregation of High-Speed Diesel (HSD), informed by the CRISIL All-India study, this refinement has resulted in a higher and more realistic estimate of transport sector energy use, with its share increasing from about 12 percent in the previous edition to around 22 percent in the current energy balance without including solid biomass and biofuels.
- Sector-wise allocation of fuels like natural gas and LPG has been strengthened through improved data mapping, enabling better representation of residential and commercial consumption.
- The allocation of imported coal has been refined to better reflect its end use, with coal supplied to the power sector now appropriately accounted, rather than being aggregated with industrial consumption.
- An analytical distinction has been introduced between conventional fuels and their blended biofuel components, recognising that supply data reported by ministries exclude blended biofuels while sectoral consumption reflects their use. This improves consistency between supply and demand estimates as blending levels increase.

Expanded analytical coverage of the energy system by incorporating biomass and biofuels across major sectors—including industry, buildings, and transport—providing a more complete representation of energy use.

Supply-side Trends and Analysis:

- Comprehensive data on domestic coal production, including details by company, state, and coal type. This also covers data on imported coal and provides historical monthly trends for coal production.
- Data on crude oil production and imports, including historical trends, region-wise import analysis, and details on production, import, and export of petroleum products.
- Detailed data on natural gas production and imports, along with along with regional import shares.
- A new section on biofuels has been added to this report, which provides insights into ethanol, methanol production in addition to the various initiatives taken by the Government of India to boost domestic production of bio-fuels.
- The report also includes an overview of biomass and biofuel estimates within India's energy mix, improving the visibility of bioenergy in the overall energy framework.
- In-depth analysis of the electricity sector, including breakdown of utility and non-utility capacity and generation. Provided detailed information of RES capacity and generation.

- **Demand-side Trends and Analysis:**

  - Key insights on sectoral energy consumption, electricity share in final energy consumption, peak demand and electricity surplus/shortage.
  - Insights on key policies, initiatives and scheme introduced by the Government.
  - Industry:
    - Energy intensive industries production and fuel consumption trends.
    - Detailed data on fuel and electricity consumption and process wise fuel consumption by the Designated Customers (DCs).
  - Buildings:
    - Analysis of fuel and electricity consumption patterns in residential and commercial buildings.
    - Residential buildings survey-based analysis covering appliance ownership, usage patterns, and appliance-wise electricity consumption
    - Commercial buildings survey-based analysis examining electricity consumption and cooling demand across different climatic zones for various types of buildings.
  - Transport:
    - Segments in the transport sector are by the mode, namely, road, rail, air and shipping
    - Trends on mode-wise passenger and freight kilometres, vehicle registration and electric vehicles registration
    - Mode wise data on fuel and electricity consumption.
    - Improved fuel consumption analysis through more granular disaggregation of High-Speed Diesel (HSD) across transport sub-sectors, informed by the CRISIL All-India study on sectoral demand for petrol and diesel.
  - Agriculture:
    - Data on diesel, electric and solar irrigation pump sets
    - Implementation status of the Pradhan Mantri Kisan Urja Suraksha evam Utthaan Mahabhiyaan (PM-KUSUM scheme), with a component-wise breakdown of pump installations.
    - Fuel and electricity consumption trends in the agriculture sector.

  - Identification of gaps in data from various sectors has been compiled along with listing out comprehensive list of parameters to ensure robust data gathering going forward.

Chapter 1: Brief Overview

India's Energy Landscape: An Integrated Snapshot

India's energy system is undergoing a profound transformation, shaped by rapidly rising demand, and an accelerating push towards clean and efficient energy solutions. As one of the fastest-growing major economies and home to nearly one-sixth of the global population, India's energy transition is central to achieving both national development objectives and global climate goals. Over the last decade, India has made substantial progress in transforming its energy system. The country has expanded its total installed power capacity to over 505 GW, more than half of which comes from non-fossil fuel sources, reflecting a significant shift toward cleaner energy infrastructure. As of 2025, India ranks among the top nations globally for renewable energy capacity, standing fourth in total renewable energy installed capacity and third in solar capacity according to the latest international statistics, underlining its growing leadership in clean energy deployment.

1.1 Growing Energy Demand and Supply-Side Realities

India's primary energy supply has expanded sharply over the last decade, reflecting economic growth, urbanisation, and rising living standards. As detailed in Chapter 4, total primary energy supply reached about 932 Mtoe in 2024-25, increasing by around 45.5 percent compared to a decade earlier. Despite notable progress in renewable energy deployment, the energy system remains heavily reliant on fossil fuels. Coal continues to dominate the primary energy mix, contributing close to 59.5 percent of total supply, underpinned by abundant domestic reserves and expanding production capacity. Oil accounts for nearly 27.9 percent of primary energy supply, with India emerging as the world's third-largest oil consumer, while natural gas contributes around 7 percent. On the demand side, India's final energy consumption stood at about 603 Mtoe in 2024-25, with industry accounting for the largest share at 50 percent, followed by transport at 22 percent, residential buildings at 12 percent, commercial buildings at 2.8 percent, agriculture at 4.6 percent, other sectors at 4.3 percent, and non-energy use accounting for about 3.9 percent.

The above assessment reflects the conventional energy balance, which excludes biomass and biofuels. When biomass and biofuels are also taken into account, India's total primary energy supply in 2024-25 is estimated at around 1,061.4 Mtoe. In this expanded energy mix, coal remains the dominant source, accounting for nearly 52 percent of total primary supply, followed by oil (25 percent), natural gas (6 percent), and renewable energy sources including nuclear (5 percent), while biofuels and biomass contribute about 12 percent. Correspondingly, total final energy consumption including solid biomass and biofuels is estimated at around 722.4 Mtoe, with the industrial sector accounting for about 48 percent, followed by buildings (22 percent, including residential and commercial biomass use) and transport (19.2 percent). Agriculture, non-energy use, and other sectors together account for the remaining share.

The total electricity consumption (including captive) doubled from 949 Billion Units (BU) to 1,623 BU between 2014-15 and 2024-25, growing at a CAGR of around 6 percent, driven by industrial expansion, rising household appliance ownership, increased space cooling demand, and improved access to electricity across rural and urban areas.

Chapter 4 provides an overview of India's energy supply, covering domestic production, imports, exports, and import dependency across major fuels. It highlights the Government of India's multi-pronged approach to strengthening energy security, including efforts to enhance domestic coal production under the *Atmanirbhar Bharat* vision, expand refining capacity, diversify crude oil import sources, and strengthen gas infrastructure through the National Gas Grid and LNG terminals. The chapter also outlines measures to improve efficiency and reduce emissions from fossil fuel use, such as the adoption of supercritical and ultra-supercritical coal technologies, coal gasification, and cleaner fuel pathways. Chapter 5 complements this supply-side assessment by examining energy demand and consumption patterns across major sectors, including industry, transport, buildings, and agriculture, providing a comprehensive picture of how energy is used across the economy.

1.2 Accelerating the Shift to Clean Energy

Over the last decade, India has made notable progress in building a cleaner and more reliable power system, driven largely by rapid expansion of renewable energy capacity and supportive policies. While the share of renewables in total primary energy supply remains modest at under 4 percent, the trajectory is clearly upward. The contribution of renewables to the energy system has grown rapidly, driven primarily by solar and wind power. As of November 2025, India's total installed renewable energy capacity was about 253.96 GW. India achieved a major milestone in 2025 by reaching 50 percent of its installed electricity capacity from non-fossil fuel sources, five years ahead of its Nationally Determined Contribution (NDC) target. Solar capacity crossed 100 GW, supported by large-scale solar parks, rooftop solar programmes, renewable purchase obligations, and production-linked incentive schemes for domestic manufacturing. The increasing share of renewables has also influenced the generation mix. On 29 July 2025, renewables met 51.5 percent of India's total electricity demand on a single day, the highest ever recorded, demonstrating how clean energy is increasingly contributing to energy reliability and peak load management.

India's vast renewable resource potential with updated Nationally Determined Contributions for the year 2035 would lay down a strong foundation for further expansion. The growing emphasis on energy storage systems, including pumped storage and batteries, is expected to play a crucial role in integrating variable renewable energy and improving grid reliability. In parallel, emerging clean energy areas such as biofuels and green hydrogen are gaining prominence. India has achieved its 20 percent ethanol-blending target in petrol ahead of schedule in 2025, and the rollout of compressed biogas, sustainable aviation fuel, and methanol initiatives underscores the country's efforts to reduce oil import dependence and decarbonise transport and industry. The National Green Hydrogen Mission marks a strategic shift toward deep decarbonisation of hard-to-abate sectors. In addition, the government has initiated a dedicated research and development roadmap for carbon capture, utilisation and storage (CCUS) to support its net-zero targets, reflecting growing efforts to address emissions from hard-to-abate sectors such as cement, steel and power.

While fossil fuels still form a significant part of the energy mix, these developments reflect a sustained and accelerating shift toward cleaner energy sources, underpinned by expanding renewable capacity, record additions in solar and wind power, and concerted policy support.

1.3 Sectoral Demand Trends and Decarbonisation Efforts

The industry sector remains the largest consumer of both energy and electricity in India, accounting for about 50.1 percent of total final energy consumption and around 40 percent of electricity consumption in 2024-25. Over the last decade, the sector has witnessed a gradual shift towards cleaner fuels, reflected in the declining share of coal in total industrial energy consumption (excluding biomass and biofuels) from around 71 percent in 2014-15 to about 58 percent in 2024-25. This transition has been supported by the implementation of energy efficiency initiatives and regulatory frameworks aimed at improving industrial energy performance, encouraging technology upgrades, and optimising processes across energy-intensive industries, even as industrial output has continued to expand.

The Perform, Achieve and Trade (PAT) scheme has played a central role in this transition by setting specific energy consumption reduction targets for large energy intensive industries and enabling the trading of efficiency certificates. Complementing PAT, targeted initiatives such as the Assistance for Deployment of Energy Efficient Technologies in Industries (ADEETIE) scheme support the adoption of energy-efficient technologies in micro, small and medium enterprises (MSMEs), a segment with significant untapped efficiency potential. More recently, policy instruments such as the Carbon Credit Trading Scheme (CCTS) have been introduced to further incentivise emissions reduction through market-based trading of carbon credits linked to emissions intensity targets, and are expected to strengthen economic signals for low-carbon investments. In the iron and steel sector, sustained efficiency improvements have contributed to a reduction in emissions intensity, which declined from 3.1 tCO_2 per tonne of crude steel in 2005 to about 2.5 tCO_2 per tonne by 2020.

The transport sector is the second-largest consumer of energy in India after industry, accounting for about 22 percent of total final energy consumption (excluding biomass and biofuels). It plays a critical role in the country's socio-economic development by enabling mobility and connectivity for nearly 1.4 billion people. Over the last five years, the transport sector has recorded a significant growth, increasing from around 98 Mtoe in 2020-21 to about 135 Mtoe in 2024-25, largely driven by rising vehicle usage in road transport. Road transport dominates the sector, carrying around 87 percent of passenger traffic and about 60 percent of freight traffic, and consequently accounting for over 86.7 percent of total transport-related energy consumption. Alongside this growth, electric mobility has gained momentum, with the share of electric vehicle registrations increasing from about 0.3 percent in 2016-17 to around 8 percent in 2024-25. As of February 2025, cumulative electric vehicle registrations in India reached approximately 56.75 lakh vehicles, reflecting rapid adoption of electric mobility across two-wheelers, three-wheelers and other EV segments.

The buildings sector is the second-largest consumer of electricity in India after industry, accounting for about 33.5 percent of total electricity consumption in 2024-25. Rising incomes, improved living standards, and near-universal household electrification have led to a sharp increase in residential electricity demand over the past decade. Residential electricity consumption increased from 217 Billion Units (BU) in 2014-15 to about 409 BU in 2024-25. This growth has been driven by higher ownership of electrical appliances, increased use of lighting and fans, and a rapid rise in space cooling demand, particularly in urban areas and warmer climatic zones.

Government interventions have played a critical role in shaping household energy consumption patterns. The Pradhan Mantri Ujjwala Yojana (PMUY) scheme led to an exponential rise in the use of Liquid Petroleum Gas (LPG) for cleaner cooking, increasing its share of residential consumption. As of 1 December 2024, a total of 10.33 crore LPG connections had been released under the scheme across the country, contributing to reduced reliance on traditional biomass and improved indoor air quality. More recent updates indicate that the total

number of PMUY beneficiaries has exceeded 10.4 crore as on December 2025, reflecting continued expansion and refill support measures.

Agriculture continues to be a key livelihood sector in India, supporting about 45 percent of the workforce as per the latest Periodic Labour Force Survey (2022-23). Energy use in agriculture is largely driven by irrigation, with electricity emerging as the dominant energy source, accounting for around 81 percent of total agricultural energy use in 2024-25, while oil consumption has steadily declined. The number of energised pump sets increased from 208 lakh in 2016-17 to 276 lakh in 2023-24, growing at a CAGR of about 4 percent. In parallel, solar pump deployment expanded rapidly, rising from 1.2 lakh in 2016-17 to about 10.86 lakh by 2024-25, reflecting a CAGR of 31.7 percent, supported largely through the PM-KUSUM scheme.

Role of Data in Enabling the Energy Transition

Data and analytics play a crucial role in understanding how India's energy system is evolving and in anticipating future energy needs. As the country moves towards its long-term goal of achieving net-zero emissions by 2070, robust data and information are essential for managing India's complex energy transition. Reliable and granular data help assess the balance between energy supply and demand, help identify areas for efficiency improvement, and strengthen evidence-based policy making.

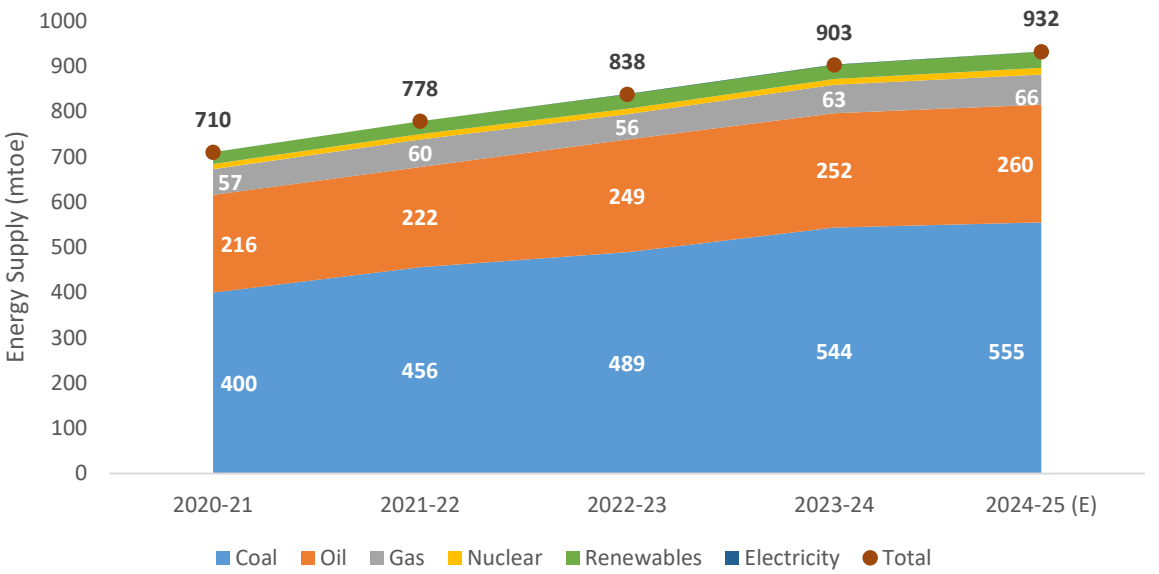
The shift towards cleaner and more decentralised energy systems requires a change in the way energy data is collected, managed, and used. Emerging areas such as decarbonisation of hard-to-abate industries, energy-efficient and climate-responsive cooling in buildings, improved weather forecasting for agriculture, and modelling of energy supply chains all depend on consistent and well-structured data. When combined with digital tools and advanced analytics, including artificial intelligence, data can support more informed decisions and improve system-wide outcomes beyond the energy sector. Robust data also helps assess future energy demand and consumption patterns, which is necessary for planning cleaner supply-side options and encouraging more efficient and sustainable energy use.

In recent years, India has made notable progress in improving the availability and transparency of energy-related data. While supply-side data systems have improved significantly, important gaps remain on the demand side, particularly at the sectoral and end-use levels. This report attempts to address some of these gaps by presenting an updated energy balance for 2024–25, along with disaggregated sectoral consumption estimates and analysis drawing on datasets such as PAT and the Standards and Labelling programme. By improving alignment between physical energy flows and energy units, and by improving coverage for non-specified consumption, the report aims to strengthen the analytical basis for understanding India's energy system and its long-term transition towards net-zero emissions by 2070.

Chapter 2: Energy Supply and Demand Trend Analysis

Primary Energy Supply

India's primary energy supply continues to evolve in response to the nation's growing population, rapid urbanisation and expanding industrial activity. As one of the world's fastest-growing economies, India's energy demand remains substantial and diverse. Total primary energy supply stood at around 932 Mtoe in 2024-25. After the pandemic, supply increased at a CAGR of 5.4 percent between 2022-23 and 2024-25. In 2024-25, it registered a growth of 3.2 percent over the previous year.



(E) - Estimated

Figure 1: Source-wise Primary Energy Supply

Source: (MoSPI, 2025) and for 2024-25, calculated based on actual data from various ministries

*Biomass and other non-commercial energy sources are not included

In 2024-25, coal and oil together account for nearly 87 percent of the country's total primary energy supply (excluding biomass and biofuels), underscoring their continued dominance in the national energy mix. The requirement for coal has increased steadily, driven primarily by rising electricity demand and growth in energy-intensive industries, remaining as a predominant fuel in the primary energy mix.

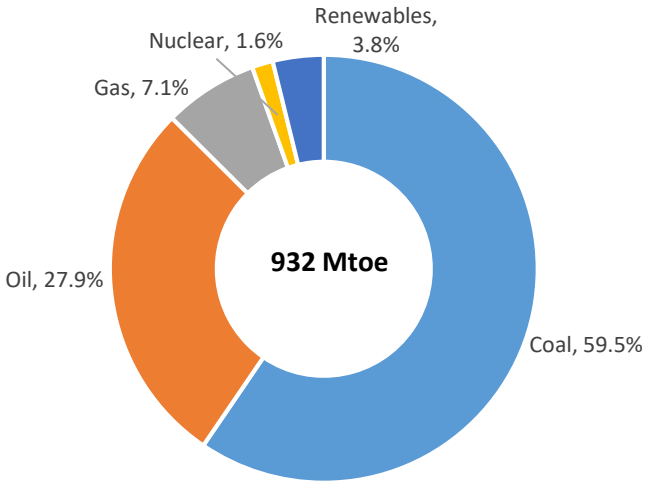


Figure 2: Source-wise Primary Energy Supply during 2024-25 (Estimated)

Source: The figures are calculated based on actual data from various ministries

*Biomass and other non-commercial energy sources are not included

When biofuels and biomass are also taken into account, India's estimated total primary energy supply in 2024-25 is estimated at around 1,061.4 Mtoe. In this expanded energy mix, coal continues to be the dominant source, accounting for nearly 52 percent of total primary supply, followed by oil at about 25 percent and natural gas at around 6 percent**.** Renewable energy sources, including nuclear, contribute roughly 5 percent, while biofuels and biomass account for about 12 percent of total primary energy supply, highlighting their significant role in meeting India's overall energy needs.

Oil remains a critical component of India's primary energy landscape, particularly for the industrial and transportation sectors. Over the past decade, India has consistently relied on imported crude oil to meet more than 80 percent of its crude oil demand, reflecting the structural imbalance between domestic production and consumption. In 2024-25, crude oil import dependence remained elevated at 89 percent, driven by rising fuel requirements in mobility, expanding freight movement, and growing industrial activity.

On the other hand, Coal imports have reduced over the years, from 22 percent in 2016-17 to 19 percent in 2024-25, mainly because domestic coal production has increased. Natural gas imports, which had gone up from 42 percent in 2016-17 to 54 percent in 2020-21, have now settled at around 50 percent as gas demand and supply have grown at a moderate pace.

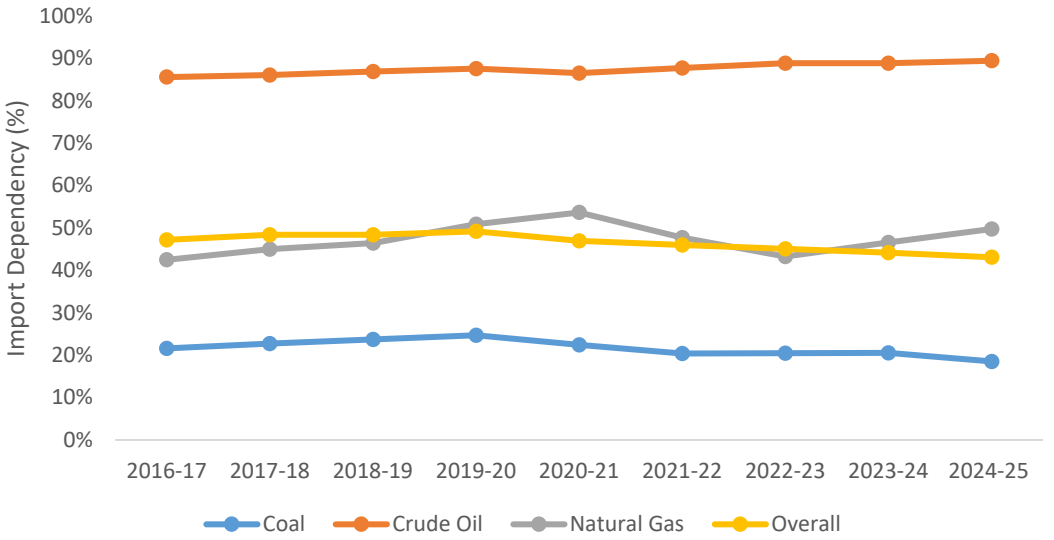


Figure 3: Import Dependency of the Primary Fuel Supply

Source: The figures are calculated based on actual data from various ministries

Final Energy Consumption

India is the third-largest energy consumer in the world, after China and the United States, reflecting its large and growing population and expanding economy. In 2024-25, oil products continued to have the largest share of the country's final energy use, making up about 39 percent of total final energy consumption. This was followed by coal at around 29 percent, electricity at about 23 percent, and natural gas at 9 percent (Figure 4).

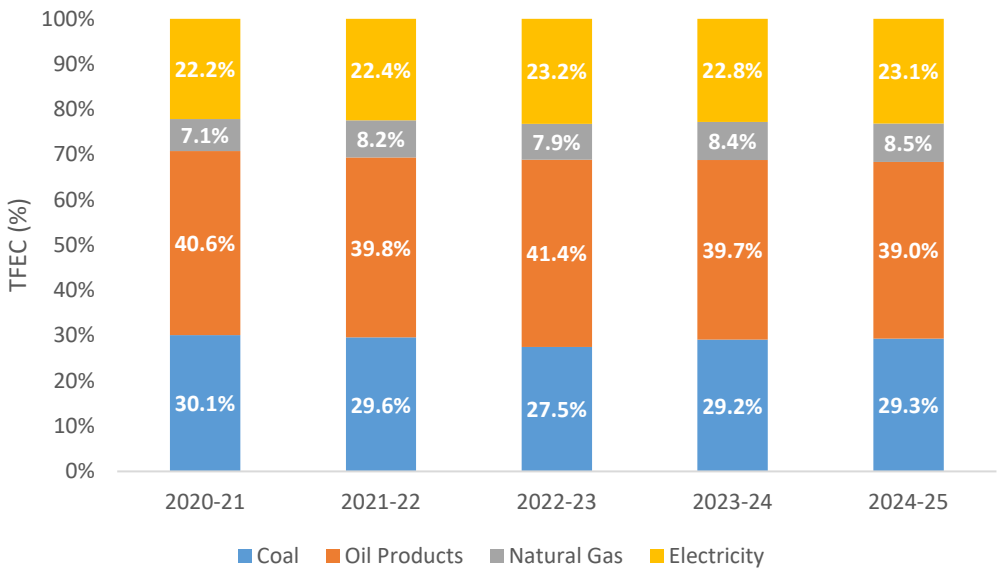


Figure 4: Fuel wise share in Total Final Consumption (TFC)

Source: The figures are calculated based on actual data from various ministries

*Biomass and other non-commercial energy sources are not included

Oil remains dominant mainly because of its widespread use in transport, industry, and agriculture, where it fuels vehicles, machines, and equipment. Coal continues to be an important energy source in TFEC, especially

for industrial use, though its share has slightly declined over recent years. Meanwhile, electricity's share has gradually increased as more homes, businesses and industries rely on electric power, and the use of electric appliances grows across the country. The slow rise in electricity's share indicate that India's energy landscape is diversifying. Growth in non-fossil electricity, electrification of end-uses and policy support for cleaner energy sources are all expected to play an increasing role in shaping the country's energy consumption in the years ahead.

Sector-wise Energy Consumption

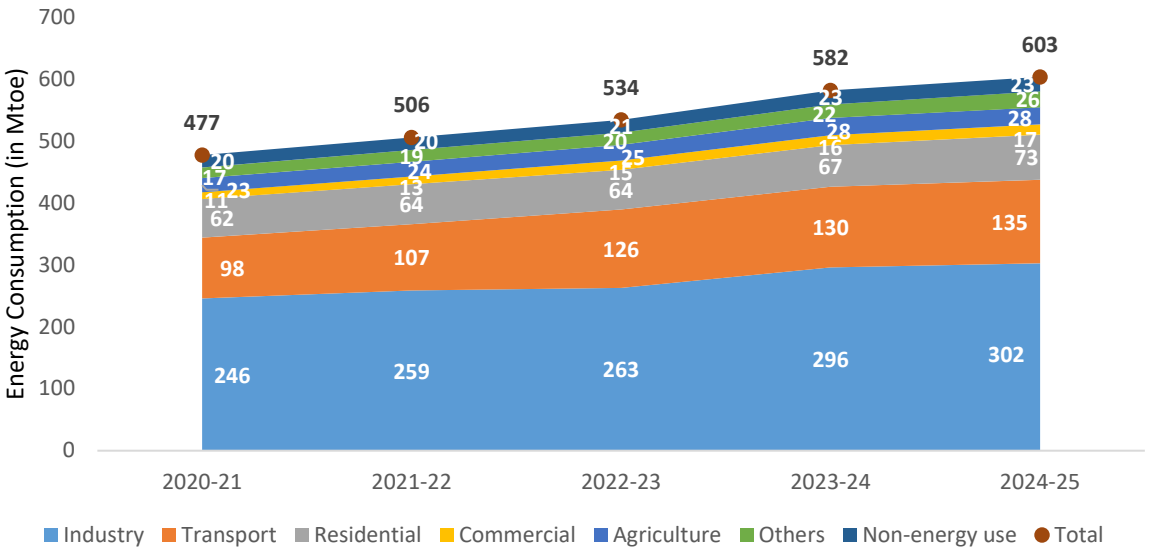


Figure 5: Sector-wise Energy Consumption

Source: The figures are calculated based on actual data from various ministries

*Biomass and other non-commercial energy sources are not included

India's demand for energy has continued to grow steadily over the past five years. The country's total final energy consumption stood at 603 Mtoe in 2024-25. During 2022-23 to 2024-25, it grew at a CAGR of about 6.2 percent. In 2024-25, final energy consumption increased by 3.6 percent over the previous year.

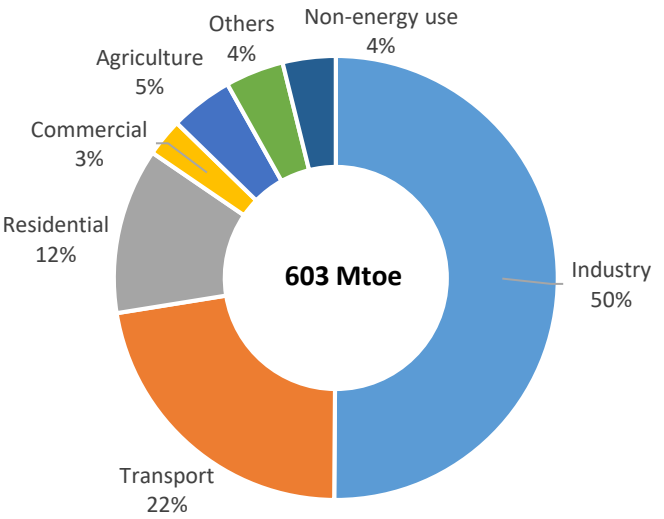


Figure 6: Sector-wise Energy Consumption during 2024-25 (Estimated)

Source: The figures are calculated based on actual data from various ministries

*Biomass and other non-commercial energy sources are not included

The industry sector remains the biggest consumer of energy, accounting for 50.1 percent of the total in 2024-25. Energy use in industry grew from 246 Mtoe in 2020-21 to 302 Mtoe in 2024-25, reflecting a CAGR of around 5 percent, while in 2024-25, it increased by around 2 percent compared to the previous year. This growth is mainly driven by large energy-intensive sectors such as steel, cement, chemicals, and the MSME manufacturing base, all of which rely heavily on energy for heating, processing, and operations.

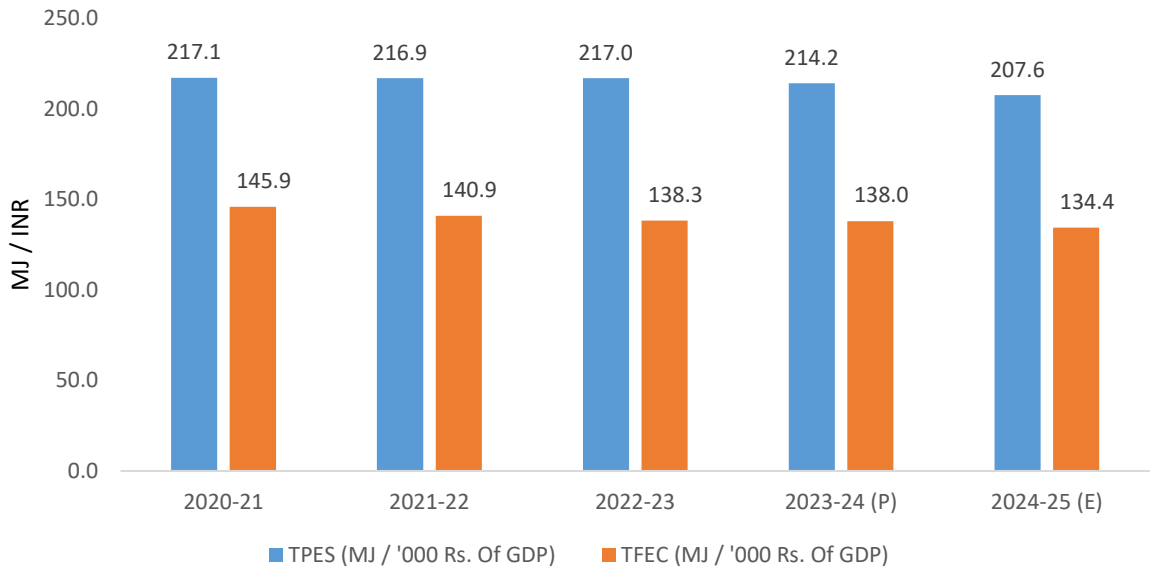
The transport sector is now the fastest-growing consumer of energy in the country. Its energy use increased from 98 Mtoe in 2020-21 to 135 Mtoe in 2024-25, and it now accounts for around 22 percent of India's total final energy consumption. Notably, it witnessed the most significant sectoral increase of around 37 percent over the last five years. This rise is closely linked to the rapid increase in vehicle ownership, the growing movement of goods by road, and the continuous expansion of highways and logistics networks. Transport energy use is still dominated by oil products such as diesel and petrol, which remain the main fuels for both passenger and freight movement. However, the Indian Government is actively promoting the adoption of electric vehicles, in response to the increasing focus on climate change and the shift towards a low-carbon economy, both globally and nationally. There is an exponential rise in the ownership of Electric Vehicle (EV) in the country rising from a meagre 0.2 percent in 2016 to 7.6 percent in 2024 (NITI Aayog, 2024).

The residential sector continues to play a growing role in India's energy demand, accounting for 12 percent of total final consumption in 2024-25. Energy use in homes increased from 62 Mtoe in 2020-21 to 73 Mtoe in 2024-25, driven mainly by rising living standards and greater ownership of appliances such as air-conditioners, refrigerators and water heaters. Residential electricity use alone has grown by about 23 percent over the last five years, rising from 331 BU to 409 BU, a trend further reinforced by more frequent heatwaves and extreme weather events, which increase the need for cooling and heating. Other sectors have also shown steady growth. Energy use in Commercial sector rose from 11 to 17 Mtoe and agriculture increased from 23 to 28 Mtoe due to expanding irrigation and mechanisation.

The sector-wise consumption discussed above is based on conventional commercial fuels and electricity and does not include the use of biomass and biofuels. When biomass and biofuels are also taken into account, India's total final energy consumption in 2024-25 is estimated at around 722.4 Mtoe. In this expanded view, the industrial sector remains the largest consumer, accounting for about 48 percent of total final energy use, followed by the building sector at around 22 percent (with residential buildings accounting for about 19 percent and commercial buildings for around 3 percent), reflecting the significant contribution of biomass and biofuels in households. The transport sector accounts for roughly 19.2 percent of total final energy consumption, while agriculture, non-energy use, and other sectors together contribute the remaining share.

Energy use per unit of GDP

Energy intensity, measured as energy consumption per unit of GDP, is an important indicator of how efficiently energy is used in the economy. Over the past five years, India has shown a gradual improvement in this indicator. Between 2020-21 and 2024-25, total primary energy supply per Rs. 1,000 of GDP declined from 217.1 MJ to 207.6 MJ, indicating more efficient use of energy in relation to economic output. A similar trend is observed in final energy consumption. Total final energy consumption per Rs. 1,000 of GDP decreased at an average rate of about 1.6 percent per year during 2021-22 to 2024-25.



(P) – Provisional, (E) - Estimated

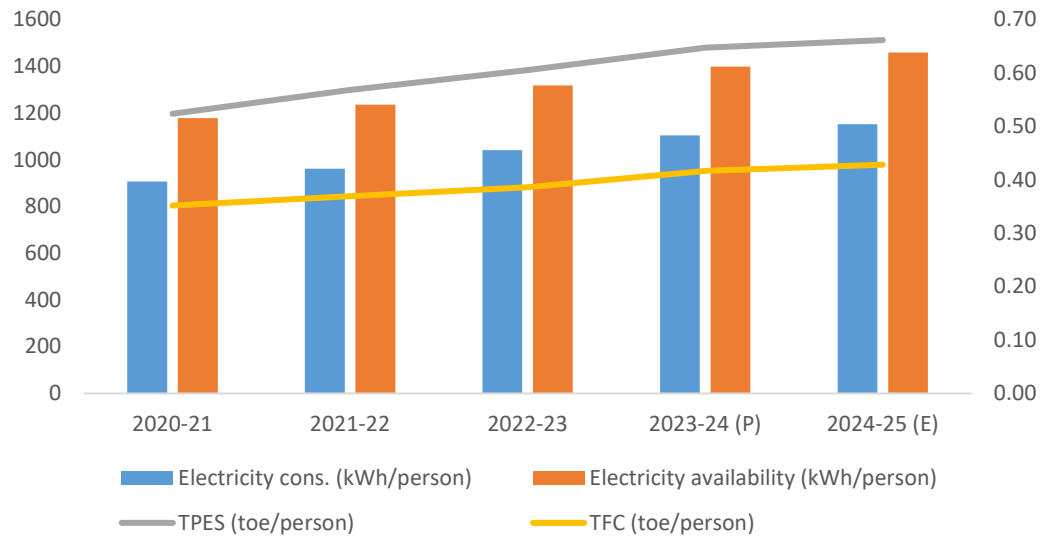
Figure 7: Energy use per unit of GDP

Source: The figures are calculated based on actual data from various ministries and GDP values are sourced from RBI

Energy use per capita

India's per capita energy use stood at 0.66 toe in 2024-25. During the period 2022-23 to 2024-25, per capita total primary energy supply increased from 0.61 toe to 0.66 toe, reflecting a CAGR of about 4.5 percent. During the same period, per capita final energy consumption increased from 0.39 toe per person to 0.43 toe per person, growing at an average rate of around 5 percent per year. Per capita electricity availability increased from 1,161 kWh in 2020-21 to 1,460 kWh in 2024-25, corresponding to a compound annual growth rate (CAGR) of about 5.5 percent. Per capita electricity consumption recorded a stronger increase, rising from 908 kWh in

2020-21 to 1,153 kWh in 2024-25, corresponding to a CAGR of about 6.2 percent, reflecting improved access to electricity and rising demand from households and economic activities.



(P) - Provisional, (E) - Estimated

Figure 8: Energy use per Capita

Source: The figures are calculated based on actual data from various ministries and population figures are taken from RBI

Energy Flow

India's energy flow for the year 2024-25 is illustrated through a Sankey Diagram Figure 9. A Sankey diagram demonstrates an entire input and output energy flow within an energy system following energy balance calculations. The width of the line indicates the amount of energy involved. It visually illustrates the flow of energy traced from energy sources to end-use consumption.

During 2024-25, the total primary energy supply reached 932 Mtoe. The coal and oil were predominant sources, collectively making to 87.5 percent of the primary energy mix. The total consumption in the same period was 603 Mtoe. The industrial sector was the largest consumer, accounting for 50.1 percent of final energy consumption, followed by the transport sector at around 22.4 percent and the residential sector at 12.1 percent.

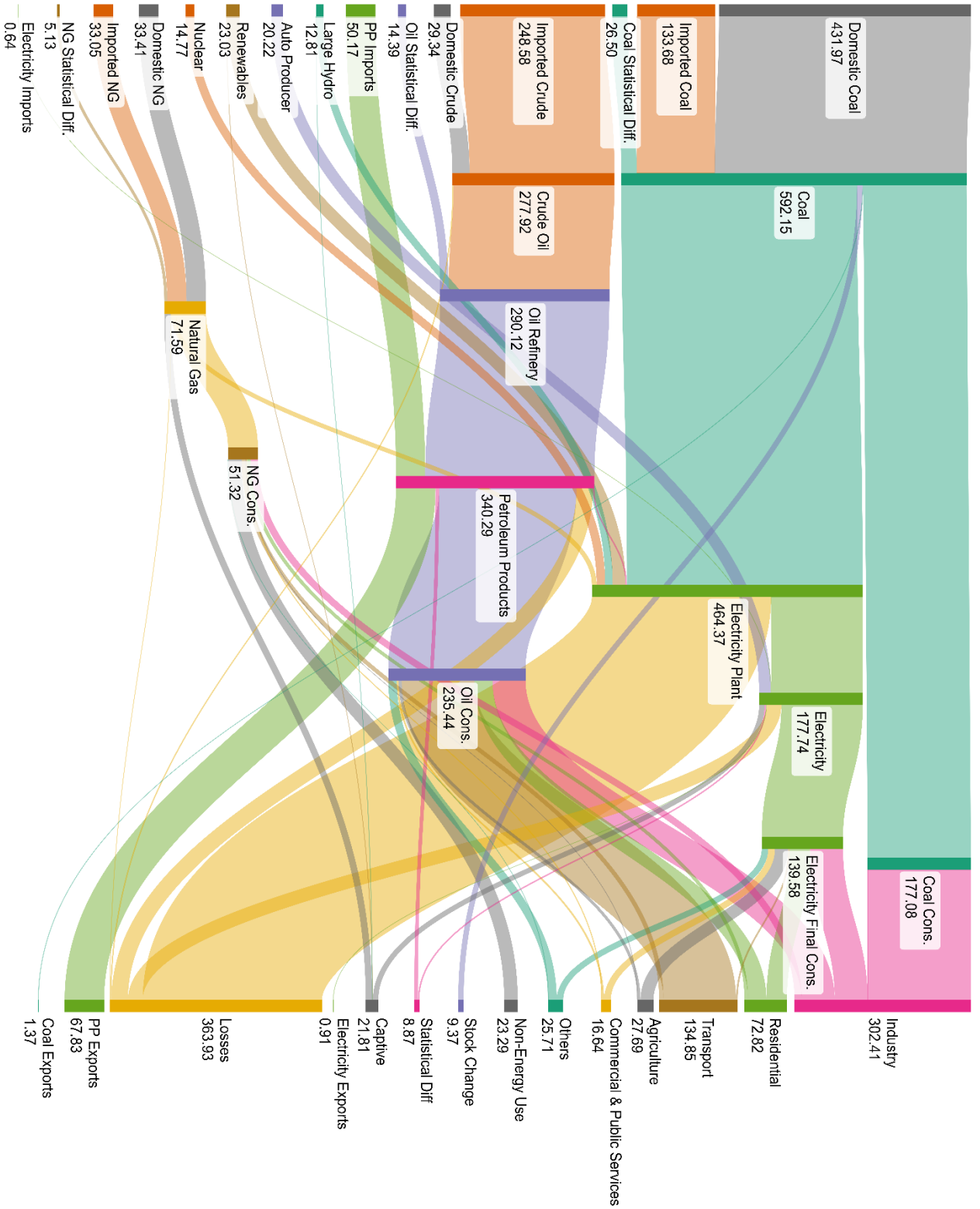


Figure 9: Sankey Diagram of Overall Energy Flow in India during 2024-25 (in Mtoe) (Estimated)

*Losses include oil refinery losses, thermal losses in electricity power plants, and transmission and distribution losses.
*Biomass and other non-commercial energy sources are not included

Disclaimer: The energy balance/Sankey diagram for 2024-25 is based on actual data from MoC, MoPnG, CEA, and MoSPI, with values converted into energy units. While every effort has been made to ensure accuracy, minor variations may occur due to data estimation and conversions. All conversion factors are sourced from MoSPI Energy Statistics report.

Energy Balance

An energy balance provides a complete picture of how energy flows, from where it comes from to how it is finally used. It maps the supply of different energy sources such as coal, oil products, natural gas, renewables, hydro and nuclear, and then tracks how these fuels are transformed, distributed and ultimately consumed in different sectors of the economy. By showing both the Total Primary Energy Supply (TPES) and the Total Final Energy Consumption (TFEC), an energy balance helps to understand which fuels dominate country's energy system, how much energy is lost or converted in the process, and which sectors use the most energy in their operations. It is a foundational tool for energy planning, efficiency policies and clean energy transitions.

In 2024-25, India's total primary energy supply stood at 932 Mtoe, comprising coal, crude oil and oil products, natural gas, nuclear, hydro, and renewable energy sources. After accounting for transformation and non-energy uses, the total final energy consumption amounted to 603 Mtoe, distributed across key demand sectors. The industrial sector remained the largest consumer, using 302 Mtoe and representing 50.1 percent of total final energy consumption.

The transport sector consumed 135 Mtoe, accounting for 22.4 percent of TFEC. Most of this energy comes from road transport and the figure reported here excludes blended biofuels such as ethanol, biodiesel and CBG. The residential sector consumed 72.8 Mtoe**,** representing 12 percent of TFEC, and end-use allocation was derived using the CLASP-BEE Residential Energy Consumption Survey (2024) for electricity consumption patterns. This figures do not include the consumption of biomass. Commercial sector accounted for nearly 16.6 Mtoe or 3 percent of TFEC, with electricity forming the dominant share of its energy use. Meanwhile, agriculture sector consumed around 27.7 Mtoe of energy in 2024-25, contributing roughly around 4.6 percent to the total final energy consumption.

The above assessment excludes biomass and biofuels consumption from the energy mix. When these fuels are included, India's total primary energy supply in 2024-25 increases to about 1,061.4 Mtoe. In this expanded energy mix, coal remains the dominant source, contributing nearly 52 percent, followed by oil (25 percent), natural gas (6 percent), and renewable energy sources including nuclear (5 percent), while biomass and biofuels together account for around 12 percent of total primary energy supply. Correspondingly, total final energy consumption rises to approximately 722.4 Mtoe. The industrial sector continues to account for the largest share at about 48 percent (343.5 Mtoe), followed by buildings at roughly 22 percent (160.4 Mtoe) and transport at around 19.2 percent (138.8 Mtoe). Agriculture, non-energy use, and other sectors together account for the remaining 11 percent.

Table 1: Energy Balance of India for 2024-25 (Estimated) (All figures are in Mtoe)

	Coal	Lignite	Crude Oil	Oil Products	Natural Gas	Nuclear	Hydro	Solar, Wind, Others	Electricity	Total
Production	422	10	29	-	33	15	13	23	-	**545**
Import	134	-	249	50	33	-	-	-	0.6	**466**
Export	1	-	-	68	-	-	-	-	0.9	**70**
Stock Exchange	-9	-	-	-	-	-	-	-	-	**-9**
Total Primary Energy Supply	**545**	**10**	**278**	**-18**	**66**	**15**	**13**	**23**	**-0.3**	**932**
Total Final Consumption	**175**	**2**	**-**	**235**	**51**	**-**	**-**	**-**	**140**	**603**

Total Final Energy Consumption	603
Industry	**302**
Iron and Steel	80
Cement	34
Fertilizer	19
Aluminium	17
Petrochemical	8
Chlor Alkali	4
Textile	3
Pulp and Paper	2
New Sectors	8
MSME	11
Non-specified Industry	116
Transport	**135**
Road	117
Railways	4
Domestic Aviation	10
Pipeline Transport	2
Domestic Navigation	2
Residential	**73**
Cooking*	40
Cooling	13
Lighting	4
Other Appliances*	17
Non-specified	
Commercial	**17**
Cooking*	5
Non-specified	12
Agriculture/Forestry	**28**
Non-specified (Others)	**26**
Non-energy use	**23**

Disclaimer: The energy balance for 2024-25 is based on actual data from MoC, MoPnG, CEA, and MoSPI, with values converted into energy units. While every effort has been made to ensure accuracy, minor variations may occur due to data estimation and conversions. All conversion factors are sourced from MoSPI Energy Statistics report.

Note:

Since MOPNG does not provide sector-specific natural gas consumption for the residential and transport sectors, the allocation of natural gas used for energy purposes across end-use sectors has been carried out using the BUR-4 breakup. The sectoral shares from BUR-4 have been applied to distribute total natural gas consumption.

Biomass and other non-commercial energy sources are not included

Residential

- **Cooking:** All LPG, natural gas and kerosene used in the residential sector is classified under cooking. Electricity consumption from induction cooktops is also included here. It is acknowledged that a small portion of LPG and natural gas may also be used for water heating, but for the purpose of this energy balance, the entire quantity is assigned to cooking.
- **Other Appliances:** This category includes electricity consumption from room heaters, geysers, refrigerators, televisions, irons, washing machines, mixer–grinders, water pumps and other household electrical devices.

Commercial

- **Cooking:** All LPG, natural gas and kerosene consumed in the commercial sector is classified under cooking activities.
- **Electricity:** Since a reliable appliance-wise breakup of electricity use in the commercial sector is not available, the total electricity consumption is reported under non-specified end uses.

Transport

Since the supply-side of energy balance does not separately account for biomass-based fuels, and because the MOPNG consumption figures for petrol and diesel already include the quantities of ethanol-blended petrol and biodiesel-blended diesel, the corresponding amounts of ethanol**,** biodiesel and compressed biogas (from natural gas) have been removed from the consumption side while estimating the TFEC for the transport sector. This avoids double counting in future and maintains consistency across the energy balance.

Chapter 3: Impact of Energy Efficiency (EE) Measures

This chapter of the India Energy Scenario 2024–25 report presents a comprehensive assessment of the impacts achieved through India's energy efficiency interventions. It evaluates the energy savings and associated benefits accrued from major national-level initiatives implemented across key end-use sectors, including appliances, industry, buildings, transport, and micro, small and medium enterprises (MSMEs). The analysis covers flagship programmes such as the Standards & Labelling (S&L) programme for appliances; the Perform, Achieve and Trade (PAT) scheme for large energy-intensive industries; the Assistance for Deployment of Energy Efficient Technologies in Industries & Establishments (ADEETIE) scheme for MSMEs; the BEE Star Rating programme and the Energy Conservation and Sustainable Building Code (ECSBC) for buildings; and transport-sector initiatives including Corporate Average Fuel Efficiency (CAFE) norms and the Faster Adoption and Manufacturing of Electric Vehicles (FAME) scheme.

Energy efficiency has emerged as a critical pillar of India's strategy to sustainably address its growing energy demand. As one of the world's fastest-growing economies, India faces the complex challenge of supporting rapid economic development while simultaneously limiting environmental impacts and strengthening energy security. Improving energy efficiency is central to addressing these challenges, as it enables moderation of energy demand growth, reduction of greenhouse gas (GHG) emissions, and minimisation of dependence on fossil fuel imports. In this context, the systematic implementation of energy efficiency measures represents a cost-effective and strategic approach to decoupling economic growth from energy consumption.

India's policy and institutional framework for energy efficiency was formally established with the enactment of the Energy Conservation Act, 2001, which provided the legislative foundation for promoting efficient use of energy across sectors. The Act led to the establishment of the Bureau of Energy Efficiency (BEE), mandated to design and implement policies and programmes aimed at improving energy efficiency and fostering energy conservation. Since its inception, BEE has operationalised a wide range of demand-side interventions, which have collectively resulted in significant and measurable energy savings across industry, buildings, appliances, and transport.

In 2023-24, India's per capita energy consumption was approximately 17.9 gigajoules (GJ), substantially lower than the global average. This reflects the country's stage of economic development, its large and diverse population, and ongoing efforts to expand reliable and affordable energy access. For 2024-25, provisional estimates indicate a modest increase in per capita energy consumption to around 18 GJ, driven by expanding economic activity, rising household and industrial energy use, and continued electrification across sectors. Despite this gradual rise, India's per capita energy consumption remains well below that of developed economies, reinforcing the importance of embedding energy efficiency as a core element of the country's development pathway.

Against this backdrop, this chapter examines the contribution of energy efficiency programmes in moderating energy demand growth and improving overall energy productivity. It highlights the cumulative impact of sector-specific interventions in delivering energy savings, reducing emissions intensity, and generating economic benefits for consumers and industry alike. The chapter further underscores the role of energy efficiency in supporting India's transition towards a more sustainable, resilient, and low-carbon energy system, while continuing to meet the aspirations of inclusive economic growth.

3.1 Findings of Impact Assessment of Energy Efficiency (EE) Measures in India

BEE conducts an annual study to assess the impact of various schemes/programmes. The assessments measure the impact by comparing actual energy consumption with the estimated energy consumption that would have occurred in the absence of the current energy efficiency measures, referred to as counterfactual. The primary objective of the study is to evaluate the total energy saved and CO2 emissions avoided, resulting from the energy efficiency initiatives in India.

Table 2: Energy Savings from various Energy Efficiency Initiatives, 2024-25

Program/ Scheme	Sector	Electricity Savings (BU)	Thermal Savings (MTOE)	Total Energy Savings (MTOE)	Avoided Emissions (MtCO2)	Avoided Costs (INR Crore)
PAT VII*	Large Industry	17.67	7.80	9.30	32.55	21179.82
PAT- VI		1.82	1.50	1.66	5.80	3775.93
PAT- V		0.01	0.68	0.75	3.41	1703.50
PAT- IV		0.01	0.75	0.92	3.56	2092.93
PAT- III		0.62	1.59	1.59	5.59	3451.00
PAT- II		36.47	10.95	14.08	68.43	42020.00
PAT- I		3.01	8.41	8.67	31.00	9500.00
Large Industries		59.61	31.68	36.97	150.34	83723.18
MSME	MSME	0.00	0.00	0.04	0.15	30.80
Industries		**59.61**	**31.68**	**37.01**	**150.49**	**83753.98**
S&L	Appliances	98.40	0.02	8.46	69.86	63960.00
UJALA	LED Lamps	184.50	0.00	15.87	131.00	119925.00
Domestic		**282.90**	**0.00**	**24.33**	**200.86**	**183885.00**
Buildings		**4.54**	**0.00**	**0.39**	**0.57**	**110.50**
SLNP	Municipal	9.06	0.00	0.78	6.43	5885.75
CAFÉ	Transport	0.00	0.00	2.52	7.40	8327.80
Total		**356.10**	**31.68**	**65.03**	**365.76**	**281963.03**

* Estimated

Source: BEE database from various scheme (As of Dec. 2025)

Table 2 shows the energy savings from various schemes/programmes of BEE. The implementation of energy schemes and programmes resulted in total energy savings of 65.03 Mtoe. It accounts for around 7 percent of the total primary energy supply in the country for the year 2024-25 excluding solid biomass and biofuels. In the expanded primary energy supply scenario including solid biomass and biofuels, energy savings accounts for around 6 percent of the total primary energy supply.

A total of 31.68 Mtoe thermal energy and 356.10 BU of electricity saving have been achieved through the implementation of various energy efficiency schemes. These energy savings have resulted in substantial economic benefits, avoiding costs of approximately INR 2,81,963.03 crore, while also preventing about 365.76 $MTCO_2e$ of greenhouse gas emissions.

During FY 2024-25, the total saving of energy by the PAT scheme was around 57 per cent, followed by S&L and UJALA collectively accounting for 37 per cent. The share of various schemes in the total energy savings in 2024-25 is presented in the figure below:

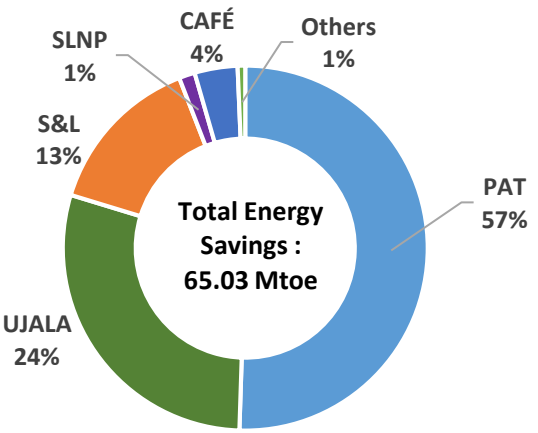


Figure 10: Scheme wise Total Energy Savings, FY 2024-25

3.2 Cross-Sectoral Energy Efficiency Impact

With accelerating urbanisation and industrial growth, energy demand has been increasing across all major sectors. To address this trend, a range of energy efficiency initiatives have been deployed across demand sectors, yielding varying levels of savings. The industrial sector has emerged as the leading contributor, accounting for nearly 57 per cent of total energy savings, while the domestic sector has delivered a substantial contribution of about 37 per cent.

Table 3: Sector-wise Energy Saving Summary, 2024-25

Sector	Electrical Saving (BU)	Total Energy Savings (Mtoe)	Avoided Emissions (Million Tonne of CO_2/year)	Avoided Costs (INR crore)
Industry[1]	59.61	37.01	150.49	83753.98
Domestic[2]	282.90	24.33	200.86	183885
Buildings[3]	4.54	0.39	0.57	110.50
Transport (CAFÉ)	-	2.52	7.4	8327.80
Others (including Municipal)	9.06	0.78	6.43	5885.75
Total	**356.10**	**65.03**	**365.76**	**281963.03**

Source: BEE database from various scheme (As of Dec. 2025)

[1] Industry Sector includes the savings from PAT scheme and MSMEs

[2] Domestic Sector includes the savings from S&L (except pump sets) and savings from UJALA programme

[3] Includes both commercial and residential buildings

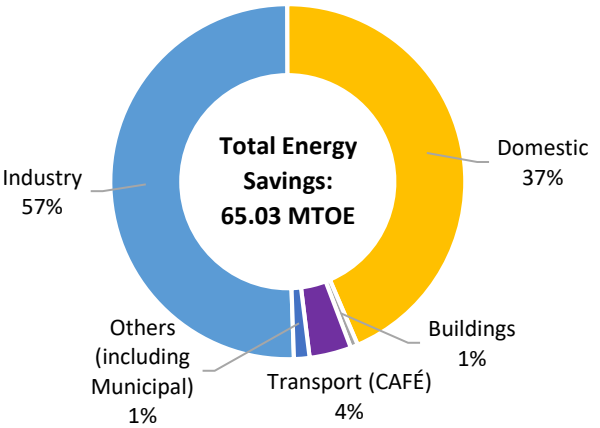


Figure 11: Sector wise break-up of Total Energy Savings, 2024-25

Source: BEE database from various scheme (As of Dec. 2025)

The energy savings data underscores the role of various programmes and schemes in promoting energy efficiency across the economy. Their effective implementation has delivered significant energy savings in major sectors, including Industry, Domestic, Buildings, and Transport. The energy savings trend over the ten-year period from FY 2014–15 to FY 2024–25 is illustrated in Figure 12.

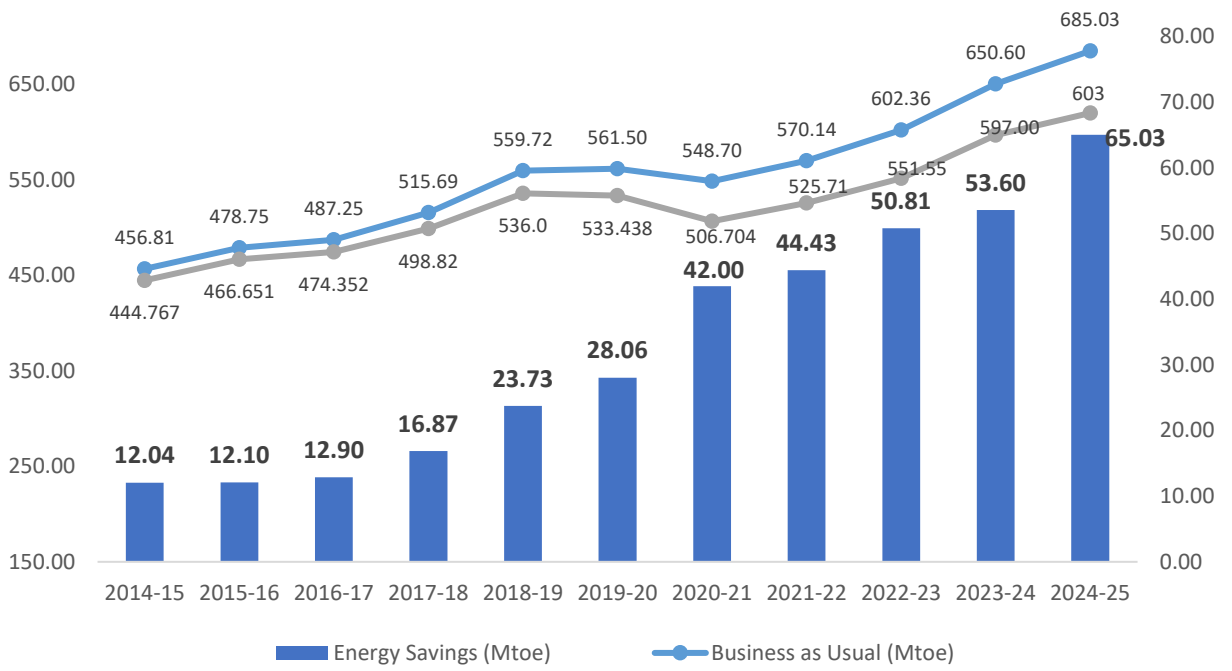


Figure 12: Impact of various Energy Efficiency Measures on the Energy Consumption of the Country

Source: (BEE, 2025)

Energy efficiency, when pursued alongside the expansion of renewable energy, serves as a powerful enabler of India's low-carbon energy transition. These interventions have delivered large-scale and enduring energy

savings while systematically strengthening institutional capacities and mainstreaming energy efficiency across sectors and regions.

Beyond measurable savings, they have transformed market behaviour, influenced technology adoption, and embedded efficiency considerations into planning and decision-making. Together, this integrated approach reduces future energy demand pressures, accelerates climate mitigation efforts, and establishes energy efficiency as a foundational element of India's sustainable and resilient energy system.

Chapter 4: Supply side - Trends and Analysis

Primary Energy Supply

4.1 Coal

Coal remains India's most significant and abundant fossil fuel, accounting for about 59.5 percent of the total primary energy supply (excluding biomass and biofuels) and 52 percent of the total primary energy supply including solid biomass and biofuels. This shows that coal, including lignite, continues to hold a dominant position in India's primary energy mix. Its critical role in supporting the nation's energy demand is reflected in the fact that, over the past decade, despite a parallel push for renewables, coal has remained the dominant fuel in India's energy mix. Coal-based power plants contributed about 73 percent of utility-scale electricity generation. This high dependency on coal is primarily due to the availability of large domestic coal reserves**.**

The substantial growth in domestic coal production aligns with the vision of 'Atmanirbhar Bharat', significantly contributing to the nation's commitment to self-sufficiency and energy security. Additionally, various reforms and policy measures implemented by the Government, such as the Coal Linkage Policy, Amendments to the Coal Mines (Special Provisions) Rules 2014, the Coal Blocks Allocation Rules 2017 (which enable auction-based allocation of coal blocks, including to private sector entities and, after 2020 reforms, wider commercial mining participation), and the launch of the Single Window Clearance portal for the coal sector to expedite the operationalisation of coal mines, have also contributed to this growth.

India ranks fifth globally in terms of coal reserves, with an estimated 400.715 billion tonnes as of 1st April 2025 (MoC, 2025). In 2024–25, the total coal (including lignite) consumption in the country stood at 1,318 million tonnes (MoC, 2025). Of this, approximately 81 percent was domestically produced, while the remaining 19 percent was imported from Australia, Indonesia, Russia, and other countries. Out of the total imported coal of 244 million tonnes (excluding coke and other products), about 58 million tonnes of coking coal were consumed by the steel sector, 63 million tonnes of non-coking coal were consumed by the power sector, while the remaining 123 million tonnes were utilized by other sectors. Historically, before 2009-10, coking coal accounted for a significant share, around 35 to 40 percent of total coal imports**.** However, over time, this share has gradually declined to below 25 percent, reflecting the increased demand for non-coking coal in the power and industrial sectors.

Domestic Coal Production in India

In 2024–25, India's coal production (including lignite) reached 1,093 million tonnes. This represents a Compounded Annual Growth Rate (CAGR) of 5 percent over the past decade and a 5 percent increase compared to 1,041 million tonnes produced in 2023–24.

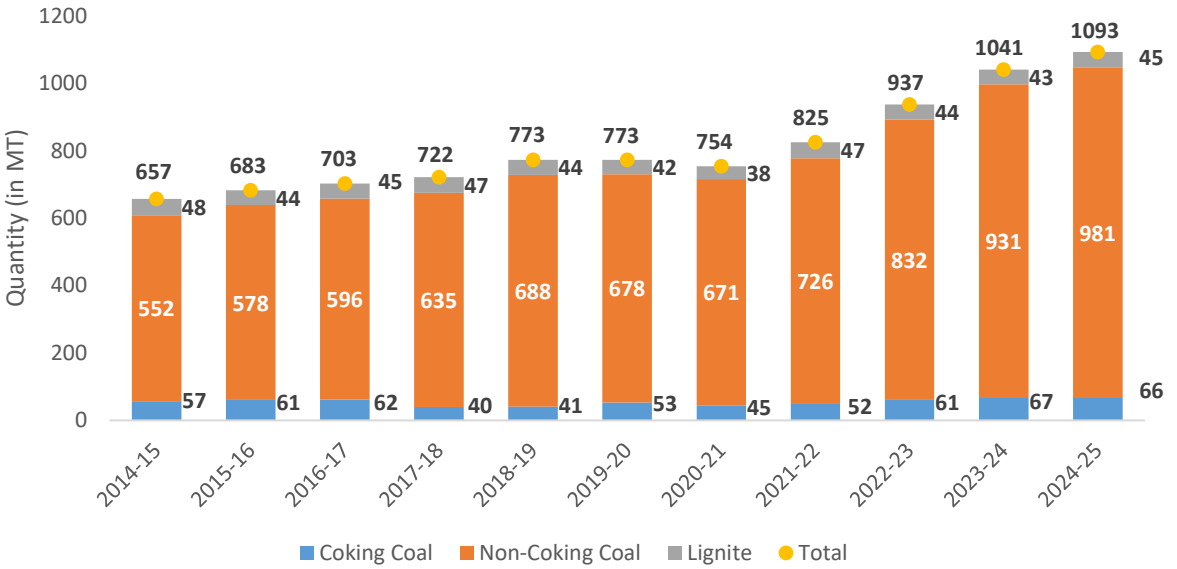


Figure 13: Domestic Coal Production from FY 2014-15 to 2024-25 (in Million tonnes)

Source: (MoC, 2025)

Over the last decade, the production of non-coking coal has shown a steady rise, increasing from about 552 million tonnes in 2014-15 to 981 million tonnes in 2024-25. This growth reflects its significant role in power generation and industrial use. In contrast, coking coal production has remained relatively low and fluctuating, moving from around 57 million tonnes in 2014-15 to 66 million tonnes in 2024-25, due to limited reserves of prime grade coking coal and heavy reliance on imports. Lignite production has stayed almost stable over the years, averaging between 40-50 million tonnes annually. Overall, the upward trend in total coal production is largely driven by the strong increase in non-coking coal production.

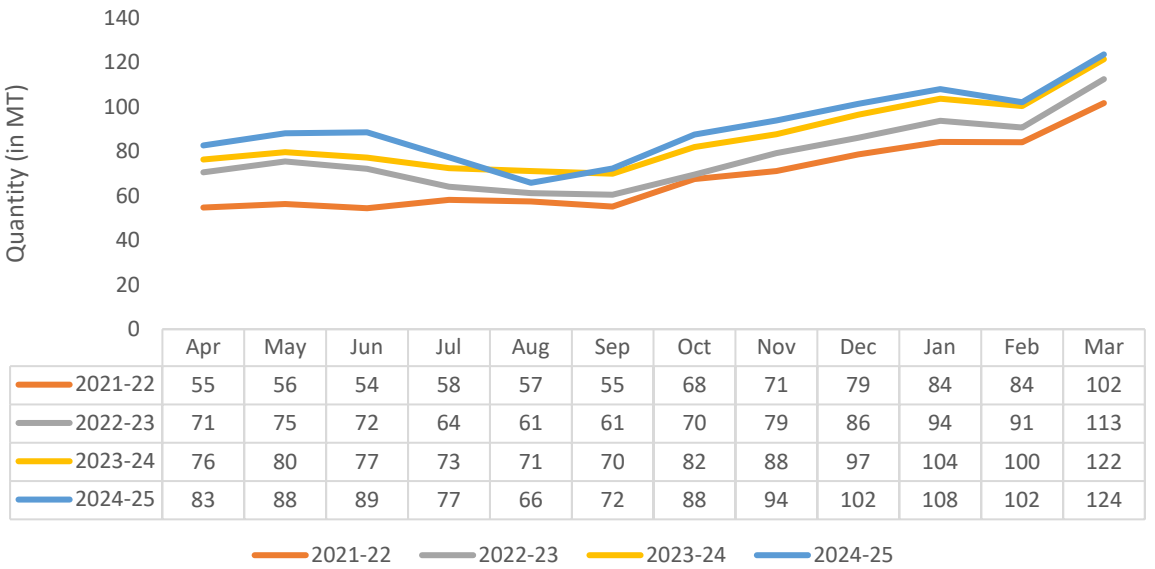
The Government of India has undertaken several policy measures, such as the Commercial Coal Mining Policy (2020) and Mission Coking Coal, to enhance self-sufficiency, reduce import dependence, and foster competition in the sector. Growth in domestic output has also been supported by the adoption of technological interventions including mechanized mining, digital monitoring systems, and improved coal evacuation infrastructure under the PM Gati Shakti framework. At the same time, India continues to focus on energy transition pathways through the adoption of cleaner coal technologies such as coal gasification, carbon capture, and ultra-supercritical plants, aligning with the national commitment to achieve net-zero emissions by 2070.

Over the years, the share of supercritical and ultra-supercritical units in the total coal-based capacity has grown sharply. In 2010, supercritical units accounted for only a small share of the capacity, but by June 2024, India had commissioned 94 supercritical units totalling 65,290 MW and 6 ultra-supercritical units totalling 4,240 MW (PIB, 2024). This reflects India's continued focus on improving efficiency and lowering emissions from its coal-based power fleet. A major step forward is the development of Advanced Ultra-Supercritical (AUSC) technology, which will further enhance plant efficiency and reduce emissions. AUSC-based plants can achieve around 46 percent efficiency, compared to about 41-42 percent for supercritical and 36-38 percent for subcritical units, leading to roughly 11 percent lower coal consumption and CO_2 emissions.

The Ministry of Coal is providing financial incentives and viability gap funding for coal gasification projects, which convert coal into synthesis gas and enable higher value addition from indigenous high-ash coal reserves. While coal gasification is not an emission-free process, its deployment is expected to be accompanied by carbon capture, utilisation and storage (CCUS) technologies to manage associated emissions and align such projects with India's broader climate objectives.

The Ministry of Coal also reports on the country's monthly coal production performance, indicating dynamic output patterns. India achieved a new monthly peak production of 124 MT in March 2025, surpassing the previous record of 122 MT set in March 2024 (refer Figure 14). Coal production, however, experiences a seasonal decline during the Monsoon season, typically from June to September. This reduction is primarily attributable to heavy rainfall, which leads to mine flooding, thereby impeding coal extraction. Logistical challenges also emerge, as heavy rains disrupt road and rail networks, obstructing the seamless transportation of coal.

The Government is advancing the First Mile Connectivity (FMC) projects to construct rail lines and mechanized conveying systems. This initiative aims to shift coal evacuation from road transport to rail, which is less susceptible to monsoon disruptions, thereby securing all-weather coal movement.



	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar
2021-22	55	56	54	58	57	55	68	71	79	84	84	102
2022-23	71	75	72	64	61	61	70	79	86	94	91	113
2023-24	76	80	77	73	71	70	82	88	97	104	100	122
2024-25	83	88	89	77	66	72	88	94	102	108	102	124

Figure 14: Monthly Coal Production Trends (incl. lignite)

Source: (MoC, 2025)

Coal Production by Company:

Coal India Limited (CIL) has eight subsidiaries namely, Bharat Coking Coal Limited (BCCL), Central Coalfields Limited (CCL), Eastern Coalfields Limited (ECL), Western Coalfields Limited (WCL), South Eastern Coalfields Limited (SECL), Northern Coalfields Limited (NCL), Mahanadi Coalfields Limited (MCL) and North Eastern Coalfields (NEC).

CIL, a state-owned enterprise, continues to be the dominant producer in the country. In 2024–25, CIL accounted for about 71 percent of total coal and lignite production, while its share in coal-only production

stood at around 74.5 percent. Over the last eight years, CIL's coal production has shown substantial growth, increasing from 554 million tonnes (MT) in 2016-17 to about 781 MT in 2024-25 (Figure 15).

Beyond CIL, other public and private sector companies together accounted for the remaining share of coal and lignite production, contributing about 29 percent in 2024–25. Of this, other public sector companies produced around 255 MT, while private sector companies produced about 57 MT (Figure 15). The recent increase in the contribution from other public and private producers is largely attributable to the operationalisation of coal blocks auctioned under the Commercial Coal Mining Policy introduced in 2020. This policy has enabled greater participation by non-CIL players and has supported the gradual expansion of coal production outside CIL.

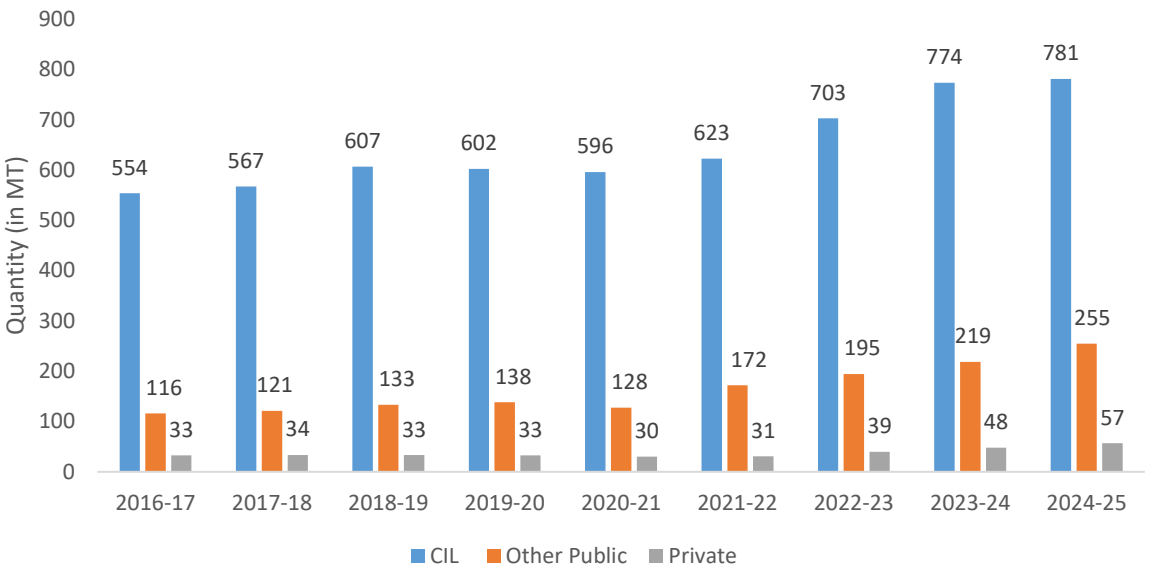


Figure 15: Company wise Domestic Coal (including lignite) Production from 2016-17 to 2024-25

Source: (MoC, 2025)

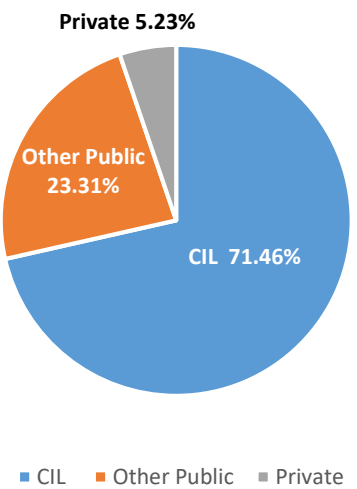


Figure 16: Company wise Percentage Share of Coal Production in 2024-25

Source: (MoC, 2025)

State Level Coal Production - A Glance

The key coal-producing states are Odisha, Chhattisgarh, Jharkhand, Madhya Pradesh, and Telangana. In 2024-25 (refer Figure 17), Odisha recorded the maximum coal production at 269 MT, followed sequentially by Jharkhand, Chhattisgarh, Madhya Pradesh, and Telangana. Collectively, these five states drive national output, accounting for 84 percent of the country's total coal production.

The high output of states like Odisha (269 MT) is directly correlated with the performance of major CIL subsidiaries operating there, particularly Mahanadi Coalfields Limited (MCL), which is the largest producer among all CIL arms.

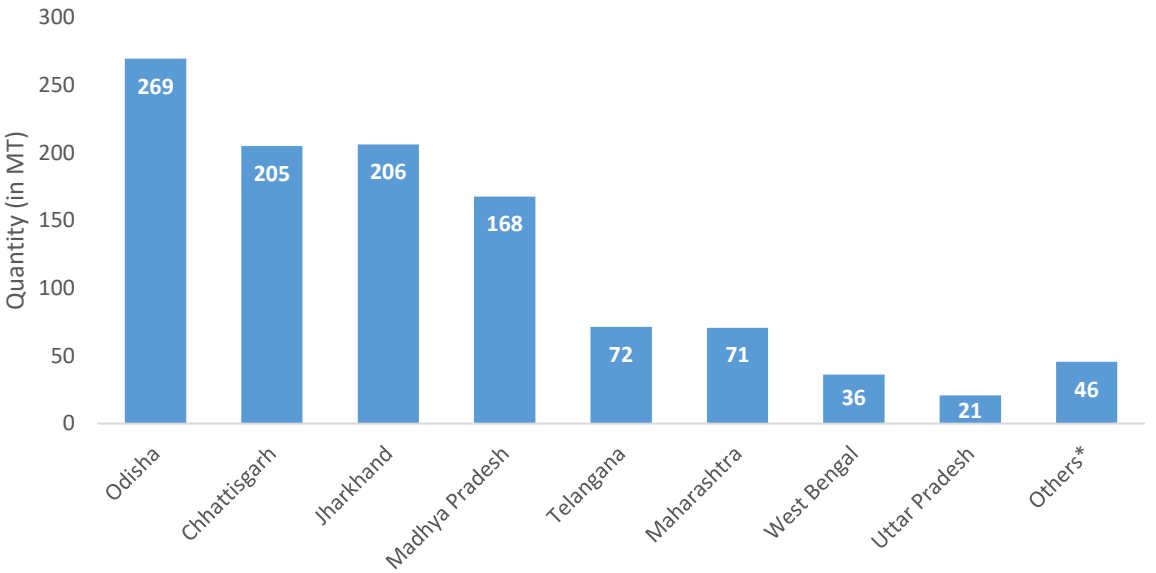


Figure 17: State wise Domestic Coal Production during 2024-25

Source: (MoC, 2025)

*Others include Jammu & Kashmir, Rajasthan, Tamil Nadu, Gujarat, and Assam.

Import and Export of Coal in India

Despite having substantial coal reserves, India is the second largest importer of coal in the world, after China. India needs to import additional coal to bridge the demand-supply gap, certain sectors, particularly steel manufacturing, remain reliant on imported high-grade coking coal, which is in limited supply domestically. The country imports various types of coal, including coking, non-coking, lignite, and coke.

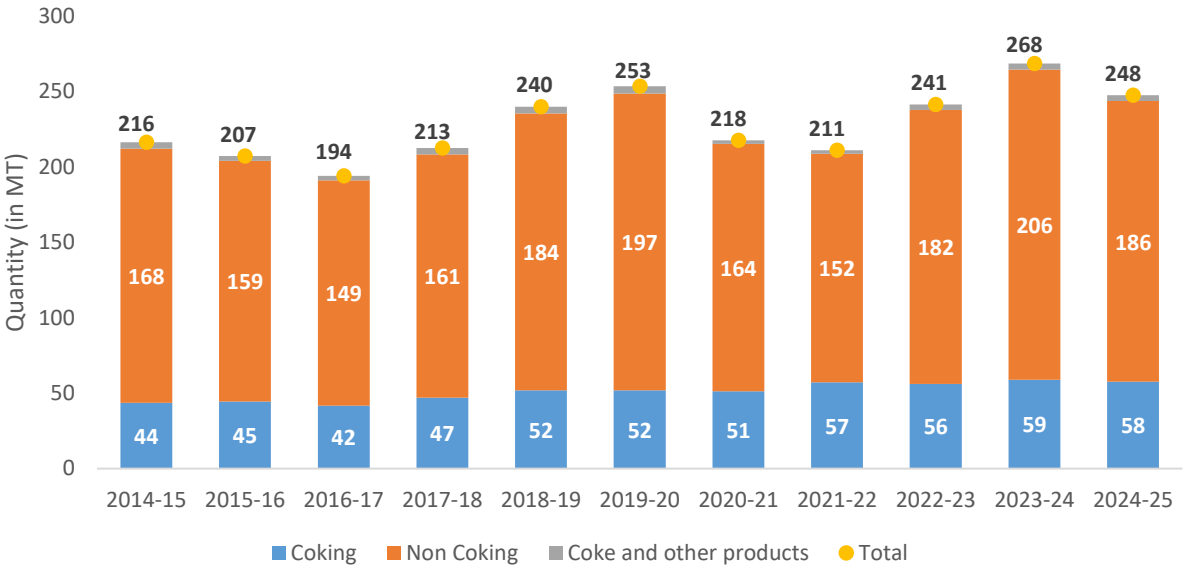


Figure 18: Coal Imports by India from 2014-15 to 2024-25

Source: (MoC, 2025)

Coal imports in the country during FY 2024-25 fell by 8 percent, totalling 244 million tonnes, compared to 265 MT in the previous fiscal year. This reduction resulted in foreign exchange savings of approximately $7.93 billion (₹60681.67 crore) (MoC 2025).

Apart from steel industry, a significant portion of the imported coal is consumed by the power sector. Over the years, coal imported by the power sector have fluctuated. In 2024–25, imported coal used in the power sector declined from 65.7 million tonnes in 2023–24 to 62.6 million tonnes, showing a decline of around 5 percent. Coal imported by the power sector is primarily used, either by imported coal based plants or for blending by thermal power plants. Imports for blending by thermal power plants sharply decreased from 23.92 million tonnes in 2023-24 to 14.02 million tonnes in 2024-25, showing a decline of 41.4 percent.

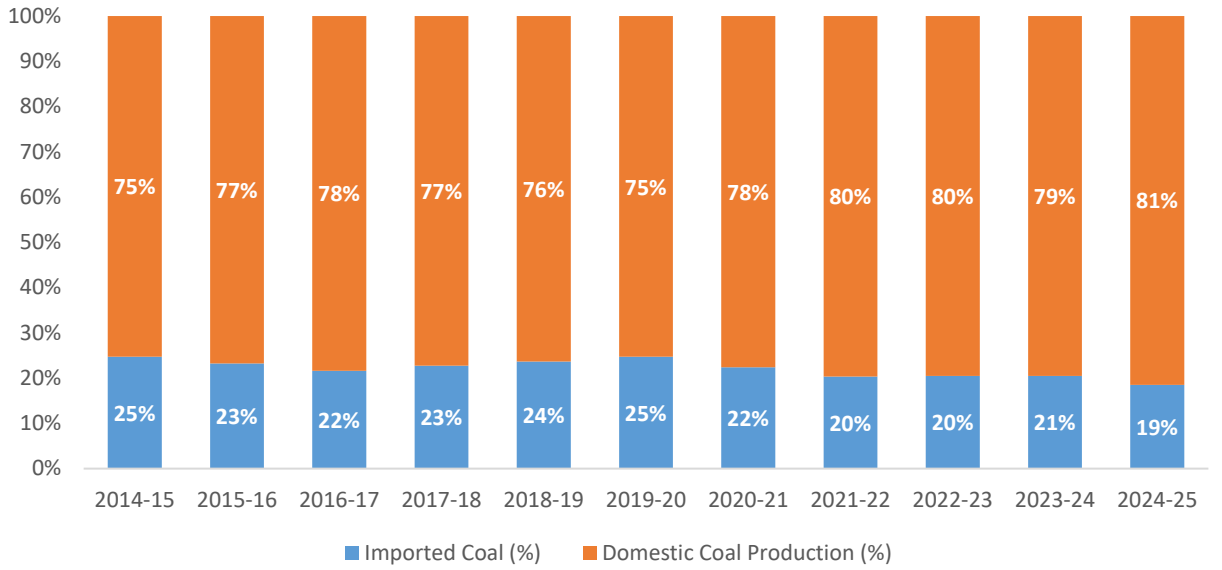


Figure 19: Domestic Coal Production and Import Share in India from 2016-17 to 2024-25

Source: (MoC, 2025)

Figure 19 highlights the decline in India's dependency on imported coal, from 25 percent in 2019-20 to 19 percent in 2024-25. The GoI implemented several measures to reduce coal imports and enhance domestic coal production. The Ministry of Coal established an Inter-Ministerial Committee (IMC) (MoC, March, 2024), with an aim to substitute imported coal with domestic coal by 2030. The major functions of committee include examining logistics and bottlenecks in coal transportation, monitoring coal imports from different sectors and improving the overall efficiency of coal supply chains. Other initiatives involve a single window clearance, expedited environment clearances and encouraging private sector participation in coal mining (Commercial Coal Mining Policy). Consequently, these endeavours led to a boost in coal production and a decline in the share of imports, particularly for non-coking coal, indicating India's commitment to self-reliance and energy security.

India's coal exports have remained relatively low over the years, ranging between 1 million tonnes to 3 million tonnes. The country primarily exports non-coking coal. Majority of the exported coal is supplied to neighbouring countries such as Nepal and Bangladesh.

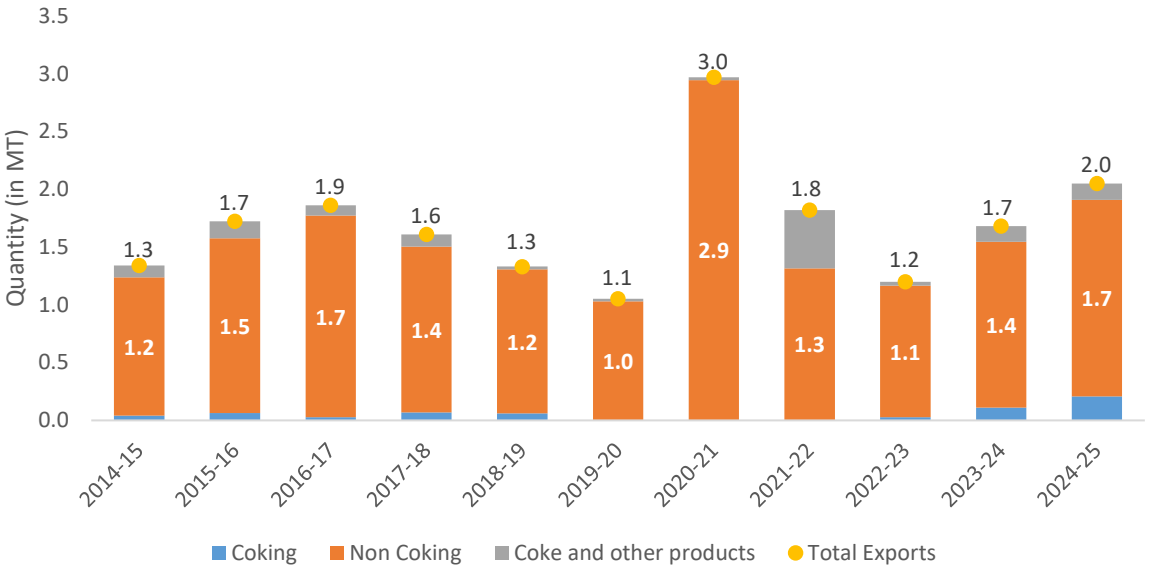


Figure 20: Coal Export by India from 2014-15 to 2024-25

Source: (MoC, 2025)

Coal Gasification Initiative

Coal gasification technology converts coal into synthesis gas (syngas), which can be further processed to produce methanol, ammonium nitrate, synthetic natural gas (SNG), and fertilizers. This not only increases value addition from coal but also aligns with India's long-term goal of achieving cleaner energy production and supporting the vision of a developed, self-reliant India by 2047.

The Government of India has been actively promoting coal gasification in order to reduce dependence on imported natural gas and crude oil, and to utilize domestic coal resources more efficiently. In 2024, the Government approved a financial incentive package of ₹8,500 crore to encourage coal and lignite gasification projects, open to both public sector undertakings (PSUs) and private companies (PIB, 2025).

Coal India Limited (CIL) has also received approval to invest in joint ventures with Bharat Heavy Electricals Limited (BHEL) and GAIL (India) to set up large-scale coal gasification facilities. Additionally, in 2022, the "Production of Syngas leading to coal gasification" category was introduced under the Non-Regulated Sector (NRS) linkage auction policy, allowing such projects to access coal at a floor price equivalent to the regulated sector's notified price, provided they commence operations within seven years.

To further support this initiative, the Government introduced a 50 percent rebate on revenue share for coal used in gasification through commercial coal block auctions, on the condition that at least 10 percent of the total coal production is utilized for gasification purposes (PIB, 2025).

4.2 Crude Oil

Crude oil is a naturally occurring, unrefined petroleum product composed of hydrocarbon deposits and other organic materials. It is a vital natural resource and serves as a primary source to produce various petroleum products, including Petrol, Diesel, LPG, Naphtha, Jet Fuel, and Lubricants, among others.

India has established itself as a major global refining hub and is currently the fourth-largest refiner in the world, following the United States, China, and Russia. As of January 2025, the country's total refining capacity stands at approximately 258.1 million metric tonnes per annum (MMTPA), equivalent to about 5.16 million barrels per day. The country's refining sector plays an important role in meeting domestic demand for petroleum products and also supports its status as a significant exporter of refined petroleum products.

In 2014, India's total refining capacity stood at 215.07 Million Metric Tonnes Per Annum (MMTPA). Between 2014 and 2025, the Indian refining sector witnessed a growth of 20 percent, driven by increasing domestic demand and the strategic importance of refining for energy security. Several refineries expanded their existing capacities, and new refineries were commissioned. Today, India operates 23 refineries, comprising 19 in the public sector, 3 in the private sector, and 1 under a joint venture (PIB, 2025). To meet future growing energy demand and enhance self-reliance, India is expanding its refining capacity. By 2030, India aims to raise its capacity to over 309.5 MMTPA or 6.2 Million barrels per day (PIB, 2025).

Projects like the HPCL Rajasthan Refinery Limited (HRRL), and expansion of existing refineries contribute to this target. The Hydrocarbon Exploration and Licensing Policy (HELP) and its successor, the Open Acreage Licensing Policy (OALP), were designed to boost domestic exploration by offering a revenue-sharing model, marketing and pricing freedom, and a single license for all hydrocarbons to attract private investments.

In 2024-25, India consumed 239 Million Metric Tonnes (MMT) of petroleum products, becoming the third largest consumer of oil in the world, after China and United States. India as one of the largest consumers of oil, relies heavily on imported crude to meet the energy demands of transportation, manufacturing and household consumption. Such heavy dependence on oil import is intricately linked to the nation's economic stability, ability to influence inflation rates, trade balances and nation's overall economic health.

As of 1st April 2025, India's estimated balance of recoverable crude oil reserves and contingent resources stood at 672.1 million metric tonnes (MMT), reflecting a marginal 0.1 percent increase compared to 671.4 MMT recorded in the previous year. Geographically, the Western Offshore region accounts for the largest share of these reserves at 31 percent, while major onshore contributions come from Assam, Gujarat, and Rajasthan (MoPNG, 2025). Crude oil contributes to nearly 30 percent of India's total primary energy supply (excluding biomass and biofuels), playing a vital role in meeting the nation's growing energy demand.

Crude Oil Production

In 2024-25, domestic production of crude oil and condensate in the country stood at about 28.7 million tonnes, decreasing significantly from 37 MMT in 2014-15, declining at an annual rate of 3 percent (refer Figure 21). This decline in production can be attributed to several factors, including the natural depletion of older and marginal fields, accessibility and technical challenges in certain reservoirs, disruptions in field activities, etc. To address the declining trend, the Government has implemented several long-term and short-term initiatives. These include reforms under the Hydrocarbon Exploration and Licensing Policy (HELP), 2019, the Policy Framework for Exploration and Exploitation of Unconventional Hydrocarbons, 2018, induction of suitable

technologies in selective fields, monetisation of small and marginal onshore discoveries through service contracts and outsourcing, and the Discovered Small Field (DSF) Policy, which aims to fast-track the development of small and marginal hydrocarbon discoveries.

Public sector enterprises such as Oil and Natural Gas Corporation (ONGC) and Oil India Limited (OIL) remain the principal producers, contributing approximately 64 percent and 12 percent of the total domestic production, respectively, in 2024–25. The remaining 24 percent of production comes from fields operated under the Production Sharing Contract (PSC) and Revenue Sharing Contract (RSC) regimes.

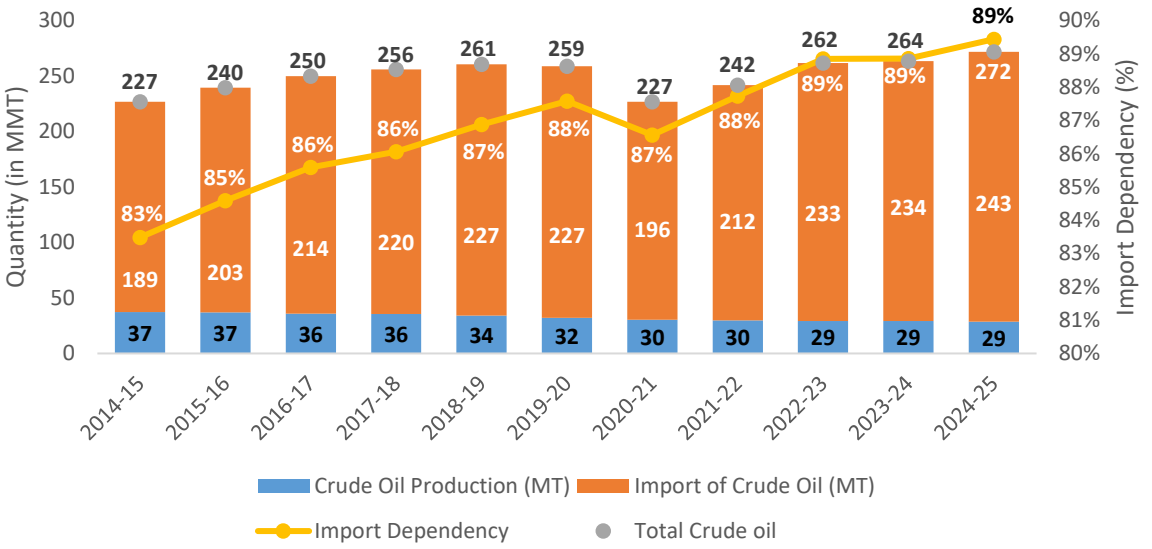


Figure 21: Crude Oil Domestic Production and Import

Source: (PPAC, 2025)

Crude Oil Imports

India is the world's third-largest importer of crude oil after China and United States, with imports of 243 MMT of crude oil in 2024-25 (MoPNG, 2025). The country's imports accounted for 83 percent of crude oil supply in 2014-15, rising to 89 percent by 2024-25, despite experiencing a temporary decline due to the COVID-19 pandemic in 2020-21.

Table 4: Monthly Crude Oil Import in India (in MMT)

Year/Month	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar
2016-17	18	18	18	17	19	18	18	19	18	17	16	18
2017-18	18	18	18	17	18	18	19	19	19	20	18	18
2018-19	17	20	19	20	19	18	21	17	20	20	17	19
2019-20	20	19	17	19	20	17	19	19	19	20	19	20
2020-21	17	15	14	12	17	15	15	18	20	20	15	18
2021-22	18	17	16	15	17	18	17	18	20	19	18	19
2022-23	22	20	19	21	18	17	18	19	20	20	19	21
2023-24	20	21	20	20	19	18	19	19	20	22	18	21
2024-25	21	22	19	19	20	19	20	19	20	21	19	23

Source: (PPAC, b)

India imports crude oil from diverse regions, including the Middle East, North America, South America, Africa, Europe, Russia, etc. (as shown in the Figure 22). Historically, India relied on the Middle East for its crude oil supply. However, its share of total crude oil imports has decreased from 64 percent in 2017-18 to 46 percent in 2024-25.

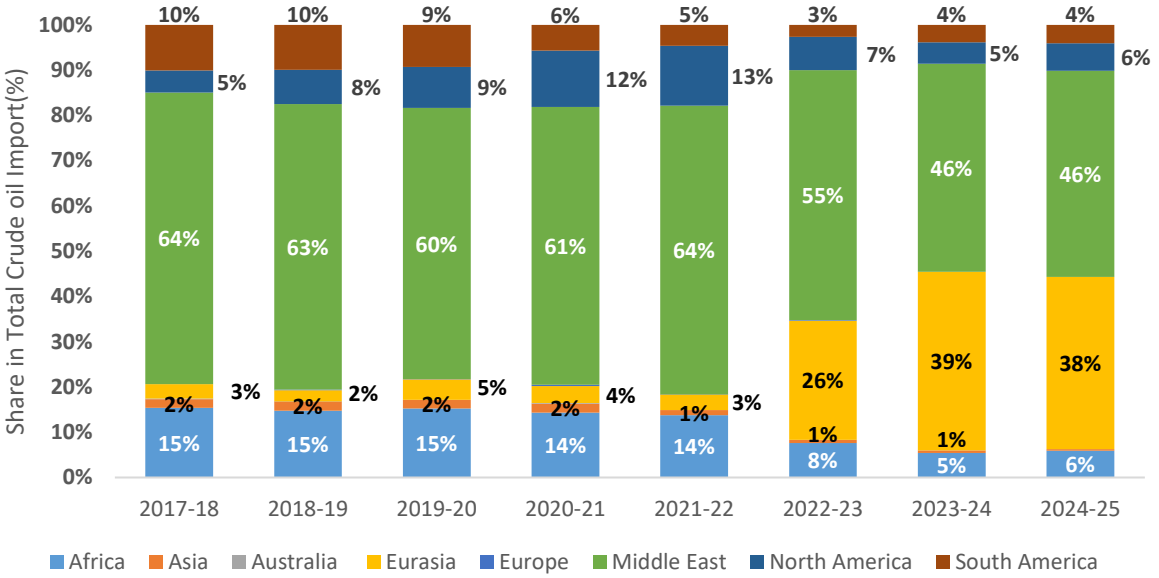


Figure 22: Region-wise Share of Crude Oil Import in India (percent), in terms of Quantity

Source: (PPAC, 2025)

To mitigate the import dependency on oil imports, the Government of India has taken several measures, such as promoting initiatives such as the electrification of the transport sector, ethanol blending in petrol, Sustainable Aviation Fuel (SAF) in the aviation sector and the production of compressed biogas. These efforts aim to reduce India's reliance on imported crude oil, while also supporting a gradual transition towards cleaner and more sustainable fuels.

4.3 Natural Gas

Natural Gas, plays a significant role in India's energy landscape. Known for its cleaner attributes as compared to coal and petroleum, it has gained prominence in recent times as a possible bridging fuel to minimise Greenhouse Gas Emissions from the Energy Sector. In 2024-25, the gas share in India's total primary energy supply (excluding biomass and biofuels) was 7 percent. The Government of India (GoI) aims to increase the share of natural gas to 15 percent by 2030 as part of the nation's energy transition, positioning it as a transitional fuel between conventional fossil fuels and renewables (PIB, Dec, 2023). In order to achieve this objective, the Government has implemented several measures. These include providing support for compressed biogas, expanding the National Gas Grid pipeline infrastructure, expanding the city gas distribution network, and allocating Liquefied Natural Gas (LNG) regasification terminals. The goal is to create a 'One Nation One Gas Grid' to ensure equitable gas availability.

In terms of production, India relies on both domestic sources and imports to meet its growing demand. Domestic production primarily occurs in gas fields located across various regions, including the Krishna-

Godavari Basin, Mumbai High, and Assam. The estimated balance recoverable reserves of Natural Gas in India as of 1st April 2025, stood at 1074 Billion Cubic Metres (BCM) against 1094.2 BCM in the previous year.

Figure 23 shows the domestic production and import of natural gas in India from 2016-17 to 2024-25[4]. Domestic natural gas production has grown at a compound annual growth rate of about 2 percent over the last eight years. To support further increase in production, the Government has focused on expanding natural gas infrastructure, including pipelines, LNG terminals, and gas storage facilities. The country has been steadily expanding its pipeline network to transport gas from production sites to consumption centres, facilitating efficient distribution across the nation. Additionally, LNG terminals, located mainly on the western and eastern coasts, serve as crucial entry points for imported natural gas, supporting India's energy needs.

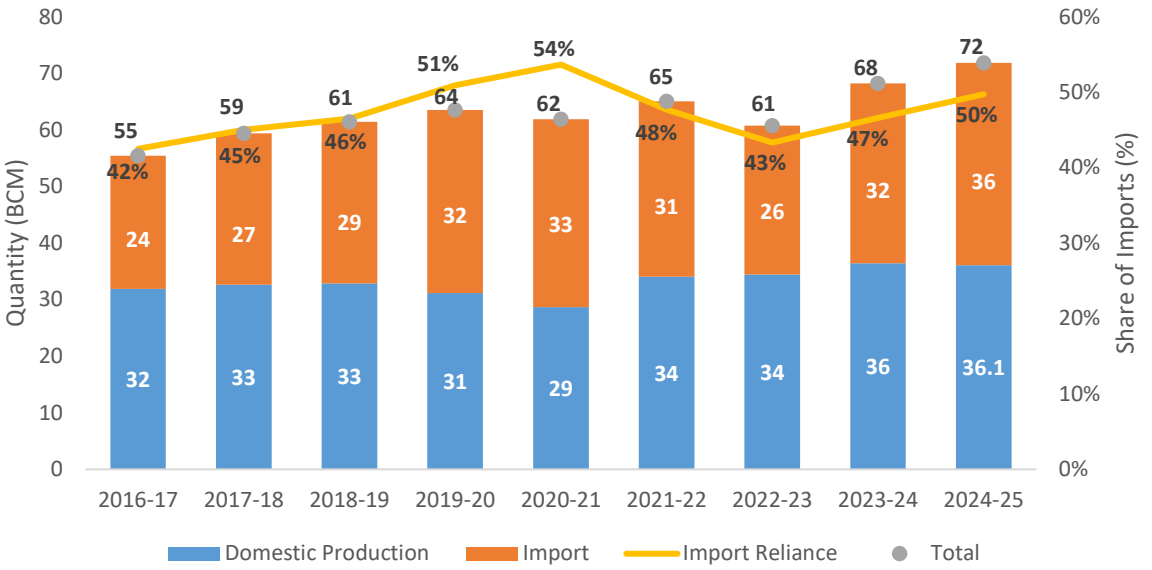


Figure 23: Natural Gas Domestic Production and Import

Source: (PPAC, 2025)

However, despite efforts to enhance domestic production, India still imports a considerable amount of natural gas - 50 percent of the total gas supply in FY 2024-25, primarily through LNG terminals. India imports natural gas primarily from the Middle-East (Qatar, UAE, Oman etc.), the United States of America, Africa (Angola, Nigeria, etc.) etc. The Middle East continues to be the biggest source, making up to 61 percent of total imports in 2024-25. Share of imports from North America have shown a steady increase over the last decade. India has a contract with Qatar to import LNG until 2028, with an extension now in place until 2048 at prices below the current rates.

[4] To maintain uniformity in data, sources of natural gas have been quantified in BCM.

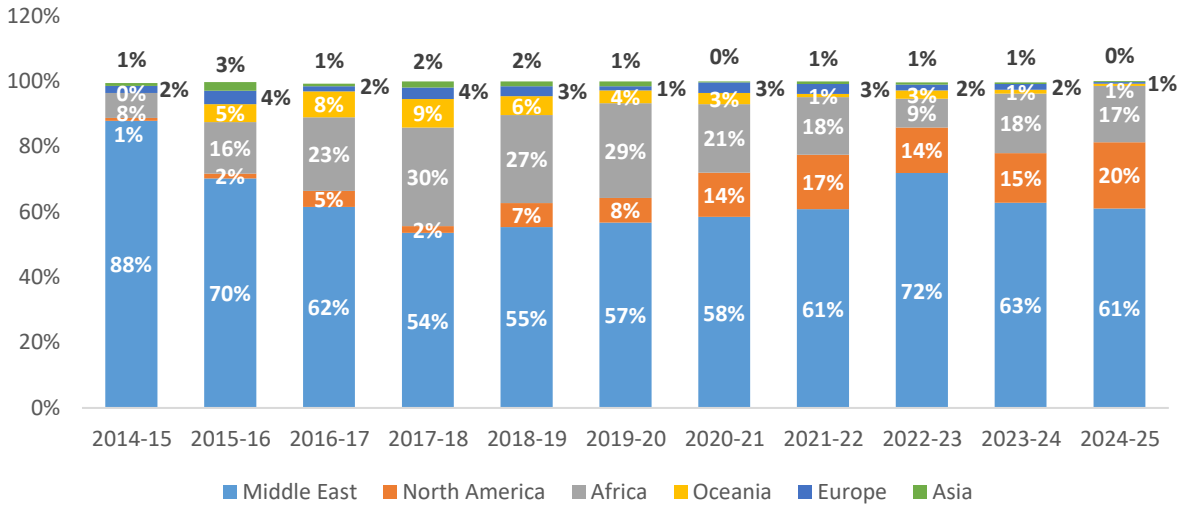


Figure 24: Region-wise Share in Import of Natural Gas in India (Percentage)

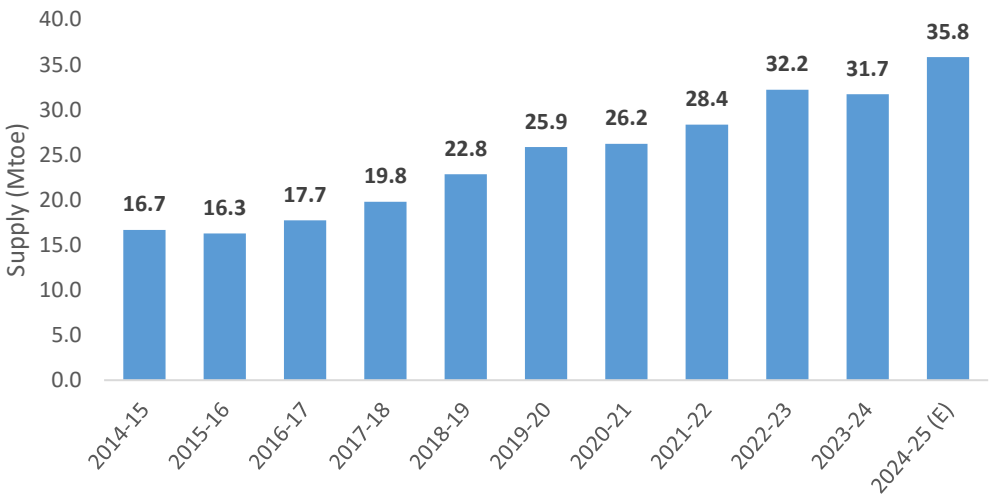
Source: (PPAC, 2025)

4.4 Renewable Energy Sources

4.4.1 Renewable Energy Sources of Electricity

RES in primary energy supply mix

Renewable energy is playing an increasingly significant role in India's energy supply, reflecting a shift towards cleaner energy sources. Over the past decade, India has witnessed remarkable growth in renewable energy supply, primarily driven by rapid expansion in solar and wind power generation. As shown in Figure 25, the total primary energy supply from renewable sources increased significantly from 16.7 Mtoe in 2014-15 to an estimated 35.8 Mtoe in 2024-25. The share of renewable energy sources in the overall primary energy supply mix (excluding biomass and biofuels) in 2024-25 is around 3.8 percent.



(E) - Estimated

Figure 25: Primary energy supply from RES (in Mtoe)

Source: (CEA, 2025)

This rise in renewable energy has been supported by several government initiatives and investments, supply from renewable energy sources is expected to continue growing. The Government of India has introduced several initiatives to meet its 2030 targets, including the establishment of ultra-mega and mega solar parks, the solar rooftop policy, PM Surya Ghar Muft Bijli Yojana, Renewable Purchase Obligations (RPOs), Renewable Generation Obligations (RGOs), Production-Linked Incentive (PLI) Schemes, and the Green Energy Corridor, among other measures.

In 2025, India achieved one of its major clean energy targets much earlier than planned. The country reached 50 percent of its total installed electricity capacity from non-fossil fuel sources, such as solar, wind, hydro, and nuclear power. This goal was originally set for 2030, as part of India's climate commitments under the Paris Agreement (PIB, 2025). Achieving it five years ahead of schedule shows the country's strong progress toward clean and sustainable energy. India also reached the 100 GW solar energy milestone in early 2025 under the National Solar Mission. This marks a major achievement in expanding renewable energy capacity and reducing dependence on fossil fuels.

Resource Potential

Recent assessments indicate that India has substantial renewable energy potential across multiple sources. The 2025 NISE assessment estimates ground-mounted solar PV potential at about 3,343 GWp, based on the use of around 6.69 percent of identified wasteland, significantly higher than the 2014 estimate of 749 GWp, which assumed 3 percent wasteland utilisation. The National Institute of Wind Energy (NIWE) estimates onshore wind potential at about 1,164 GW at 150 m hub height.

To support the integration of variable renewable energy, energy storage plays a critical role to enable reliable integration of renewable energy by firming variable solar and wind generation and shifting supply to periods of high demand. It also supports grid stability by reducing congestion, curtailment, and dependence on fossil-based balancing power. These systems are important because they help store excess power from solar and wind energy and supply it when demand is high. In this context, India has also identified around 181 GW of total pumped storage potential, based on the latest CEA assessments.

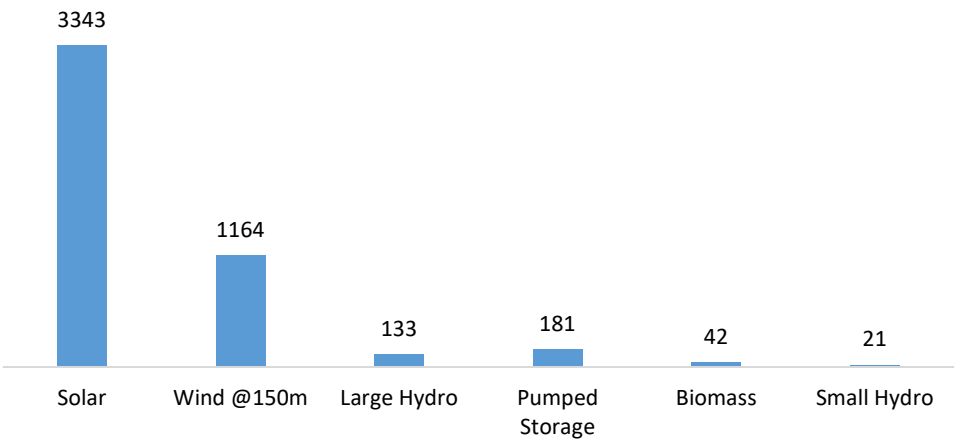


Figure 26: Resource potential for various renewable energy sources (in GW)

Source: (ICED, 2025)

4.4.2 Biofuels

India's energy needs are currently met by fossil fuels with a heavy reliance on imports to satisfy the growing demand. In response, the Government is prioritising energy security intending to reduce dependency on fossil fuel imports. India imports about 89 percent of its crude oil, 18 percent of its coal and nearly 50 percent of its natural gas, and is the third-largest importer of crude oil globally, underscoring the strategic importance of domestically available alternative energy sources.

Within this broader energy system, biomass and biofuels in India encompass a broad range of energy forms derived from biological resources, including liquid biofuels such as ethanol and biodiesel**,** gaseous biofuels such as biogas and compressed biogas**,** and energy derived from solid biomass and organic waste. These fuels are consumed primarily in the residential, industrial, power and transport sectors, either through direct use or through blending with conventional fuels. As per TERI estimates, the total primary supply (TPS) of biomass and biofuels in India is estimated at around 132.2 Mtoe in 2022-23 and 129.4 Mtoe in 2023-24. These estimates are based on a consumption-based approach, wherein total utilisation of biomass and biofuels across sectors is taken to represent domestic supply.

The biofuel sector holds substantial potential to enhance the country's energy security, lower its carbon footprint and generate employment. The Government of India has been vigorously promoting biofuels as part of its broader strategy to boost the share of renewable energy, particularly in the transportation sector. The Government has announced various measures to boost the domestic production of biofuels (see Figure 27).

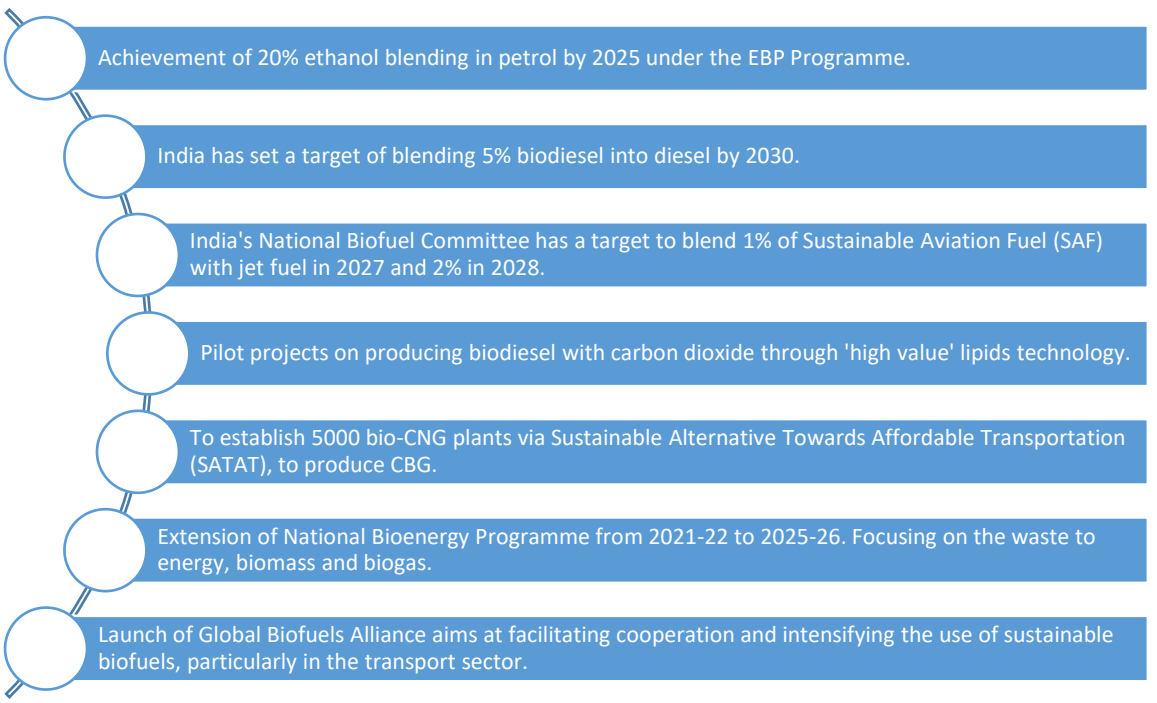


Figure 27: Government Initiatives related to Biofuels

With the heavy reliance on fossil fuels, India acknowledges the importance of alternative fuels that are better for the environment (less particulate matter, lower greenhouse gases) and cost-competitive with fossil fuels. This envisions the importance of biofuels in the Indian energy basket. Biofuels are increasingly recognized for their potential to reduce dependency on fossil fuel imports, achieve savings on foreign exchange, enhance

energy security and promote rural development. Biofuels are derived from plants, algae, or organic waste offering sustainable alternatives to conventional fossil fuels. The most common types of biofuels include bio-alcohols such as ethanol, methanol, propanol and butanol, along with biodiesel, Bio-gas and bio-oils. Further, the biofuels are also categorised as (Das, S., 2020):

- First Generation (1G) 'Basic Biofuels' – Ethanol from molasses and biodiesel from edible oilseeds
- Second Generation (2G) 'Advanced Biofuels' – Produced from non-edible plants, agro-residues like rice straw or sugarcane bagasse, municipal solid waste (MSW), even damaged grains unfit for eating.
- Third Generation (3G) – 'Advanced Biofuel' – Produced from non-food sources, primarily algae.

The Government of India announced the National Biofuel Policy (NBP) in 2018 and further amended it in 2022, to reduce import dependency of fossil fuels by boosting the domestic biofuel production. It encourages the use of biomass and organic waste for clean energy generation. The programme was revised during 2024–25 to include updated Central Financial Assistance (CFA) for setting up pellet and briquette manufacturing plants, aiming to improve biomass utilization and expand the country's renewable energy mix (MNRE, 2024–25). Government is also promoting blending of ethanol in Petrol under the Ethanol Blended Petrol (EBP) programme. The Government has decided to advance the blending target of 20 percent bioethanol in petrol by Ethanol supply year (ESY) 2025-26, from earlier target of 2030. India has achieved strong growth in ethanol blending and is nearing the E20 target. For instance, by ESY 2024-25 ethanol blending had crossed 19 percent mark (PIB, 2025). With continued progress, the 20 per cent ethanol blending target was also achieved in October 2025, indicating that India reached the E20 milestone ahead of schedule. Target has also been set for blending of 5 percent biodiesel in HSD by 2030. The blending rate has reached about 0.5 percent in 2024-25, led mainly by PSU OMCs, Limited feedstock and collection issues have held back growth. Government is also exploring blending of isobutanol with diesel. In addition, India is also taking early steps toward integrating Sustainable Aviation Fuel (SAF) into its energy mix. On February 4, 2025, India launched the SAF Alliance to promote adoption and develop domestic production capacity. The country has set blending targets of 1 percent by 2027, 2 percent by 2028, and 5 percent by 2030 for international flights.

Government is providing multiple financial assistance to promote availability of ethanol for blending in Petrol including ethanol from surplus sugarcane, damaged food grains. Long term offtake agreements are also being done by OMCs to ensure offtake of ethanol. To help sugarcane farmers in realizing the better price, Government has been revising MSP of sugarcane and also coming out with assured offtake prices which are revised from time to time. Government is also promoting development and demonstration of technologies for production of Advance Ethanol under PM JI-VAN Yojana. Under the scheme Government is providing financial assistance of ₹ 1800 Cr for setting up of about 12 Commercial Projects and ₹ 150 Cr for 10 Demonstration Projects.

Under SATAT (Sustainable Alternative towards Affordable Transportation)-2018, Government targets 5,000 bio-CNG plants by 2025, Furthermore, an amount of ₹565 crore has been allocated for Biomass Aggregation Machinery to 100 CBG producers till 2027. However, on the ground, only around 100 CBG plants have actually started operations, and about 42.7 TMT of CBG were sold in 2024-25. Total financial outlay of ₹ 994.50 Cr for the period of FY 2024-25 to FY 2025-26 has been made for providing subsidy for laying pipeline between CBG plant and CGD network for upliftment of biogas. The portal for submission of application was made live on 1st Sept-24.

Ethanol

Ethanol blending with petrol has come a long way in India over the last decade. It is derived primarily from sugarcane molasses and maize, and is being blended with petrol to make it cleaner and cheaper in the long run. The share of ethanol blended with petrol escalated to 749 crore litres (19.1 percent) in 2024-25 (Nov'24 to Jul'25) from a mere 67 crore litres (2 percent) in 2014-15, with a compound annual growth rate (CAGR) of 27 percent, making India the third largest producer of Ethanol in the world. In energy terms, ethanol contributed around 4 Mtoe in 2024-25, forming a small but growing share of India's total energy supply. The Government's support enabled India to achieve 10 percent ethanol blending in petrol by June 2022, five months ahead of its target[5] and the country has since achieved the target of 20 per cent ethanol blending in petrol (E20) during the Ethanol Supply Year 2025.

To push domestic ethanol production, a series of measures were introduced after 2014. These include bringing back the administered price system, allowing alternate routes for making ethanol, and amending the Industries (Development & Regulation) Act, 1951 – this gave the Centre full control over denatured ethanol to ensure smooth movement between states. GST on ethanol for the programme was cut from 18 percent to 5 percent.

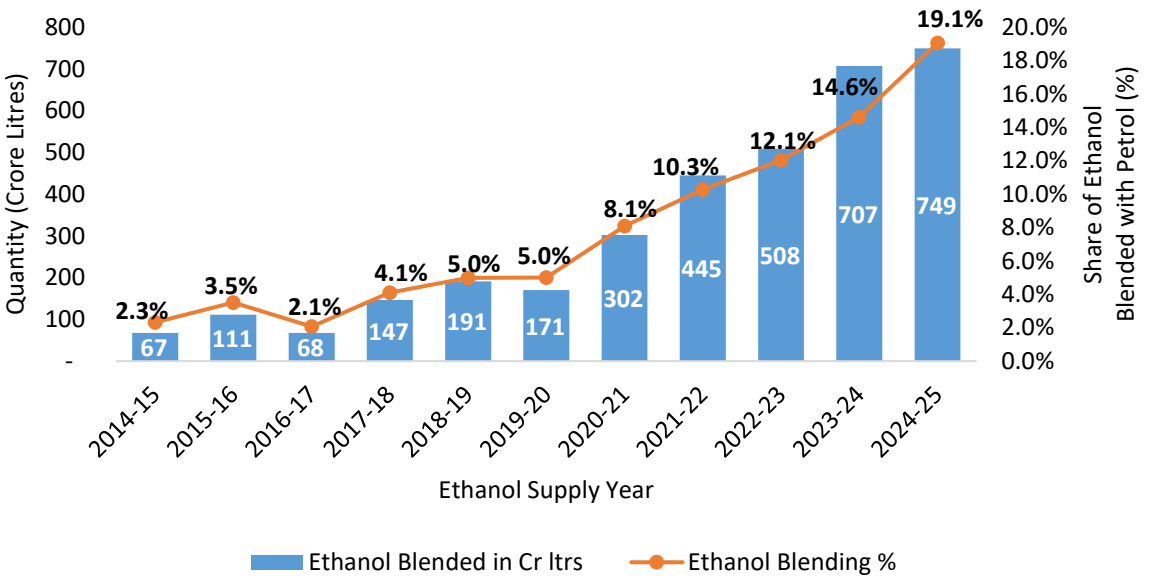


Figure 28: Ethanol Supply and Blending in India

Source: (MoPNG, 2025)

*Ethanol Supply Year up to 2021-22 was from December to November. For 2022-23, it covered Dec 2022 to Oct 2023. Thereafter, the period was revised to run from 1 November of the current year to 31 October of the following year.
*The value for 2024-25 represents supplies from Nov 2024 to Jul 2025.

Historically, ethanol production in India has relied heavily on 'C-heavy' molasses. C-heavy molasses is a by-product of the sugar refining process characterised by a lower sugar content compared to other molasses variants. Consequently, ethanol yield per volume from C-heavy molasses has been relatively lower (Singh,

[5] Target to achieve 10% blending of ethanol in petrol in the country under Ethanol-Blending Programme by November 2022

2021). However, the amendment of the National Biofuel Policy (NBP) in 2022 permitted the utilisation of additional molasses and alternative feedstocks for biofuel production. This policy revision facilitated the diversion of other feedstocks such as B-heavy molasses, sugar, sugar syrup, maize and damaged food grains towards ethanol production. In 2024-25, maize alone accounted for the largest share in the total feedstock at 45 percent, followed by sugarcane juice at 19.7 percent, B heavy molasses at 14.5 percent while C heavy molasses, surplus and damaged food grains accounted for 21 percent.

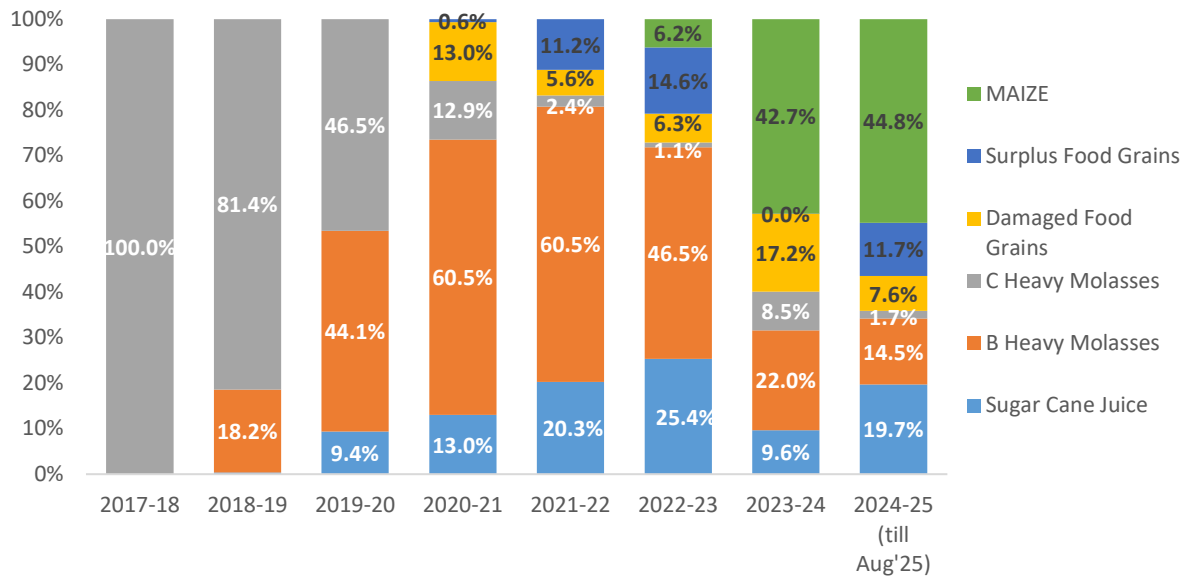


Figure 29: Percentage Contribution from Different Feedstocks in Ethanol

Source: (MoPNG, 2025)

Methanol

Methanol is another clean alternative fuel which emits less NO_x and particulate matter (PM) than gasoline. As methanol contains no sulphur, it does not produce SOx emissions. While it can be blended with petrol, its toxic nature makes handling and large-scale use challenging. Methanol can also be converted to dimethyl ether (DME) as a cleaner diesel alternative and used as a feedstock in the petrochemical industry. With feedstocks like natural gas, coal, or biomass, India's methanol production and usage are still in the early stages, but the country has significant potential attributed to methanol's diverse applications.

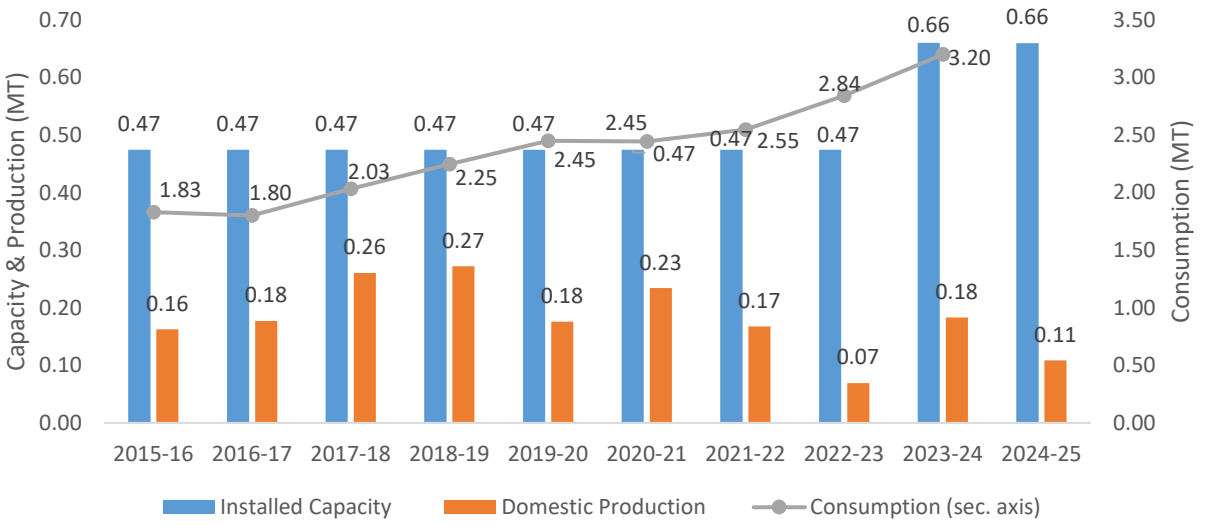


Figure 30: Year-wise Performance overview of Methanol

Source: (DCPC, 2025)

As shown in the Figure 30 installed capacity held steady at 0.47 million tonnes (MT) for years, from 2015-16 right through 2022-23, before rising to 0.66 MT in 2023-24 and staying there for 2024-25 – that's a modest 4 percent compound annual growth rate (CAGR) over the nine years. On the other hand, domestic production was 0.11 million tonnes (MT) in 2024-25, decreasing at a CAGR of 4 percent over the same period.

Methanol consumption in India grew by 7 percent from 1.83 MT in 2015-16 to 3.2 MT in 2023-24. Based on the significant shortfall between domestic production and consumption (as shown in Figure 30), India has remained dependent on methanol imports, largely due to the price disadvantage of domestically produced methanol. Table 5 indicates a consistent rise in methanol imports in India. Over 90 percent of methanol is imported from countries like Saudi Arabia and Qatar. Additionally, India exports methanol to other countries namely Sri Lanka, South Africa, and Nepal.

This reliance on imports underscores the push for a 'methanol economy' – NITI Aayog's programme to turn coal and waste into fuel, slashing oil imports and emissions. Other efforts, like the 2015 Methanol Economy Research Programme and Assam's 2018 cooking fuel pilot, aim to build on this, but scaling production remains the real hurdle.

Table 5: Import, Export & Net Imports of Methanol (in MT)

Year	Import (MT)	Export (MT)	Net Imports (MT)
2016-17	**1.64**	**0.01**	**1.62**
2017-18	**1.78**	**0.01**	**1.77**
2018-19	**1.99**	**0.01**	**1.98**
2019-20	**2.29**	**0.01**	**2.27**
2020-21	**2.22**	**0.01**	**2.21**
2021-22	**2.40**	**0.02**	**2.38**
2022-23	**2.82**	**0.08**	**2.73**
2023-24	**3.07**	**0.05**	**3.02**

Source: (DCPC, 2024)

Since the methanol economy is considered as one of the viable future economies, methanol and dimethyl ether could replace fossil fuels for energy storage and ground transportation fuels. NITI Aayog has launched the 'Methanol Economy Programme' to further enhance domestic methanol production. This initiative aims to increase the use of methanol in India, positioning it as a key chemical feedstock to reduce the country's dependence on imported crude oil. Additionally, it can lower greenhouse gas emissions such as particulate matter, NO_x and SO_x, thereby improving urban air quality (NITI Aayog, 2021). Other initiatives such as the Methanol Economy Research Programme (MERP) launched by the Department of Science and Technology in 2015 and the Methanol Cooking Fuel Programme (MCFP) launched by Assam Petrochemicals in 2018 have also been undertaken to boost methanol production.

4.4.3 Green Hydrogen

India aims to achieve energy independence by 2047 and reach net-zero emissions by 2070, with green hydrogen playing a crucial role in these objectives. Green hydrogen is particularly effective for industries that are difficult to decarbonize, such as steelmaking, where direct electrification is not feasible. By substituting fossil fuels with green hydrogen as a feedstock, these industries can significantly reduce their carbon footprint. Key industrial applications include:

- **Steel Making:** Substituting coal with green hydrogen.
- **Cement Production:** Using green hydrogen in kilns.
- **Fertilizer Production:** Utilizing green hydrogen to produce ammonia
- **Chemical Manufacturing:** Employing green hydrogen as a feedstock for chemicals like ammonia.
- **Refining:** Using green hydrogen for desulfurization of petroleum products.

In January 2023, India launched the National Green Hydrogen Mission (NGHM), with a budget of ₹19,744 crores. This includes ₹17,490 crores for the Strategic Interventions for Green Hydrogen Transition (SIGHT) program, ₹1,466 crores for pilot projects, ₹400 crores for R&D, and ₹388 crores for other components. The Mission aims to establish India as a global hub for green hydrogen production, usage, and export, targeting an annual production of 5 MMT by 2030. The government has increased its financial support for the National Green Hydrogen Mission in FY 2025-26, allocating about ₹600 crore, almost twice the amount set aside in the previous year's budget.

The "Strategic Interventions for Green Hydrogen Transition (SIGHT) Program - Component I: Incentive Scheme for Electrolyser Manufacturing Tranche - II," is designed to make Indian-made electrolysers competitive in performance and cost. It also aims to build out the domestic supply chain and support both existing and new electrolyser technologies. The Solar Energy Corporation of India (SECI) will act as the nodal agency for implementing the scheme.

To support these goals, India is boosting domestic electrolyser manufacturing. The government is funding 3,000 MW of electrolyser manufacturing capacity to scale up local production. In March 2024, the Ministry of New and Renewable Energy (MNRE) announced an allocation of ₹4,440 crore for electrolyser manufacturing under the SIGHT II Programme for the period FY 2025-26 to 2029-30. Projections suggest that India's domestic electrolyser market could reach $31 billion by 2050, driven by a demand for 226 GW. In the near term, a demand of 20 GW is expected by 2030, highlighting the nation's potential for substantial growth in the hydrogen ecosystem (NITI Aayog, 2022). Moreover, MNRE has planned to set up at least two Green Hydrogen

Hubs by 2025–26. These hubs will receive support for infrastructure development and will help connect hydrogen producers with end-users in sectors like steel, transport, and fertilizers.

Some of the other developments/announcements on green hydrogen are:

- MNRE has released the Guidelines for Implementation of Strategic Interventions for Green Hydrogen Transition (SIGHT) Programme Component-II of the National Green Hydrogen Mission:
    - Incentive for Procurement of Green Ammonia Production (under Mode-2A): The incentive will be Rs. 8.82/kg of Green Ammonia in the first year of production and supply, Rs. 7.06/kg during the second year of production and supply, and Rs. 5.30/kg during the third year of production and supply.
    - Incentive for Procurement of Green Hydrogen Production (under Mode-2B): The incentive will be Rs. 50/kg of Green Hydrogen in the first year of production and supply, Rs. 40/kg during the second year of production and supply and Rs. 30/kg during the third year of production and supply.
- MNRE announced that India had already awarded tenders supporting about 862,000 tonnes per annum of green hydrogen production capacity under the National Green Hydrogen Mission.
- MNRE launched a ₹100 crore call for proposals for pilot projects producing green hydrogen from biomass and waste materials under NGHM.
- Pilot projects are being supported for the use of green hydrogen in shipping, steel and transport sectors under the National Green Hydrogen Mission.
- Jindal Stainless Ltd., in collaboration with Hygenco commissioned India's 1st green hydrogen plant in the stainless steel sector at Hisar, Haryana, which aims to reduce CO2 emission by 2,700 metric tonnes per annum.
- The Green Hydrogen Certification Scheme of India has been notified to establish a framework for measurement, monitoring and certification of green hydrogen based on greenhouse gas (GHG) emission intensity.
- The Ministry of New and Renewable Energy has increased the annual allocation of Green Ammonia in the fertilizer sector from 5.50 lakh tonnes to 7.50 lakh tonnes, under the SIGHT Programme of the National Green Hydrogen Mission.
- Financial support has been announced for the development and upgradation of testing facilities**,** standards and regulatory infrastructure, with a total outlay of ₹200 crore during 2024–26.
- SIGHT Programme **–** Component II (Tranche II) provides incentives for green hydrogen production with a total outlay of ₹13,050 crore during FY 2025–26 to 2029–30, covering 450,000 tonnes per annum of capacity, including 40,000 TPA reserved for biomass-based pathways and the remaining capacity under technology-agnostic pathways.
- The Indian Railways' "Hydrogen for Heritage" project, which plans to deploy 35 hydrogen trains on heritage and hill routes, with an estimated cost of ₹80 crores per train and ₹70 crores per route for infrastructure (PIB, 2023).

Secondary Energy Supply

4.5 Petroleum Products

India, with a refining capacity of 258.1 Million Metric Tonne per annum (MMTPA), as of January 1st, 2025, stands as the third-largest refiner in Asia and fourth-largest refiner in the world, after United States, China, and Russia. Moreover, India is a net exporter of petroleum products, despite being a net importer of crude oil. The country's refining capacity far exceeds domestic crude production, turning the refining sector into a strategic asset that adds value to imported crude, making petroleum products the top contributor to India's export basket.

India operates 23 refineries, comprising 19 in the public sector, 3 in the private sector, and 1 under a joint venture. Of the total capacity, 158.6 MMTPA is owned by public sector entities, 11.3 MMTPA is operated through a joint venture, and the remaining 88.2 MMTPA is in the private sector.

Key public sector refineries include Indian Oil Corporation Limited (IOCL), Bharat Petroleum Corporation Limited (BPCL), Hindustan Petroleum Corporation Limited (HPCL), Chennai Petroleum Corporation Limited (CPCL), and Numaligarh Refinery Limited (NRL). In the private sector, Reliance Industries Limited (RIL) and Nayara Energy operate large-scale export-oriented refineries. These geographically dispersed refineries are interconnected through cross-country pipelines.

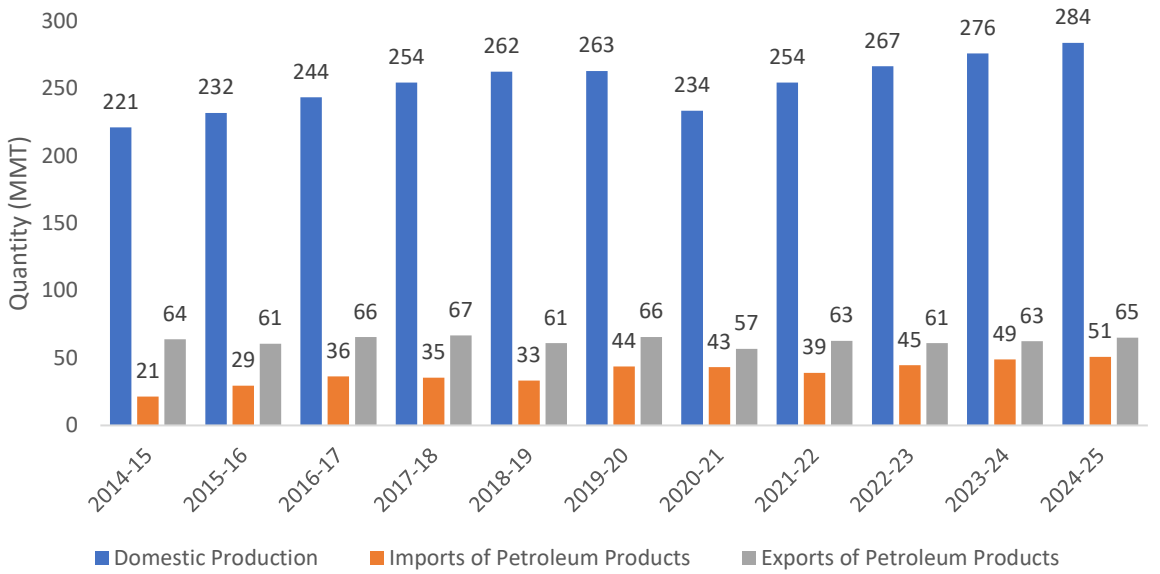


Figure 31: Total Petroleum Products Domestic Production, Import and Export in India

Source: (PPAC, 2025)

- Production of petroleum products increased from 221 MMT in 2014-15 to 284 MMT in 2024-25, reflecting a CAGR of about 2.5 percent.
- Over the last ten years, imports of petroleum products increased at a CAGR of around 9 percent, while exports remained stable.

Table 6: Domestic Production, Import, Export and Consumption of various Petroleum Products in India in 2024-25 (in MMT)

Petroleum Product	Production	Imports	Exports	Net Availability	Consumption
Diesel(HSD + LDO)*	118.85	0.04	28.03	90.87	91.92
Petrol*	48.26	0.23	15.83	32.67	34.10
Naphtha	18.31	0.94	5.17	14.08	13.03
Aviation Turbine Fuel	17.75	0.00	8.55	9.20	8.98
Petroleum Coke	14.96	13.15	0.69	27.42	22.00
LPG	12.79	20.67	0.55	32.90	31.33
Furnace Oil & Low Sulphur Heavy Stock	10.86	7.67	2.41	16.12	6.50
Bitumen	5.30	2.90	0.02	8.18	8.58
Lubes	1.30	2.86	0.02	4.15	4.58
Kerosene	1.01	0.00	0.01	1.00	0.41
Others	34.37	2.43	3.79	33.01	11.56
Total	283.77	50.90	65.08	269.60	239.22

Source: (PPAC, 2025)

*Consumption figures exclude ethanol and biodiesel blending

4.5.1 Liquefied Petroleum Gas

Liquefied Petroleum Gas (LPG), known for its high calorific value and clean-burning properties, is widely utilized across the domestic, industrial, and transport sectors. In India, LPG remains the most preferred fuel for households to meet their cooking and heating requirements, with the majority of LPG consumption occurring in the residential sector. Beyond domestic applications, a portion of LPG is also used in chemical and metallurgical industries, supporting diverse manufacturing processes. Additionally, the transport sector also utilizes LPG, although its share remains relatively small, underscoring its significant yet limited role in India's energy mix.

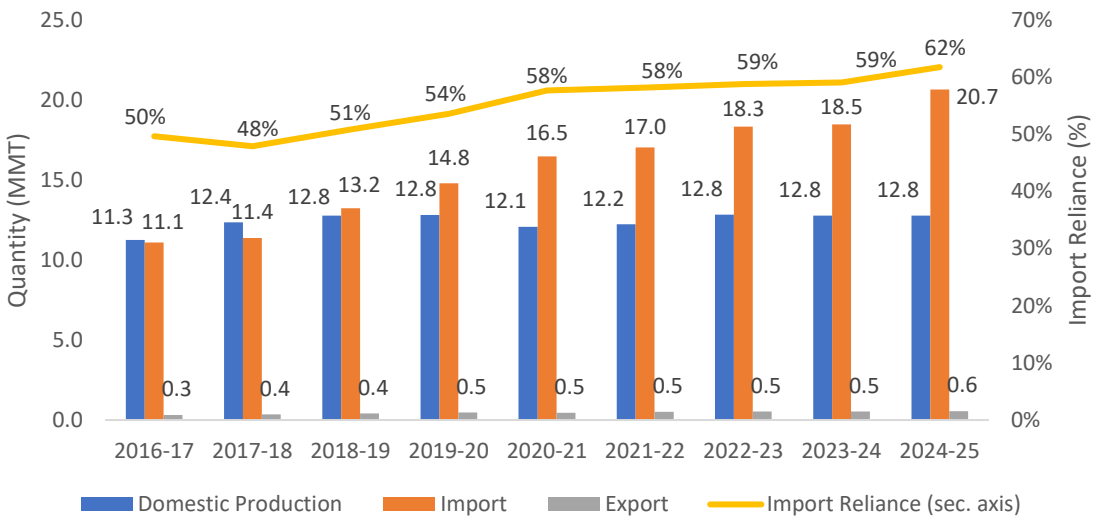


Figure 32: Domestic Production, Import and Export of LPG in India

Source: (PPAC, 2025)

Figure 32 illustrates the trends in domestic production, imports, and exports of LPG over the last eight years. India's LPG imports have shown a significant increase, rising from 11.1 MMT in 2016-17 to 20.7 MMT in 2024-25, exhibiting a CAGR of about 8 percent over this period. This surge has been primarily driven by the expansion of household LPG coverage under Government schemes, particularly the Pradhan Mantri Ujjwala Yojana (PMUY), along with rising urban demand, leading to an increase in import dependency from 50 per cent in 2016-17 to 62 per cent in 2024-25.

India's domestic LPG production, on the other hand, has shown only a modest increase, from 11.3 MMT in 2016-17 to 12.8 MMT in 2024-25, growing at a CAGR of 1.6 percent. However, the growth in production has not kept pace with the rising demand in the country. This highlights the need to further strengthen domestic refining capacity and encourage investments in upstream projects to reduce reliance on imports in the future.

The increasing dependency on imported LPG significantly influences the pricing dynamics of LPG in the country. The Government launched PAHAL (Pratyaksh Hanstantrit Labh) or Direct Benefit Transfer of LPG (DBTL) scheme in 2014 to address the rising price of domestic LPG. Under this scheme, LPG cylinders (14.2 kg) for domestic consumers are sold at market-linked prices or non-subsidised prices, and the eligible subsidy is directly transferred into the bank accounts of consumers. This approach ensures that consumers receive the financial benefit without distorting the market price of LPG.

4.5.2 Naphtha

Naphtha is typically used in industries such as petrochemicals, solvents, fuel blending and fertilizers. It is also used as a raw material to produce gasoline, plastics, and chemicals.

The production of domestic naphtha was 18 MMT in 2024-25. Additionally, India's export in naphtha was at 8.7 MMT in 2016-17 which reduced to 5 MMT in 2024-25. Imports of Naphtha also decreased from 2.8 MMT in 2016-17 to 1 MMT in 2024-25.

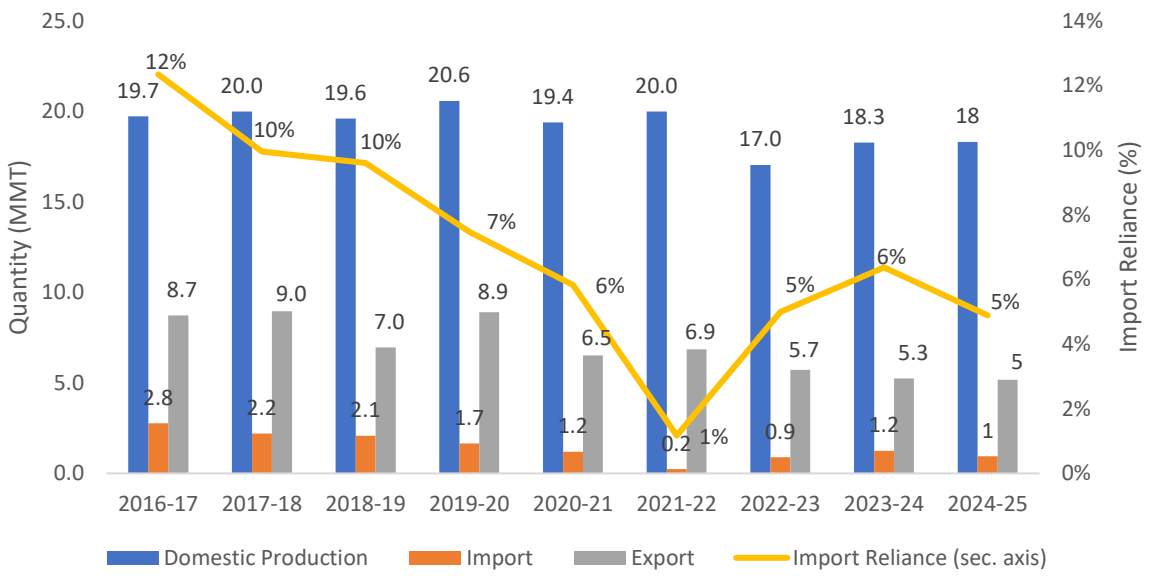


Figure 33: Domestic Production, Import and Export of Naphtha in India

Source: (PPAC, 2025)

4.5.3 Kerosene

Kerosene, a flammable hydrocarbon liquid, serves as household fuels for cooking, lamps and heaters. It is also used in jet engines in its refined form, and as a solvent for greases and insecticides. Households are responsible for about 56 percent of the total kerosene consumption. In the last eight years, there is a substantial drop in the production of kerosene, from 6 MMT in 2016-17 to 1 MMT in 2024-25. The primary reason behind this drop is the alternative choice for sources of energy by individuals. The PM UJJWALA Scheme was a catalyst in reducing the consumption of kerosene by substituting its usage with LPG in the domestic sector.

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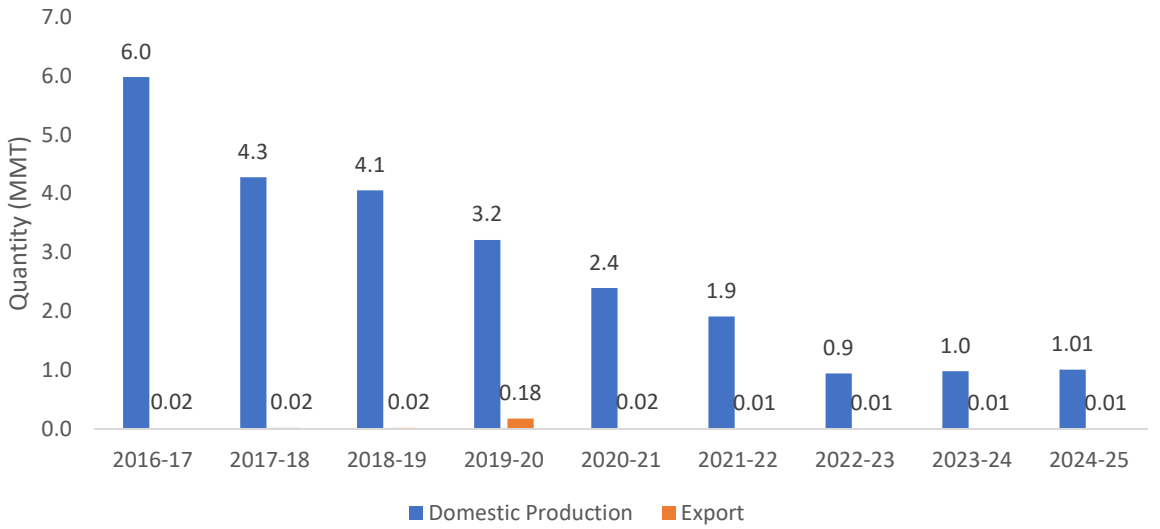


Figure 34: Domestic Production and Export of Kerosene

Source: (PPAC, 2025)

4.5.4 Aviation Turbine Fuel

Aviation Turbine Fuel (ATF), commonly known as jet fuel, is a petroleum-based product or a blend of petroleum and synthetic fuels primarily used to power aircraft engines. In addition, ATF also functions as a hydraulic fluid in aircraft engine control systems and aids in cooling specific fuel system components.

The growth in India's air travel is underscored by the surge in domestic ATF production, which reached 17.8 MMT in 2024–25. This growth reflects a Compound Annual Growth Rate (CAGR) of 3.2 percent over the last eight years. The COVID-19 pandemic severely impacted the sector, with nationwide lockdowns and travel restrictions leading to a sharp 53 percent decline in production and a 49 percent drop in exports in 2020-21 compared to the previous year, However, since 2020-21, India has achieved self-sufficiency in ATF, with zero dependence on imports.

In 2024-25, India strengthened its position in the global export market with ATF exports reaching 8.6 MMT. Netherland, United Arab Emirates, United Kingdom, Togo, etc., forms the major markets for Indian ATF export.

The aviation sector aims to produce Sustainable Aviation Fuel (SAF) using indigenous feedstocks and technologies, starting with used cooking oil (UCO) and gradually expanding to other feedstocks such as sugarcane molasses. India plans to use 1 percent blending of SAF for its international commercial flights by 2027, which would require around 140 million litres of SAF per year, with an aim to increase this to 2 percent blending by 2028 (PIB, Nov 2023).

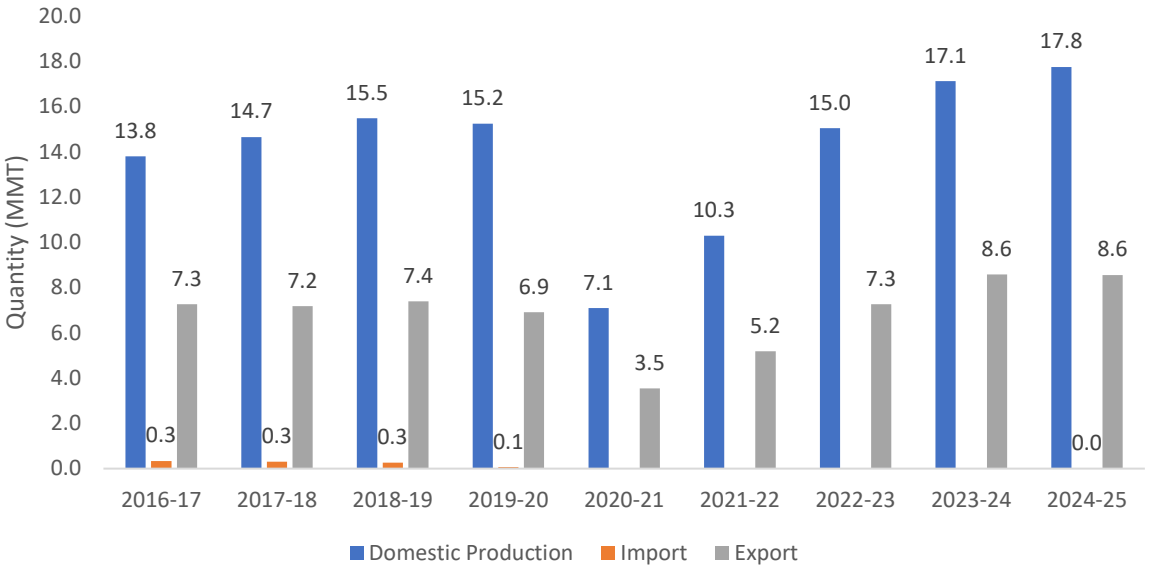


Figure 35: Domestic Production, Import and Export of ATF

Source: (PPAC, 2025)

4.5.5 Diesel

Diesel is one of the most important petroleum fuels in India, widely used in heavy-duty vehicles such as trucks, buses, trains, ships, and industrial machinery. Due to its high energy density and efficiency, diesel remains the backbone of transportation and industrial activity across the country. This section covers both High-Speed Diesel (HSD) and Light Speed Diesel (LSD).

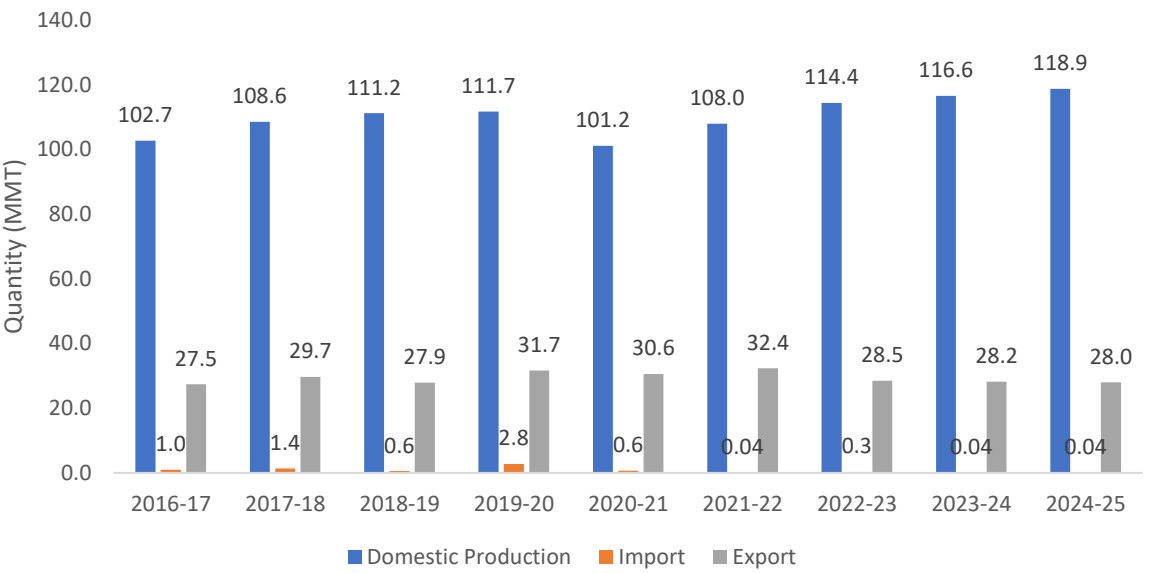


Figure 36: Domestic Production, Import and Export of Diesel

Source: (PPAC, 2025)

Over the years, India has maintained strong domestic production of diesel, meeting almost the entire national demand through its refineries. As shown in Figure 36, domestic production increased from 102.7 MMT in 2016-17 to 118.9 MMT in 2024-25, registering a compound annual growth rate (CAGR) of 1.8 percent.

However, production dipped to 101.2 MMT in 2020-21, marking a 9 percent decline compared to the previous year. This fall was primarily due to the COVID-19 pandemic, which severely disrupted fuel demand, industrial activity, and transportation during nationwide lockdowns. As economic activity resumed post-pandemic, diesel output quickly recovered, crossing 114 MMT in 2022-23 and continuing to grow thereafter.

On the trade front, diesel imports declined, though the overall import volume continued to be quite low. Exports, on the other hand, remained significant, averaging around 29 MMT annually, as Indian refineries supplied surplus diesel to key international markets, leveraging the country's refining strength.

4.5.6 Petroleum Lubricant

Petroleum-based lubricants are used to reduce the friction between the surfaces. Lubricants come in various forms, including motor oils, gear oils, hydraulic fluids, and greases, and are widely used in automotive, industrial and commercial applications to maintain the efficiency and longevity of the machinery.

The trends in the domestic production, import and export of Petroleum Lubricant in India are represented in Figure 37.

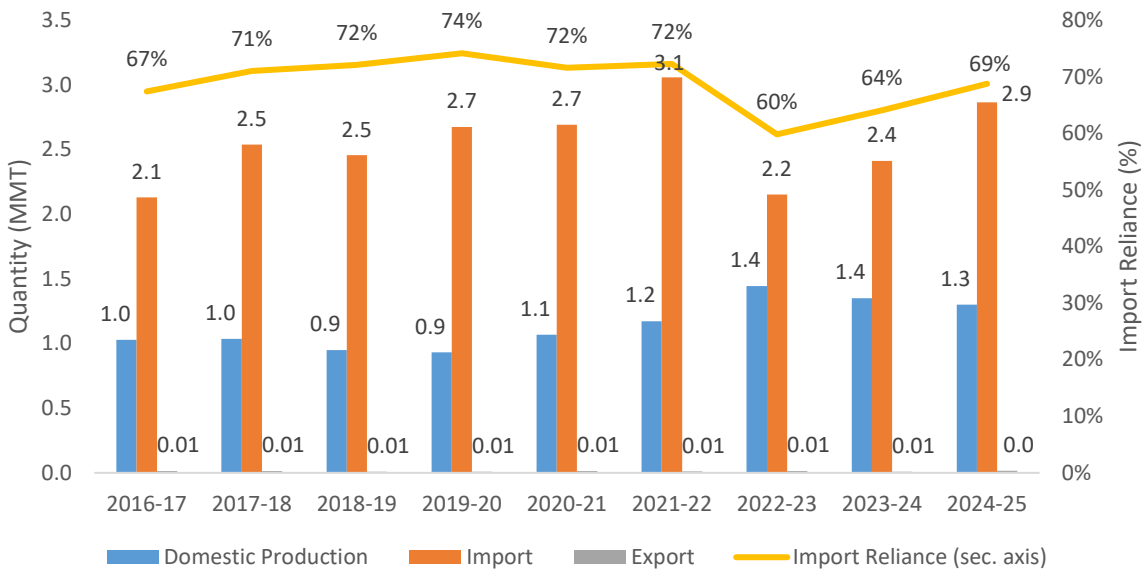


Figure 37: Domestic Production, Import and Export of Petroleum Lubricants

Source: (PPAC, 2025)

- Domestic production grew at a CAGR of 3 percent from 2016-17 to 2024-25.
- Imports increased by 4 percent every year over the same period.
- Imports of petroleum lubricants were twice the output of domestically produced lubricants, reflecting a heavy reliance on imports to meet the demand, while exports remained minimal.

4.5.7 Petroleum Coke

Petroleum coke, also known as pet coke, is used as a carbon source or feedstock in various industrial applications, including cement, iron & steel, power generation, and metal smelting.

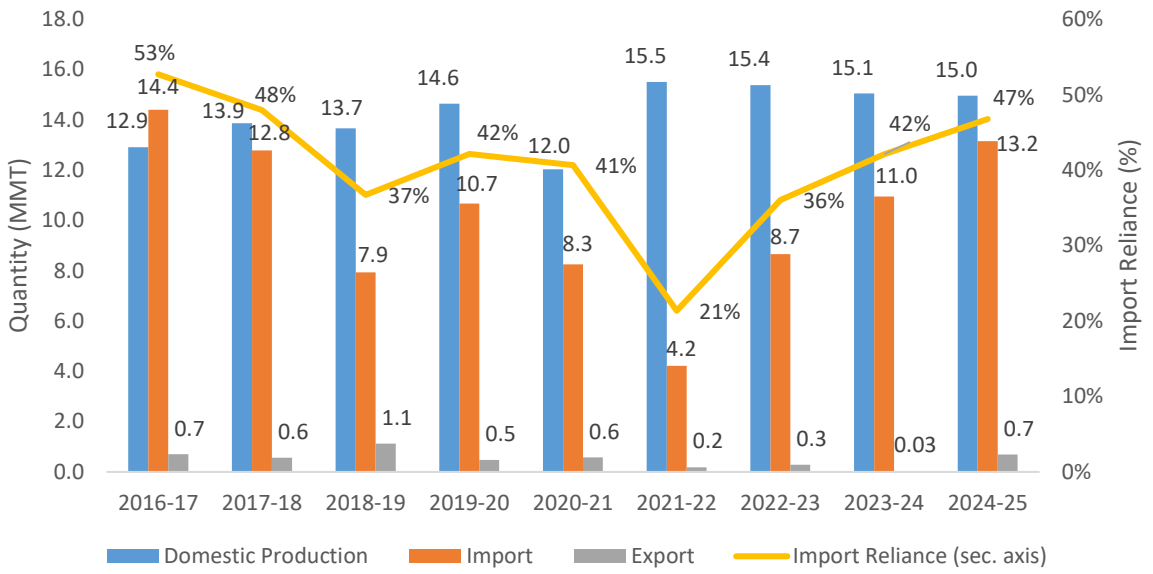


Figure 38: Domestic Production, Import and Export of Pet coke

Source: (PPAC, 2025)

- In 2024-25, 53 percent of the total pet coke available was produced domestically
- From 2016-17 to 2024-25, imports of pet coke gradually dropped by 1.1 percent each year. Exports in pet coke declined by 0.1 percent during the same period due to rising demand from industrial sectors and a relatively higher focus on domestic consumption.

4.5.8 Bitumen

Bitumen is primarily used in the construction industry, as a binding agent in the production of asphalt concrete for road construction and maintenance. It is also utilised in waterproofing products and roofing materials.

The data in Figure 39 illustrates a significant reliance on imports to meet the country's bitumen demand over the last eight years. India is the third largest importer of bitumen worldwide, reaching 2.9 MMT in 2024-25 from 1 MMT in 2016-17. This surge reflects a notable 15 percent CAGR. However, domestic production has remained similar throughout this period.

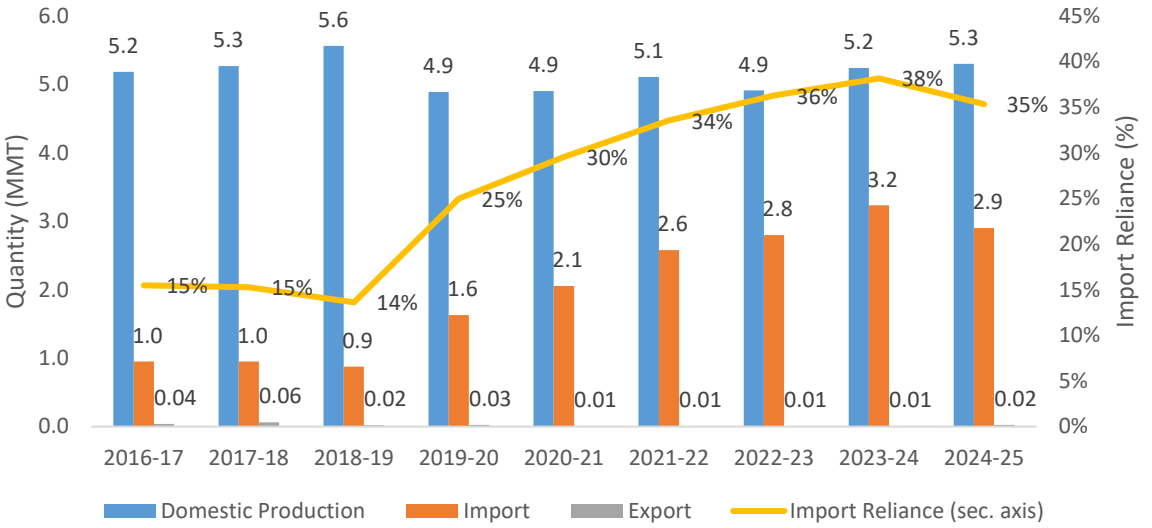


Figure 39: Domestic Production, Import and Export of Bitumen

Source: (PPAC, 2025)

4.5.9 Petrol

Petrol or gasoline, is widely used as a transportation fuel, though also used in other applications, such as powering small engines, generators, and lawn mowers.

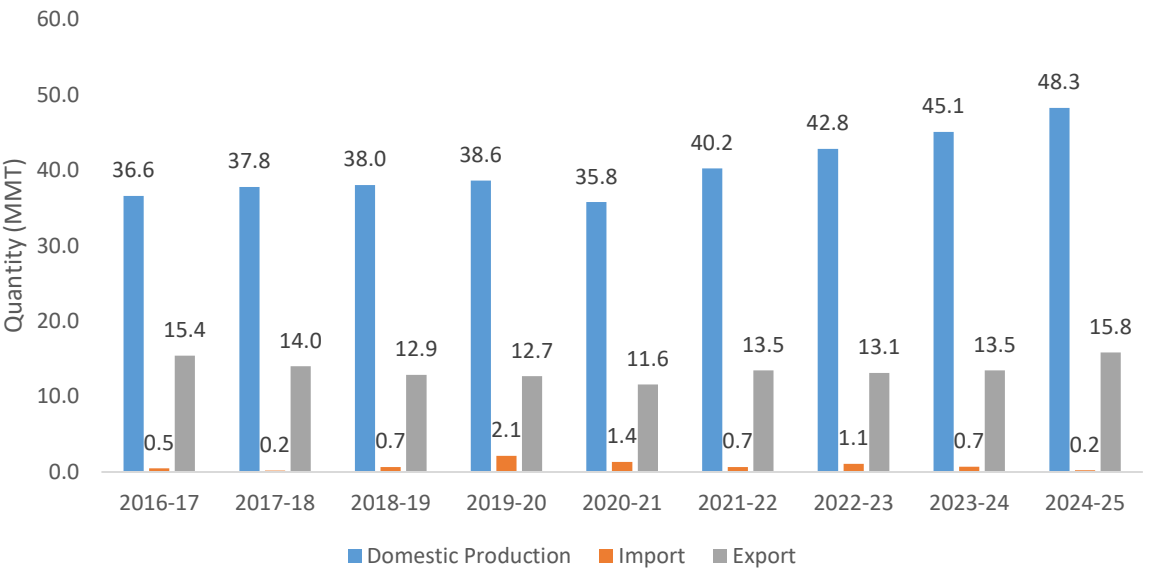


Figure 40: Domestic Production, Import and Export of Petrol

Source: (PPAC, 2025)

- Domestic petrol production has increased by 3.5 percent CAGR over the past eight years.
- The exports increased by 0.3 percent CAGR over the same period, while imports remained quite low.

4.6 Electricity

Electricity plays a significant role in shaping nation's infrastructure and economy, as it is one of the most efficient forms of energy used across all sectors. It powers homes, industries, transport, and services, making it the backbone of both daily life and the economy. India's electricity grid has undergone significant transformation, marked by the creation of a unified national grid and the achievement of 100 percent village and household electrification through schemes like Saubhagya and Deen Dayal Upadhyaya Gram Jyoti Yojana. India has also worked to cut down technical and commercial losses, improve distribution efficiency, and promote energy conservation through programs such as UJALA, Standards & Labelling (S&L) and Energy Conservation and Sustainable Building Codes (ECSBC).

India's electricity generation mix is quite diverse. India's electricity generation basket ranges from conventional sources such as coal, lignite, diesel, natural gas, hydro and nuclear, as well as alternative sources like wind, solar, biomass and waste-to-energy. In recent years, renewable energy has grown rapidly, supported by government initiatives such as the National Solar Mission and Green Energy Corridor Project. This shift has also been driven by the growing need to reduce carbon emissions and move towards cleaner sources of power. With the rapid increase in demand for electricity, India is the third-largest producer of electricity in the world and there has been a substantial surge in capacity expansion to meet the country's needs.

4.6.1 Utility

Electricity Capacity

India stands as the third largest electricity producer worldwide, with a total installed capacity of 475.2 GW (Utility-based) as of March 2025. The country's total installed capacity has grown steadily from about 276 GW in 2014-15 to 475 GW in 2024-25, reflecting a CAGR of around 5.6 percent over the last decade. Coal-based power plants continue to hold the largest share, contributing around 47 percent of the total installed capacity. This share has come down from about 60 percent in 2014-15, showing a clear effort of the country to shift from fossil fuels to cleaner sources.

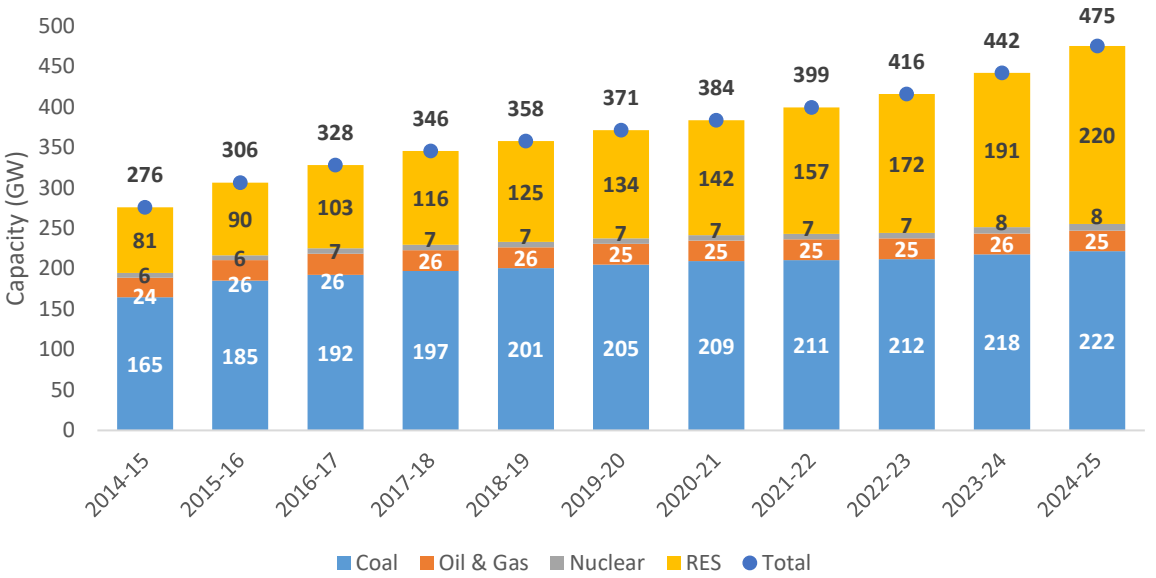


Figure 41: India's Electricity Installed Capacity (Utility)

Source: (CEA, 2025)

From 2014-15, non-fossil fuel-based capacity, including renewable energy and nuclear power, has grown rapidly at a CAGR of around 10 percent, reaching 228 GW as of March 2025. This growth has mainly been driven by renewables. The share of renewable energy sources in total installed capacity has increased steadily from about 29.4 percent in 2014-15 to over 46.3 percent in 2024-25.

India has already achieved its Nationally Determined Contribution (NDC) target of having 50 percent of its total installed power capacity from non-fossil fuel sources, five years ahead of the 2030 goal (as per the Ministry of Power and Reuters report, July 2025). Non-fossil fuel-based capacity stands at around 243 GW, accounting for 50.07 percent of the total installed capacity (PIB, 2025).

Renewable Energy

Renewable energy (RE) includes a diverse range of sources such as hydro, solar, wind and bio-power. In the last few years, India has emerged as a prominent player in the global RE sector. As of March 2025, India's installed renewable capacity stood at about 220 GW (Utility-based), making up roughly 46 percent of the country's total 475 GW electricity capacity. Solar accounts for about 48 percent of the renewable capacity, followed by wind at 22.73 percent. Hydropower contributes nearly 24 percent of the renewable mix (21.69 percent large hydro and 2.3 percent small hydro), while bio-power accounts for the remaining 5.26 percent.

Over the last ten years, solar capacity has expanded more than 20 fold, reaching 106 GW by March 2025. Of this, around 81 GW is ground-mounted solar (77 percent), 17 GW is rooftop (16 percent), and the remainder comes from hybrid and off-grid systems. Rooftop solar, which began in 2017–18 with merely 1 GW, has surged to 17 GW by 2025, reflecting an annual growth of 49 percent.

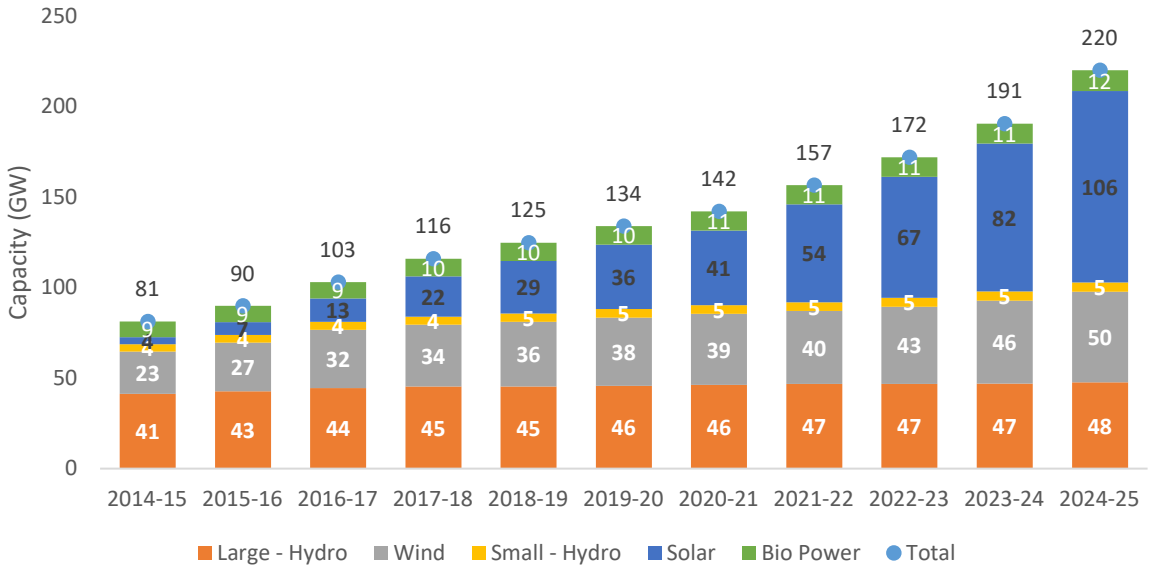


Figure 42: Renewable Energy Installed Capacity (Utility)

Source: (CEA, 2025)

To speed up rooftop solar adoption in the residential category, the Government launched the PM Surya Ghar Muft Bijli Yojana in February 2024. This scheme aims to install RTS capacity for one crore households aiming to provide up to 300 units of free electricity per month per household, with a total financial outlay of Rs. 75,021 crores (MNRE, 2024). As of January 2025, 8.46 lakh households have benefited under the scheme. (PIB, 2025).

This rapid growth in solar energy capacity is primarily driven by various initiatives taken by the Government. One such initiative is the Production-Linked Incentive (PLI) scheme, which has been crucial in boosting domestic solar cell and module manufacturing to make India a global leader in the solar industry and reduce the country's dependence on imports, particularly from China. This initiative aligns with the vision of Atma Nirbhar Bharat.

On the wind side, India ranks fourth globally in cumulative wind capacity, with 50 GW by March 2025. Wind power contributes around 23 percent to the total renewable energy capacity (220 GW) and represents 10.5 percent of the total electricity capacity in the country. The wind capacity installation has grown at a CAGR of 8 percent, over the last ten years.

The reason behind this growth is a mix of supportive policies, compliance with wind Renewable Purchase Obligation (RPO) targets set by the State and Central Governments, falling technology costs, the development of wind and renewable energy parks to provide ready infrastructure, dedicated grid integration, and increasing demand from the commercial and industrial sector.

In the first half of FY 2026 (April–September 2025), India added 25 GW of new renewable capacity (led by solar) - the highest ever in a six-month period. (MNRE, 2025). The expansion of large-scale solar and wind projects, such as the Gujarat Hybrid Renewable Energy Park, and the government's announcement to tap around 76 GW of hydropower potential in the Brahmaputra basin, have further strengthened India's renewable ecosystem.

Electricity Generation:

India's electricity generation has shown a consistent annual growth of 5 percent over the past ten years. In 2024-25, the country generated 1824 BU of electricity. Coal-based electricity holds the largest share in generating electricity, accounting for nearly 73 percent, followed by the low carbon sources like renewable energy at 22.1 percent, nuclear at 3.1 percent and oil and gas together making up the remaining 1.8 percent. Coal- and nuclear-based generation have each grown at a CAGR of around 5 percent over the last ten years, while oil & gas–based generation has declined at a CAGR of about 3 percent during the same period.

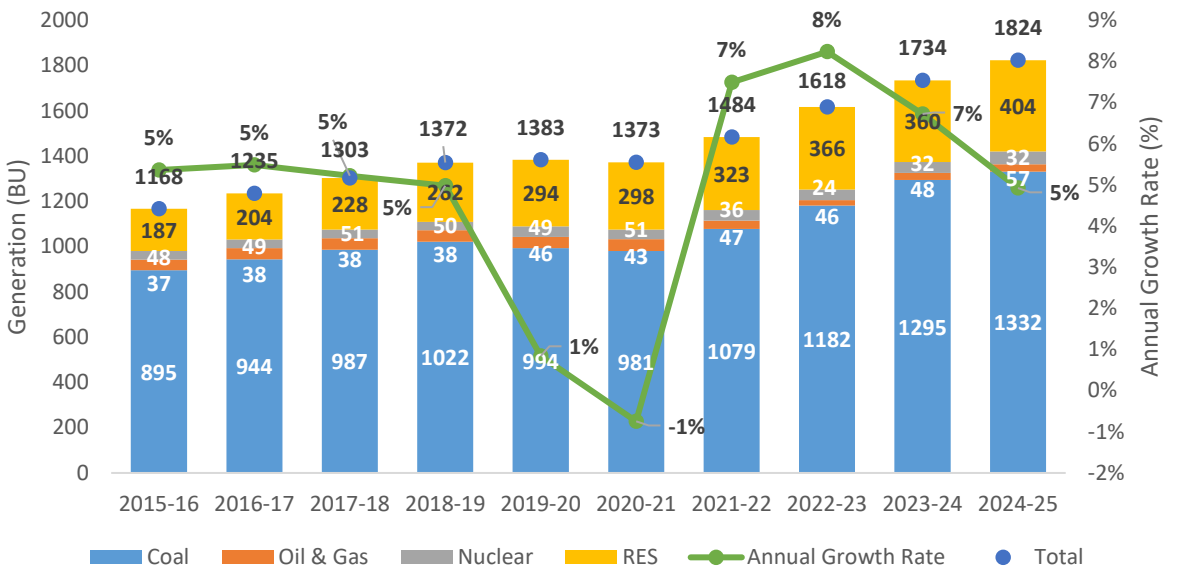


Figure 43: Source-wise Electricity Generation

Source: (CEA, 2025)

There has been a significant growth in capacity addition of Renewable Energy (RE). In addition to it, India also witnessed a substantial increase in generating renewable energy. The graph below shows the RE generation across all sources for utilities from the span of 2014-15 to 2024-25. Over this period, electricity generation from renewable energy sources experienced a CAGR of 8 percent, rising from 191 BU in 2014-15 to 404 BU in 2024-25. This growth in renewable generation is higher than that of fossil-fuel-based generation, but still slightly lower than the growth seen in renewable installed capacity, which stood at around 10 percent during the same period. Within this segment, hydro still holds the largest share at around 40 percent of the total generation from renewables, but its growth in the past ten years has remained relatively modest at about 1.6 percent per year. In contrast, solar energy has emerged as the fastest-growing source, accounting for 36 percent of total renewable generation and exhibiting a remarkable annual growth of 41 percent over the past decade. Wind energy contributes around 21 percent of renewable generation, growing at approximately 9.5 percent annually during the same period.

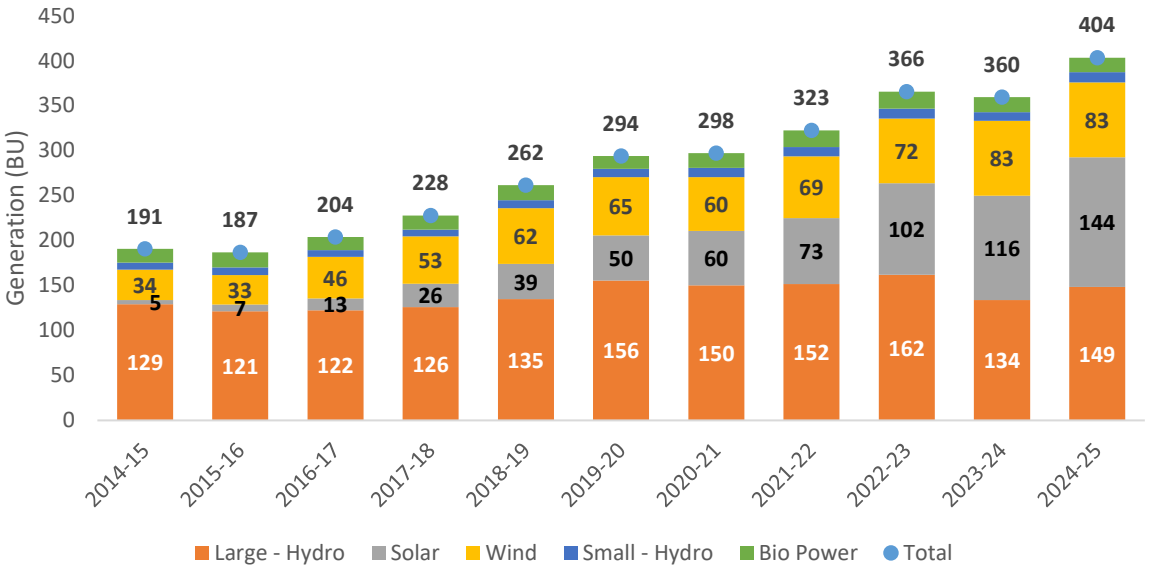


Figure 44: Source-wise Renewable Electricity Generation

Source: (CEA, 2025)

4.6.2 Non-Utility Plants

Installed Capacity

Non-utility plants, also called captive power plants, are set up mostly by big industries like aluminium, cement, chemicals, fertilizers, iron and steel, paper, and sugar. These plants help them get extra power besides what they buy from the grid, or act as backup when the main supply fails or gets unreliable. In this context, we are referring to captive plants with a demand of 0.5 MW and above.

The non-utility generating capacity stood at 81.7 GW as of 2024-25, reflecting a CAGR of around 6.2 percent over the past ten years. India's industrial sector expanded a lot, with power demand from heavy industries rising. Policies like Make in India pushed manufacturing, needing more reliable power. In total capacity, 57 percent is contributed by coal, marking the largest share, followed by 24 percent by diesel, 11 percent by renewables, 8 percent by gas and 0.1 percent by hydro.

Figure 45 shows coal based capacity remains stable at around 45-48 GW in recent years, even though the total captive capacity has kept growing. Industries continue to use coal mainly because it is easily available and affordable. Diesel-based capacity has been rising in the last few years, while gas-based plants remain quite small and have stayed almost unchanged at around 6-7 GW.

In 2014–15, captive renewable capacity was just about 1 GW - roughly 2.9 percent of the total. By 2024-25, it has grown to nearly 9.1 GW, taking its share to around 11.2 percent. This increase is largely due to supportive policies such as tax incentives, falling solar equipment costs, and RPO requirements that encourage industries to add renewable capacity on their own.

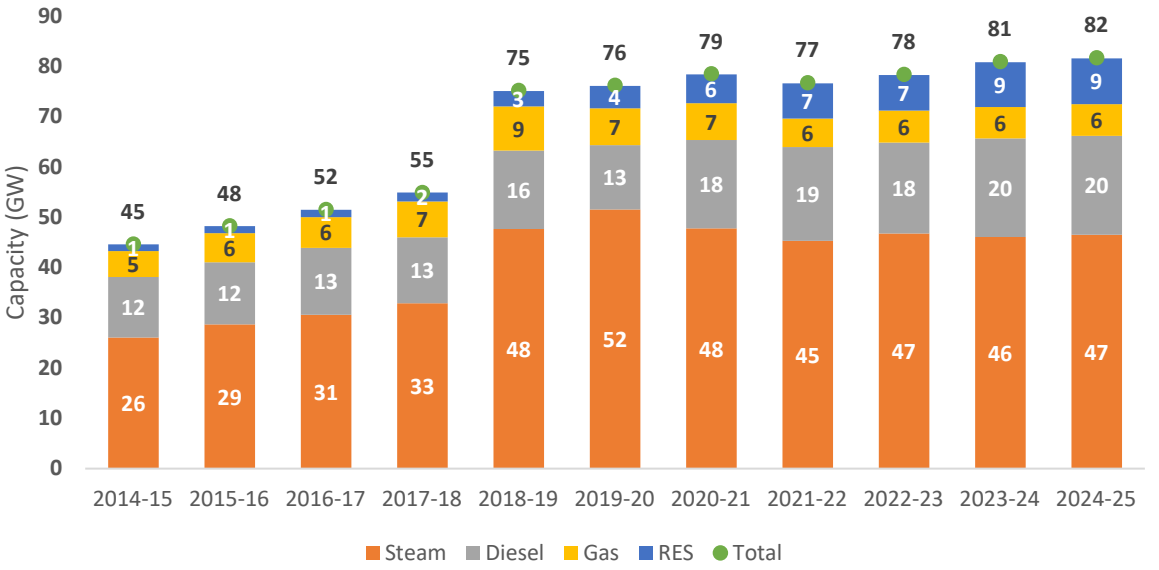


Figure 45: Source-wise Installed Capacity of Non-Utility Plants

Source: (CEA, 2025)

Generation

Non-utility or captive power plants play a key supporting role for industries. In 2024-25, these plants produced 235 Billion Units (BU) of electricity. This marks a steady average growth of 3.8 percent per year since 2014-15, when generation stood at 162 BU. The gross generation dipped by 6 percent in 2020-21 as compared to the 2019-20, due to the COVID restrictions. Industries like aluminium, fertilizers, and textiles halted production during this period, many captive units ran at 20-30 percent load or shut down. The generation also dipped in 2021-22 by 7 percent mainly due to the conversion of some non-utility plants to utility plants.

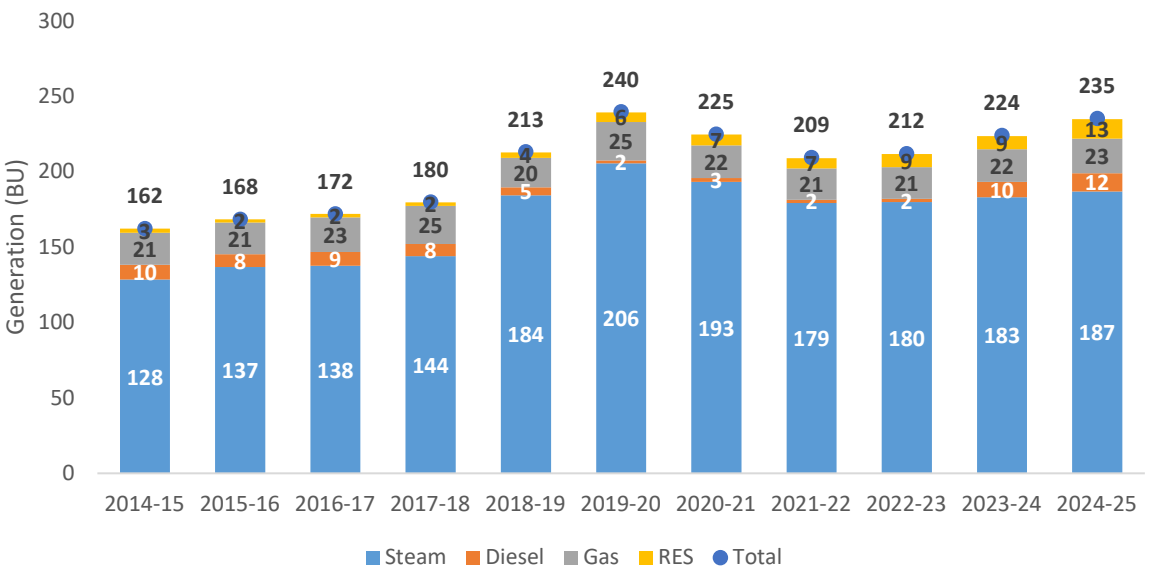


Figure 46: Source-wise Electricity Generation of Non-Utility Plants

Source: (CEA, 2025)

In 2014-15, steam-based generation (mainly coal) dominated captive power output with a 79.1 percent share, followed by gas-based generation at 13 percent, diesel-based generation at 6.1 percent, renewables-based generation at just 1.6 percent, and hydro-based generation nearly negligible at 0.1 percent. Over the decade, steam-based generation has held its ground, rising slightly to 79.5 percent by 2024-25, reflecting the continued reliance on coal for reliable and consistent power in industries like cement, steel, and paper. Gas-based generation, however, saw a clear decline to 9.8 percent, hit by high LNG prices and limited domestic supply. Diesel dipped a bit to 5.1 percent, used mostly as backup. The big shift came from renewables, which grew more than threefold to 5.4 percent, still small in generation compared to their 13.1 percent installed capacity share, due to lower running hours of solar and wind, but a clear sign of industries adopting cleaner options where possible.

State's Insights on Electricity Supply

Table 7 presents an overview of electricity supply (utility) in key states for the year 2024–25, covering both installed capacity and electricity generation.

Table 7: Overview of Electricity Supply (Utility) in key states in the year 2024-25

State/UT	Installed Capacity (MW)	Share in Total Capacity (%)		Generation (MW)	Share in Total Capacity (%)	
		Non RE	RE		Non RE	RE
Gujarat	58.22	73%	27%	105.73	91%	9%
Maharashtra	51.67	60%	40%	145.02	79%	21%
Rajasthan	47.12	0%	100%	73.42	0%	100%
Tamil Nadu	43.08	70%	30%	91.71	84%	16%
Uttar Pradesh	36.19	94%	6%	166.21	99%	1%
Karnataka	34.67	0%	100%	51.95	0%	100%
Madhya Pradesh	32.83	93%	7%	146.12	98%	2%
Andhra Pradesh	30.02	0%	100%	72.87	0%	100%
Chhattisgarh	25.52	85%	15%	166.43	84%	16%
Telangana	17.93	45%	55%	56.97	0%	100%

Source: (CEA, 2025)

Uttar Pradesh and Madhya Pradesh continue to rely heavily on fossil fuels, with more than 90 percent of both installed capacity and generation coming from conventional sources. Chhattisgarh, Gujarat and Tamil Nadu also record a high share of non-renewables in generation, indicating continued dependence on thermal power for meeting demand. In contrast, Rajasthan, Karnataka, and Andhra Pradesh report a fully renewable installed capacity profile in the utility segment, while Telangana and Maharashtra show a growing share of renewable capacity.

However, in several of these states, renewable capacity additions are yet to translate proportionately into generation share, as conventional sources still account for a larger portion of electricity production. Overall, the 2024–25 trends reflect steady progress in renewable capacity expansion alongside continued reliance on thermal power for grid stability and base-load requirements.

Chapter 5: Demand side - Trends and Analysis

Electricity Demand

India has continued to witness a steady increase in electricity consumption across all major sectors over the years. In 2024-25, total electricity consumption reached 1,623 BU, recording an increase of about 5 percent over the previous year. This increase in electricity consumption is driven by the rising demand from residential, commercial, and industrial sectors.

The industrial sector remains the largest consumer of electricity, accounting for nearly 40 percent of total consumption in 2024-25. Electricity demand from this sector has grown steadily in line with expanding manufacturing output, infrastructure development, and increased production activities, underscoring the critical role of reliable power supply in supporting India's industrial growth.

The residential sector is the second-largest consumer, contributing around 25 percent of total electricity usage, with an annual growth rate of 7 percent, driven by rising living standards, increased penetration of electrical appliances, particularly for space cooling and improved electricity access in both rural and urban areas. Government initiatives such as the Sahaj Bijli Har Ghar Yojana (Saubhagya Scheme) have played an important role in expanding household electrification and supporting this growth.

The agriculture sector accounts for about 16 percent of total electricity consumption, making it the third-largest consumer. Electricity use in this sector has shown a consistent upward trend, largely due to improved access to power and the increasing adoption of electric pumps for groundwater irrigation. The Government's efforts to phase out diesel pumps and promote electric alternatives have further contributed to the rising electricity demand in agriculture.

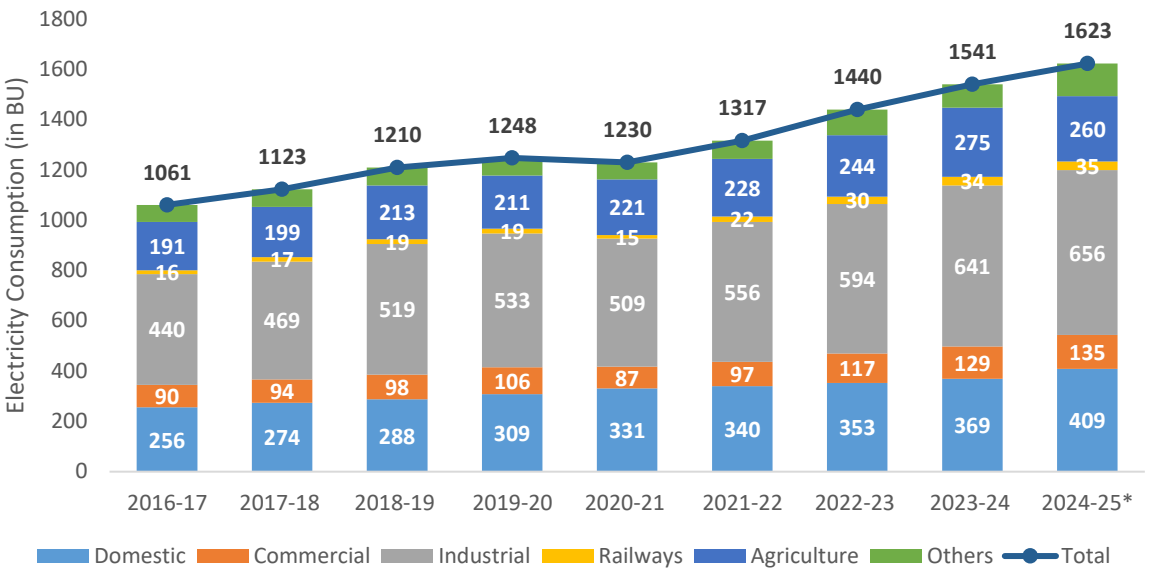


Figure 47: Sector-wise Electricity Consumption

Source: (CEA, 2025)

Electricity Peak Demand

India's electricity demand surged to a record high of 250 GW in 2024-25, reflecting a 3 percent rise from 2023-24. The increase in peak demand has been driven by a combination of factors. Higher industrial and commercial activity, supported by steady economic growth, has contributed significantly to electricity consumption during peak hours. In addition, rising space cooling requirements, particularly during periods of higher ambient temperatures, have played an important role in pushing demand to new levels.

Emerging sources of demand, including the growing adoption of electric vehicles and associated charging infrastructure, the expansion of Global Capability Centres (GCCs), have also begun to add to peak electricity requirements. Despite the sharp rise in demand, the power system was able to meet the peak requirement in 2024-25, reflecting improvements in generation capacity, transmission infrastructure, and system planning.

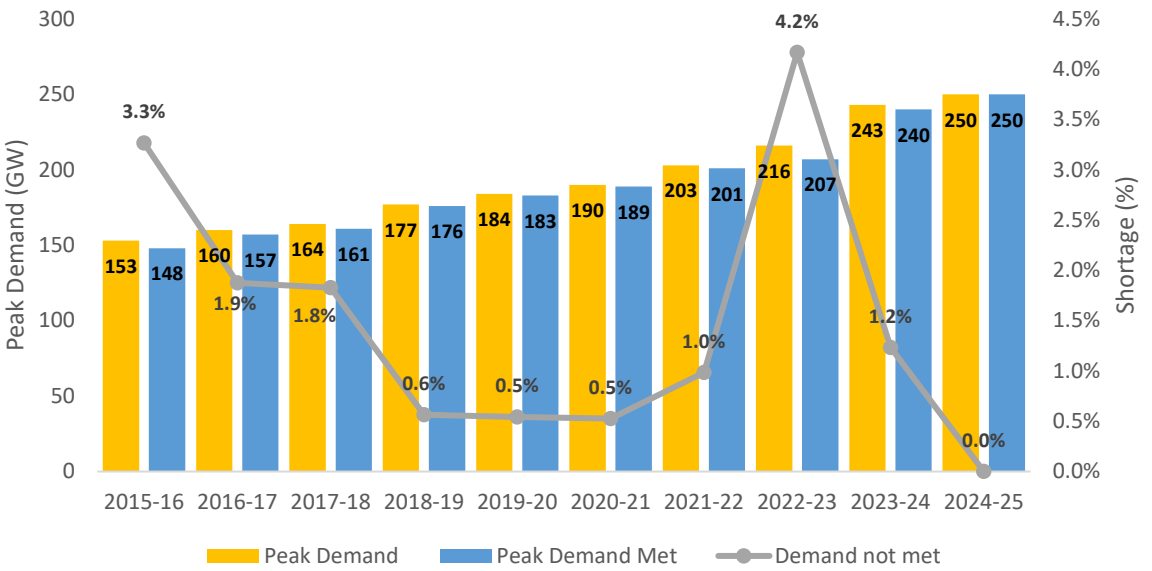


Figure 48: India's Peak Electricity Demand Trends

Source: (CEA, 2025)

Over the last decade, India's peak electricity demand has grown steadily at an average rate of about 5.4 percent, increasing from 148 GW in 2014 to around 250 GW in 2024. In the years prior to the COVID-19 pandemic, peak electricity demand in India generally occurred during the monsoon months of August and September, driven largely by higher residential and commercial consumption, particularly for lighting and space cooling under humid conditions.

However, since 2022, a clear shift in the timing of annual peak demand has been observed, with peak loads increasingly occurring during the summer months between April and July. This shift is primarily attributed to rising temperatures**,** more frequent and intense heatwaves**,** and rapidly growing space cooling demand, especially during April and May.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2012	125	130	128	129	133	135	130	128	132	134	127	129
2013	133	128	132	132	136	133	131	132	135	131	128	131
2014	135	136	136	142	142	148	146	146	146	146	137	142
2015	140	139	143	137	144	142	145	149	153	151	141	138
2016	138	143	145	153	151	149	147	151	160	155	149	145
2017	148	150	155	159	160	156	157	164	162	162	151	153
2018	159	159	162	162	172	172	170	173	177	173	163	164
2019	164	162	169	177	184	184	177	179	175	165	156	172
2020	172	179	171	133	167	167	172	169	177	171	161	184
2021	190	190	186	183	169	194	203	198	181	180	167	184
2022	193	194	202	216	206	212	192	197	200	187	188	206
2023	213	211	209	216	222	224	209	239	240	222	205	214
2024	223	223	222	224	250	246	227	217	231	219	208	224
2025	237	238	235	235	232	243	221	230	229	211		

Figure 49: Monthly Peak Demand Variations (in GW)

Source: (CEA, 2025)

*Green to Red Colours Signify the Increasing Intensity of Peak Demand

5.1 Industry

Industries in India are categorised into energy-intensive and non-energy-intensive sectors both playing a vital role in the nation's economic landscape. Energy-intensive industries like aluminium, cement, chlor-alkali, fertilizer, iron and steel, petrochemicals, pulp and paper, and textiles require substantial energy to operate. Non-energy-intensive sectors, such as automotive, food processing, pharmaceuticals, and IT, include a diverse array of micro, small, and medium enterprises, typically consume less energy per unit of output.

The industrial sector continues to be one of the strongest contributors to India's growth. In 2024-25, the secondary sector, which includes manufacturing, mining, electricity, gas, water supply and construction, accounts for about around 28 percent of the Gross Value Added for the country at current prices (MOSPI, 2025). In 2024-25, the industry sector is responsible for around 50.1 percent of the total final energy consumption (excluding biomass and biofuels), making it the biggest energy-using sector in the country, consuming roughly around 40 percent of the total electricity consumption.

Industrial energy consumption data indicates that large quantum of energy usage is linked to unspecified industries, with no further segmentation or detailed insights available for these sectors. The publicly accessible data on industrial fuel consumption is inadequate, with notable gaps, particularly regarding sector-specific fuel usage and its applications, such as power generation or industrial processes. This data is essential for analysing fuel consumption patterns and formulating effective decarbonisation strategies or sectoral net-zero initiatives. Further, under the PAT scheme, eight energy-intensive industries were identified. Their energy-consuming plants consuming energy beyond certain threshold limits, known as Designated Consumers (DCs), are mandated to report fuel usage and related data.

Policy Initiatives in the Industry Sector

As India aims to become a $30-35 trillion economy by 2047 under the 'Viksit Bharat 2047' vision, the industrial sector plays a pivotal role in turning that ambition into reality. To boost manufacturing, attract investment, and improve competitiveness, the Government of India has rolled out several landmark initiatives.

One of the earliest was the Make in India campaign, launched in September 2014. This aims to facilitate investment, foster innovation, enhance skill development, protect intellectual property & build best in class manufacturing infrastructure. Since its launch, the initiative has achieved significant progress across various sectors. The Foreign Direct Investment (FDI) inflows have doubled inflows from USD 45.15 billion in 2014-15 to USD 83.6 billion in 2021-22. It was a major accomplishment by its eighth year of implementation in 2021-22 (PIB, Sep, 2022).

To further develop manufacturing and support the 'Atmanirbhar Bharat' vision, the Government announced a Production Linked Incentive (PLI) Scheme for 14 key sectors. In August 2025 the government noted that across 14 sectors the PLI programme had helped attract investments of about ₹1.76 lakh crore and create over 1.2 million jobs, with production/sales of more than ₹16.5 lakh crore (Economictimes, June 2025). The incentive disbursement stood at about ₹21,534 crore over 12 schemes as of June 2025 (Lok Sabha reply), marking concrete progress beyond the original targets. Kicking in alongside are sector-specific versions such as PLI for “Automobiles & Auto Components”, PLI for “Advanced Chemistry Cell (ACC) Battery Storage” and the “Drone PLI” scheme, which further broaden the manufacturing base.

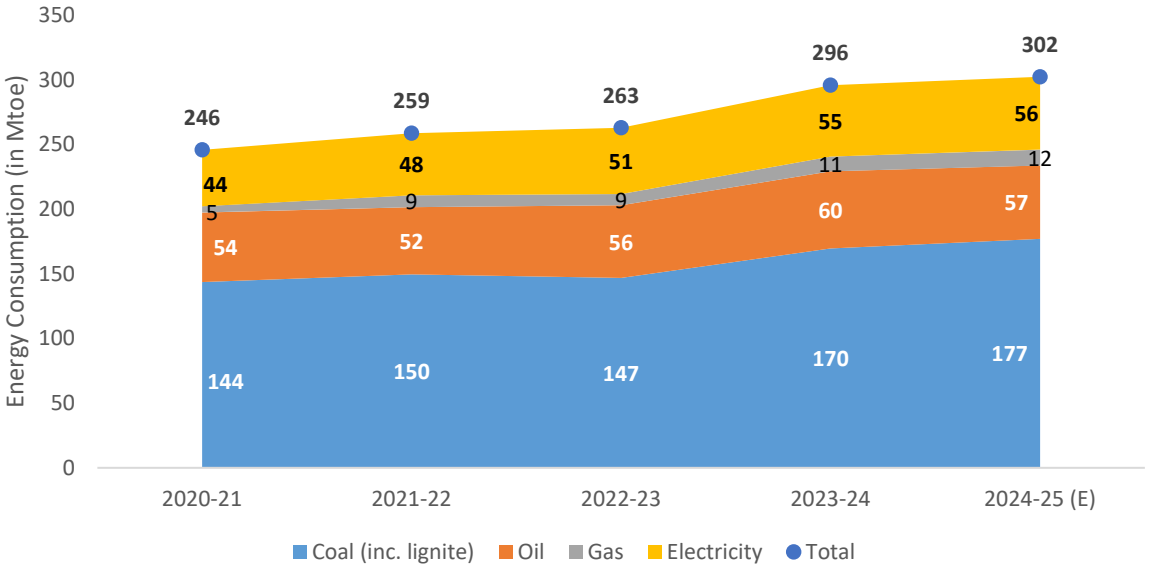
The Skill India Mission, launched in 2015, aims to equip youth with industry-relevant skills. The programmes like Pradhan Mantri Kaushal Vikas Yojana (PMKVY), Jan Shikshan Sansthan (JSS), National Apprenticeship Promotion Scheme (NAPS) and Craftsman Training Scheme (CTS) through Industrial Training Institutes (ITIs) are some initiatives. Since their launch, these programmes have trained around 2.55 crore of candidates (Digital Sansad a, Feb, 2024).

Efforts to make it easier to do business in the country are continuing, mainly through simplifying procedures, digitalise, decriminalise and removing old compliance rules that made things slow. The Department for Promotion of Industry and Internal Trade (DPIIT) works with different ministries and states to push these improvements. The Business Reform Action Plan (BRAP) assesses States/UTs on reforms such as investment enablers, transparency and online single-window systems. As a result, India improved its rank from 142nd in 2014 to 63rd in 2019 in the Doing Business Report, 2020 by World Bank taking a leap of 79 places in five years (PIB, Feb, 2024).

The PM Gati Shakti National Master Plan, launched in October 2021, aims to streamline multimodal infrastructure planning via a Geographic Information System (GIS) based platform, reducing logistics costs and enhancing efficiency. Till now, it has more than 1,614 GIS data layers mapped into the system, covering central ministries and state agencies, and showing rail lines, roads, ports, industrial clusters and utility networks. This helps identify gaps in connectivity for sectors like fertilizers, steel, food and coal, so that new links can be planned in the right places. Higher investment in transport infrastructure is also being directed through the national budget to support this approach. These steps are meant to lower logistics costs, reduce delays and create a better environment for industries to grow in the coming years.

As the industrial sector continues to grow, managing its energy demand becomes increasingly important. This substantial energy utilisation underscores the sector's importance in the economy. It also highlights the need for implementing advanced energy-efficient practices and technologies to sustain growth while mitigating environmental impacts.

A: Final Energy Consumption



(E) – Estimated

Figure 50: Final Energy Consumption in the Industry Sector

Source: Calculated based on actual data from various ministries

*Sector-wise allocation of natural gas consumption for the industry has been carried out using the BUR-4 natural gas consumption break-up.
*Natural gas used for non-energy purposes has been excluded from the final energy consumption of the industry sector.
*The energy consumption shown above does not include biomass and biofuels, which are discussed separately below.

- The total final energy consumption in the industry sector has been increasing over the past few years. It has gone up from 259 Mtoe in 2021-22 to about 302 Mtoe in 2024-25, which reflects a CAGR of around 5 percent.
- Coal continues to be the main source of energy for industries, and its consumption has remained the highest among all fuels, rising from 150 Mtoe to 177 Mtoe over this period. Coal now accounts for roughly 58 percent of the industrial energy use in the sector. Oil products are the next major contributor, and their consumption increased from 52 Mtoe to 57 Mtoe, representing about 19 percent of the industrial energy use. Electricity has also grown gradually, moving from 48 Mtoe to 56 Mtoe, which is also around 19 percent of the energy mix. Natural gas used for energy purposes in the industry sector remains a very small share at close to 4 percent of the energy mix.
- This pattern shows that while overall industrial energy use is rising, the sector is still heavily dependent on coal. The gradual increase in electricity use indicates a slow shift toward more electrified processes, but the change is not yet large enough to replace fossil fuels in a significant way. It should be noted that the above analysis excludes biofuels, which are discussed separately below.
- In the industrial sector, biofuels are used primarily in the form of solid biomass fuels such as bagasse, wood and other agro-residues, industrial by-products such as black liquor, and gaseous biofuels including biogas in select applications. These fuels are largely utilised for process heat and captive energy generation, enabling partial substitution of fossil fuels. The use of biofuels is most prominent across several industrial subsectors, including sugar, pulp and paper, brick manufacturing, textiles, cement, chlor-alkali and others.

- Based on TERI estimates from the biomass and biofuels assessment, the final energy consumption of biomass and biofuels in the industrial sector is estimated at around 41 Mtoe in both 2022-23 and 2023-24, making industry the second-largest consumer of biofuels after the residential sector.

B: Fuel Consumption

Table 8: Consumption of various Energy Products in the Industry Sector (in MT)

	Unit	2020-21	2021-22	2022-23	2023-24	2024-25 (P)
Coal	MT	270	293	278	316	309
Lignite	MT	6	10	8	7	9
Natural Gas (E)* **(incl. energy and non-energy use)**	MMSCM	26623	32135	31718	37319	38348
LPG	TMT	217	184	234	380	371
Naphtha	TMT	14030	13240	12107	13812	13028
Diesel	TMT	4961	4865	3819	4829	5098
Fuel Oil	TMT	2162	2410	2311	1566	1855
Petroleum Coke (E)	TMT	15605	14255	18343	20319	21122
Bitumen (E)	TMT	7524	7816	8041	8807	8582
Other Petroleum Products (E)	TMT	12791	12297	15842	14696	11561
Electricity	MU	508776	556481	593895	640626	655562

(P) – Provisional, (E) - Estimated

Source: Data from various ministries

*Sector-wise allocation of natural gas consumption for energy purposes has been carried out using the BUR-4 sectoral break-up of natural gas consumption.

- The Iron and Steel Sector is a primary consumer of coal amongst other industries. Coal consumption in the industry sector rose from 293 MT in 2021-22 to 309 MT in 2024-25, growing at a CAGR of about 2 percent.
- Natural gas consumption has also gone up from 32,135 MMSCM in 2021-22 to 38,348 MMSCM in 2024-25, with a CAGR of around 6 percent. But most of this gas is not used for energy. It is mainly used as a feedstock, especially in fertilizer manufacturing and petrochemical production. This is why natural gas shows a large volume even though its share in final industrial energy use is quite small.
- Among the Petroleum Products, naphtha is the most consumed petroleum product after petroleum coke. Naphtha serves as a crucial feedstock in the petrochemical industry and is used as a solvent in the chemical industry. Fuels such as petroleum coke, bitumen and other petroleum products are also used in industries, but the exact breakdown across different industrial sub-sectors is not clearly reported.
- Electricity shows the fastest growth among the major energy sources. Electricity use increased from 508,776 MU in 2020-21 to 655,562 in 2024-25, reflecting a CAGR of about 6.54 percent. Industries are using more electric motors, machinery, automated systems and process controls. The industry sector accounts for around 40 percent of the total electricity consumption.

Energy Consumption in Industries

The Perform, Achieve and Trade (PAT) scheme was launched by the Bureau of Energy Efficiency (BEE) in March 2012 with the objective of improving energy efficiency across India's energy-intensive sectors. The scheme follows a three-year rolling cycle under which eligible industrial units are assigned Specific Energy Consumption (SEC) reduction targets based on their baseline energy use. These targets are differentiated across units, reflecting variations in existing efficiency levels, and are intended to drive progressive improvements in energy performance over successive cycles.

Since its inception, the PAT scheme has been implemented across eight cycles and currently covers a total of 1,333 industrial units, referred to as Designated Consumers (DCs), spanning 13 sectors. These include energy-intensive industries as well as Thermal Power Plants, Refineries, Railways, Distribution Companies (DISCOMs), Buildings and Distribution Companies (DISCOMs). Of the total DCs notified under PAT, 826 belong to energy-intensive industrial sectors, covering eight major subsectors: Iron and Steel, Cement, Fertiliser, Aluminium, Pulp and Paper, Textile, Petrochemical (cracker units), and Chlor-Alkali. As the present analysis focuses specifically on industrial energy consumption, other PAT sectors such as Thermal Power Plants, Refineries, Railways, DISCOMs, and Buildings are excluded from further consideration in this section.

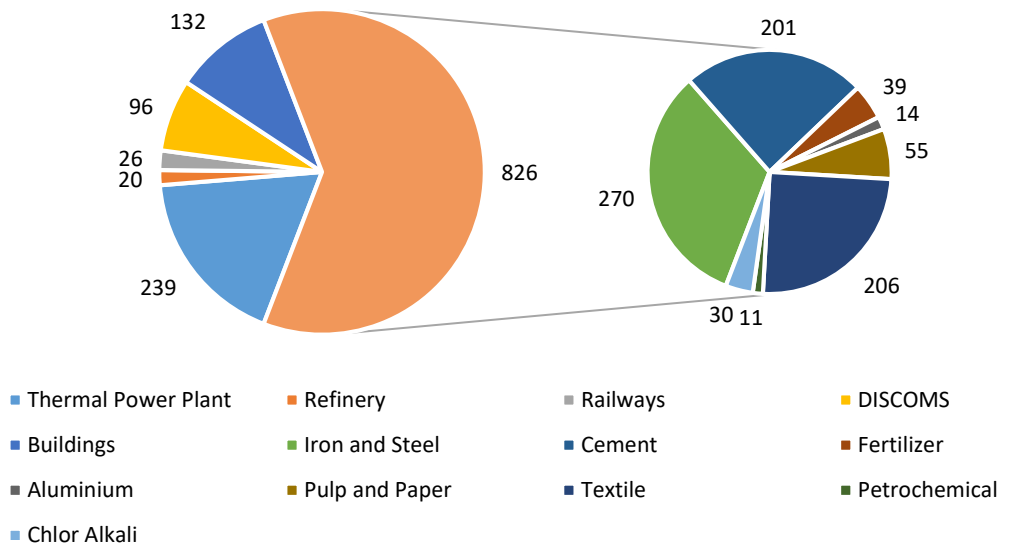


Figure 51: DCs Notified Under the PAT Scheme

Beyond its role as a market-based energy efficiency mechanism, the PAT scheme has become an important source of granular and consistent data on industrial energy use. Designated Consumers are required to submit detailed annual information on production levels, fuel and electricity consumption, and specific energy consumption indicators. This reporting framework has significantly strengthened the availability of plant-level energy data across energy-intensive industries and provides a robust basis for analysing sector-wise energy consumption patterns in India's industrial sector.

Data Collection Process in PAT

The Bureau of Energy Efficiency (BEE) undertakes detailed feasibility studies to identify Designated Consumers (DCs) and to define sector-specific energy consumption thresholds. For each notified DC, a comprehensive baseline study is carried out to document existing production processes, fuel and electricity consumption patterns, and technology deployment. This baseline information serves as the reference point for setting unit-specific energy efficiency targets under the PAT framework. These baseline assessments form the basis for setting unit-level energy efficiency targets.

On an annual basis, DCs are required to submit operational and energy consumption data through sector-specific reporting formats, as prescribed by BEE. The data submission covers key parameters such as production output, fuel use, electricity consumption, and specific energy consumption. To ensure data reliability, BEE has put in place a robust monitoring and verification mechanism, supported by mandatory energy audits conducted by accredited energy auditors. This process helps maintain consistency, accuracy, and continuity in the reported data, thereby enabling robust analysis and reliable inference on trends in India's industrial energy consumption.

In parallel, efforts are underway towards expanding the coverage of the PAT scheme by proposing the inclusion of additional energy-intensive sectors in upcoming cycles. These include Automobile, Ceramic, Chemical, Copper, Dairy, Glass, Port Trusts, Tyre Manufacturing, Zinc, and Mining. Targeted programmes have also been initiated to improve energy efficiency, sustainability, and competitiveness within the Micro, Small and Medium Enterprises (MSME) sector. These initiatives focus on detailed energy consumption mapping across selected energy-intensive MSME sub-sectors, addressing a segment that has traditionally remained data-constrained.

Coverage of Industrial Energy Consumption Data

For the financial year 2024-25, total energy consumption of the industrial sector is estimated at 302.4 million tonnes of oil equivalent (Mtoe). Using data collected through the PAT framework and associated programmes, BEE has mapped 185.7 Mtoe of this consumption across different segments of the industry sector, as illustrated in Figure 52 and presented in Table 9. This mapped consumption includes 166.6 Mtoe from eight energy-intensive sectors covered under PAT, 8.1 Mtoe from newly added sectors, and 11 Mtoe from MSMEs.

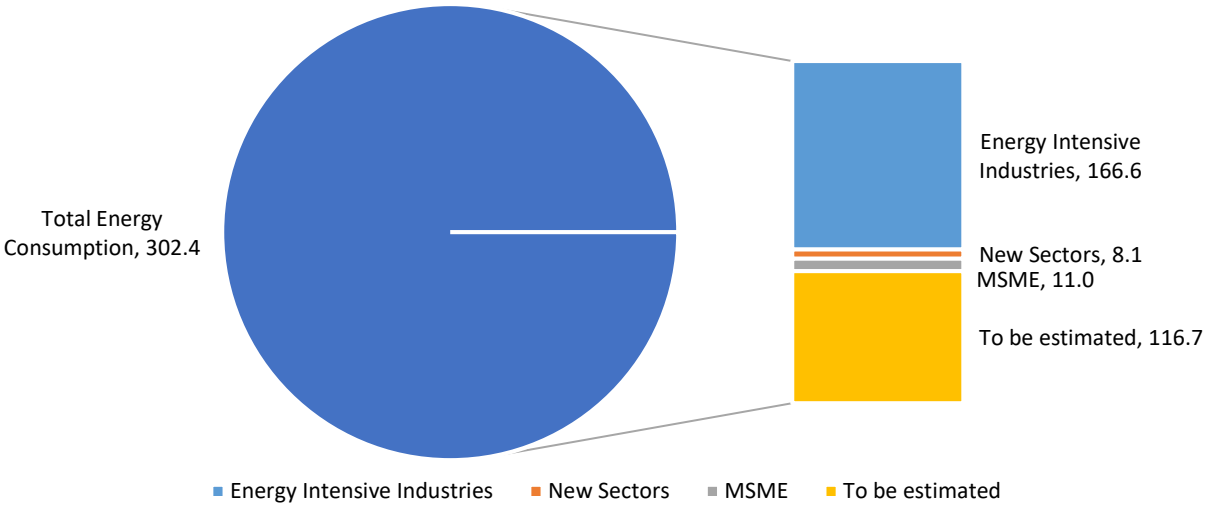


Figure 52: Estimated Industrial Energy Consumption (in Mtoe)

Figure 53 illustrates the estimated coverage of various energy-intensive industries under the PAT scheme. It indicates that the aluminium sector is completely covered with 96 percent and 94 percent of the chlor alkali and cement sectors respectively, included in the PAT scheme.

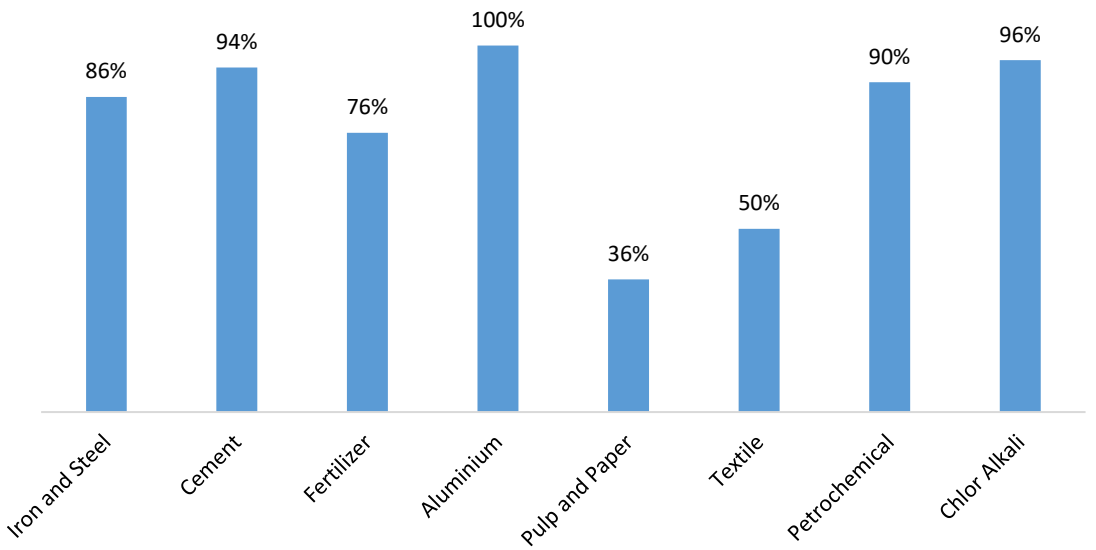


Figure 53: Energy Intensive Industries covered under PAT Scheme (estimated)

Table 9 provides the details on Sectoral Energy Consumption in different sectors along with the PAT coverage.

Table 9: Estimated Industry Energy Consumption across Different Sectors (2024-25)

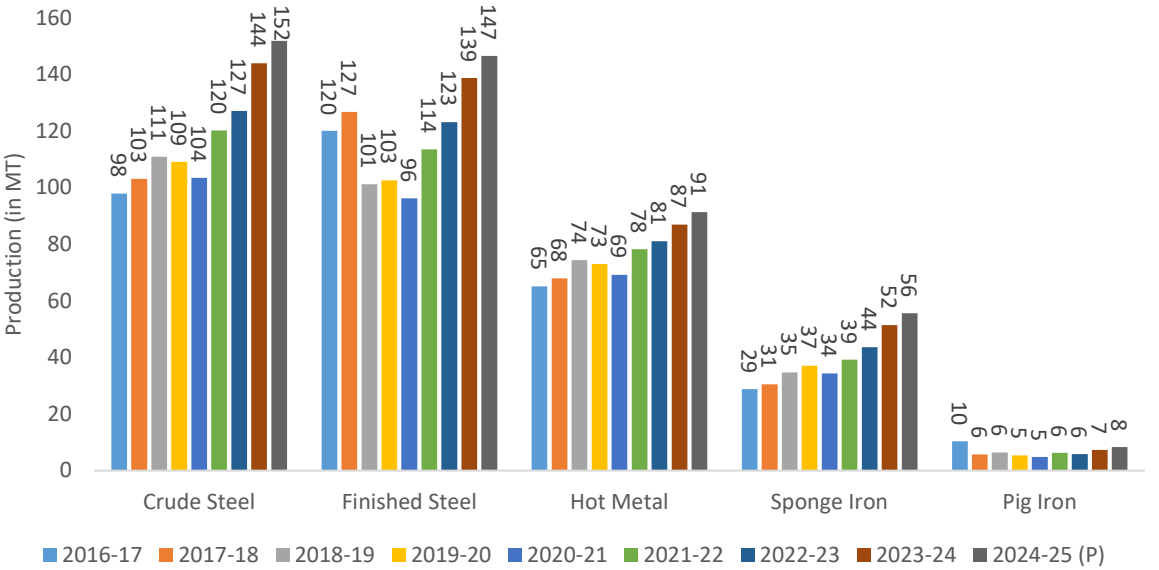
Sector	Sectoral estimated annual Energy Consumption (Million Toe)	DCs under PAT
Energy Intensive Industries		
Iron and Steel	80.00	270
Cement	34.15	201
Fertilizer	18.71	39
Aluminium	17.25	14
Petrochemical	8.10	11
Chlor-Alkali	3.65	30
Textile	2.84	206
Pulp and Paper	1.86	55
Sub Total	**166.6**	**826**
New Sectors		
Automobile Assembly Units	0.90	147
Ceramic	0.70	35
Chemical	1.36	37
Copper	0.25	3
Dairy	0.77	50
Glass	1.90	25
Port Trust	0.23	27
Tyre Manufacturer	0.76	66
Zinc	0.45	3
Mining	0.83	422
Sub Total	**8.14**	**815**
MSME		
Bricks	0.18	-
Chemical	0.29	-
Food processing	0.15	-
Forging	0.23	-
Foundry	0.28	-
Glass & Refractory	0.34	-
Leather	0.03	-
Paper	1.71	-
Pharma	1.13	-
Steel re-rolling	0.95	-
Textile	5.72	-
Sub Total	**11.01**	-
Grand Total	**185.71**	-

5.1.1 Iron and Steel

The Iron and Steel Sector holds significant importance in India's economic growth, contributing about 2 percent to the GDP and employs around 6 lakh people directly and 20 lakh people indirectly (Ministry of Steel, 2017). India ranks as the world's second-largest producer of crude steel, with crude steel production of 144.3 million tonnes and finished steel production of 139.15 million tonnes in FY 2023-24. India's per capita finished steel consumption was 97.7 Kg in 2023-24, compared to the global average of 219.3 Kg (Ministry of Steel, 2024).

The National Steel Policy, introduced in 2017, continues to guide the sector's long-term direction, aiming to build a modern and competitive steel industry in the country. Its target is to reach 300 million tonnes of crude-steel capacity by 2030 and to raise per-capita steel use to about 158 kg. Over the last few years, the Government has added several supporting measures to push this vision forward, including the PLI scheme for specialty steel, relaxed FDI rules, and large infrastructure programmes under PM Gati Shakti. The PLI scheme has attracted investment commitments worth Rs. 43,874 crore and a clear focus on higher-value steel grades (PIB, 2025). Together, these efforts are meant to boost capacity, reduce import dependence and encourage more advanced steel production in the coming decade.

Despite its growth prospects, the iron and steel sector face significant environmental challenges being the highest energy consumer and emitter of CO2 emissions among other industries. India's steel sector accounts for about 12 percent of India's carbon dioxide (CO2) emissions, with an emission intensity of 2.6 tonne of CO2 per tonne of crude steel compared with the global average emission intensity of 1.9 tCO2/tcs (IEEFA, 2023). In 2019, the sector accounted for about 39 percent of India's total greenhouse gas emissions. Recognising the sector's importance for economic development and its impact on carbon emissions, the Government has initiated measures to decarbonise the industry and committed to achieve Net-Zero target by 2070. These initiatives include the Steel Scrap Recycling Policy of 2019, aimed at increasing domestic scrap availability and reducing coal consumption in steel production. It is also adopting the Best Available Technologies (BAT) available globally in modernisation & expansions projects. As a result, the carbon emission intensity of the iron and steel industry decreased from 3.1 tonnes per tonne of crude steel (T/tcs) in 2005 to around 2.6 T/tcs by 2020 (PIB, Feb., 2022). The steel sector also plays an important role in the National Green Hydrogen Energy Mission, which aims to deploy green hydrogen in iron and steel making processes. Acknowledging global concerns about green steel taxonomy, India has formed a Task Force on the Development of Taxonomy for Green Steel. It engages industry, academia and other stakeholders to advance discussions and recommendations. Moreover, the Ministry of Steel supports research and development activities aim to enhance energy efficiency and reduce carbon footprints in the steel sector, providing financial assistance for technology-driven projects. The following graph illustrates the year-on-year production of Iron and Steel in India.



(P) – Provisional

Figure 54: Iron and Steel Production Trends

Source: (Ministry of Steel, 2025)

- Crude-steel production increased from 98 MT in 2016-17 to 152 MT in 2024-25 (P), with capacity utilisation of around 80 percent. Under the National Steel Policy, crude-steel production is expected to reach 255 MT by 2030-31.
- Finished-steel output fell by nearly 20 percent between 2017-18 and 2018-19 due to weak demand, but recovered strongly after the pandemic, reaching 147 MT in 2024-25 (P). The demand for finished steel is projected to touch 230 MT by 2030-31.
- Hot-metal production rose from 65 MT in 2016-17 to 91 MT in 2024-25 (P), reflecting a CAGR of about 4 percent.
- Sponge-iron production increased steadily from 29 MT to 56 MT over the same period.
- Pig-iron production declined from 10 MT in 2016-17 to 8 MT in 2024-25 (P).

Energy Consumption

Iron and steel production is an energy-intensive process that requires substantial energy at different stages of manufacturing. Coal plays a critical role in the sector, both as a reducing agent and as a source of thermal energy. As shown in Figure 55, solid fuels continue to dominate the fuel mix in the iron and steel sector, accounting for around 87 per cent of the total thermal energy consumption across 270 Designated Consumers in FY 2024-25. Gaseous fuels contribute a smaller share of energy use, while liquid fuels account for a relatively minor portion of total consumption. The figure also presents electricity consumption for 58 Designated Consumers, highlighting the sector's dependence on captive power generation as a significant share of electricity demand is met through captive sources compared to grid supply.

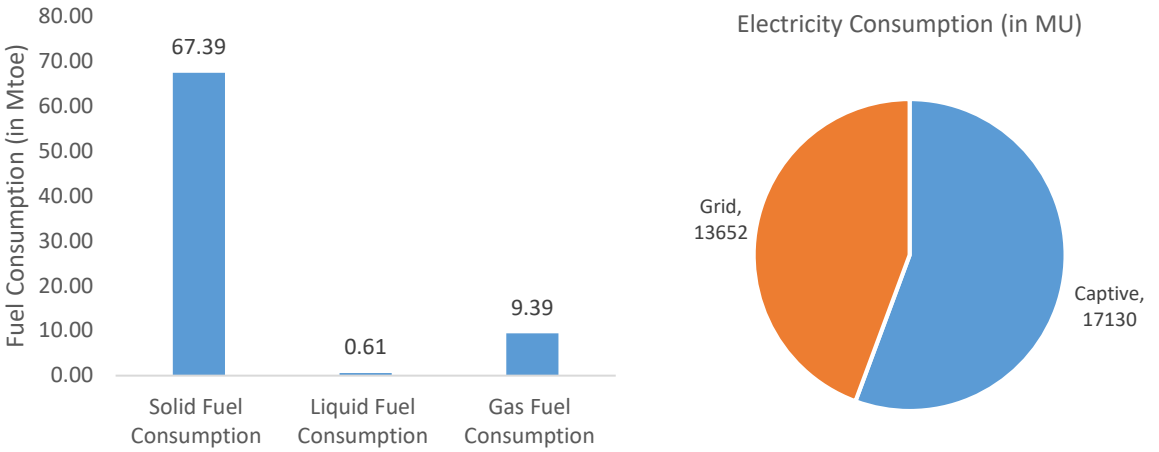


Figure 55: Estimated fuel-wise consumption (270 DCs) and electricity consumption (58 DCs) in the Iron and Steel Sector, 2024-25

Note: As detailed fuel-wise data are not available for all Designated Consumers, the fuel-wise distribution is estimated using consumption shares from a representative sample of DCs. The grid–captive electricity split is available only for a subset of DCs and is presented separately; therefore, grid electricity should not be combined with the fuel-wise distribution to reconcile with total energy consumption.

5.1.2 Aluminium

India's aluminium industry is an important part of the country's metal sector. The industry has grown well over the years because India has good bauxite reserves, strong domestic demand for aluminium products, and favourable policies. At present, India has an installed primary aluminium capacity of about 4.17 million tonnes per year. This makes India one of the leading aluminium-producing countries in the world. Major producers such as Hindalco, Vedanta and NALCO together support most of this capacity. India also contributes roughly 5.7 percent of global primary aluminium production, reflecting its growing role in the global market.

As India works toward its economic and development goals, aluminium will play an even more important role across key sectors such as power, transportation, construction and packaging. Industry-based assessments indicate that aluminium demand in India is expected to nearly double by 2033, increasing from around 4.5 million tonnes at present to close to 9 million tonnes (IBEF, 2025). This growth is attributed mainly to rising demand from infrastructure development, urbanisation, and industrial expansion. This growth is supported by Government initiatives such as Make in India, Housing for All, Smart Cities Mission, National Infrastructure Pipeline and the FAME scheme to promote electric vehicles and renewable energy capacity expansion. Given its extensive use in renewable energy, especially solar power, aluminium demand is set to rise, aiming to achieve 500 GW of renewable energy by 2030 (PIB, 2023).

The aluminium industry is highly energy-intensive, it involves several stages: mining of bauxite, refining it to alumina, and then smelting alumina to make aluminium metal. While aluminium smelting is predominantly electricity-intensive, the refining stage also requires significant thermal energy for process heat. In India, aluminium smelting requires about 14,361 kWh of electricity to produce 1 tonne of aluminium, compared to the global average of 14,145 kWh (BEE a, 2018).

Since aluminium sector consumes a substantial amount of energy, the Government has classified it as energy-intensive under the PAT scheme. Under this scheme, the BEE has notified 14 DCs from the aluminium sector up to PAT Cycle VII (from 2021-22 to 2024-25). In PAT Cycle I (from 2012-13 to 2014-15), the sector achieved a reduction of 0.73 Mtoe against a target of 0.456 Mtoe, while in PAT Cycle II (from 2015-16 to 2018-19), it

achieved energy savings of 1.226 Mtoe against the target of 0.46 Mtoe, demonstrating 167 percent of the energy savings target achievement (BEE, Dec, 2023). Further to reduce energy consumption and increase energy efficiency, BEE has listed several energy-efficient technologies for various sectors including aluminium. In addition to this, the Ministry of Mines has provided the Sustainable Development Framework, encouraging sustainable and energy-efficient practices in the mining and metals sectors.

Aluminium production in India has shown steady growth over the past eight years. Production increased from 2.90 million tonnes in 2016-17 to 4.20 million tonnes in 2024-25 as shown in the Figure 56, reflecting the compound annual growth rate of 4.7 percent from 2016-17 to 2024-25. This rise in production is supported by India's large bauxite reserves and continuous capacity expansion by major producers. Four major producers namely National Aluminium Co. Ltd (NALCO), Hindalco Industries Ltd (HINDALCO), Bharat Aluminium Co. Ltd (BALCO) and Vedanta Aluminium Ltd (VAL) are at the forefront in aluminium production. The following graph shows year-on-year production of Aluminium in India.

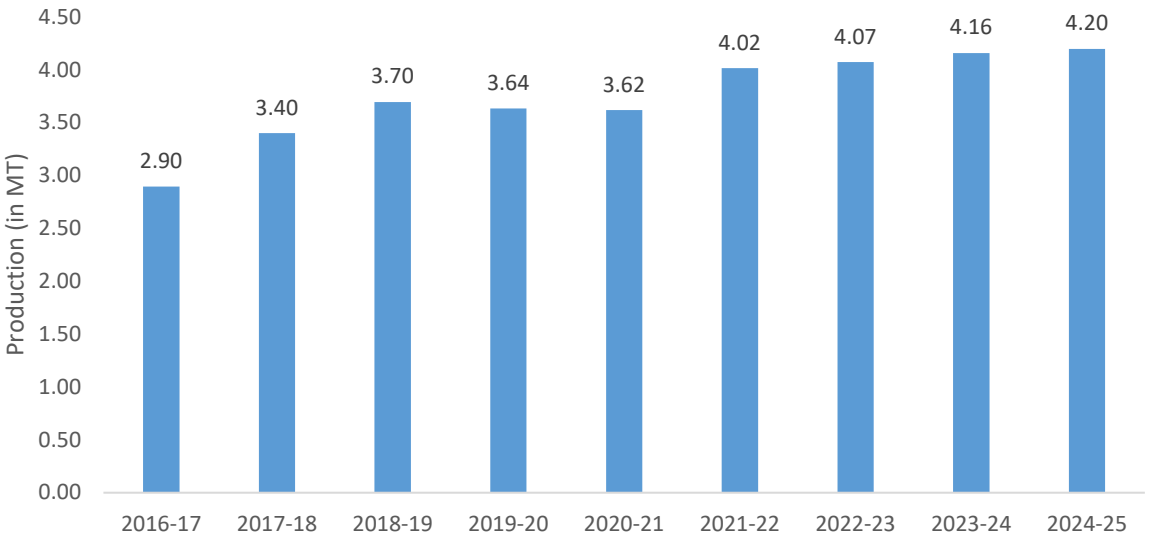


Figure 56: Aluminium Production Trends

Source: (Indian Bureau of Mines, 2025)

Energy Consumption

Figure 57 shows the energy consumption profile of the aluminium sector under the PAT scheme for FY 2024-25, covering 14 Designated Consumers. Solid fuels dominate the sector's fuel use, with limited contributions from liquid and gaseous fuels. A large portion of these solid fuels is used for power generation in the industry's captive power plants.

Electricity consumption in the aluminium sector is largely met through captive generation, which accounts for about 89 per cent of total electricity use, while the remaining 11 percent is sourced from the grid. This highlights the sector's strong dependence on captive power to meet its energy-intensive and continuous electricity requirements.

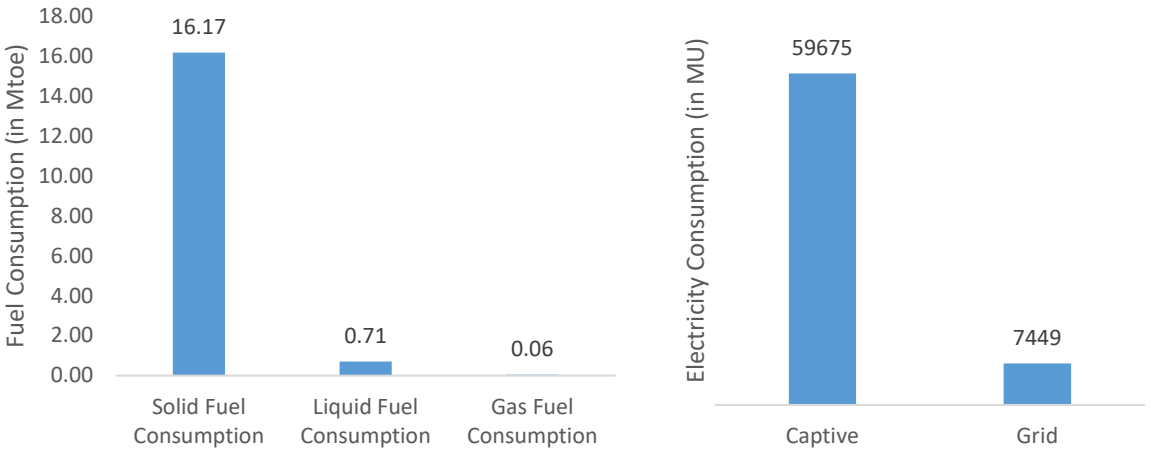


Figure 57: Fuel and Electricity Consumption within the Aluminium Industry (by 14 DCs)

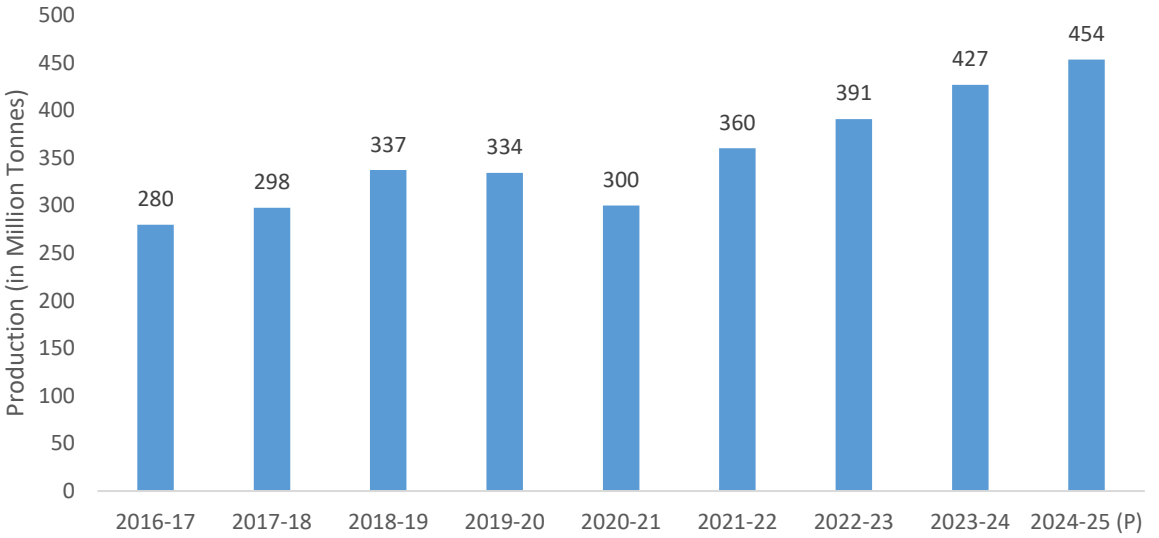
5.1.3 Cement

India's cement industry is a key driver of the country's growth and infrastructure development. As the world's second-largest producer of cement after China, India has an installed cement production capacity of about 700 million tonnes per annum (Cement Manufacturers' Association). Despite being the second largest producer, India's per-capita cement consumption - around 290 kg - remains significantly below the global average of about 470 - 520 kg per person per year, indicating substantial growth potential for the sector. However, the sector is poised for substantial growth due to Government initiatives focused on housing, infrastructure, and smart cities. Programmes like Pradhan Mantri Awas Yojana (PMAY), Smart City Mission, Bharatmala Pariyojna, PM Gati Shakti-National Master Plan (NMP) and Sagarmala Programme are expected to drive future demand.

However, India's cement industry continues to face significant environmental challenges due to its high energy use and associated carbon emissions. In 2019, the cement sector accounted for about 13 per cent of India's manufacturing and construction emissions, making it the second-largest emitting sector after iron and steel. Additionally, a significant share of emissions from the cement sector arises from industrial process and product use (IPPU), primarily due to calcination during clinker production, which accounts for roughly 73 per cent of total cement sector emissions. A large share of its emissions comes from fuel used in kilns, electricity consumption, and the chemical process involved in converting limestone to clinker. Clinker production is the most carbon intensive step, as it releases CO_2 both from fuel combustion and from the calcination of limestone. More clinker production means more limestone use and higher emissions.

The cement industry is one of the eight energy-intensive sectors under the PAT scheme, which has improved the sector's energy efficiency. Under the PAT scheme, the BEE has notified 175 DCs from the cement sector up to PAT Cycle VII. To further mitigate emissions, India is developing low-carbon alternatives like Limestone Calcined Clay Cement (LC3) and geopolymer cement, which can reduce carbon emissions by 30 percent and 80 percent, respectively. Additionally, India aims to become a global hub for green hydrogen through the 'National Green Hydrogen Mission'. Incorporating green hydrogen in cement sector can reduce emissions by repurposing waste heat and replacing natural gas in cement kilns. This can help in eliminating all stationary combustion CO2 emissions.

Industry assessments show that the country's installed cement capacity is around 636 million tonnes per year in FY 2023-24, and ongoing expansion projects are expected to push this further over the next few years. In terms of output, cement production has grown steadily from 280 million tonnes in 2016-17 to about 454 million tonnes in 2024-25, rising at a CAGR of nearly 6 percent over this period. The graph below presents the year-on-year trend in cement production.



(P) – Provisional

Figure 58: Cement Production Trends

Source: (Indian Bureau of Mines and MOSPI, 2025)

Energy Consumption

Cement manufacturing is an energy-intensive process, with coal, pet coke and lignite are used primarily as kiln fuels for producing clinker. For FY 2024-25, estimated fuel-wise consumption across 201 Designated Consumers shows that thermal energy use in the cement sector is dominated by solid fuels, while liquid fuels contribute only a marginal share. Figure 59 also presents electricity consumption for 49 Designated Consumers, indicating that more than 75 percent of total electricity demand is met through captive generation, with the remaining requirement supplied from the grid.

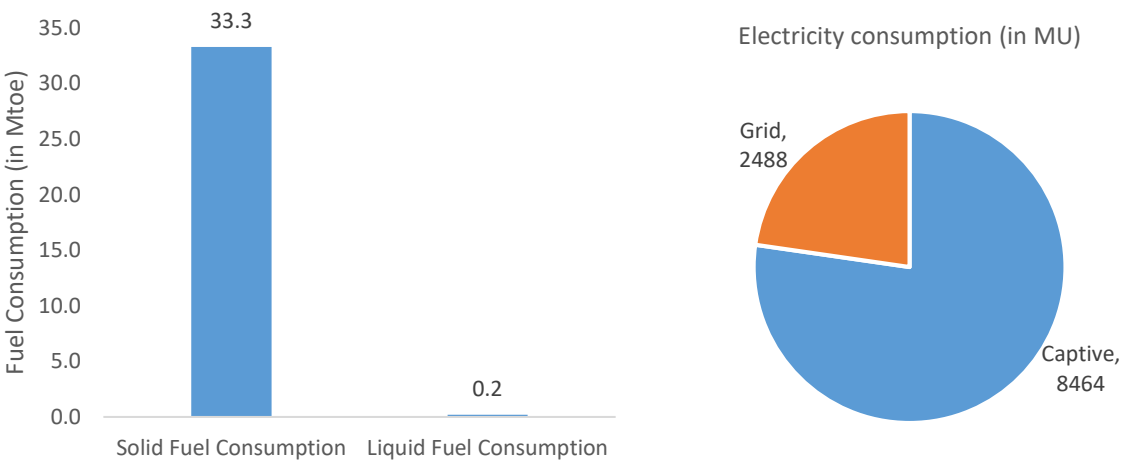


Figure 59: Estimated fuel-wise consumption (201 DCs) and electricity consumption in (49 DCs) in the Cement Sector, 2024-25

Note: As detailed fuel-wise data are not available for all Designated Consumers, the fuel-wise distribution is estimated using consumption shares from a representative sample of DCs. The grid–captive electricity split is available only for a subset of DCs and is presented separately; therefore, grid electricity should not be combined with the fuel-wise distribution to reconcile with total energy consumption.

Figure 60 illustrates the distribution of solid and liquid fuel use within the cement industry by end use for FY 2024-25. Solid fuels are used predominantly in core process operations. In case of liquid fuels, the majority is consumed in process applications, with limited use in captive power generation and diesel generator sets. This distribution highlights the continued dependence of cement manufacturing on solid fuels for process heat requirements.

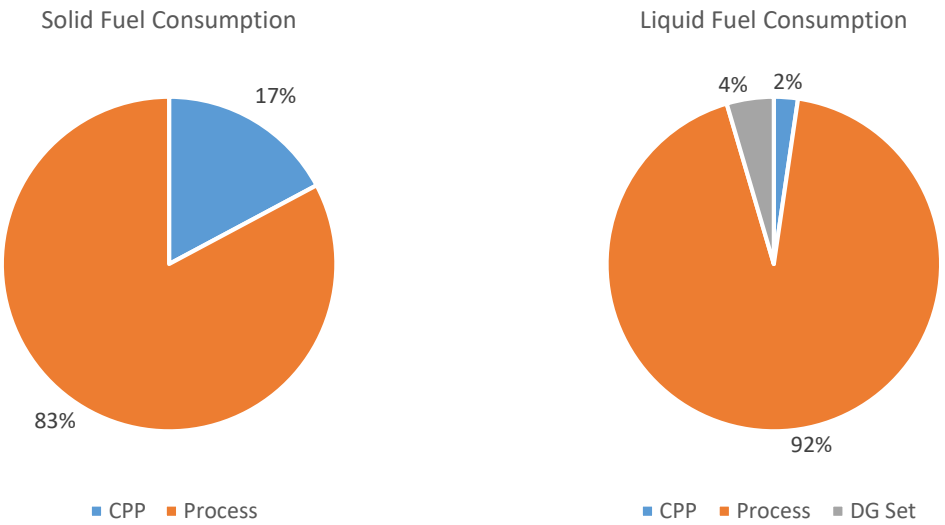


Figure 60: Distribution of Fuel used in Cement Industry (in 2024-25)

5.1.4 Chlor-Alkali

The chlor-alkali industry is one of the older chemical sectors in India and continues to play an important role in supplying basic chemicals such as caustic soda, chlorine and hydrogen. Caustic soda remains the primary product, while chlorine and hydrogen are by-products. Over the last few years, the sector has expanded steadily, and India's installed caustic soda capacity is now around 5.8 million tonnes per year (FY 2023-24), with capacity utilisation improving as demand grows in textiles, paper, alumina refining and pharmaceuticals.

The production of chlor-alkali products, especially caustic soda, is highly energy-intensive. Recognising the substantial energy demands, the sector has consistently pursued cleaner and more efficient technologies, resulting in significant advancements. Caustic soda is produced through the electrolysis process, using diaphragm cell, mercury cell or membrane cell technologies. Amongst these, the mercury cell process is the most energy-intensive, while the membrane cell process is the most energy-efficient. Due to its high energy consumption and associated environmental pollution, mercury cell technology has been almost entirely phased out in India. The mercury cell process consumes approximately 3200 kWh per metric ton of caustic soda and transitioning to membrane cell technology has reduced energy demands by at least 35 percent to around 2100 kWh per MT of chlor-alkali (BEE b, 2018). Such improvements are crucial as the chlor-alkali

industry is recognised as an energy-intensive sector under the PAT scheme. Up to PAT Cycle VIII (from 2022-23 to 2025-26), the BEE has notified 29 DCs in this sector. These have achieved substantial energy targets and reductions in CO2 emissions under various cycles, showcasing the sector's commitment to energy efficiency.

Despite these advancements, a substantial amount of hydrogen is still released as a co-product in chlor alkali plants, which often gets wasted. This hydrogen can be utilised as a clean energy source. Additionally, chlor-alkali plants can use hydrogen fuel cells to convert hydrogen into electricity, thereby reducing greenhouse gas emissions and further minimising the environmental impact of chlor-alkali production.

The following graph illustrates the growth in production of various chemicals in India.

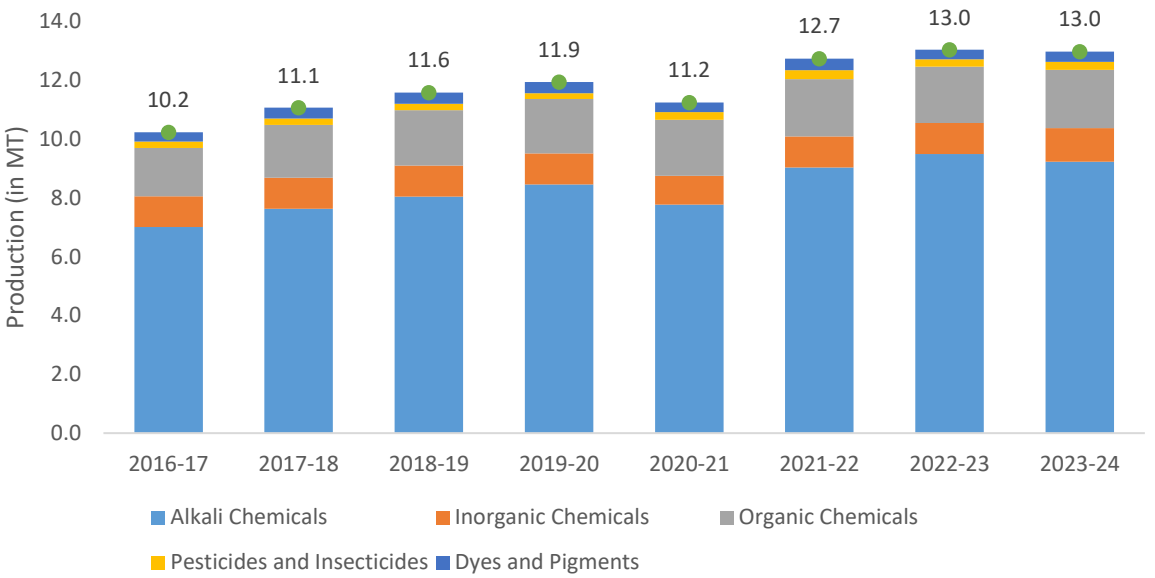


Figure 61: Major Chemical Production Trends

Source: (DCPC, 2024)

- Alkali chemicals continue to make up the largest share of major chemical production, contributing around 73 percent of the total output in 2023-24. The category mainly includes caustic soda, soda ash and liquid chlorine.
- The production of alkali chemicals has increased steadily over the years, supported by demand from PVC manufacturing, water treatment, textiles and the pharmaceutical sector. Output has grown from around 7 million tonnes in 2016-17 to about 9.2 million tonnes in 2023-24, with a CAGR of nearly 4 percent.
- Inorganic chemicals remain relatively stable in production, as demand in glass, ceramics and other industrial uses has been consistent. Organic chemicals continue to play a key role in plastics and synthetic fibres, while pesticides, insecticides, dyes and pigments support agriculture, textiles and printing. These chemicals together show a steady, broad-based demand across industries.

Energy Consumption

The chlor-alkali industry is energy-intensive, with solid fuels, primarily coal and lignite, playing an important role in meeting both electricity and thermal energy requirements. For FY 2024-25, estimated fuel-wise

consumption across 30 Designated Consumers indicates that solid fuels constitute the dominant share of thermal energy use, while gaseous fuels contribute a smaller share and liquid fuels play a very limited role. Figure 62 also presents electricity consumption for 24 Designated Consumers, showing that a substantial share of electricity demand is met through captive generation, with the balance sourced from the grid, reflecting the sector's need for a reliable and continuous power supply.

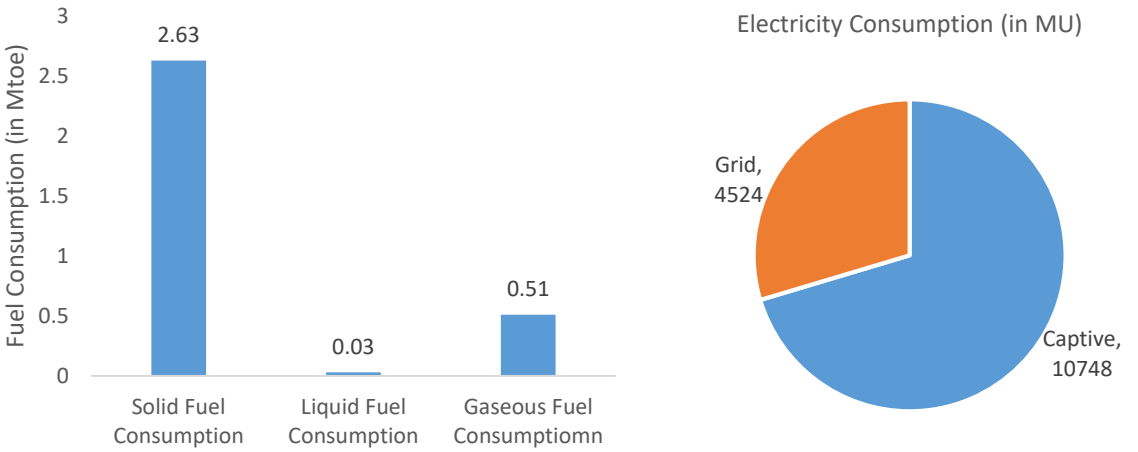


Figure 62: Estimated fuel-wise consumption (30 DCs) and electricity consumption (24 DCs) in the Chlor Alkali Sector, 2024-25

Note: As detailed fuel-wise data are not available for all Designated Consumers, the fuel-wise distribution is estimated using consumption shares from a representative sample of DCs. The grid–captive electricity split is available only for a subset of DCs and is presented separately; therefore, grid electricity should not be combined with the fuel-wise distribution to reconcile with total energy consumption.

Figure 63 shows the distribution of solid, liquid, and gaseous fuel use within the chlor-alkali sector for FY 2024-25. Solid fuels are used largely for captive power generation and cogeneration, supporting both electricity and steam requirements for production processes. Liquid fuels are used mainly in process applications, with smaller shares supporting captive power and backup generation. Gaseous fuels are split between use in gas turbines and direct process heating, indicating their dual role in electricity generation and thermal applications within the sector.

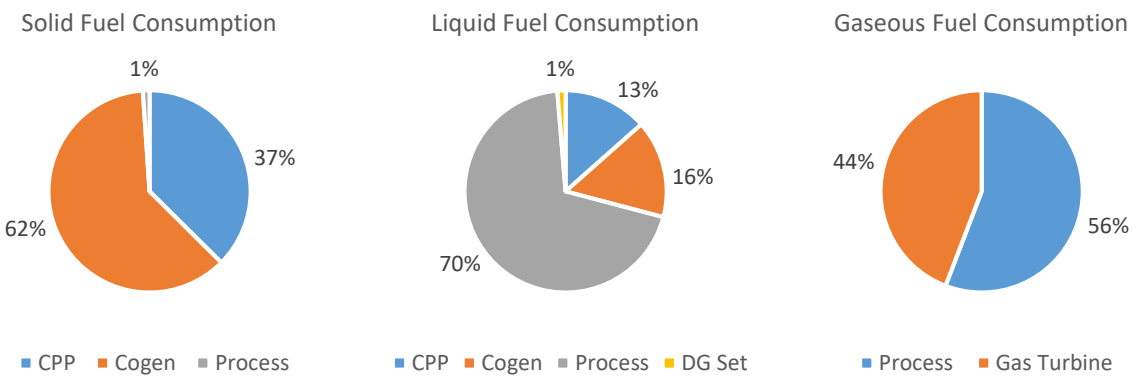


Figure 63: Distribution of Fuel used in Chlor Alkali Sector (in 2024-25)

5.1.5 Fertilizer

India's fertilizer industry remains a backbone of its agricultural economy. India remains the second-largest consumer and third-largest producer of Fertilizers globally. India's fertilizer industry contributes roughly 20 percent to the global output. The major fertilizers produced in India include Urea, Di-Ammonium Phosphate (DAP) and other complex fertilizers. Over the past decade, domestic fertilizer production has grown steadily, with total production around 50.3 million tonnes in 2023-24, reflecting both government support and rising demand from farmers. In recent years, urea production has continued to expand, with India recording its highest-ever domestic urea output of over 31.4 million tonnes in 2023-24. These growth trends support India's efforts to strengthen self-sufficiency in fertilizer supply.

Urea production is the highest contributor to the emissions from the sector, majority of these emissions stem from the use of natural gas in fertilizer production, where natural gas serves both as a feedstock and a fuel for urea production. Traditionally, urea production relied on fuel oil and naphtha as primary fuels. However, fertilizer manufacturers are gradually transitioning to a cleaner alternatives.

This transition supports the Government's efforts to reduce energy consumption and lower emissions in the fertilizer industry. Consequently, the fertilizer sector falls under the PAT scheme, with urea plants being the majority of DCs under the PAT scheme. During PAT Cycle-1 (2012-13 to 2014-15), the fertilizer industry has surpassed its energy-saving target of 0.478 Mtoe, achieving an impressive total energy saving of 0.78 Mtoe. It marked a remarkable 63 percent achievement over the energy savings targets. Similarly, the New Urea Policy 2015 aims at promoting energy efficiency within urea manufacturing units. This policy establishes specific energy consumption norms for both existing and new urea units, offering rewards to those exceeding prescribed energy efficiency levels.

Additionally, the Government of India has launched the 'National Green Hydrogen Mission' with a budget of Rs. 19744 crores (PIB, Mar, 2023). This mission aims at making India a global hub for green hydrogen production, usage and export. This initiative can facilitate the transition to green hydrogen for ammonia production, a key input for the fertilizer industry, thereby reducing dependence on fossil fuels and lowering emissions from the sector. The adoption of green hydrogen in India's fertilizer industry can ensure food and strengthen agricultural value chains.

The following graph shows the year-on-year production of various fertilizers in India.

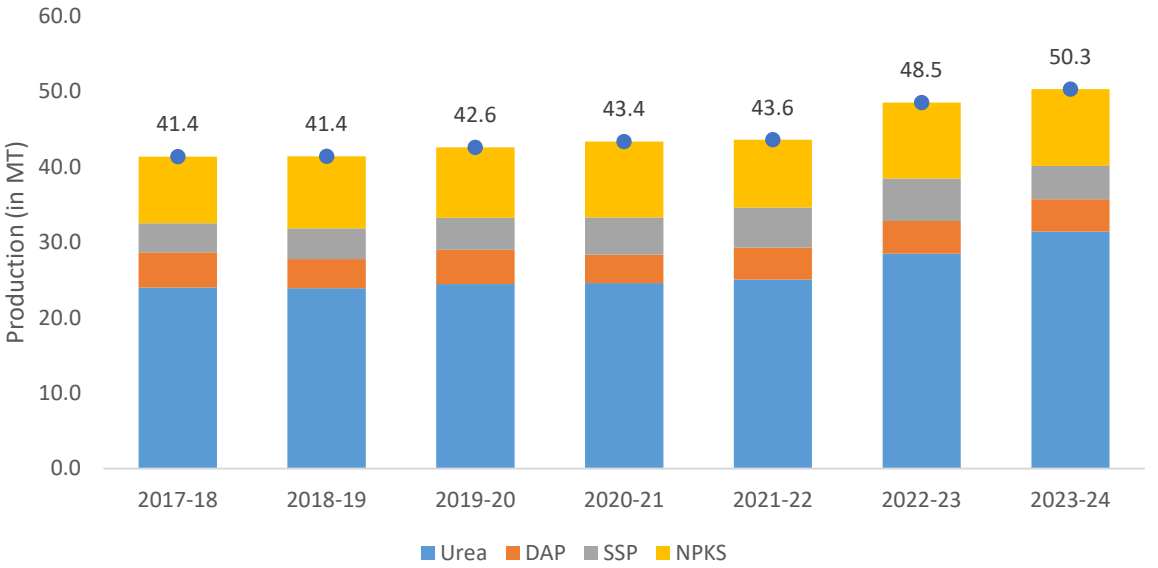


Figure 64: Fertilizer Production Trends

Source: (Ministry of Chemicals and Fertilizers, 2024)

- Total fertilizer production has shown an overall upward trend, rising from 41.4 MT in 2017-18 to 50.3 MT in 2023-24, reflecting a compound annual growth rate of 3.3 percent.
- Urea remains dominant in the fertilizer production landscape due to its crucial role in the industry. From 2017-18 to 2020-21, urea production showed a steady trend, but it increased significantly after 2021-22, rising to 31.4 MT from 25.1 MT in 2021-22. Production of other fertilizers has remained fairly steady.

Energy Consumption

The fertiliser industry is energy-intensive and relies heavily on natural gas, which is used both as a feedstock and as a fuel in production processes. For FY 2024-25, estimated fuel-wise consumption across 39 Designated Consumers shows that gaseous fuels account for the dominant share of total thermal energy use, while solid and liquid fuels contribute only marginally. As presented in Figure 65, electricity consumption for 32 Designated Consumers indicates a strong dependence on captive power generation, with over 85 per cent of electricity demand being met through captive sources with the remaining share sourced from the grid.

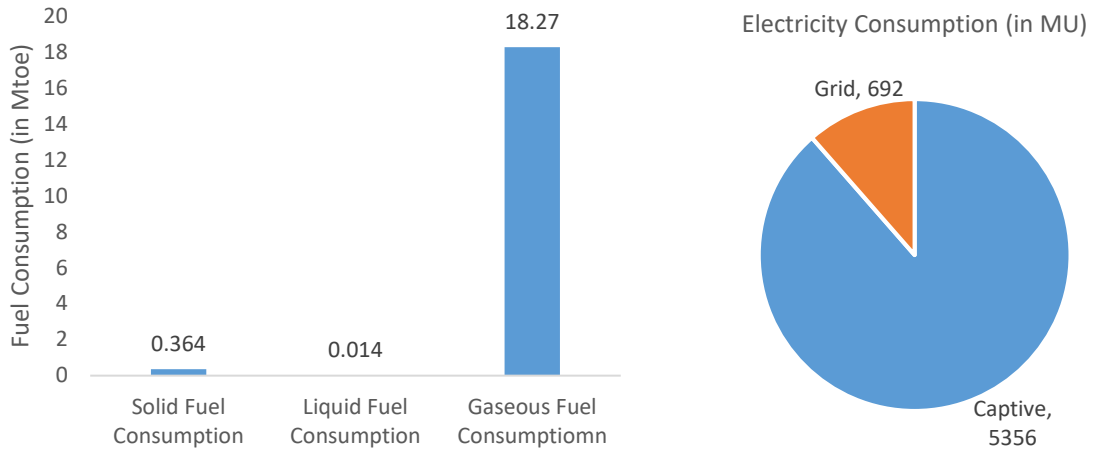


Figure 65: Estimated fuel-wise consumption (39 DCs) and electricity consumption (32 DCs) in the Fertilizer Sector, 2024-25

Note: As detailed fuel-wise data are not available for all Designated Consumers, the fuel-wise distribution is estimated using consumption shares from a representative sample of DCs. The grid–captive electricity split is available only for a subset of DCs and is presented separately; therefore, grid electricity should not be combined with the fuel-wise distribution to reconcile with total energy consumption.

Figure 66 illustrates the distribution of fuel use within the fertiliser sector by end use for FY 2024-25. A major share of all fuel types is utilised in core industrial processes, reflecting the energy-intensive nature of fertiliser production. Specifically, most of the solid and liquid fuels are consumed in process applications, with a smaller portion supporting cogeneration. Gaseous fuels are used predominantly for process requirements, while the remaining share is utilised in gas turbines for power generation.

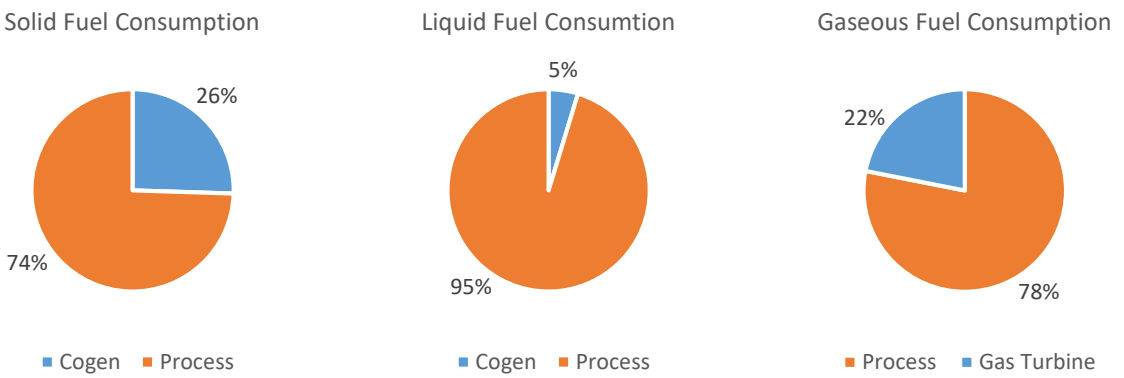


Figure 66: Distribution of Fuel used in Fertilizer Industry (in 2024-25)

5.1.6 Petrochemical

India's chemical and petrochemical industry continues to be a major part of the economy, supplying both domestic needs and export markets. It has maintained its position as the sixth largest producer of chemicals in the world and the fourth largest in Asia. The sector is gaining momentum with the support of Government initiatives like 'Make in India' and 'Atmanirbhar Bharat', which provide essential technical support and significant investments to strengthen the industry further. Moreover, strategic policies like the National Petrochemical Policy of 2007, the Hydrocarbon Vision 2030 launched in 2016, and initiatives such as Skill India,

100 percent Foreign Direct Investment (FDI) in petrochemical industry and the Production Linked Incentive (PLI) Scheme 2021 have collectively ushered in an era of unprecedented growth. This has solidified India's position as a global player in the petrochemical arena.

However, petrochemical production is associated with high energy use and substantial greenhouse gas emissions. As these industries grow, emissions are expected to rise. In 2019, the chemical sector accounts for 0.5 percent of manufacturing industries and construction sector emissions. The petrochemical sector relies significantly on imported crude oil because the production of most products requires naphtha, making it energy intensive. Ammonia production, an energy-intensive process primarily used in the fertiliser industry, also finds applications in refrigerants and pharmaceuticals. Ethylene and propylene, which are the key building blocks of petrochemical production, are also major energy consumers, second only to ammonia production. Improving energy efficiency is essential for reducing greenhouse gas emissions in these industries. The petrochemical sector (cracker units) has been included in PAT Cycle IV (from 2017-18 to 2021-22), mandating emission reductions under the PAT scheme.

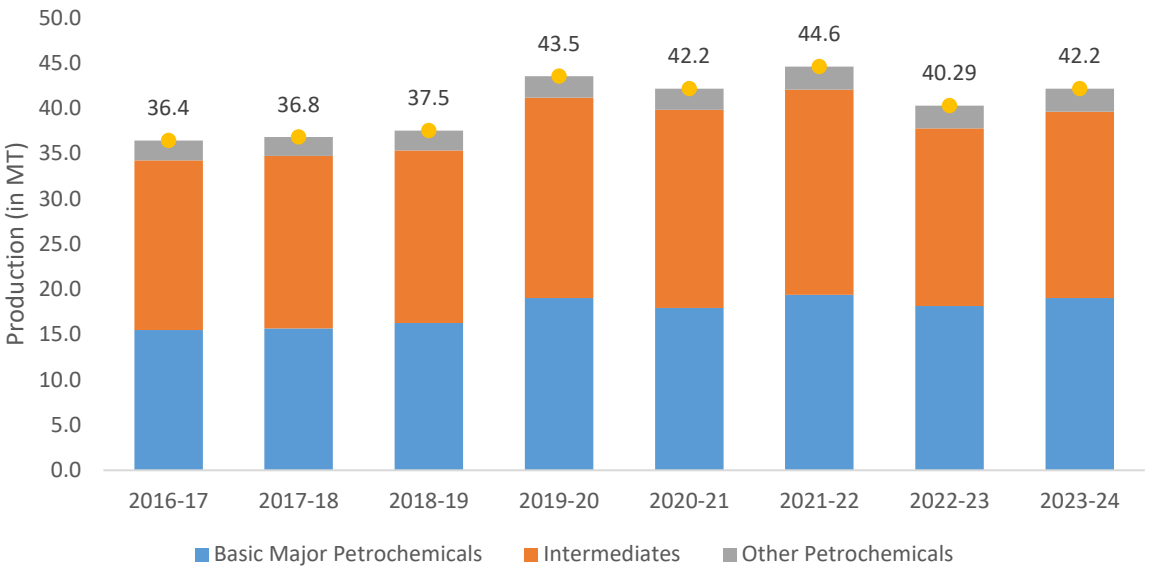


Figure 67: Production of Different Petrochemicals

Source: (DCPC, 2024)

Petrochemical production has generally moved upward over the past several years, rising from 36.4 million tonnes in 2016-17 to about 42.2 million tonnes in 2023-24. The sharpest jump came in 2019-20, when output reached 43.5 million tonnes from 37.5 Million tonnes in 2018-19. After that, the growth has been steady, without large year-to-year increases.

The major petrochemicals produced in India include synthetic fibres, polymers, synthetic rubber, detergent intermediates and performance plastics. The intermediates category covers fibre intermediates as well as key building-block chemicals used to make downstream products.

Intermediates account for roughly half of the country's petrochemical output. Around 49 percent of total production comes from intermediates such as fibre intermediates, olefins and aromatics, while the remaining 51 percent includes polymers, synthetic fibres, synthetic rubber and other petrochemicals.

In 2023-24, major petrochemical imports reached 7.32 million tonnes and has been rising steadily, while exports were about 1.64 million tonnes. This gap shows that domestic demand is rising faster than India's current production levels. Domestic per-capita consumption of many petrochemical products is still lower than in developed countries, suggesting further growth potential as the economy expands and industrial applications broaden.

Energy Consumption

The petrochemical sector is characterised by a high dependence on gaseous fuels, which are used extensively both as energy sources and as feedstock in production processes. As shown in Figure 68, estimated fuel-wise consumption for FY 2024-25 across 11 Designated Consumers indicates that gaseous fuels account for the largest share of total thermal energy use in the sector, followed by Solid fuels contributing a smaller share, while liquid fuel consumption remains marginal. This fuel mix reflects the process requirements of the petrochemical industry, where natural gas and related gaseous fuels play a central role in supporting continuous and energy-intensive operations.

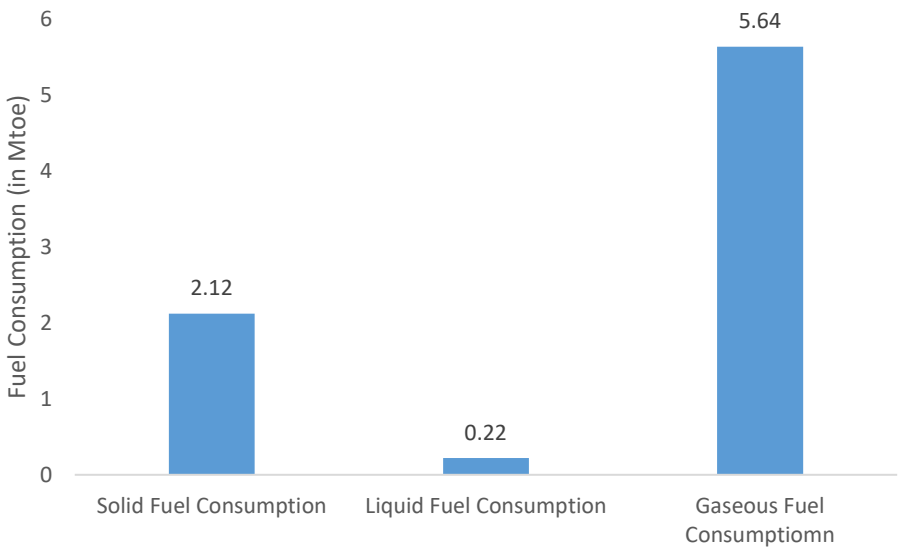


Figure 68: Estimated fuel-wise consumption (11 DCs) in the Petrochemical Sector, 2024-25

Note: As detailed fuel-wise data are not available for all Designated Consumers, the fuel-wise distribution is estimated using consumption shares from a representative sample of DCs.

5.1.7 Pulp and Paper

India's paper industry continues to play an important role in the global paper market, constituting to about 5-7 percent of world's production of paper, paperboard, newsprint and specialty grade paper. According to the latest information, India has around 850-900 paper and pulp mills, though roughly 550 of them are currently in operation, covering a mix of wood-based, agro-based and waste-paper-based mills. Most of the production today is driven by recycled fibre, which accounts for nearly three-fourths of total output. Wood-based mills

contribute roughly 18 percent, while another 6 percent comes from agro-residue-based units (CPPRI, 2024). In the fiscal year 2021-22, the industry produced 22.4 million tonnes of pulp and paper, with approximately 7-8 percent of this production exported. The industry employs more than 0.5 million people directly and 1.5 million people indirectly (BEE c, 2028).

In the past few years, the industry has gone through a number of changes. The packaging paper segment has expanded quite rapidly, and this has even created some oversupply in kraft grades in certain periods. Alongside this, mills have been facing issues such as fluctuating raw material prices, shortages of coal at times, and shifts in global paper demand. Even with these challenges, many units have continued to invest in modernising their equipment and upgrading production processes to improve quality and efficiency.

The sector also remains energy-intensive, but there has been steady progress on the efficiency front. Over the past five years, the industry has reportedly brought down its overall energy consumption by about 20 percent. Integrated mills meet 40-50 percent of their thermal energy needs using black liquor and other biomass residues, which helps reduce dependence on coal. More mills are adopting cleaner technologies and digital tools for process control and resource optimisation. It is also one of the most polluting sectors. The average emission intensity for the Indian pulp and paper industry is 1.58 MTCO2 per metric ton of paper. Wood and agro-based mills are major consumers of coal for steam and power generation.

The modernisation of paper mills is crucial for improving the quality of paper production. It is also significant in reducing environmental impact through the adoption of energy-efficient technologies. A range of energy-efficient technologies with significant energy-saving potential have been identified, including those applicable to the paper and pulp industry. Under the PAT scheme, a total of 48 DCs have been notified till PAT Cycle VII (from 2021-22 to 2024-25).

The graph illustrates the trends in production of paper, paperboard and newsprint from 2016-17 to 2021 22. During this period, production rose steadily from 16.9 million tons to 22.4 million tons, indicating a consistent upward trajectory over the years.

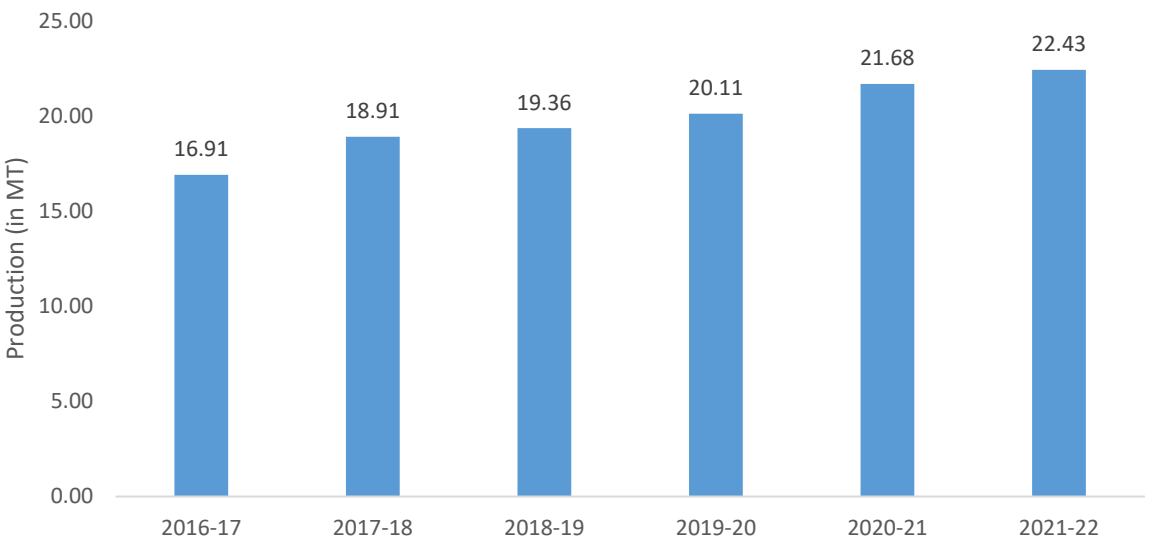


Figure 69: Trends of Production in Paper, Paperboard and Newsprint

Source: (CPPRI, 2022)

Energy Consumption

Within the pulp and paper industry, large wood-based and agro-based mills are among the major consumers of coal for steam and power generation, while medium-scale agro-based mills generally rely on locally available biomass for steam production. Many mills also utilise black liquor, a by-product of the pulping process, as an energy source to generate steam and electricity through combustion in recovery boilers. As shown in Figure70, estimated fuel-wise consumption for FY 2024-25 across 55 Designated Consumers indicates that solid fuels account for the largest share of thermal energy use in the sector, while liquid and gaseous fuels contribute only a limited share. The figure also presents electricity consumption for 53 Designated Consumers, showing that a substantial majority of electricity demand is met through captive generation, with the remaining share sourced from the grid.

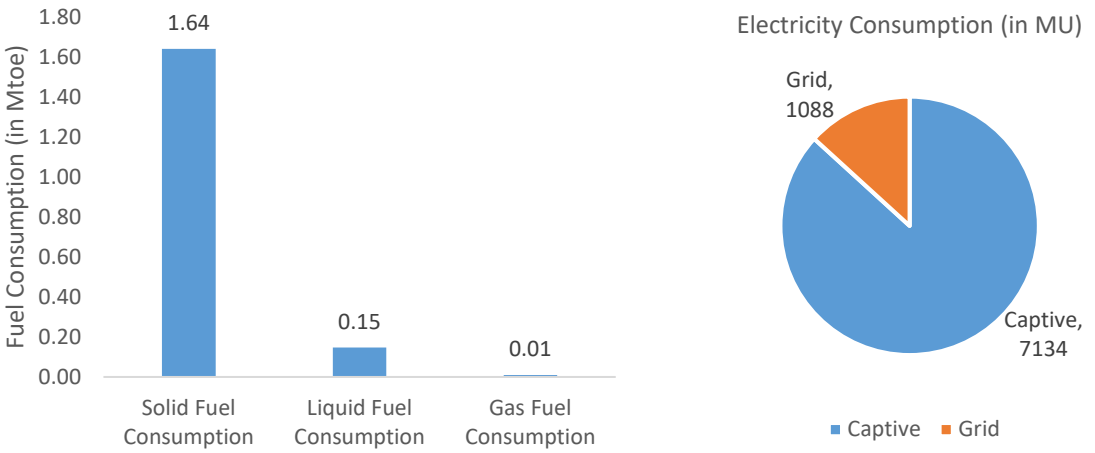


Figure 70: Estimated fuel-wise consumption (55 DCs) and electricity consumption (53 DCs) in the Pulp & Paper Sector, 2024-25

Note: As detailed fuel-wise data are not available for all Designated Consumers, the fuel-wise distribution is estimated using consumption shares from a representative sample of DCs. The grid–captive electricity split is available only for a subset of DCs and is presented separately; therefore, grid electricity should not be combined with the fuel-wise distribution to reconcile with total energy consumption.

5.1.8 Textile

India continues to hold a strong position in the global textile and apparel industry. The sector contributes meaningfully to the national economy, accounting for around 2.3 percent of GDP**,** nearly 13 percent of industrial production, and about 12 percent of India's exports. India is the second-largest producer of textiles and garments and also the third largest exporter of textile and apparel in the world with a 4.6 percent share in global trade. This is expected to grow by a compound 10 percent annually from $165 billion in 2022 to reach $350 billion by 2030 (Rathee, 2024). The textile sector employs approx. 45 million people directly and another 60 million through allied sectors (Department of Textiles, 2023), making it one of the largest sources of employment in the country.

Over the years, the Government has introduced a number of schemes aimed at strengthening the textile value chain and encouraging modernisation of the textile industry. Programmes under the Technology Upgradation Fund Scheme (TUFS) have supported units in replacing older machinery with newer, more efficient equipment. Substantial assistance has been released under TUFS and Amended TUFS over time, helping mills improve productivity and reduce operational costs through technology upgradation (Ministry of Textiles, 2025). The scheme disbursed Rs 15,909 crore from 1999-2000 to 2012-13 and Rs 8714.45 crore under Amended TUFS

(ATUFS) from 2015-16 to 2022-23, incentivising 1117 energy-saving machines (Parliament LARRDIS, 2014). Additionally, schemes like SAATHI were designed especially for MSME units, helping them shift to energy-efficient motors and other equipment, which contributed to lowering electricity consumption and energy costs. In recent years, the Government has also expanded its focus toward developing larger, integrated textile ecosystems through schemes like the PM MITRA Parks, the Production Linked Incentive (PLI) Scheme for Textiles, and the Textile Cluster Development Scheme (TCDS). These initiatives aim to build modern processing infrastructure, promote manmade fibre and technical textile segments, and support more sustainable production practices (Ministry of Textiles, 2025).

Further, under the PAT scheme, BEE has notified a total of 168 DCs till PAT Cycle VII (from 2021-22 to 2024-25) and has achieved substantial energy savings targets. Furthermore, the BEE-GEF-UNIDO Programme focuses on promoting energy-efficient and renewable energy technologies in MSME clusters, including those in the textile sector, contributing to environmental sustainability. The project has been able to implement around 33 energy efficiency (EE) and renewable energy (RE) projects with energy savings of 213 toe and reduced CO2 emissions of 1390 tonnes and achieved co-financing investment from MSME's INR 8.73 crores (BEE, Dec, 2023). Additional schemes like the Production Linked Incentive (PLI), Textile Cluster Development Scheme (TCDS), and Integrated Processing Development Scheme (IPDS) incentivise production and eco-friendly practices, further bolstering India's textile sector.

India's textile production has remained fairly steady over the past several years, with some shifts across different fibre types. Cotton continues to make up the largest share of total output, although its production shows small ups and downs, from around 5.9 million tonnes in 2016-17 to 5.5 million tonnes in 2023-24 (P). Man-made fibres have seen a gradual rise, reflecting the growing use of polyester and viscose in the domestic market. Jute production has remained mostly stable, with only minor year-to-year variations. Raw silk output is very limited compared to other fibre categories and contributes only a small portion to the overall production basket. Overall textile production increased from 8.9 million tonnes in 2016-17 to about 9.2 million tonnes in 2023-24 (P), showing a broadly steady trend with moderate fluctuations across the years. India's cotton production is forecasted to reach 7.2 million tonnes (approximately 43 million bales of 170 kg each) by 2030, driven by increasing consumer demand. The following graph illustrates India's textile production trends over the years.

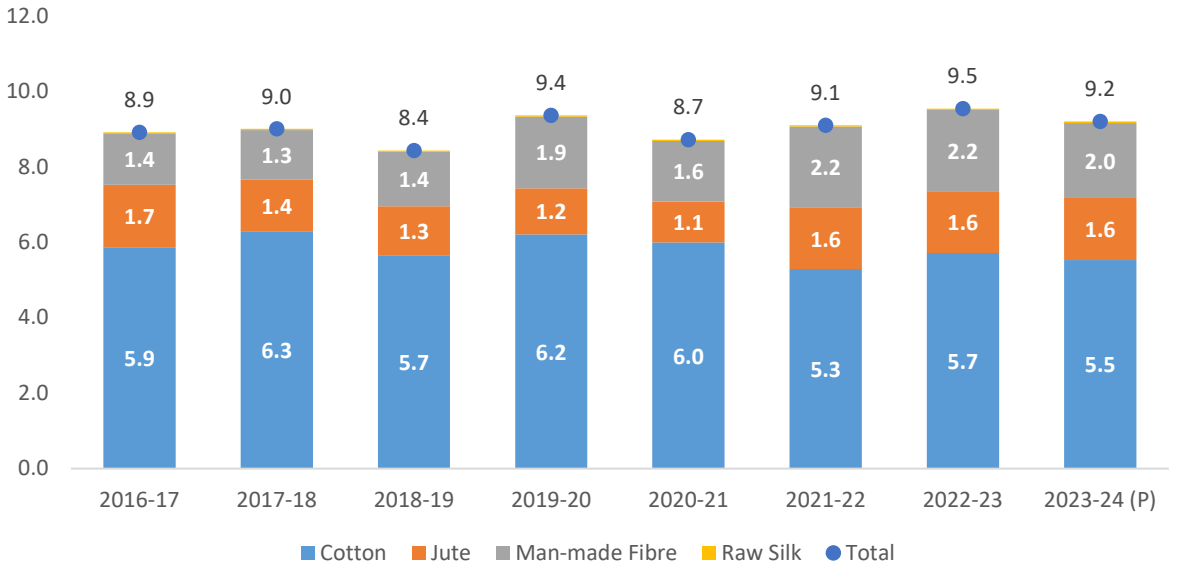


Figure 71: India's Textile production trends

Source: (CPCOC & Ministry of Textile, 2025)

Energy Consumption

The textile sector encompasses a wide range of activities such as spinning, weaving, processing, and finishing, all of which require energy for both process heat and power. As shown in Figure 72, estimated fuel-wise consumption for FY 2024-25 across 206 Designated Consumers indicates that solid fuels constitute the largest share of thermal energy use in the sector, primarily for steam generation. Liquid and gaseous fuels contribute relatively smaller shares of total fuel consumption. The figure also presents electricity consumption for 83 Designated Consumers, showing that a larger share of electricity demand is met from the grid, while the remaining portion is supplied through captive generation.

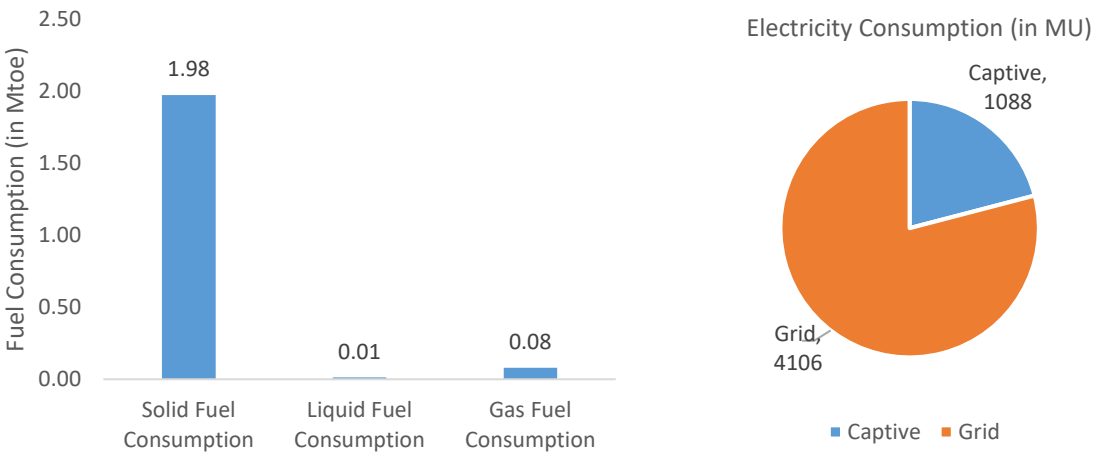


Figure 72: Estimated fuel-wise consumption (206 DCs) and electricity consumption (83 DCs) in the Textile Sector, 2024-25

Note: As detailed fuel-wise data are not available for all Designated Consumers, the fuel-wise distribution is estimated using consumption shares from a representative sample of DCs. The grid–captive electricity split is available only for a subset of DCs and is presented separately; therefore, grid electricity should not be combined with the fuel-wise distribution to reconcile with total energy consumption.

Figure 73 illustrates the distribution of solid, liquid, and gaseous fuel use within the textile sector by end use for FY 2024-25. In the case of solid fuels, the majority is used for cogeneration, accounting for over 60 per cent of total solid fuel consumption, followed by process use at around 35 percent. Liquid fuels are used predominantly in industrial processes, which account for about 70 percent of liquid fuel consumption, with the remaining share split between DG sets and cogeneration. Gaseous fuels are also used mainly for process applications, accounting for around 70 percent of total gaseous fuel use, while the remaining share is utilised in gas-based power generation.

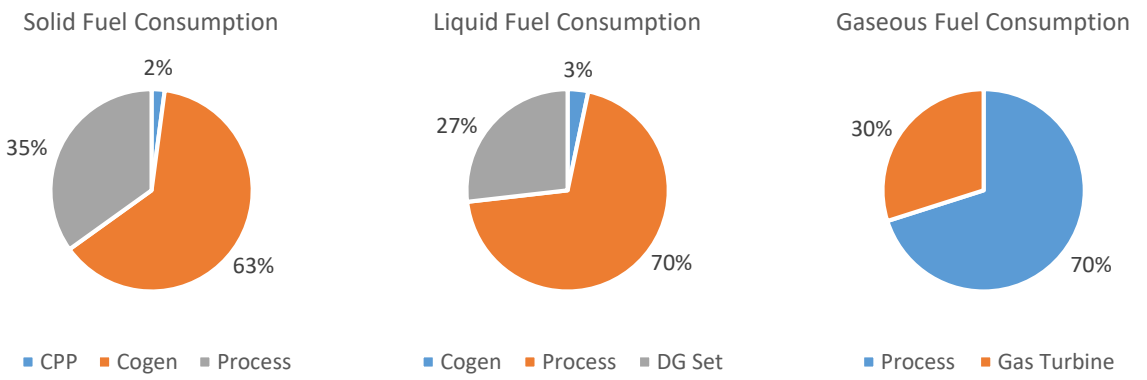


Figure 73: Distribution of Fuel used in Textile Industry (in 2024-25)

5.2 Buildings

India's building sector, including both residential and commercial structures, is a rapidly expanding contributor to national energy demand. Growing urbanisation, population expansion, rising incomes, and a steady increase in built-up floor area have all contributed to a sharp rise in energy consumption. Near-universal electrification and increasing penetration of electrical appliances, particularly for cooling, lighting, and cooking, have transformed the energy landscape of the country. India overtook China in 2023 to become the world's most populous nation (World Population Review, 2023). Urbanisation has risen from 31 percent in 2011 (Census of India, 2011) to an estimated 35 percent in 2023, and it is projected to reach 38 percent by 2036 (MoH&FW, 2020). This demographic shift, along with government initiatives like the Pradhan Mantri Awas Yojana (PMAY), which aims to provide "Housing for All", has led to an unprecedented surge in both residential and commercial construction. This combination of factors has driven a marked rise in electricity use in buildings over the last decade.

Further, the expansion of peri-urban areas and the construction of pucca houses in rural India are contributing to the steady rise in household energy needs. The average floor area of residential buildings in 2020-21 was 50.5 m^2 in rural regions and 64.5 m^2 in urban areas, with an all-India average of 54.2 m^2 (MoSPI, 2023). On the commercial front, the total floor area of all commercial buildings was about 1.1 billion m^2 in 2017, projected to reach an estimated 1.78 billion square metres by 2027 (Kumar et al., 2018). The building sector accounts for around 15 percent of total energy consumption (excluding biomass and biofuels) in 2024-25.

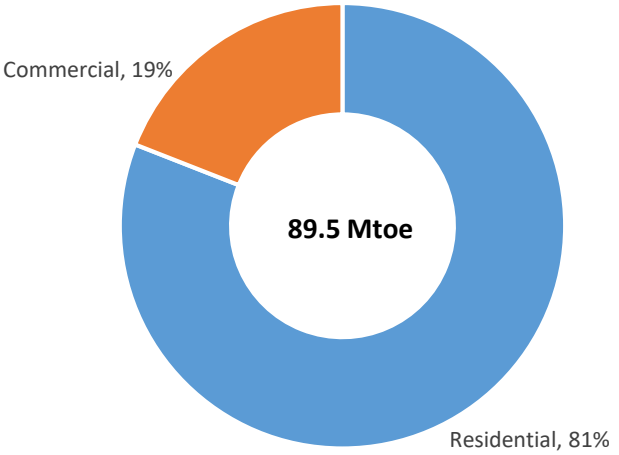


Figure 74: Total Energy Consumption in Buildings in 2024-25 (E)

Source: The figures are calculated based on actual data from various ministries

Residential energy consumption accounted for 81 percent of total building energy use, while commercial buildings comprised the remaining 19 percent (refer to Figure 74). In terms of total final energy consumption, residential buildings consumed about 72.8 Mtoe**,** accounting for 12.1 percent, while commercial buildings consumed around 16.7 Mtoe**,** representing 2.8 percent of final energy consumption. Energy demand in the building sector is primarily driven by electricity used for lighting, space cooling, heating, and cooking. The above analysis, however, does not account for biomass consumption, which remains a significant component of residential energy use, predominantly for cooking and water heating in rural households.

In addition to commercial fuels and electricity, solid biomass constitute a substantial component of energy use in the building sector. Based on TERI estimates from the biomass and biofuels assessment, total final energy consumption from solid biomass and biofuels in buildings is estimated at about 74.1 Mtoe in 2022-23 and 70.9 Mtoe in 2023-24. Residential buildings account for the majority of this consumption, contributing around 98 percent in 2022-23 and about 94 percent in 2023-24, reflecting the continued reliance on biomass-based fuels for cooking and water heating in households.

Key Policy Interventions in Building Sector

- Energy Conservation and Sustainable Building Code (ECSBC): India has taken a major step in 2024 toward a greener future with the introduction of two new building codes: the Energy Conservation and Sustainable Building Code (ECSBC) for commercial buildings and the Eco Niwas Samhita (ENS) for residential buildings. The revised codes apply to large commercial buildings and multi-storied residential complexes with a connected electricity load of 100 kW or more, which means the codes will impact big offices, shopping malls, and apartment buildings and will help in reduction of 18 percent electricity consumption. Additionally, it incorporates sustainability features related to natural cooling, ventilation, water, and wastewater disposal. States may adopt these building codes.
- To widen the scope of the Building Labelling Programme based on Energy Consumption, a labelling programme for Net Zero Energy Buildings (NZEB) and Net Positive Energy Buildings (NPEB) has been

introduced. The programme is named as “Shunya” Labelling Programme. Shunya is the Hindi meaning of Zero (0) thus making it suitable to label the NZEB and NPEB buildings as Shunya.

- To reduce electricity demand through use of energy efficient appliances, the Standards and Labelling (S&L) programme was launched in 2006 under the Energy Conservation Act, 2001. The programme aims to improve energy efficiency in residential, commercial, and industrial appliances, particularly in cooling and refrigeration equipment. The S&L program mandates affixing of star label on appliances in accordance with the provisions of EC Act. Energy performance standards are revised periodically to keep pace with technological advancements and market trends. Consequently, product label information is updated, and star ratings, ranging from 1 to 5, are assigned based on energy efficiency. The star rating plan is reviewed every two years or before the label’s validity period expires, whichever comes first. As on November 2024, the program covers 39 appliances, with 16 appliances under mandatory regime of labelling and 23 appliances under voluntary regime of labelling. Through S&L program, electricity savings of 89.84 billion units (BU) were achieved during FY 2023-24.
- To evaluate the impact of the S&L programme, it is essential to capture production data for the registered appliances. Under the programme, manufacturers are required to submit production data for each product to BEE either quarterly or annually, with penalties for non-compliance. As of November 2024, BEE has registered a total of 3553 brands and 28,320 models across various appliance categories. The total production for all appliances under the programme was 549 million units for 2023-24, compared to 567 million units for 2022-23.
- Indian Initiatives like SAUBHAGYA and Deen Dayal Upadhyaya Gram Jyoti Yojana (DDUGJY) aims at providing electricity to all homes. 99 percent of households have been electrified under SAUBHAGYA (Ministry of Power, 2024). The UJALA (Unnat Jyoti by Affordable LEDs for All) scheme promotes affordable energy-efficient appliances like light-emitting diode bulbs, tube lights and fans. The program achieved remarkable success, saving 47.8 billion units of energy and reducing carbon dioxide emissions by 38.78 $MTCO_2$ each year.
- As the number of buildings continue to rise, energy consumption is expected to rise significantly. This rise in the building sector is influenced by the various national missions, such as the Pradhan Mantri Awas Yojana (PMAY), which aims to provide ‘housing for all’. As of 8th July 2024, under PMAY, 8.4 million houses have been completed in urban areas (Ministry of House & Urban Affairs, 2024), while 5.7 million houses were completed in 2022-23, in the rural area (Ministry of Rural Development, 2024). Furthermore, the Government recently announced plans to construct an additional 30 million houses in both rural and urban areas under the PMAY (PIB, Jun, 2024). Initiated in 2015, the Smart Cities Mission aims to develop 100 cities with advanced infrastructure and governance, including expanding housing opportunities for all.

Building Sector: Electricity Consumption

The section is divided into two sub-sections: residential and commercial buildings. Each sub-section analyses energy consumption trends, considering both fuel and electricity usage in these building categories. India is undergoing a rapid transformation in its electricity consumption landscape. The combined residential and commercial building sector in India accounts for 33.5 percent of the total electricity consumption in 2024-25. Electricity consumption from the combined residential and commercial building sector has grown at CAGR of around 6.3 percent, over the past decade.

Details of the national electricity consumption including the share of commercial and domestic buildings sectors are presented in the Figure 75. Out of the total consumption of electricity in 2024-25 (P), industry sector accounted for the largest share (40 percent), followed by domestic (25 percent), agriculture (16 percent) and commercial sectors (8 percent).

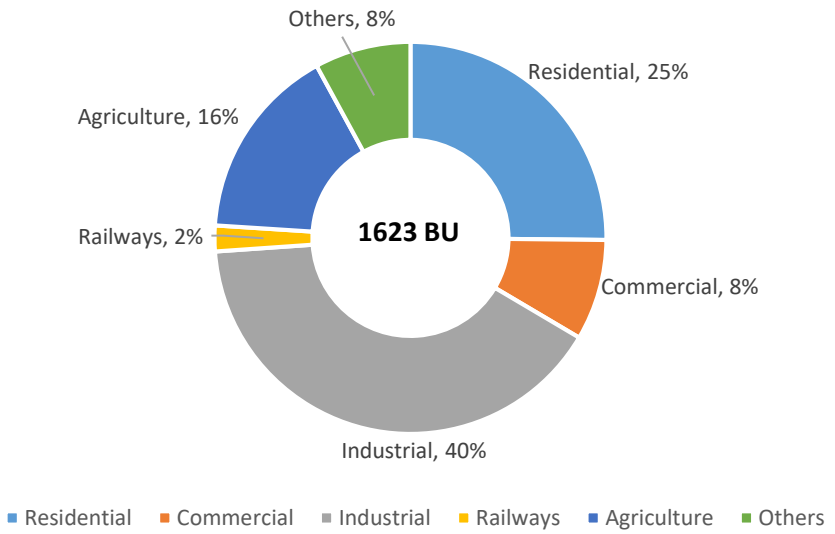


Figure 75: Sector-wise electricity consumption in 2024-25(E)

Source: (CEA, 2025)

5.2.1 Residential Buildings

The residential building sector in India is changing faster than ever before. Households that once depended on a few basic appliances and traditional fuels are now becoming active contributors to national energy demand. Rising incomes, expanding electrification, urban lifestyles, and growing expectations of comfort are reshaping how households consume energy. If current patterns continue, under a business-as-usual scenario, energy use in the residential segment is expected to grow eight-fold by 2050, driven by increased appliance ownership, cooling demand, and continued urbanisation.

Households in India use energy primarily for lighting, cooking, space cooling, heating, and running an expanding range of appliances. The energy sources that support these activities remain diverse, including electricity, LPG, piped natural gas, biogas, solid biomass, and kerosene. While electricity, LPG and biomass continue to dominate, the balance between them is shifting as more families move toward cleaner and more convenient options.

Fuel Usage in Residential Buildings

In India, many households continue to rely on solid fuels such as firewood, dung cakes, coal and agricultural residues for cooking. As of 2020-21, about 34 percent of Indian households still depend on firewood and crop residues as their main cooking fuel (MoSPI, Mar, 2023). This reliance varied significantly between rural and urban areas, for rural areas the figure was about 47 percent, compared to just 6.5 percent in urban households (MoSPI, Mar, 2023). In rural India, firewood and chips were the primary cooking energy sources for over 76.3

percent of households in 2009-10 (MoSPI, Sept, 2012). It significantly reduced to 47 percent in 2020-21, showing that India has made significant progress in moving towards cleaner cooking fuels over the past decade.

Government initiatives have played a major role in accelerating this transition. The Pradhan Mantri Ujjwala Yojana (PMUY) was launched in 2016. The scheme set a target to provide 8 crore LPG connections by 2020 to households using traditional fuels, this target was achieved in 2020. Later, Ujjwala 2.0 was launched in 2021 to provide one crore additional LPG connections, which was completed in December 2022. As the programme completes nine years in 2025, over 10.33 crore families have already received LPG connections, and another 25 lakh connections have been cleared for release in 2025-26, taking the total to about 10.58 crore. More importantly, most beneficiaries are continuing to use LPG, and the number of active domestic LPG consumers across the country has now risen to about 32.94 crore. The Government has also increased the LPG subsidy to Rs.300 per 14.2 kg cylinder for 12 refills annually to make it affordable. Because of these efforts, the number of active domestic LPG consumers has increased from 14.5 crore in April 2014 to 32.7 crore by September 2024, significantly boosting the use of clean cooking fuel nationwide.

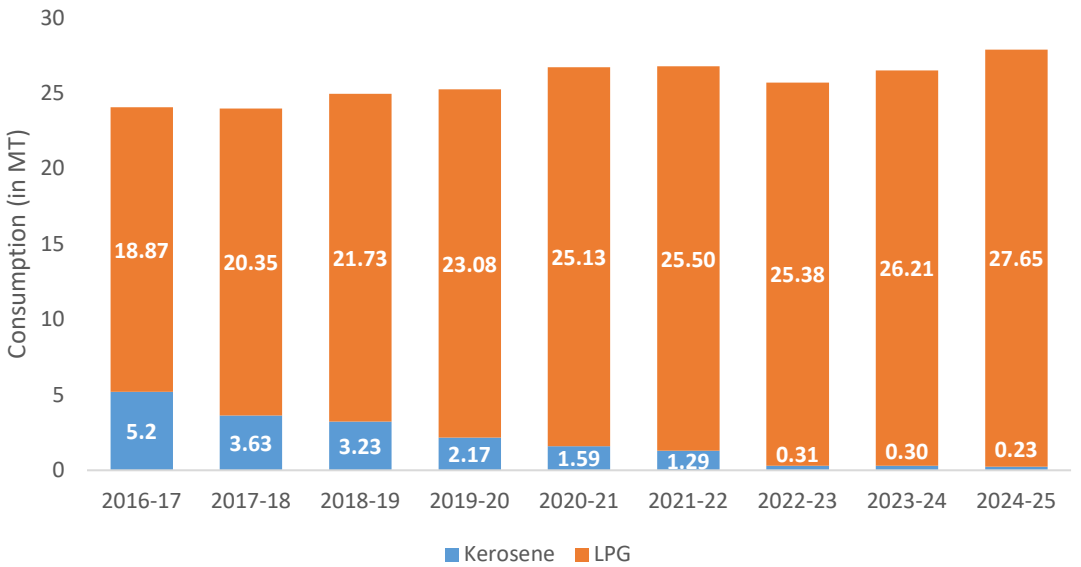


Figure 76: LPG and Kerosene Consumption in Residential Sector

Source: (MoPNG, 2025)

Figure 76 shows that LPG consumption has been on an increasing trend since 2016-17, whereas the consumption of kerosene has declined during the same period. The LPG consumption has increased from 18.87 MT in 2016-17 to 27.65 MT in 2024-25, growing at a CAGR of about 5 percent. The decrease in kerosene usage can be attributed to its gradual replacement by LPG and electricity, driven by the schemes like PMUY and Saubhagya, along with 'Go Electric' Campaign and the National Efficient Cooking Programme. These schemes promoted electric cooking appliances like induction cooktops and electric pressure cookers. Natural gas is also emerging as a key energy source in urban residential areas. The estimated consumption of piped natural gas (PNG) in the residential sector is around 6716 MMSCM, contributing nearly 6.21 Mtoe of energy, which makes this sector responsible for around 12 percent of the total final energy consumption from natural

gas in 2024-25. The Pradhan Mantri Urja Ganga pipeline project and the City Gas Distribution (CGD) network auctions are rapidly expanding PNG infrastructure to new cities and towns.

Alongside modern cooking fuels, solid biomass continue to constitute a major component of residential energy use in India, particularly for cooking and water heating. Based on TERI estimates from the biomass and biofuels assessment, the final energy consumption of solid biomass and biofuels in the residential sector is estimated at around 72.3 Mtoe in 2022-23 and 67.0 Mtoe in 2023-24. Despite the increasing adoption of LPG, electricity, and piped natural gas, the continued use of biomass reflects its persistence in household energy consumption, especially in rural and semi-urban areas.

Electricity consumption in residential buildings

Residential buildings contribute around 81 percent of the total energy consumption of Buildings sector (when accounting for all fuels except biomass). Although, many homes still depend on traditional fuels, especially in rural areas, the role of electricity is growing fast. Residential buildings are one of the major consumers of electricity in India. In 2024-25, the residential buildings accounted for 25 percent (408.5 BU) of total electricity consumption (refer to Figure 77). Schemes like SAUBHAGYA achieved near-universal electrification, while UJALA made energy-efficient LED lighting affordable for millions. This had a dual effect: it brought more households onto the grid and reduced the cost of lighting.

Households uses electricity for cooking, heating, cooling, lighting and powering electrical appliances. The increasing ownership of appliances in Indian households has further boosted electricity demand, as people turn to electrical appliances for work, education and comfort.

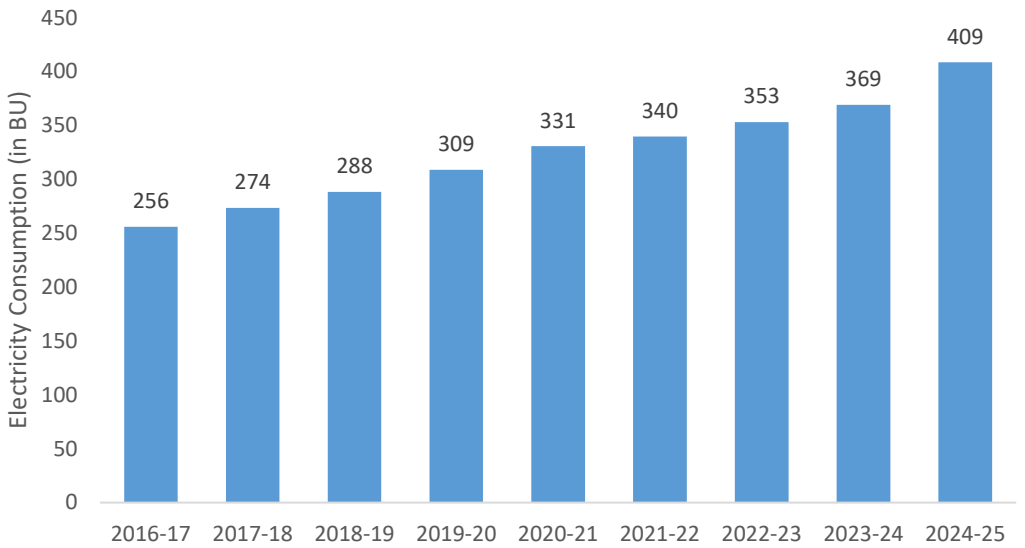


Figure 77: Electricity Consumption in the Residential Sector

Source: (CEA, 2024)

- The overall electricity consumption in the household sector has risen by around 60 percent from the FY 2016-17 to FY 2024-25.
- An increase in electricity consumption by 7 percent during 2020-21 can be attributed to the pandemic, which led to a rise in appliance usage while 'working from home', including air conditioners, lights, laptops, and other electronic devices.

The Expanding Reach of Star-Labelled Appliances: A Shift towards Widespread Efficiency

The Standards & Labelling (S&L) program has set its role as one of the country's most impactful drivers of energy efficiency. While the program's foundation was built on regulating high-consumption appliances like air conditioning, the latest data reveals a compelling story: star-labelled appliances are now an increasingly integral part of the Indian consumer's everyday life. The objective of helping consumers make informed choices about the energy performance of appliances and equipment, has shifted the focus from primarily air conditioners to a broader suite of home and commercial appliances.

Table 10: Production of Mandatory, Star-Labelled Appliances in FY 2024-25

S. No.	Appliances	Star 1	Star 2	Star 3	Star 4	Star 5
1	Room Air Conditioner (Fixed Speed)	105650	426665	2109534	2095	4683
2	Room Air Conditioner (Variable Speed)	0	14370	10053640	262422	4421342
3	Ceiling Fan	62638776	1077884	472015	63486	8922778
4	Colour Television	2351775	2261193	1441238	118537	25900
5	Direct Cool Refrigerators	3906596	2506126	3951728	711342	2582842
6	Frost Free Refrigerators	222839	3198322	862092	686	0
7	Distribution Transformer	245500	146594	101	1	29660
8	Stationary Storage Type Electric Water Heater	534	17940	335227	1379612	3768608
9	TFL	8776492	18000	341570	0	0
10	Washing Machine (Semi/Top Load/Front Load)	0	4229	168496	20065	12214856
11	LED LAMPS	162594304	204336971	113696018	118790	392475
12	Chillers	14	191	1369	772	581
13	Deep Freezers	21906	23628	189747	348173	774031
14	Light Commercial Air Conditioners	39837	22895	0	0	0
15	Light Commercial AC Variable Speed	259	10077	24675	5265	20530
16	Ultra-High Definition (UHD) Televisions	1943860	2484443	944359	183181	1215

Source: (S&L Scheme, BEE)

Most of the mandatory labelled appliances in FY 2024-25 show a gradual shift towards higher efficiency levels. For room air conditioners, the production numbers are highest in the 3-Star category, followed by 5-Star models, while 1-Star units are very limited. A similar pattern can be seen in the stationary storage type electric water heater, where 3-Star, 4-Star and especially 5-Star models dominate the production mix. Washing machines also reflect this movement, with 5-Star models forming the largest portion, suggesting that consumers and manufacturers are aligning with more efficient options. Deep freezers follow a similar trend, with the highest production in 5-Star models, indicating progress in another energy-relevant category. These

shifts suggest that in several major appliance types, the market is moving toward better efficiency levels rather than lower-rated products.

In contrast, some appliances still show a concentration in the lower star bands and may need further policy attention. Refrigerators are present across all star levels, but the 1-Star, 2-Star and 3-Star models remain the most common, while 5-Star units are fewer. For several other products — such as colour televisions, UHD televisions, LED lamps, distribution transformers and TFLs — the production is mainly in the lower star categories, indicating that efficiency uptake in these appliances is moving more slowly.

Household Survey: Key Findings on Residential Energy Use (CLASP–BEE, 2024)

The Bureau of Energy Efficiency (BEE), in collaboration with CLASP, conducted a detailed Residential Energy Consumption Survey (2024) to understand how households across India use energy in their daily lives. This national household survey adopted a stratified multistage sampling approach to ensure representation across India's diverse climatic, geographic, and socio-economic contexts. As a first step, the country was stratified into five major climatic zones i.e., Hot-Dry, Warm-Humid, Temperate, Composite, and Cold, to capture variations in energy use patterns driven by climate.

The total sample comprised 4,321 households, distributed across urban (approximately 70 percent, 3,061 households) and rural areas (approximately 30 percent, 1,260 households). A higher urban sample share was adopted to account for greater heterogeneity in appliance ownership, dwelling characteristics, and energy consumption patterns in urban settings. Within each climatic zone, households were further selected through a multistage process to ensure coverage across different socio-economic strata and geographic regions. The final dataset includes 4,321 completed household surveys, providing a representative snapshot of residential energy use across India's varied climatic zones, settlement types, and income groups.

Key observations include:

- Sample: 4,321 households across 20 states.
- Average annual household electricity consumption (survey mean): 1,805 kWh per year (urban: 1,937; rural: 1,486).
- Appliance ownership: Nearly every household owns ceiling fans and LED lights. Ownership of refrigerators and washing machines is common in urban areas, while air-conditioners (ACs) are present in about 13 percent of all households (around 17 percent in urban and 4 percent in rural areas).
- LPG use (households reporting): 91 percent (urban 93.3 percent, rural 87 percent). About 93 percent of urban and 87 percent of rural households now use clean fuels (LPG, PNG, electricity, or biogas) for cooking. However, in rural areas, traditional fuels like firewood and agricultural residues are still used for cooking needs.
- Electricity consumption by end-use category: Thermal comfort appliances, such as fans, air-coolers and ACs, account for nearly 40 percent of total household electricity use. Kitchen appliances contribute around 28 percent, lighting 11 percent, and the rest comes from entertainment and miscellaneous loads.

- Cooling demand: Cooling requirements are rising rapidly. Over half of the households that own ACs purchased them within the last five years, indicating a continued increase in residential electricity demand during summer months.
- Awareness and purchasing behaviour: Around two-thirds of respondents were aware of energy-efficient appliances, but only a small share considered energy efficiency as the top priority when purchasing, showing a gap between awareness and action.

Electricity Consumption in Households

Electricity consumption in Indian homes is rising steadily with the expansion of electrification and growing use of electrical appliances. This survey estimates the average annual household electricity consumption across surveyed households to be about 1,805 kWh per year. This is higher than the national average of 1,164 kWh per year (around 97 kWh a month) reported in the 2022-23 Household Consumption Expenditure Survey conducted by the National Sample Survey Office (NSS). Urban households consume nearly 1,937 kWh per year, while rural households use about 1,486 kWh.

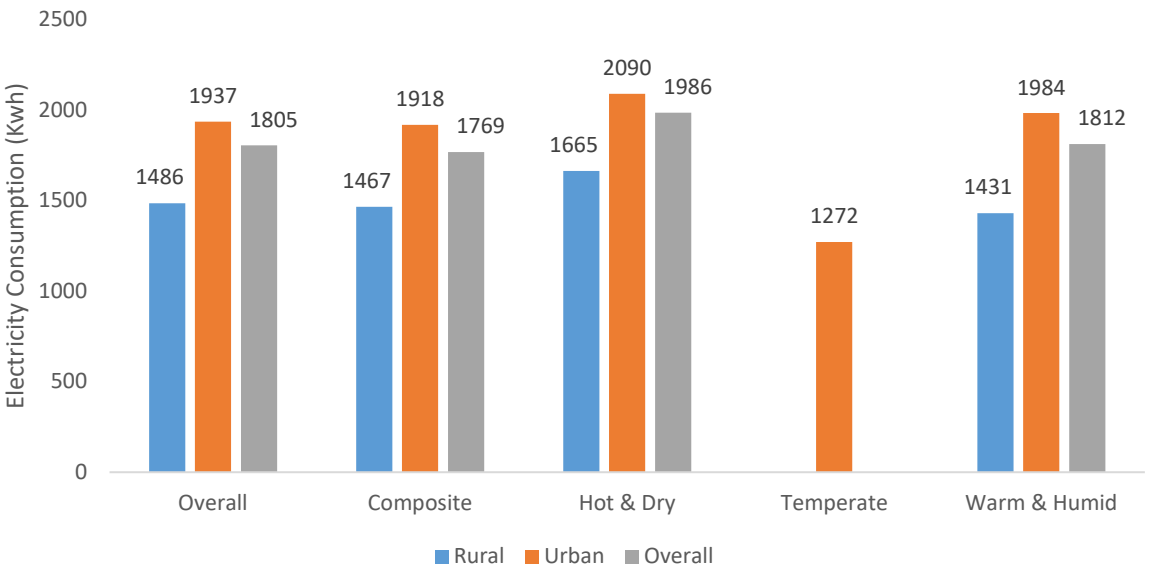


Figure 78: Average annual electricity consumption per surveyed household

Note: No rural households were surveyed in the temperate zone, and the cold zone had limited samples, so both were excluded from analysis

As shown in the Figure 78, Electricity use in homes varies across India's climate zones. It is highest in hot and dry areas (about 1,986 kWh/year) due to greater cooling needs and lowest in temperate zones (around 1,272 kWh/year) where weather is moderate. Composite and warm–humid regions also show higher use, reflecting India's growing demand for cooling in warmer climates.

As per the survey findings, electricity use in households increases clearly with income levels. In urban areas, the upper-income group recorded the highest average annual consumption at around 2,249 kWh, followed by middle-income households consuming about 1,812 kWh per year. Together, these two groups account for nearly 80 percent of urban electricity demand. In rural areas, the upper-income group, which makes up only 9.5 percent of households, had the highest average consumption at about 1,880 kWh per year, while middle income households consumed around 1,486 kWh annually. These findings show, as income levels rise,

households own and use more appliances such as refrigerators, washing machines and air-conditioners, which leads to higher electricity consumption and a growing share of energy demand from better-off families.

End-Use Pattern of Electricity Consumption

Electricity in Indian households is mostly used for cooling, cooking, lighting, and running appliances. As per the survey, thermal comfort appliances like fans, coolers, and air-conditioners take the largest share, using about 40 percent of total household electricity. Kitchen appliances such as refrigerators, mixers, induction cooktops, and microwaves together account for 28 percent, while lighting takes about 11 percent. The remaining 21 percent goes toward televisions, washing machines, water pumps, and other small household devices.

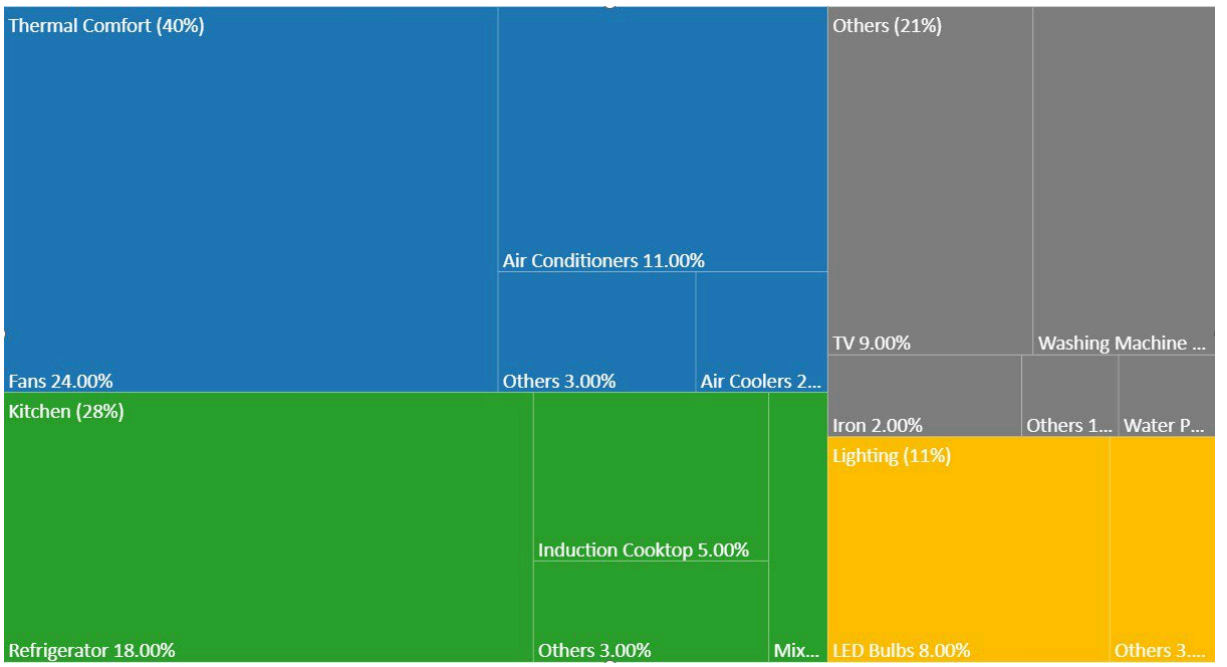


Figure 79: Share of Electricity consumption by different appliances across surveyed households

Figure 79 shows that cooling appliances dominate electricity use, which is not surprising given India's rising temperatures and longer summers. Fans are the most widely used appliance, found in almost every household and accounting for about 24 percent of total household electricity use. Air-conditioners (ACs) contribute around 11 percent, while air-coolers make up another 2 percent.

Kitchen appliances come next, within this group, refrigerators alone contribute the most, around 18 percent since they run continuously throughout the year. Induction cooktops, microwaves, mixers, and electric kettles together add about 10 percent, and their use is growing quickly in urban homes. This rise in appliance ownership and usage is steadily increasing electricity demand in kitchens.

Lighting now takes a smaller share, at around 11 percent, due to the widespread adoption of LED bulbs under the UJALA programme. However, as households build larger spaces and install more lights, overall lighting demand remains steady despite efficiency improvements.

The remaining 21 percent of electricity consumption comes from other appliances, such as televisions (8 percent), washing machines (6 percent), water pumps (4 percent), and miscellaneous devices (3 percent).

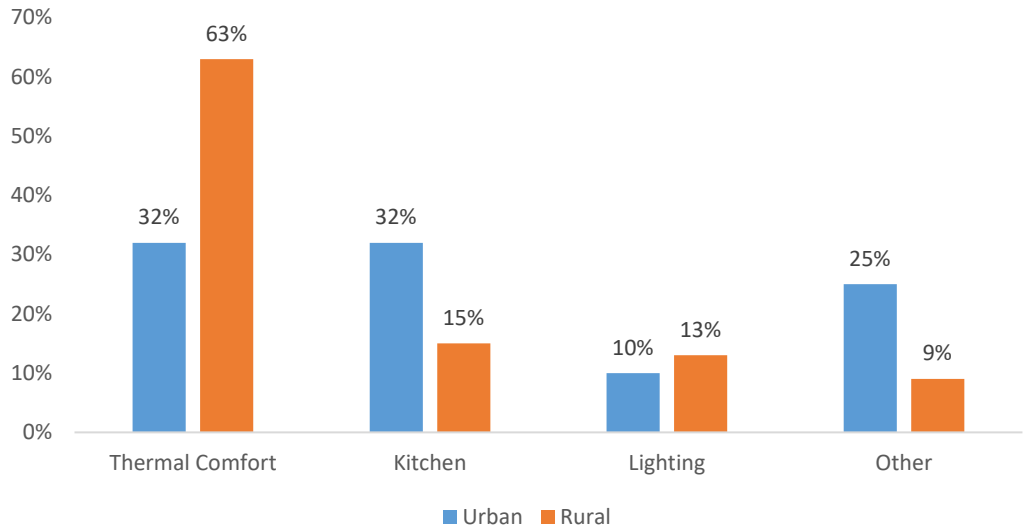


Figure 80: Share of electricity consumption by appliances across different categories of households

As shown in Figure 80, the story of energy use differs sharply between city and village households. In rural households, the daily need for cooling means that thermal comfort alone consumes over 60 percent of their electricity. Meanwhile, urban households present a more balanced picture, where along with thermal comfort, the kitchen also plays a big role in their electricity consumption, reflecting the higher ownership of kitchen appliances like refrigerators that run constantly.

Appliance Ownership and Usage Trends

Household appliance ownership in India has grown sharply in the last few years. Better electrification, higher incomes, and affordable products have changed how Indian families use energy at home. According to the survey, almost every household now owns ceiling fans and LED lights, making them the most common electrical appliances across the country. Refrigerators are present in around 64 percent of households, almost 76 percent in urban areas but only 36 percent in rural homes. Ownership of washing machines stands at about 22 percent overall, while televisions are owned by roughly 55 percent of households.

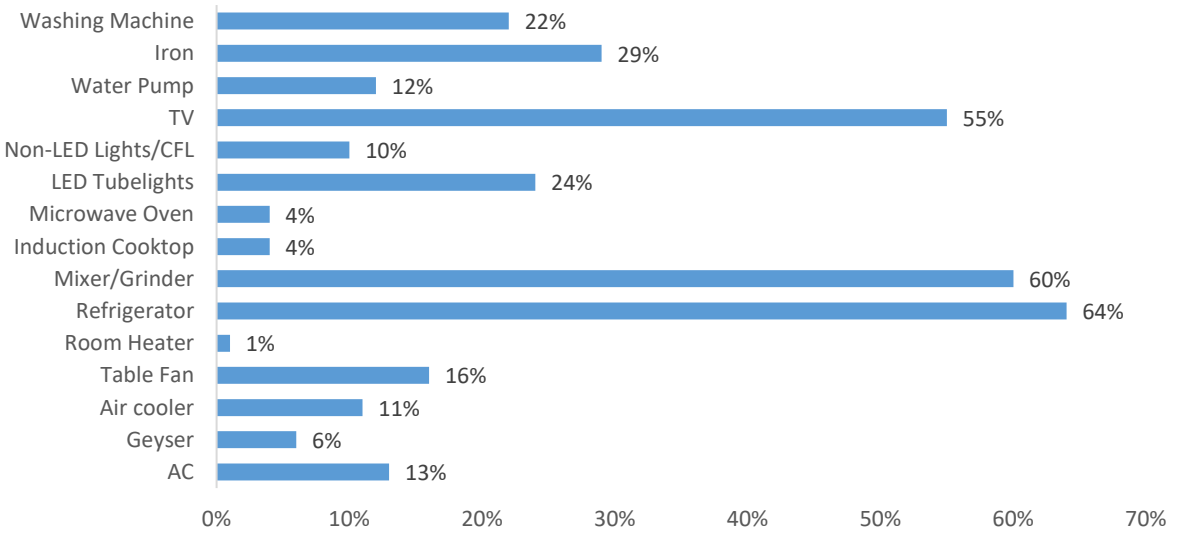


Figure 81: Household level ownership of appliances across surveyed households

Cooling appliances are becoming more common. Air-conditioners are now owned by about 13 percent of all households, close to 17 percent in urban and 4 percent in rural areas. Air-coolers appear in nearly 11 percent of homes, mainly in hot-dry and composite zones. The share of inverter ACs and BLDC fans is rising, nearly one-third of ACs and 27 percent of total geysers are 5 star rated, own by surveyed household, showing that energy-efficient models are slowly replacing older ones.

When it comes to daily use, fans and lights are operated the most often for 10-15 hours a day in summer. Refrigerators run throughout the day, while washing machines are typically used three to four times a week. In contrast, air-conditioners are used for only three to five hours a day but add significantly to total power use. More than 10 percent of the households own TV, Refrigerator and Mixer, on the other hand, less than 10 percent own Geyser, Induction cooktop, Microwave oven and Room Heaters.

These findings underline how fast homes are becoming appliance-rich. Rising ownership of cooling and kitchen devices will keep pushing electricity demand up, especially in cities. Encouraging efficient appliances through the Standards & Labelling (S&L) Programme and consumer-awareness campaigns will be vital in keeping this growth sustainable.

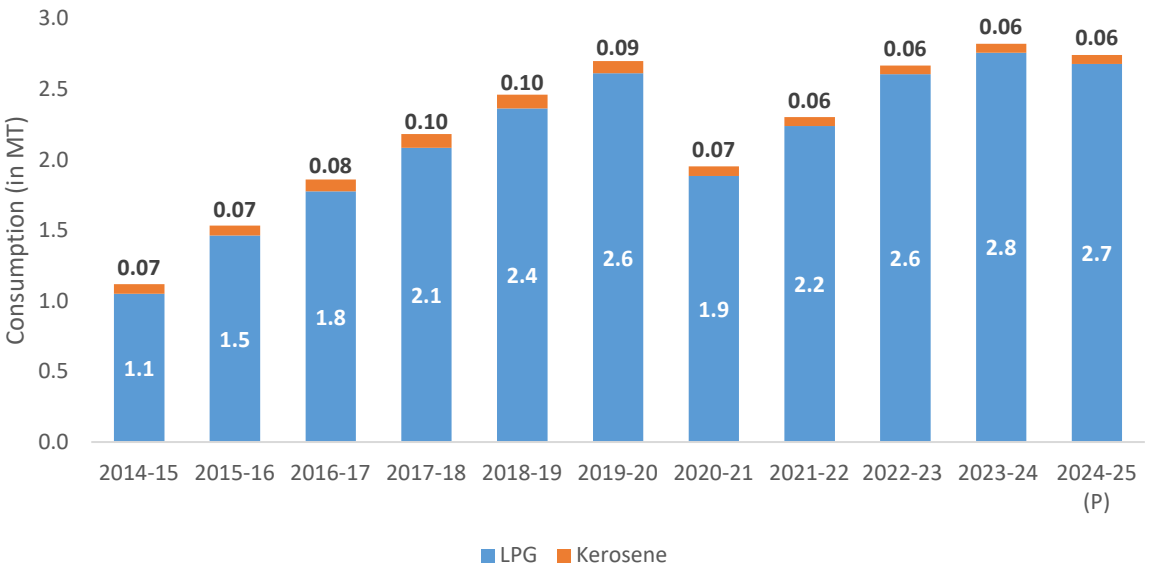
5.2.2 Commercial Buildings

The collective built-up area of commercial buildings is projected to reach 1.9 billion square meters by 2030. With one of the highest growth rates in the sector, it becomes imperative to regulate and optimize energy consumption in commercial buildings to ensure sustainable development. The commercial sector in India continues to expand steadily, driven by economic growth, urbanisation and rising service-sector activity. The major categories of commercial buildings include hotels and restaurants, hospitals, educational institutions, retail spaces, office buildings, assembly areas, transit buildings and warehouses (MoEFCC, Mar, 2019). With India's economic growth, both the number of commercial buildings and the energy they consume are expected to rise. In 2024-25, commercial buildings consumed 16.64 Mtoe, accounting for about 19 percent of the

building sector's total energy use, excluding biomass and biofuels, with electricity comprising 70 percent of this consumption.

Fuel Usage in Commercial Buildings

In commercial buildings, LPG and natural gas are the main fuels used. LPG consumption has increased to about 2.7 MMT in 2024-25, and natural gas use in the sector is estimated at around 1.9 Mtoe (2081.6 MMSCM). These are largely used for cooking in hotels, restaurants and cafeterias, and for some water-heating needs. Kerosene use is now very small, about 0.06 MMT, and is mostly limited to a few older or smaller establishments that still use wick stoves or keep it as a backup heating fuel. Overall, fuel use remains modest, with electricity meeting most of the energy demand in commercial buildings.



(P) - Provisional

Figure 82: Petroleum Product Consumption in the Commercial Sector

Source: (MoPNG, 2025)

In addition to LPG, natural gas, and electricity, biomass is also used to a limited extent in commercial buildings. This includes use in select establishments such as small hotels, roadside eateries, religious institutions, and institutional kitchens, primarily for cooking and water-heating purposes. Based on TERI estimates from the biofuels assessment, the final energy consumption of biofuels in commercial buildings is estimated at around 1.8 Mtoe in 2022-23 and 3.9 Mtoe in 2023-24.

Electricity Consumption in Commercial Buildings

Electricity is the main source of energy in commercial buildings, accounts for nearly 70 percent of the total energy consumed in commercial buildings (excluding biomass and biofuels). Electricity is predominantly used for lighting, heating, air conditioning, office equipment and other building operations. In the national context, the commercial sector uses about 8.3 percent of India's total electricity consumption and contributes 25 percent of the electricity used in the overall building sector.

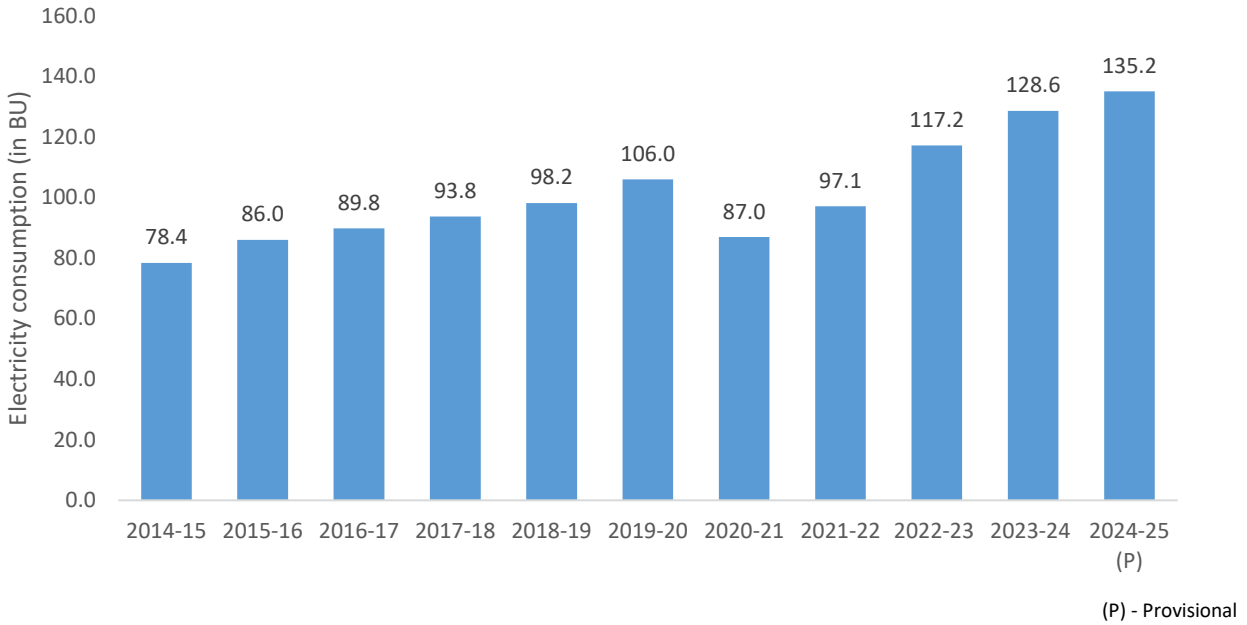


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Figure 83: Electricity Consumption in the Commercial Sector

Source: (CEA, 2025)

As shown in the Figure 83, the dip in 2020-21, when consumption fell to 87 BU due to COVID-19, was followed by a steady recovery as economic activity resumed. Between 2014-15 and 2024-25, electricity use in this sector grew from 78.4 BU to 135.2 BU, recording a CAGR of about 5.6 percent.

Commercial Sector Survey Findings

With the growing share of electricity use and cooling demand in commercial buildings, there is a need to understand how these loads are changing across different environments. To support this, a commercial buildings survey was carried out. This survey was carried out to understand how electricity and cooling demand is evolving in different urban conditions across the country. Four major cities - Delhi, Mumbai, Bangalore and Hyderabad, were selected to represent India's key climatic zones. The assessment relied on a geospatial and machine-learning based tool, which allowed the building footprints, heights and total usable space to be mapped without the need for manual measurement.

The survey covered a wide mix of building types, including offices, retail spaces, hospitals, educational institutions, warehouses, recreation centres and Government buildings. In total, 391 buildings were analysed in Delhi, 1,498 in Mumbai, 633 in Bangalore and 283 in Hyderabad.

Table 11: Commercial sector survey coverage

City	Number of Buildings Covered	Climatic Zone
Delhi	391	Composite
Mumbai	1,498	Warm & Humid
Bangalore	633	Temperate
Hyderabad	283	Hot & Dry

These cities represent composite, warm-humid, temperate and hot-dry climates respectively, allowing the study to capture how different weather conditions influence electricity use and cooling needs. The coverage provides a useful snapshot of the commercial sector's energy profile in diverse urban settings.

Energy Performance Index (EPI) Analysis

The Energy Performance Index (EPI) provides an indication of how efficiently a building uses electricity per unit of floor area. A lower EPI reflects better energy performance, while higher values suggest greater electricity use, often influenced by building operations, occupancy levels and cooling demand.

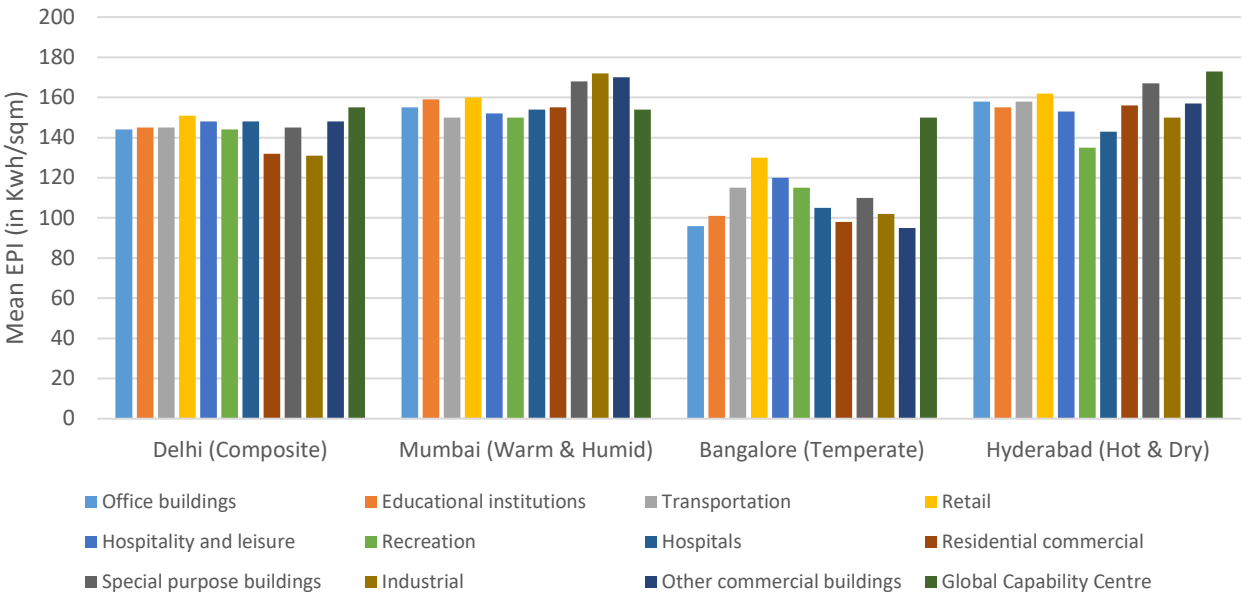

Figure 84: Mean Energy Performance Index (EPI) of different buildings in different cities

Across the four cities, the mean EPI values show a clear climatic influence. Mumbai and Hyderabad generally record higher EPI levels across most building categories, which is expected because warm-humid and hot-dry climates require greater cooling throughout the year. Bangalore, with its temperate climate, consistently shows the lowest EPI values across most building types. Delhi, representing a composite climate, lies between these extremes EPIs, with EPI values that reflect both cooling in summer and some heating needs in winter. These variations highlight how climate and building usage patterns strongly influence electricity consumption in commercial buildings.

Cooling Energy and Space Cooling Demand Analysis

The cooling demand assessment shows clear differences across the four cities, shaped mainly by local climatic conditions. Mumbai records the highest cooling demand across most building categories, reflecting the city's warm and humid weather where cooling and dehumidification are required for much of the year. Hyderabad also shows high cooling demand, driven by its long and intense hot–dry summers. Delhi, with a composite climate, generally displays moderate cooling requirements, high during peak summer but lower in other seasons. Bangalore consistently reports the lowest cooling demand, owing to its temperate climate and reduced need for space cooling for most of the year.

The patterns seen in the cooling energy demand (kWh/sqm) match this trend. Office buildings, retail spaces, hotels, hospitals and other commercial facilities in Mumbai and Hyderabad show higher electricity use for cooling, while the same categories in Bangalore remain significantly lower. Delhi typically falls in the middle, reflecting the variation in its seasonal cooling needs.

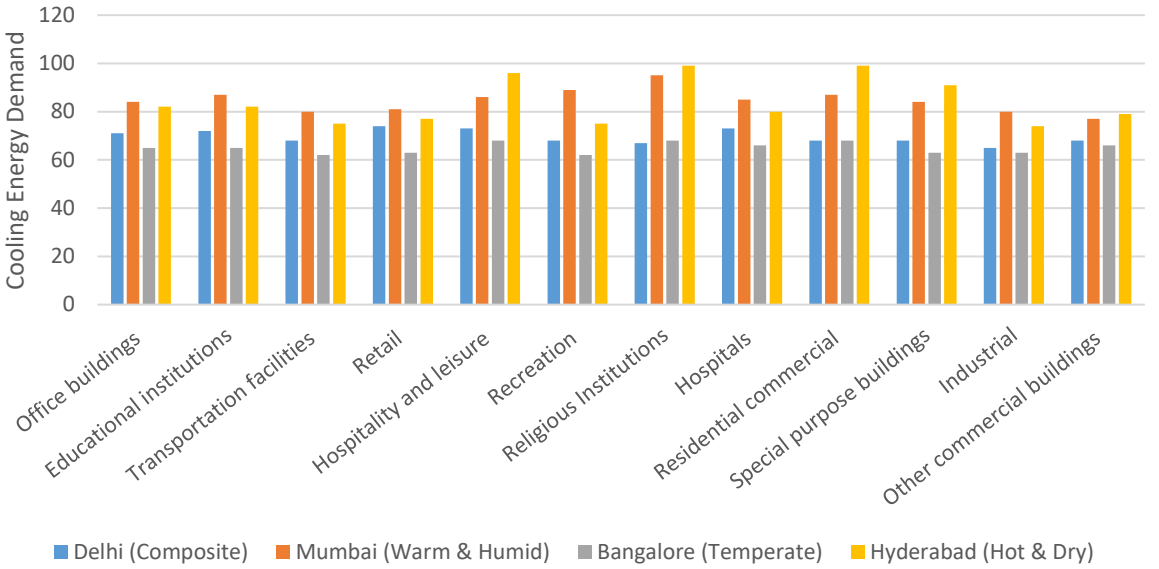

Figure 85: Cooling energy demand (kwh/sqm) across various building types in different climatic zones

A similar pattern emerges in the space cooling demand, which represents the underlying cooling load required to maintain comfortable indoor conditions. Buildings in Mumbai and Hyderabad show higher thermal loads, driven by climate-related factors such as humidity and high outdoor temperatures. Buildings in Bangalore again reports the lowest thermal loads, indicating that its climate naturally reduces the requirement for heavy cooling.

Cooling demand also varies across building types, reflecting differences in operating hours, internal heat gains and occupancy patterns. Retail buildings, hospitality buildings and special-purpose facilities such as auditoriums and data centres show some of the highest cooling energy demand across all cities, owing to long operating hours and significant internal loads from lighting, equipment and footfall. Educational institutions and residential commercial buildings such as hostels show moderate cooling demand, while transport facilities and recreational buildings fall in a similar range. Industrial buildings consistently record higher cooling needs in most cities due to equipment heat and large enclosed spaces that require active cooling. In contrast, religious buildings generally exhibit lower cooling demand, as their operating periods and internal loads are comparatively limited. These differences illustrate how building function, rather than climate alone, plays an important role in shaping cooling requirements in the commercial sector.

Electricity Consumption Patterns in Commercial Buildings

Electricity use in commercial buildings is shaped largely by cooling requirements, lighting needs and the growing use of office and service equipment. The survey findings from the four cities show that cooling remains the single largest contributor to electricity use, particularly in Mumbai and Hyderabad, where climatic conditions keep cooling loads high for most of the year. Delhi's electricity use reflects its composite climate,

with higher demand in the summer months, while Bangalore continues to show lower electricity consumption due to its moderate weather and reduced dependence on mechanical cooling.

The survey also assessed the total electricity consumption, cooling electricity use and cooling demand at a per-building level for the baseline year 2023. Delhi shows the highest electricity consumption per building (2.24 million units). Bangalore and Hyderabad follow, with Mumbai showing lower per-building electricity consumption, might be due to a higher prevalence of mid-sized commercial establishments.

Table 12: City wise per commercial building results

Parameters (2023)	*Delhi*	*Mumbai*	*Bangalore*	*Hyderabad*
Per commercial building total electricity consumption (million units)	2.24	1.31	2.10	1.93
Per commercial building energy consumption of cooling system (million units)	1.59	1.07	1.41	1.49
Per commercial building cooling demand (million units)	4.36	2.94	3.88	4.10
Per commercial building GHG emission (tonsCO2)	1945	1205	1790	1731

Both, energy consumption of cooling system and cooling energy demand per building follows a similar pattern, with Delhi averaging 1.59 million units of cooling energy use. While this is higher than the other cities in absolute terms, the earlier per-square-metre analysis shows that Mumbai and Hyderabad have higher cooling energy demand due to their climatic conditions. The two perspectives together indicate that Delhi's surveyed buildings are larger in scale, as Mumbai and Hyderabad exhibit higher cooling demand per unit area.

Table 12 also reports the greenhouse gas emissions associated with the electricity supplied to commercial buildings. Delhi shows the highest per-building emissions at 1,945 tons of CO_2, mainly because the buildings sampled there are larger and draw more electricity over the year. Bangalore (1,790 tons) and Hyderabad (1,731 tons) follow, while Mumbai reports the lowest emissions at 1,205 tons of CO_2 per building.

The variations across the four cities reflect the influence of their climatic conditions on electricity use, cooling needs and overall efficiency. Delhi's composite climate leads to high cooling requirements in summer, which contributes to higher per-building electricity use. Mumbai experiences consistently high cooling and dehumidification loads throughout the year, resulting in lower efficiency compared to the other cities. Bangalore, with its moderate weather, shows the lowest cooling demand and better overall energy efficiency due to less dependence on HVAC. Hyderabad has high cooling needs during its long, dry summers and moderate demand in the remaining months.

Climate-Responsive best practices for Commercial Buildings

- Commercial buildings in Delhi perform better when they use flexible HVAC systems that can handle both summer cooling and winter heating. Measures such as solar shading, reflective roofing and improved insulation help reduce seasonal peaks in demand. However, many older buildings still lack

adequate insulation, and the dual summer-winter requirement remains a challenge for overall efficiency.

- In Mumbai, where cooling and dehumidification are needed almost year-round, buildings see benefits from advanced HVAC systems with integrated dehumidifiers, good natural ventilation and shading, and the use of reflective materials to limit heat gain. Continuous humidity and high latent loads pose persistent challenges, often increasing operational energy use.
- Bangalore's moderate climate allows buildings to rely more on passive strategies such as cross-ventilation, natural daylighting and efficient lighting systems. Minimal dependence on HVAC contributes to better energy performance.
- Buildings in Hyderabad benefit from evaporative cooling, night ventilation and reflective or cool roofing to manage intense daytime heat. Energy performance improves where passive design features are well integrated. High summer temperatures increase cooling demand, and many older structures face challenges due to limited insulation or shading.

5.3 Transport Sector

The demand for mobility in the country has continued to expand with the rise in urbanisation, income levels and increased access to transport services. Rising commercial activity, including the rapid growth of e-commerce and logistics networks, has contributed to higher freight movement across cities. Rising domestic tourism and expanding connectivity through highways, airports and public transport systems have further added to passenger travel. These shifts reflect the way economic activities and lifestyle changes are shaping mobility patterns in India, and highlight the growing dependence on transport for both social and commercial needs.

Energy consumption in the transport sector has continued to rise steadily over the past few years. The total energy use increased from 98 Mtoe in 2020-21 to 135 Mtoe in 2024-25 (Provisional) and when blended fuels such as ethanol, biodiesel and compressed biogas are included, the consumption is approximately 139 Mtoe. The sector accounts for nearly 22 percent of the total final energy consumption (excluding biomass and biofuels).

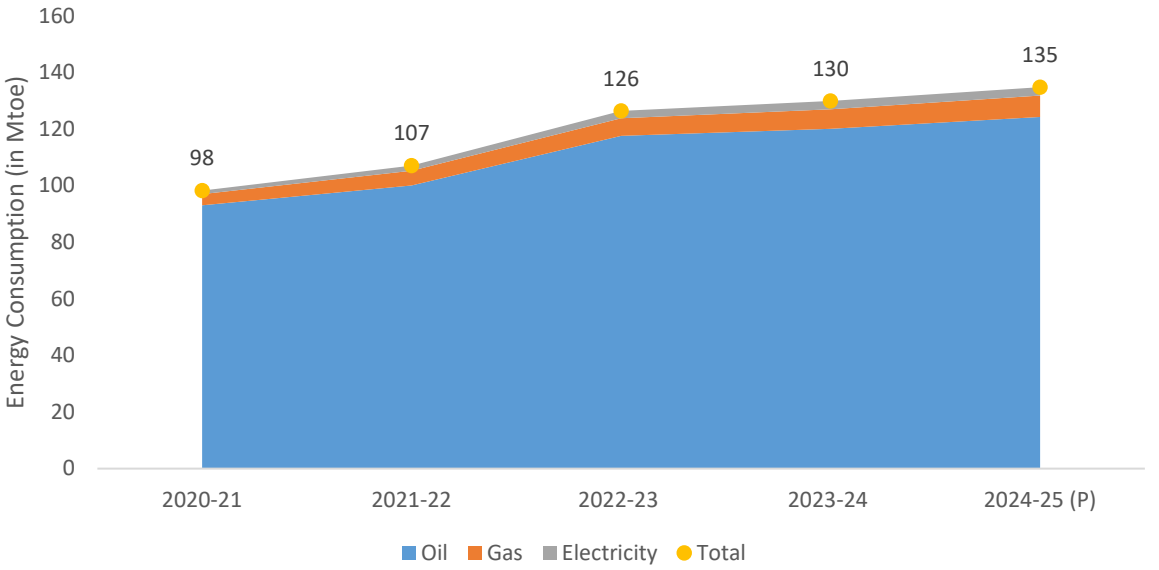

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Figure 86: Energy Consumption in the Transport Sector

Source: Calculated based on actual data from various ministries

*Above energy analysis excludes ethanol, biodiesel and CBG; these quantities were removed from petrol, diesel and natural gas before calculating consumption.

*Sector-wise natural gas allocation has been done using the BUR-4 breakup, as detailed consumption data is not provided by MOPNG.

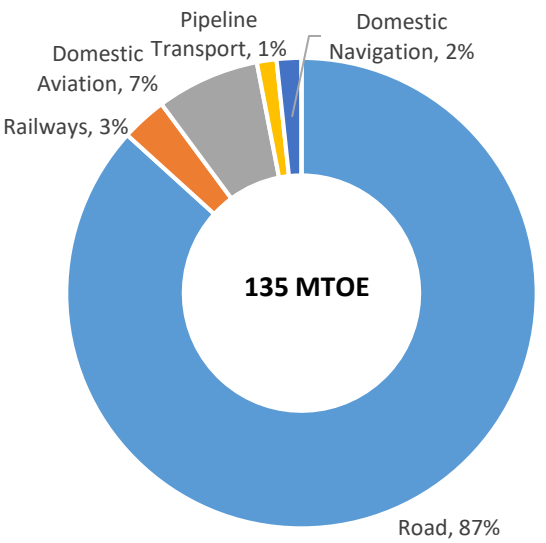


Figure 87: Sector-wise Energy Consumption in Transport Sector for 2024-25 (P)

Source: The figures are calculated based on actual data from various ministries

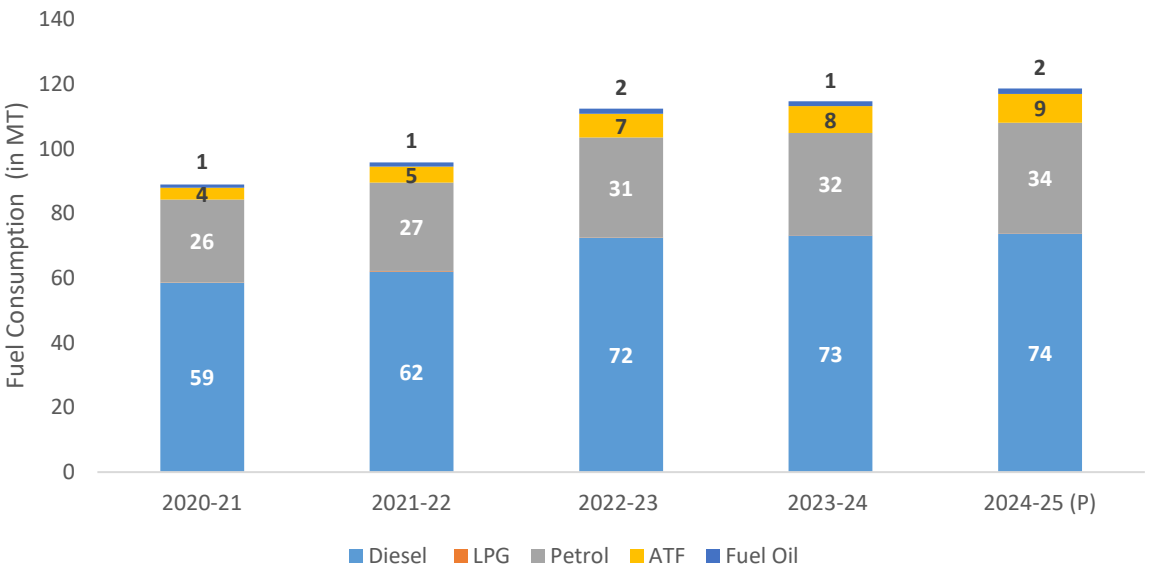
* Above energy analysis excludes ethanol, biodiesel and CBG; these quantities were removed from petrol, diesel and natural gas before calculating consumption.

Oil remains the dominant energy source for transport, forming the largest share in the energy mix, while gas and electricity show gradual increases in line with new technology adoption and alternative fuel programmes.

The mode-wise energy consumption pattern continues to be dominated by road transport, accounting for 87 percent of the total energy use in 2024-25. This reflects the expanding fleet of private and commercial vehicles and the growing movement of both passengers and freight by road. It is followed by domestic aviation (7 percent), supported by expanding air connectivity. Railways accounts for 3 percent followed by domestic shipping (2 percent) and others.

Fuel Consumption Trends

Transport continues to be one of the major users of petroleum products in the country, and diesel remains the most widely consumed fuel within the sector. As seen in Figure 88, diesel forms the largest share of fuel use, mainly due to its extensive use in freight vehicles, buses, commercial transport and a large portion of passenger cars sold in earlier years. Petrol follows as the second most consumed fuel, supported by the growing population of two-wheelers and small passenger vehicles in urban and semi-urban areas. Over the years, Aviation Turbine Fuel (ATF) is also rising, while LPG and Fuel oil make up only a small share, contributes marginally to overall transport fuel use.



(P) - Provisional

Figure 88: Petroleum Product Consumption in the Transport Sector

Source: (MoPNG, 2025)

* Oil Consumption excludes blended Ethanol with Petrol and blended Biodiesel with Diesel

Alongside petroleum products, the transport sector also consumes natural gas in the form of compressed natural gas (CNG) and electricity. The consumption of natural gas in transport is estimated at about 8,221 MMSCM, corresponding to around 7.61 Mtoe of energy, reflecting the expansion of city gas networks and the increasing adoption of CNG in cars, auto-rickshaws, and buses. . One of the reasons behind this rise is the lower fuel-running cost per km. Although, its usage is still much smaller compared to diesel and petrol.

In addition to petroleum products and natural gas, biofuels are increasingly being integrated into the transport energy mix, primarily through blending with conventional fuels. The total energy contribution from biofuels in the transport sector is estimated at around 4.1 Mtoe. While biofuels currently account for a relatively small

share of overall transport energy use, their role is expanding in line with policy initiatives aimed at diversifying fuels and reducing dependence on imported petroleum products.

5.3.1 Road Transport

Road transport remains the backbone of India's mobility system, carrying the lion's share of both passenger travel and goods movement across the country. India now has one of the largest road networks in the world, stretching over 66.71 lakh kilometres (PIB, 2024). In this, National Highway network increased by around 60 percent from 91,287 km in 2014 to 1,46,145 km in year 2023. Most of the freight in India travels by road. Government figures show that around 71 percent of freight movement happens on roads (NITI Aayog, 2021).

Passenger movement also depends mainly on roads, especially because of the high number of two-wheelers, cars, autos and buses. Registrations on the VAHAN portal show that two-wheelers form the majority of vehicles in use, followed by cars, which indicates how personal mobility shapes energy use in the road transport segment. With the rising mobility trends, the Indian cities grapple with growing traffic congestion, air pollution and rising emissions, the policy focus has been towards promoting sustainable mobility. Furthermore, India's recent global climate commitments and net-zero goal have also been one of the key factors in shaping these policies.

Several government measures over the past few years have influenced how road transport operates, how fast vehicles move, and how much fuel is used. One of the major steps has been the continued expansion of national highways and expressways. The Ministry of Road Transport and Highways notes steady growth in highway construction, which has reduced travel time on important routes and supported smoother freight movement. Some key policies like the National Urban Transport Policy and the National Electric Mobility Mission Plan have aimed to encourage the use of public transportation as well as non-motorised transport means like cycling.

On the electrification of the current vehicle fleet, the Government launched the FAME scheme, followed by FAME-II, with a budget of ₹10,000 crore, to support electric buses, two-wheelers, three-wheelers and cars through demand incentives and facilitate faster adoption of electric vehicles. FAME-II alone was designed to support about 7,000 e-buses, 10 lakh electric two-wheelers, 5 lakh e-three-wheelers and 55,000 e-four-wheelers, with most of the funds earmarked as purchase incentives. Building on the FAME and FAME-II initiatives, the Government launched the PM E-DRIVE (PM Electric Drive Revolution in Innovative Vehicle Enhancement) scheme in October 2024, with an outlay of about ₹10,900 crore to accelerate the adoption of electric vehicles, expand charging infrastructure and support the domestic EV ecosystem. The scheme provides upfront demand incentives for a wide range of EV categories, including electric two- and three-wheelers, buses, ambulances and trucks, and promotes deployment of public fast chargers and other supporting infrastructure.

Apart from this, the Central Government has also enabled supply-focused policies such as PLI Scheme and the Advanced Chemistry Cell (ACC) PLI Scheme which seek to boost production of the EVs too.

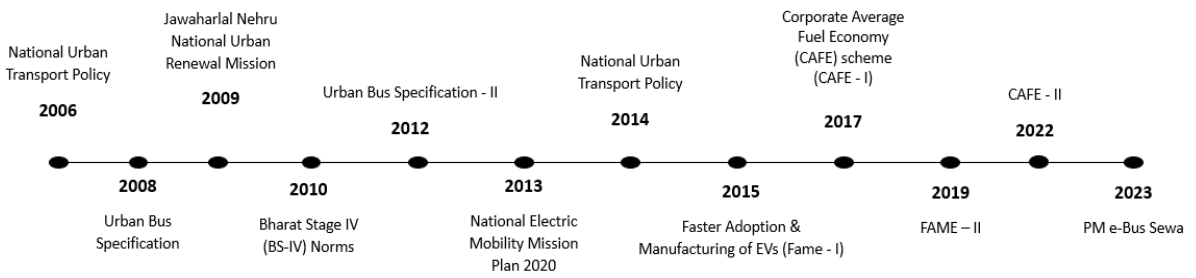


Figure 89: Key Road Transport Policies in India

Furthermore, emission and efficiency rules continue to play an important role. The move from BS-IV to BS-VI emission standards has led to cleaner engines and better fuel quality for both petrol and diesel vehicles, which helps reduce local air pollution from road traffic. In addition to this, in 2017, the Government introduced Corporate Average Fuel Efficiency (CAFÉ) norms to reduce fuel consumption and lower CO_2 emissions, aiming to decrease oil dependency and air pollution. These norms are applicable for petrol, diesel, liquefied petroleum gas (LPG), CNG, hybrid, and electric passenger vehicles with gross vehicle weight (GVW) below 3500kgs. These standards were introduced in two phases-the first CAFÉ Norms Stage I fuel consumption standards were introduced effective 2017-18, and the CAFÉ Norms Stage II standards came into force in 2022-23. The CAFÉ scheme results in significant energy savings, CO_2 reduction, and cost savings. At the same time, the National Ethanol Blending Programme has achieved 20 percent ethanol blending (E20) in petrol in 2025. Apart from this, the Urban Bus Specification I & II as well as the PM e-Bus Sewa policies have aimed at upgrading the existing public bus infrastructure and making it more inclusive. This evolution in the policy landscape reflects India's dedication to developing a sustainable and low-carbon transportation system. This system can support its growing economy and population while addressing critical environmental and public health concerns.

Mobility Trends

The continued rise in vehicle usage across categories has led to a steady growth in both passenger and freight movement on roads. As shown in Figure 90, activity levels have expanded steadily from 2015 to 2024, with passenger-kilometres increasing from about 4295 billion to over 8169 billion, showing a CAGR of around 7 percent. Freight movement has followed a similar trajectory, growing from nearly 1124 billion tonne-km to around 2220 billion tonne-km, at an estimated CAGR of about 8 percent. A brief dip appears in passenger-kilometres, due to temporary slowdown in travel and logistics activity during the pandemic. Overall, these trends point to sustained growth in daily travel needs and freight demand, reinforcing the role of road transport in supporting mobility and economic activity.

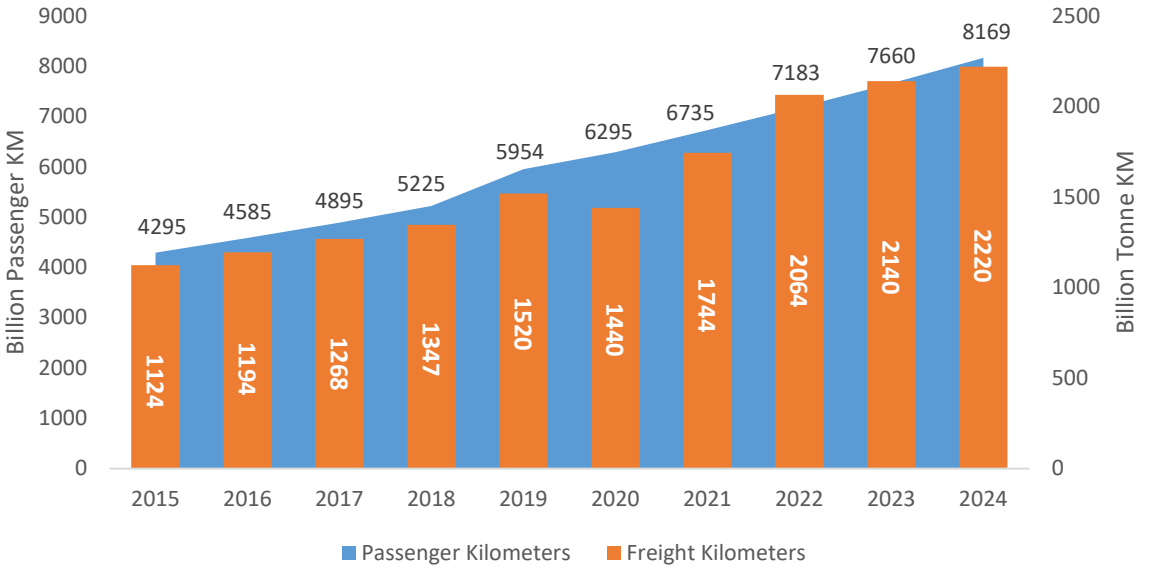


Figure 90: Road Transport's Passenger & Freight Kilometres in India

Source: (TERI)

Year on Year Vehicles Registered in India

Vehicle registrations have more or less settled back after the big fall during the COVID-19 years. The chart in Figure 91 shows how the numbers dipped sharply in 2020-21 and then slowly started rising again, and by 2024–25 they are almost at par with pre-COVID levels.

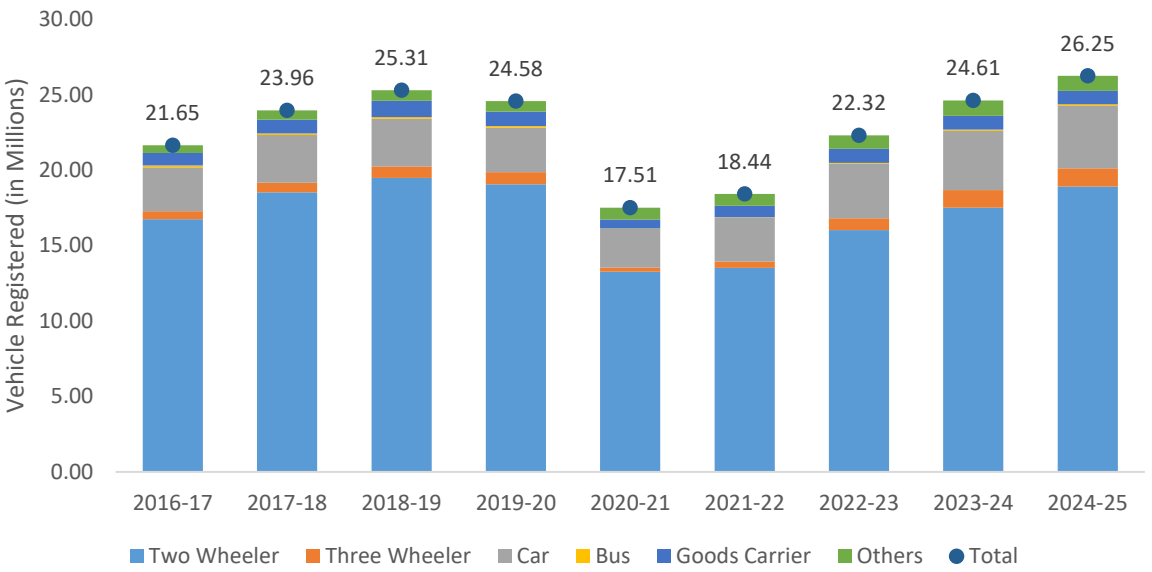


Figure 91: Category-wise Vehicles Registered in India

Source: (Vahan Dashboard, 2025)

Two-wheelers still make up the largest share of registrations every year. Their share remains above 70 percent, although it has come down a bit, from around 77 percent in 2016-17 to about 72 percent in 2024-25. On the other hand, registrations of other vehicle types are increasing. The share of three-wheelers has grown from roughly 2.4 percent in 2016-17 to 4.7 percent in 2024-25 of total registrations, showing a strong CAGR of about 11 percent. Cars have also moved up gradually, from about 13.4 percent to 15.7 percent, growing at around 5 percent CAGR during this period. More cars and three-wheelers are entering the fleet each year, suggesting shifting mobility choices and possibly rising affordability in some segments.

Alongside the growth in overall vehicle registrations, EV registrations are also seeing a rapid growth. With rising emphasis on adopting the less carbon-intensive pathways for mobility, electrification of India's transport sector is one of the biggest ongoing transitions. The EV market in India is witnessing a significant rise, owing to consumer-friendly EV policies, fiscal and monetary incentives from the Government. The rising concerns of air pollution and its effect on health, increased enthusiasm of lower carbon-footprint at an individual level and other reasons are also contributing factors.

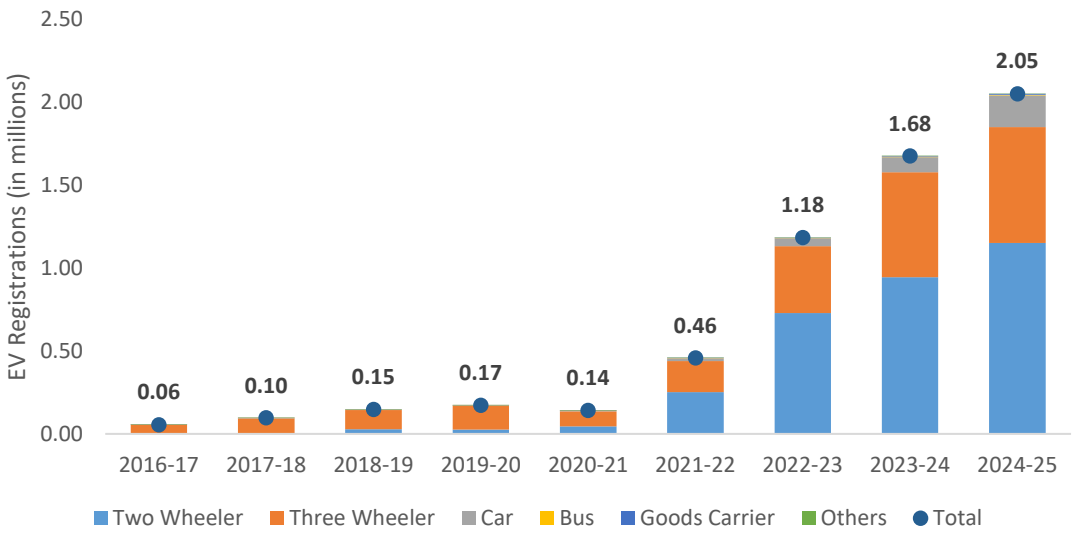


Figure 92: Electric Vehicles Registered in India

Source: (Vahan Dashboard, 2025)

As shown in Figure 92, EV registrations pick up sharply after the COVID-19 period. Between 2020-21 and 2024-25, the numbers grow at a very fast pace, with a CAGR of about 95 percent. Most of this rise comes from electric two-wheelers and three-wheelers, which continue to dominate EV adoption. EV cars remain a smaller segment, but their share is gradually increasing each year. Figure 93 shows the states with the highest EV registration numbers. In 2024–25, Uttar Pradesh recorded the highest number of EV registrations, followed by Maharashtra, Karnataka, and Tamil Nadu.

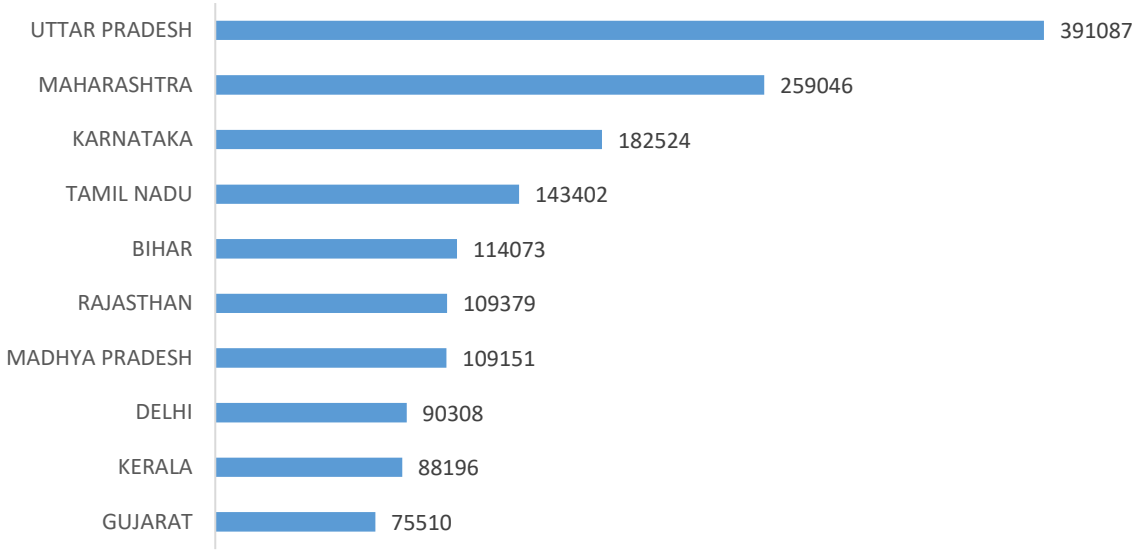


Figure 93: Top 10 States with Highest EV Registration in FY 2024-25

Source: (Vahan Dashboard, 2025)

Fuel Consumption in the Road Transport Sector

Table 13 shows that High Speed Diesel (HSD) continues to be the main fuel used in this segment. HSD consumption has risen steadily from 56694 TMT in 2020-21 to 71949 TMT in 2024-25 (Provisional), with a CAGR of about 6 percent over this period. Petrol is the next major fuel, supported mainly by the growing number of two-wheelers and passenger cars. Petrol consumption increased from 25584 TMT to 34095 TMT over the same period, marking a CAGR of around 7.4 percent. Natural gas, which includes CNG, forms a smaller share but shows a gradual increase from 3835 MMSCM to 6208 MMSCM (Estimated). This reflects the expansion of city gas networks and the uptake of CNG-based public and shared transport in several urban centres. Other fuels such as fuel oil, LDO and Auto-LPG contribute marginally and show a declining or stable trend.

Table 13: Fuel consumption in Road Transport

	2020-21	2021-22	2022-23	2023-24	2024-25 (P)
Fuel Oil (TMT)	132	172	178	174	177
LDO (TMT)	2	2	2	2	1
HSD* (TMT)	56694	59664	69956	71086	71949
Auto LPG (TMT)	118	122	107	88	73
Petrol* (TMT)	25584	27340	30964	31638	34095
Natural Gas* (MMSCM) (E)	3835	5058	4982	5578	6208

(P) – Provisional, (E) – Estimated

Source: (MoPNG, 2025)

* The road transport sector analysis excludes ethanol, biodiesel and CBG; these quantities were removed from petrol, diesel and natural gas before calculating consumption.
*Sector-wise natural gas allocation has been done using the BUR-4 breakup, as detailed consumption data is not provided by MOPNG.

In addition to conventional fuels, biofuels are also used in road transport, primarily through blending and fuel substitution. Ethanol blending in petrol contributes the largest share, with an estimated energy contribution of around 3.8 Mtoe, reflecting the expansion of ethanol blending levels over recent years. Biodiesel, blended with diesel, contributes a smaller share, estimated at about 0.29 Mtoe. The use of compressed biogas (CBG) in road transport, mainly as a substitute for CNG in select vehicle segments, remains limited, with an estimated contribution of around 0.04 Mtoe. While biofuels currently account for a relatively small share of total road transport energy use, their role is gradually expanding as part of efforts to diversify transport fuels and reduce dependence on imported petroleum products.

A significant portion of diesel is consumed by road transport; however, due to data reporting issues, this consumption was not accurately reflected in the Road Transport category but is instead recorded under the Reseller/Retail category in the Indian Petroleum and Natural Gas Statistics report. To address this issue, the present report uses the end-use consumption data of diesel provided by the Petroleum Planning and Analysis Cell (PPAC) based on the CRISIL All-India study on sectoral demand for petrol and diesel.

As a result, the representation of energy consumption in the transport sector has improved significantly. Consequently, the share of the transport sector in total final energy consumption has increased from about 12 percent in the previous edition to around 22 percent in the current energy balance. At the same time, this methodological improvement has reduced the share of energy reported under non-specified and “other” categories from about 18 percent in the earlier energy balance to nearly 4 percent in the present edition, thereby improving the overall clarity and consistency of sectoral energy consumption estimates. As per PPAC, Table 14 presents the end-use consumption of HSD for 2023-24 and 2024-25, and it clearly shows that road transport remains the dominant consumer, accounting for around 79 percent of total diesel use in 2024-25.

Table 14: Distribution of HSD to different End-Use sectors (in 000’tonnes)

FY	Road Transport	Aviation/shipping	Railways	Agriculture	Power Generation	Industry	Mobile Towers	Others	Total
2023-24	71473	764	1458	4147	1462	4604	277	5467	89651
2024-25	72272	764	1210	4242	1472	4916	280	6251	91407

Source: (PPAC, 2025)

* Road Transport column in Table 14 also includes blended Bio-diesel with HSD

A breakdown of vehicle-wise diesel consumption in 2024-25 in the sector is given below. Trucks dominate the diesel sales since most of the freight mobility needs is covered by the trucks. They have the highest average daily distance travelled amongst all the vehicle segment.

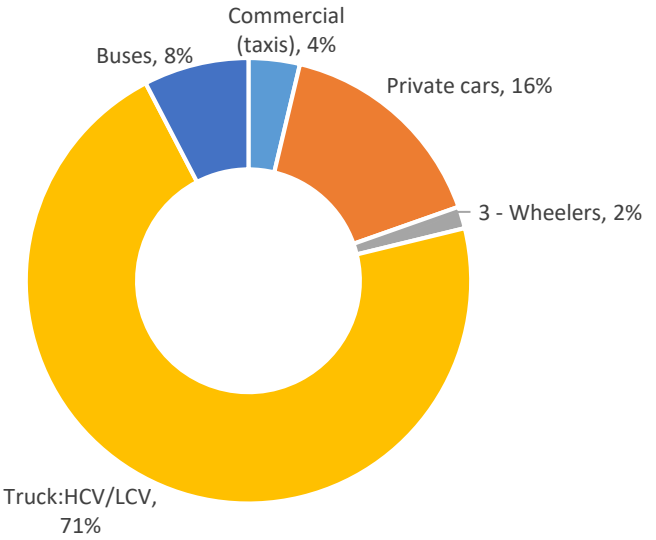


Figure 94: Vehicle Category wise Diesel Consumption in 2024-25

Source: (PPAC, 2025)

Electricity Consumption by Public EV Charging Stations

With the uptake of EVs, the transport sector is also witnessing an increase in electricity consumption. The public EV charging stations recorded electricity use of about 847.8 MU in 2024-25, which is more than four times the 204.84 MU recorded in 2022–23. This suggests that electricity demand linked to EV charging is growing quickly and is likely to rise further as efforts to increase EV adoption continue across the country.

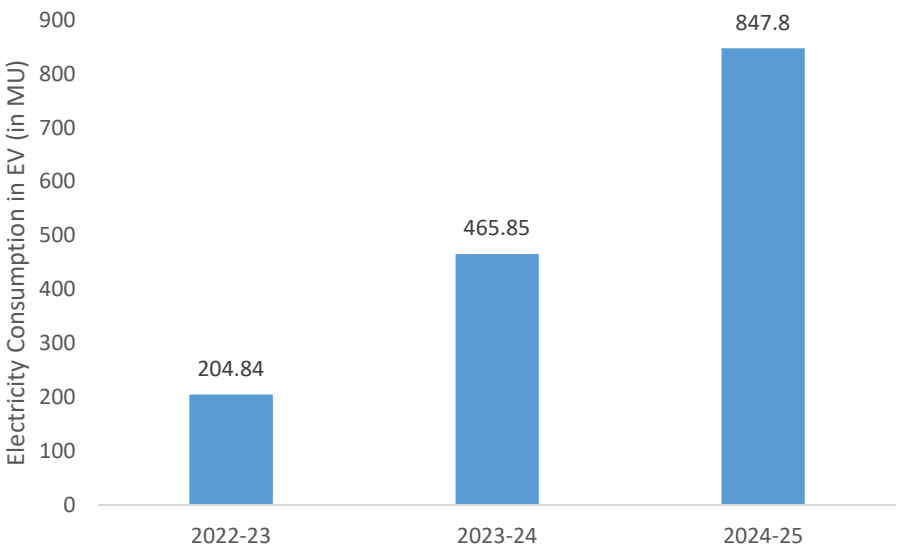


Figure 95: Electricity Consumption by Electric Vehicles via EV Charging Stations

Source: (CEA, 2025)

5.3.2 Railways

Indian Railways continues to remain a major mover of both people and goods, and its scale has grown further over the last year. With new "*Vande Bharat*" trains being introduced, upgrades to signalling systems, and increased track electrification, the network is seeing improvements in both capacity and efficiency. Indian Railways has one of the largest railway networks in the world, the size of its network has grown steadily over the decades. From about 53,596 route km in 1950-51, the network expanded to 69,181 route km by 2023-24, reflecting the continuous role of railways in connecting regions and supporting freight and passenger movement (Indian Railways, 2025). These numbers show the gradual expansion of the rail system over the decades and its central role in carrying passengers and freight across the country.

It has set the target to become net-zero carbon emitter by 2030 (PIB, Mar, 2023). Its Mission 100 percent Electrification policy is seen as pivotal for the country's entire energy sector. Recent updates indicate that the broad-gauge portion of the network has now reached about 90 percent electrification, marking a major milestone in the shift towards cleaner and more energy-efficient rail operations. Currently, it is pursuing a comprehensive strategy to become more environmental friendly and reduce its carbon footprint. Indian Railways has been undertaking modernisation initiatives since the 1980s to improve efficiency and upgrade its technology. However, in recent years, it has placed a strong focus on 'greening' its operations and reducing environmental impact. To attain this, some of the key policies aimed at greening of the IR infrastructure. An extension of PAT Scheme has been introduced to IR. IR Energy-Efficiency Action Plan & Policy (IREAP) and 'Mission 100 percent Electrification' (Indian Railways, Feb, 2021).

At the same time, to achieve an ambitious goal of net-zero carbon emitter by 2030, IR estimates a requirement of around 30,000 MW of RE capacity by the same year. As of December 2023, it has commissioned about 216.36 MW of solar power plants (both rooftop and land-based) and about 103.4 MW of wind power plants. It has also secured an additional 2,150 MW of renewable energy capacity.

Mobility Trends

Figure 96 shows that freight movement by rail has been growing steadily even during the COVID years. Freight kilometres increased from 620 billion tonne-km in 2016-17 to about 974 billion tonne-km in 2023-24, reflecting a CAGR of around 6 percent, as demand for long-distance goods transport continues to shift towards the railways. Passenger movement, however, shows a different pattern. Passenger kilometres fell sharply during 2020-21 and 2021-22 because of lockdown restrictions, limited services, and safety protocols. But the numbers have been recovering each year since then, rising from just 231 billion passenger-km in 2020-21 to 1,065 billion passenger-km in 2023-24. This bounce-back reflects the return of regular travel and resumption of suburban and long-distance services.

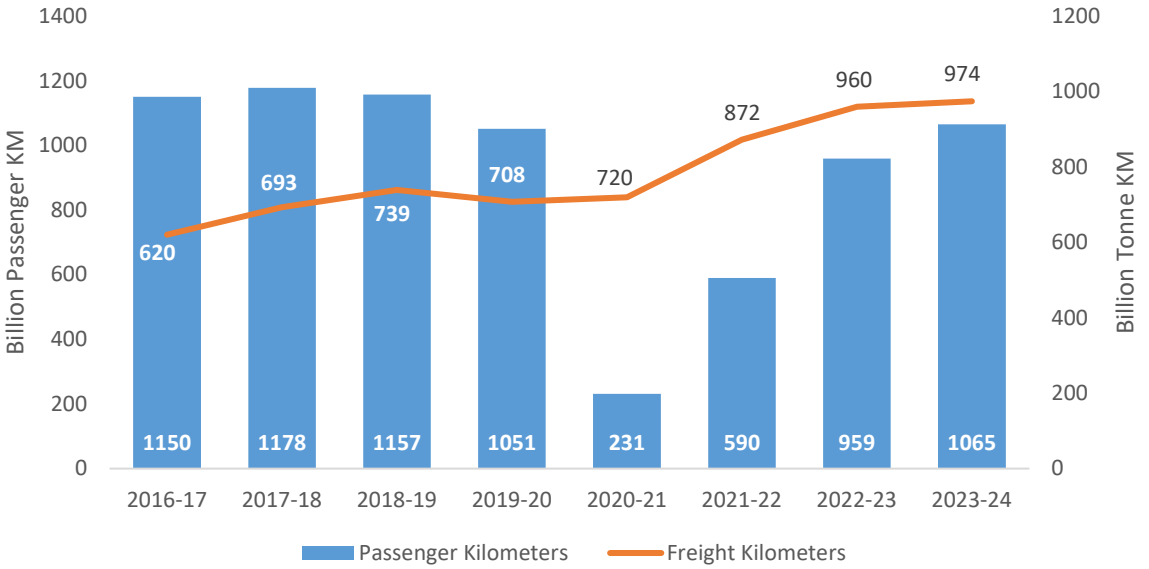


Figure 96: Railways' Passenger & Freight Kilometres in India

Source: (Indian Railways, 2025)

Fuel Consumption by Railways

As shown in Table 15, High Speed Diesel (HSD) continues to be the main fuel used by Indian Railways. The consumption of HSD was at 1222.3 TMT in 2020-21, rose to 1748.4 TMT in 2021-22, and then gradually declined to 1210.0 TMT in 2024-25. This downward trend reflects the steady progress in route electrification and the reduction of diesel-based traction on the network. The use of Light Diesel Oil (LDO), LPG and Fuel Oil remains very small and shows only marginal levels across the years, indicating their limited role in railway operations.

Table 15: Fuel Consumption by Indian Railways

	2020-21	2021-22	2022-23	2023-24	2024-25 (P)
LPG (TMT)	0.7	1.0	1.7	1.2	0.2
HSD (TMT)	1222.3	1748.4	1715.4	1457.6	1210.0
LDO (TMT)	0.3	0.3	0.4	0.4	0.3
Fuel Oil (TMT)	0.0	0.4	0.4	0.1	0.1

(P) - Provisional

Source: (MoPNG, 2025)

Electrification of Railways and Electricity Consumption

As per the 2021 policy, Mission 100 percent Electrification was introduced to electrify the Broad Gauge (BG) network of Indian Railways (Indian Railways, Feb, 2021). As of 2024-25, 93.16 percent of the BG network is electrified with 62,253 route KMs out of 66,820 total BG route KMs. This showcases remarkable progress by Indian Railways towards the goal of achieving 100 percent BG network electrification.

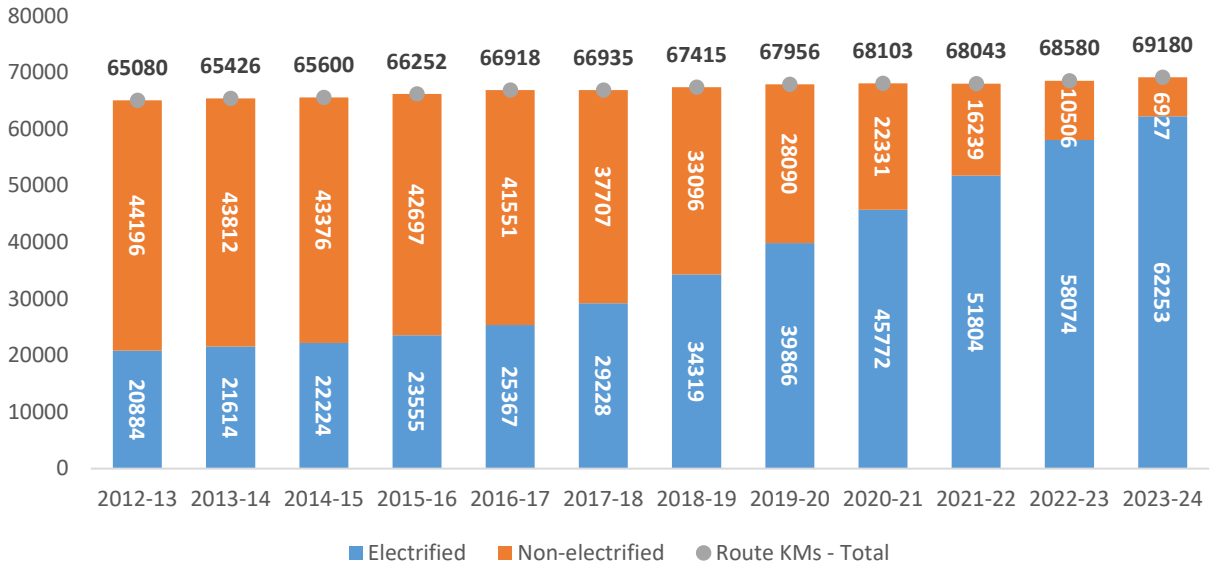
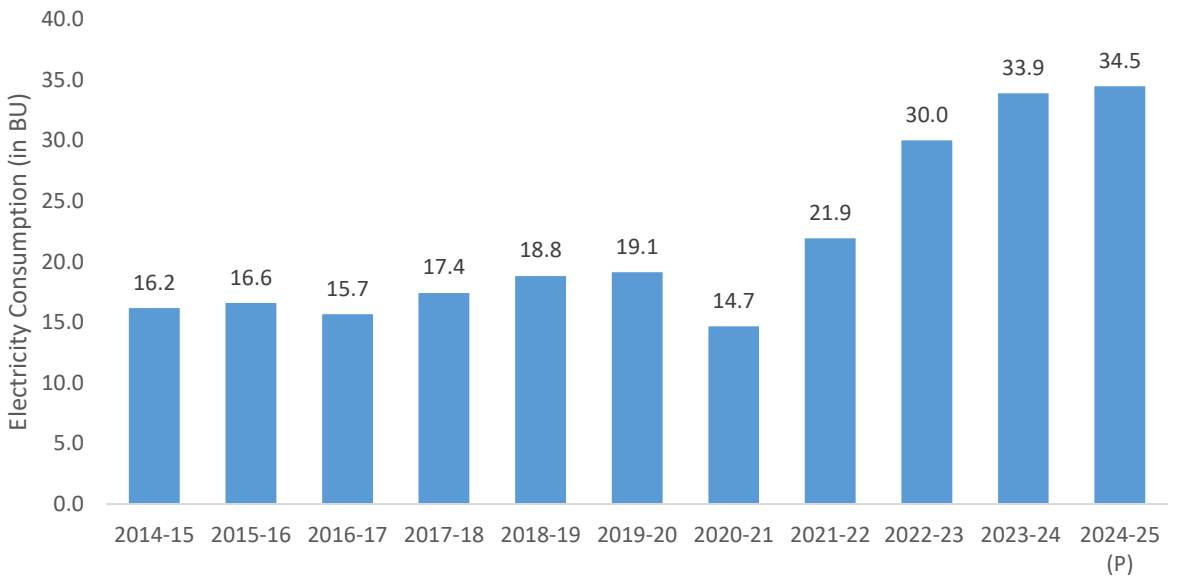


Figure 97: Electrification of Railways' Network Route

Source: (Indian Railways, 2025)

Due to the rapid electrification of the BG network, the electricity consumption in railways is also on the rise. The consumption has grown from about 16.2 BU in 2014-15 to around 34.5 BU in 2024-25, reflecting a CAGR of roughly 7.9 percent over this period. This rise is closely linked to the continued electrification of the broad-gauge network and the gradual reduction in diesel-based operations. The introduction of more electric locomotives, higher freight movement on electrified routes, and improvements in operational efficiency have supported this upward trend. With the network now nearing 100 percent electrification, electricity is becoming the main source of traction energy for the railways.



(P) - Provisional

Figure 98: Electricity Consumption in Railways

Source: (CEA, 2025)

5.3.3 Aviation

India's aviation sector has grown very fast in the last decade and is now one of the biggest in the world. Recent estimates from IATA show that India has become the third-largest air transport market globally in terms of passengers starting their journey here, after the United States and China; about 174 million passengers flew from or within India in 2024, which is roughly 4.2 percent of global traffic. Passenger numbers have climbed from around 460 million in 2014 (domestic plus international, counted both ways) to about 750 million in 2025, reflecting a mix of low-cost carriers, more routes and higher disposable incomes. The physical network has expanded in step with demand. The number of operational airports has more than doubled from 74 in 2014 to 157 in 2024. The Ministry of Civil Aviation has also stated that the goal is to reach around 350–400 airports by 2047, which shows how central air connectivity has become to India's long-term growth plans.

GoI has implemented various policies and initiatives to promote sustainable practices in the aviation sector, recognizing its significant contribution to energy consumption and carbon emissions. India participates in global frameworks such as CORSIA and has started to frame its own pathway for Sustainable Aviation Fuel (SAF). Based on the recommendations of the National Biofuel Coordination Committee, the Government has announced indicative SAF blending targets of 1 percent in 2027, 2 percent in 2028 and 5 percent by 2030, to begin with international flights. Under the Sustainable Green Airports Mission, Airports Authority of India reports that, as of March 2025, 81 AAI-managed airports are operating on 100 percent green energy, building on earlier milestones where airports like Cochin and Mumbai had already shifted fully to renewable electricity (PIB, Mar, 2023). The mobility trends of aircrafts, passengers as well as freight for 2020 to 2022 are captured in the figure below.

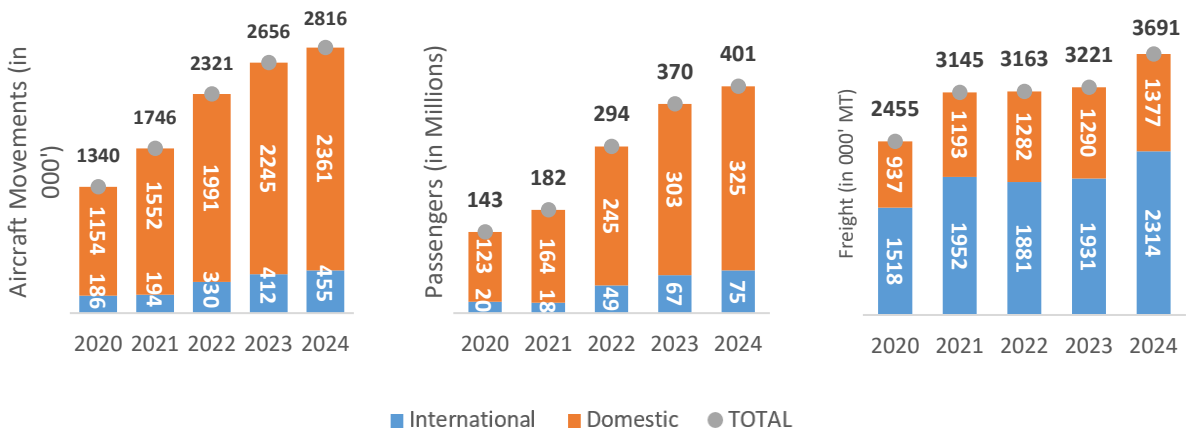


Figure 99: Aircraft, Passenger and Freight Movement in Aviation Sector

Source: (Ministry of Civil Aviation, 2025)

Fuel Consumption in Aviation

Table 16 illustrates fuel consumption in the aviation sector from 2020-21 to 2024-25. The aviation sector mainly consumes ATF, and the data clearly shows how its use has been rising in recent years. ATF consumption increased from about 3,698 TMT in 2020-21 to 8,985 TMT in 2024-25, reflecting the strong recovery in air travel and the continued expansion of domestic and international flight operations. In contrast, the

consumption of HSD in aviation is very small and has remained negligible throughout the period, falling from 2.3 TMT to 0.8 TMT**.**

Table 16: Fuel Consumption in Aviation Sector

	2020-21	2021-22	2022-23	2023-24	2024-25 (P)
ATF (TMT)	3697.8	5008.0	7378.1	8247.1	8984.7
HSD (TMT)	2.3	2.7	1.2	1.2	0.8

Source: (MoPNG, 2025)

5.3.4 Shipping

India's maritime network remains a critical pillar of its trade infrastructure. The shipping industry plays a crucial role to global trade, accounting for 95 percent of the country's trade by volume and 68 percent by value (Ministry of Ports, Shipping and Waterways, 2024). The country has a coastline of over 7,500 km, and is served by the major ports and a growing network of inland water routes. A recent government press release noted that in FY 2024-25 the country's inland waterways moved a record 145.5 million tonnes of cargo, a sharp jump from 18.1 million tonnes in 2013-14, implying a compounded annual growth rate of roughly 20.9 percent.

In 2016, the National Waterways Act was introduced to develop and utilise India's inland waterways for cargo and passenger movement. Additionally, the Maritime India Vision 2030, a 10-year blueprint for the maritime sector, includes the Indian Coastal Green Shipping initiative. Under this initiative, ports have undertaken activities to reduce GHG emissions. These include using electrically powered port equipment, adopting alternative fuels like LNG/CNG and transitioning towards Renewable Energy. Meanwhile, ports are also beginning to install renewable energy capacity in their internal operations, one report notes that major port facilities have reached about 140 MW of installed renewable capacity, with green-hydrogen and methanol bunkering pilots also under way (Indian Infrastructure, 2025). The shipping industry plays a crucial role to global trade, accounting for 95 percent of the country's trade by volume and 68 percent by value (Ministry of Ports, Shipping and Waterways, 2024). The mobility trends of freight via shipping have been captured in the Figure 100.

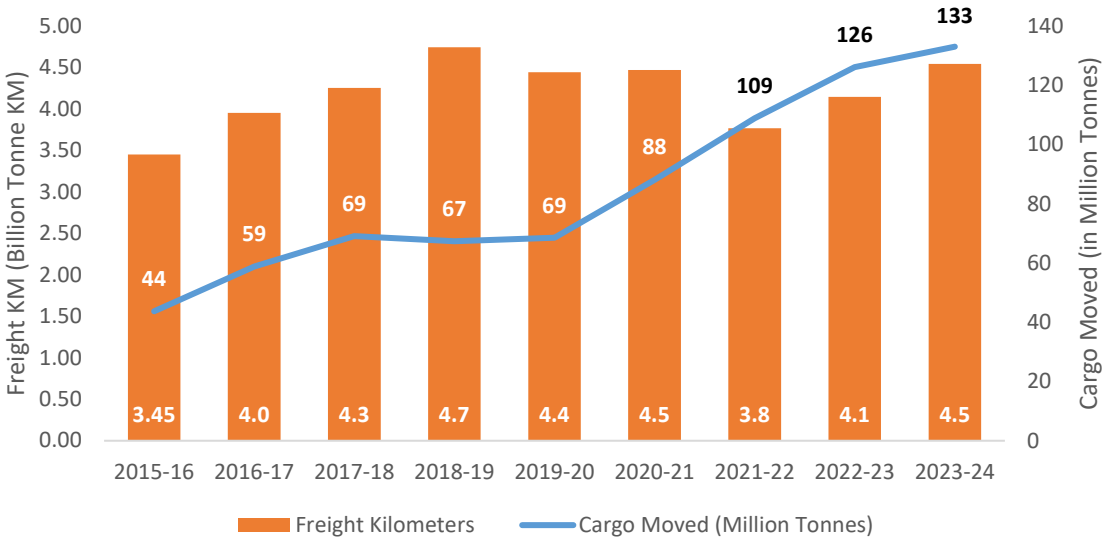
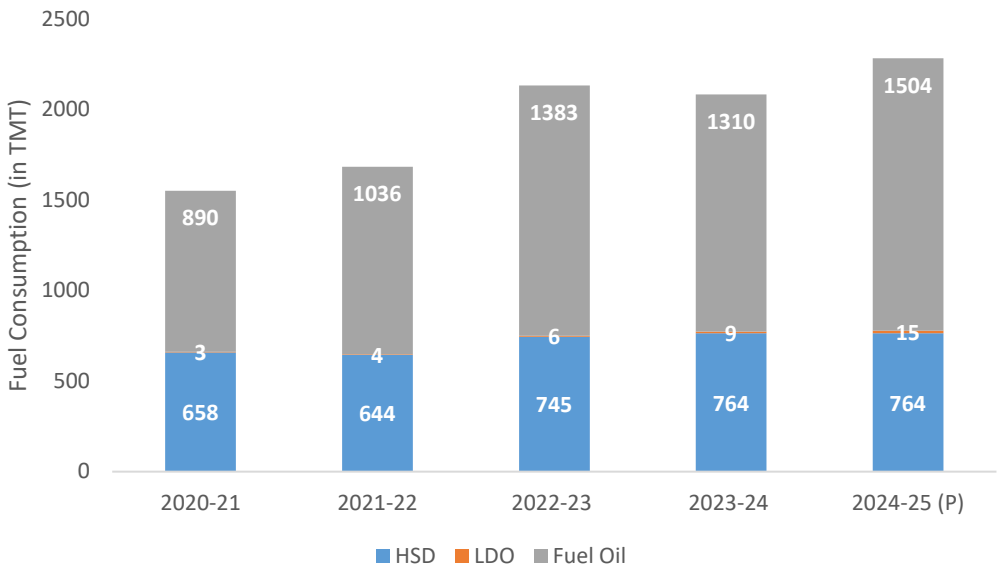


Figure 100: Freight Mobility Trends of Inland Waterways in Shipping

Source: (Ministry of Ports, Shipping and Waterways, 2025)

Fuel Consumption in Shipping

Figure 101 provides a year-on-year fuel consumption in the shipping sector. It showcases that FO and HSD are the most consumed fuels in this sector. Fuel oil continue to witness a healthy growth, It has increased from about 890 TMT in 2020-21 to around 1,504 TMT in 2024-25, rising at a CAGR of around 14 percent. High Speed Diesel (HSD) is the next major fuel used in vessels and port operations, and it has remained fairly steady, moving from 658 TMT to 764 TMT over the same period. The use of Light Diesel Oil (LDO) is very small, with only marginal quantities recorded each year.



(P) - Provisional

Figure 101: Fuel Consumption in Shipping

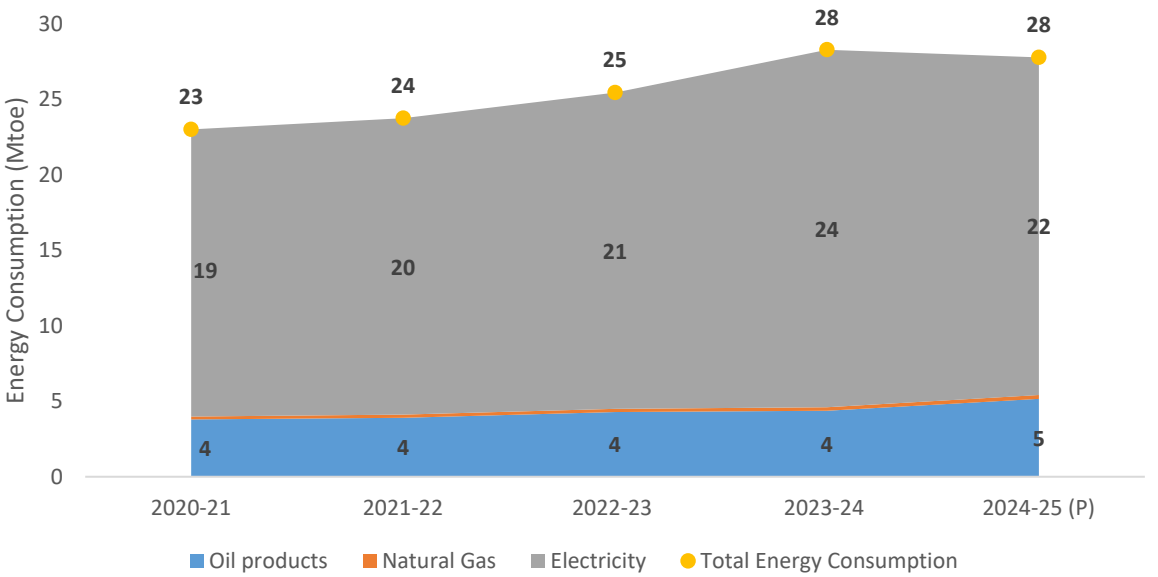
Source: (MoPNG, 2025)

5.4 Agriculture

The agriculture sector continues to play an important role in the Indian economy, and for the employment of the masses of the country. Often referred to as the backbone of the nation's economy, it contributes to 18 percent of India's Gross Value Added (GVA) at current prices in the year 2024-25 (MoSPI, 2025). The sector supports around 45 percent of the workforce in the country. Although the share of the agriculture sector in India's economy has been gradually decreasing over the last few decades, it remains vital for food security, rural income and overall economic stability.

India's agricultural practices have been shaped according to its diverse agro-climatic zones, soil diversity and land availability. Over the decades, the Green Revolution, subsequent policy reforms, increasing mechanisation and now the push towards digitalisation, have all changed how this sector works in the country. At the same time, there is growing awareness that agriculture is extremely vulnerable to climate change. Weather has become more unpredictable. Rainfall patterns are shifting, heat waves are becoming more frequent and water stress is growing in many regions. These changes affect crop productivity, input use and the overall stability of farm incomes. Small and marginal farmers, who form the majority, are especially affected because they often lack access to reliable irrigation, storage or modern equipment.

Energy is used in the sector along the value chain from the preparation of land for sowing, to cultivation, irrigation, harvesting, processing, transport and storage. Indirectly, the large-scale use of chemical fertilizers, which are energy intensive to produce, can indirectly contribute to energy usage. In terms of fuel consumption practices, there is an extensive use of electricity for irrigation, while fuel is mostly used for tractors, harvesters or other farm machinery. The Total Energy consumption of this sector is around 28 Mtoe, which is approximately 4.6 percent of the total final energy consumption. Figure 102 indicates that the biggest contributor to energy consumption in the sector over these years has been electricity which continues to increase. In 2024-25, electricity made up to 81 percent of the total energy consumption in the sector, showing the continued dependence on electric irrigation pumps and the expansion of groundwater-based farming. While oil products (mainly diesel) remain important for mechanisation, their share has stayed relatively flat, and natural gas use continues to be negligible in this sector.



(P) – Provisional, (E) - Estimated

Figure 102: Energy Consumption Trend in the Agriculture Sector

Source: Calculated based on actual data from various ministries

Certain cultivation practices, policies and schemes intended to support farmers and encourage agriculture production, are also contributing to energy intensity of the sector. The agriculture sector receives high amounts of subsidies, particularly for fertilizers and electricity. The current system of providing subsidies for fertilizers has led to their excessive usage. This overuse poses a major problem due to improper and unsafe handling of these harmful chemicals. Given the implications of the climate crisis, the threat of land and soil degradation and the looming concern of depleting water levels, there is a recognition to transform the agriculture practices. It is imperative to change existing patterns in order to reduce energy usage and minimize environmental impact.

Policies

Improving energy efficiency and reducing energy usage in agriculture continues to be an important policy priority. It can help accelerate the efforts to reduce carbon emissions, improve agricultural output, and reducing economic burden on DISCOMs and the state by lowering the costs of energy subsidies. Accordingly, the policies introduced into this sector are targeting towards reduction of energy usage and dependence on the subsidised power supply. Discouraging over pumping is largely a matter of change in behaviour, since farmers currently do not have any incentive to invest in changing their current water and electricity consumption patterns. Therefore, the ongoing efforts revolve around improving the efficiency of irrigation systems. This includes gradually phasing out old, inefficient pump-sets and replacing them with modern energy-efficient models, expanding the use of solar-powered pumps, and strengthening feeder separation and feeder-level solarisation so that farmers receive more reliable and better-managed power supply.

The Agricultural Demand-side Management (AgDSM) programme, is introduced to promote energy efficiency and reduce the total quantum of consumption. Through this programme, inefficient agricultural pump sets are being replaced with BEE 5 star rated and high efficiency pump sets. As of August 2024, a total of 81,180 pumps have been installed in the state of Andhra Pradesh and Uttar Pradesh by the Energy Efficiency Services Limited (EESL) (Ministry of Power, 2024), resulting in peak load demand reduction of 38,932 kW. Other pilot projects were also completed in Maharashtra, Karnataka and Rajasthan.

A major push remains on solar irrigation through the Pradhan Mantri Kisan Urja Suraksha evam Utthaan Mahabhiyan (PM-KUSUM) scheme, which was introduced in March, 2019, with the main aim of de-dieselisation of the farm sector, providing water and energy security to farmers, increasing the income of farmers and curbing environmental pollution. The scheme comprises of three components, it targets 10,000 MW of decentralised ground or stilt-mounted grid-connected solar power plants or other renewable energy-based power plants (Component A), 14 lakh off-grid standalone solar water pumps (Component B), and 35 lakh grid-connected agriculture pumps including feeder level solarization (Component C).

Progress under the scheme has been a bit uneven, Component A, the big decentralised solar plants, the progress has been moving slow – as of November 2025, only about 653 MW has actually been installed out of the 10,000 MW target, barely 6.5 percent, this part clearly needs a stronger push. But Component B, the off-grid pumps, is doing much better - over 9.17 lakh pumps are installed till November 2025, around 66 percent of the target. The picture for Component C is mixed: for the individual pump solarisation (IPS), progress is slower, just 10,535 pumps solarised out of 60,828 sanctioned, while the feeder-level solarisation (FLS) is picking up more speed, crossing 9.74 lakh solarised pumps, roughly 27 percent of the total sanctioned. So, overall, the momentum is there, but it's uneven. As of October 2022, Under the PM-KUSUM scheme, the solar capacity installed under all three components is helping reduce about 0.53 million tonnes of CO_2 every year.

Most of this reduction comes from Rajasthan, Haryana, Maharashtra and Punjab, while many other states, also show measurable contributions.

Table 17: Status of Component A, B & C of PM-KUSUM

	Component A	Component B	Component C	
	Solar or RE based Power Plant Capacity (MW)	**Pumps (No.s)**	**No. of Individual Pump Solar (IPS)**	**No. of Feeder Level Solar (FLS)**
Sanctioned	10000	12,72,758	60,828	35,61,855
Installed	653.49	9,17,275	10,535	9,74,458

Source: (National Portal (PM-KUSUM), 2025)

The DDUGJY scheme, launched in 2014, focuses on separating agriculture and non-agriculture feeders. Maharashtra began this with Gaothan Feeder Separation in 2006. This separation addresses the technical issues and power cuts, benefiting rural consumers and the farmers by dedicating 6-8 hours of power to agricultural feeders. It reduces the financial burden on the DISCOMs, curbs groundwater exploitation, and enhances rural electricity quality. States like Uttar Pradesh, Andhra Pradesh, Karnataka, Gujarat and Punjab actively support feeder segregation. There are 80,631 feeders with more than 30 percent agricultural load, feasible for segregation, and 49,512 have already been segregated under different schemes. Under DDUGJY, they finished 7,833 feeders before it closed in 2022. Under the newer RDSS, about 31,119 feeders are sanctioned, but only 3,874 are segregated so far.

Other initiatives promote energy-efficient agricultural practices. The Pradhan Mantri Krishi Sinchayee Yojana (PMKSY) includes programmes like 'Per Drop More Crop' and the 'Micro Irrigation Fund' to enhance water use efficiency. The Atal Bhujal Yojana encourages farmers to save groundwater through community water planning and micro-irrigation, and it is active across multiple states. The National Food Security Mission supports millet cultivation, aiming to improve soil fertility and diversify crops needing less energy and water. Aligning these policies with goals of energy efficiency and reduced consumption holds significant potential for enhancing agricultural sustainability.

Pump sets usage

The number of the Pump sets energised has grown steadily, from about 208 lakh in 2016-17 to nearly 276 lakh in 2023-24, growing at a CAGR of around 4 percent. For the first few years the increase is not much, but it picks up quite noticeably after 2020-21. This shift mainly comes from better and more reliable rural power supply, driven by feeder strengthening and segregation work under DDUGJY and later RDSS. As electricity availability improved, farmers found electric pumps more dependable and cheaper to run than diesel pumps. Rising irrigation needs and policy efforts to move farmers away from diesel, along with the parallel push for solar pumps under PM-KUSUM, further supported the rapid uptake of electricity-based irrigation.

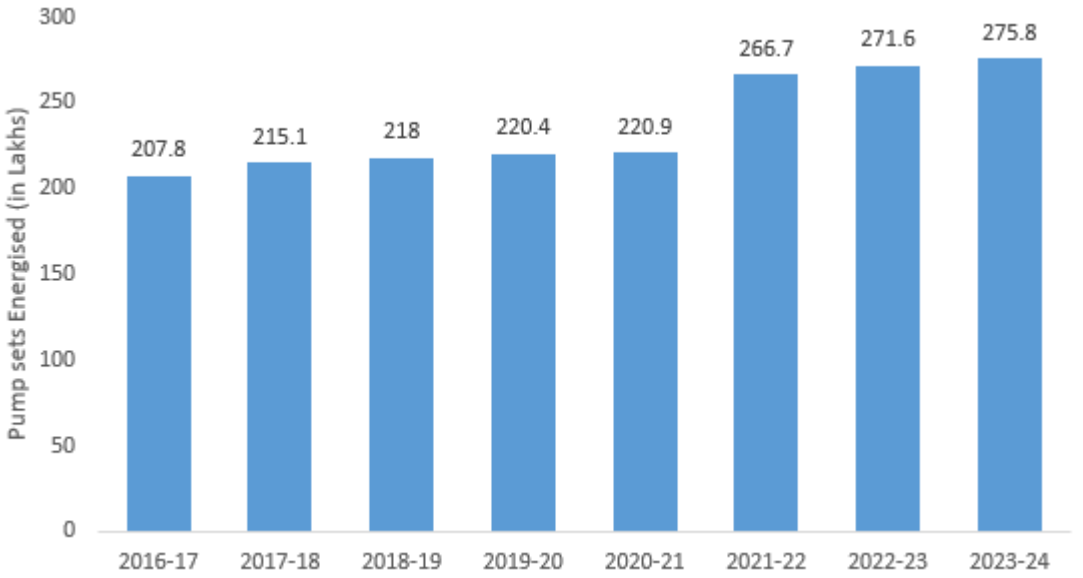


Figure 103: Number of Pump Sets energised

Source: (CEA, 2025)

Out of the total pump sets in the country, Maharashtra, had the highest number of energised pump-sets, accounting for 16.4 percent in 2022-23. Karnataka and Madhya Pradesh followed at 11.48 and 11.44 percent, respectively. (CEA d, 2024). Other states like West Bengal, Telangana, Tamil Nadu and Gujarat also have a significant number of energised pump sets. Recent policy pushes through, PM-KUSUM are encouraging uptake of solar water pumps even further.

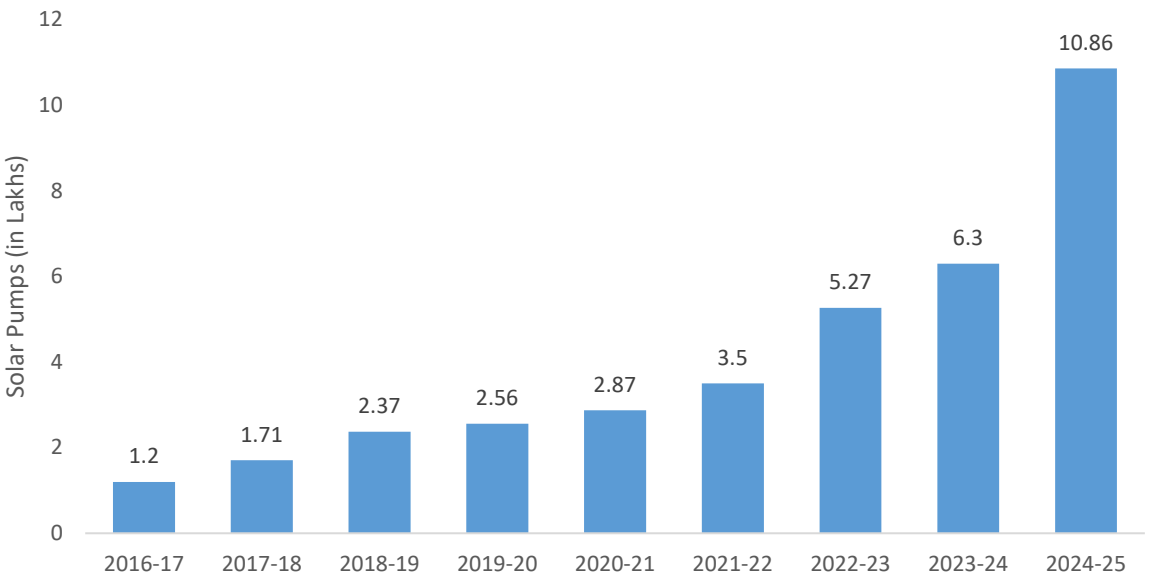


Figure 104: Number of Solar Pumps

Source: (MOSPI, 2025)

Solar pump installations show a much faster expansion, rising from about 1.2 lakh in 2016-17 to over 10.9 lakh in 2024-25, growing at a very high CAGR of nearly 32 percent. The acceleration becomes visible after 2020-21, with strong additions in the last three years. This rapid growth is mainly driven by the PM-KUSUM scheme, declining solar panel costs, and state incentives that make solar pumps attractive for farmers seeking lower irrigation costs and more dependable daytime power.

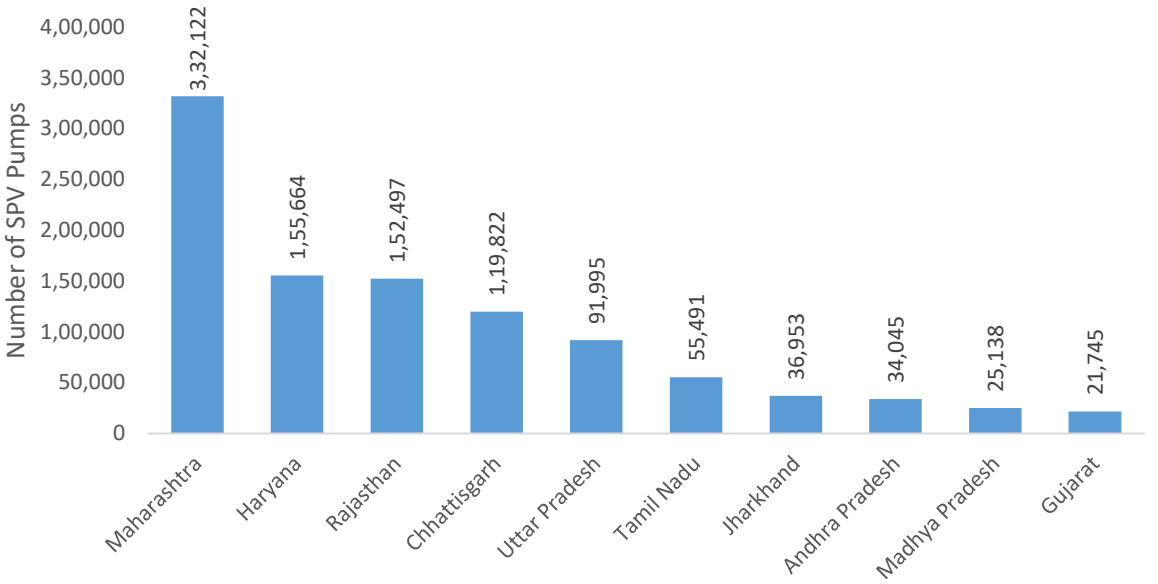


Figure 105: Top 10 states with highest Number Installation of Solar Photovoltaic Pump Sets till 2025

Source: (MoSPI, 2025)

- Maharashtra shows a significant surge, with SPV pump installations rising from 91,408 in 2023-24 to 332,122 in 2024-25**,** showing an increase of 263 percent.
- Haryana, Rajasthan and Chhattisgarh continue to maintain high installation, while other states such as Uttar Pradesh and Tamil Nadu show moderate but steady adoption.

Agriculture Sector Energy Consumption Trends

Electricity consumption

Figure 106 shows electricity consumption in the sector has risen from 169 BU in 2014-15 to 260 BU in 2024-25, rising at a CAGR of 4.4 percent. This steady rise highlights a growing demand for electricity within the sector over this period.

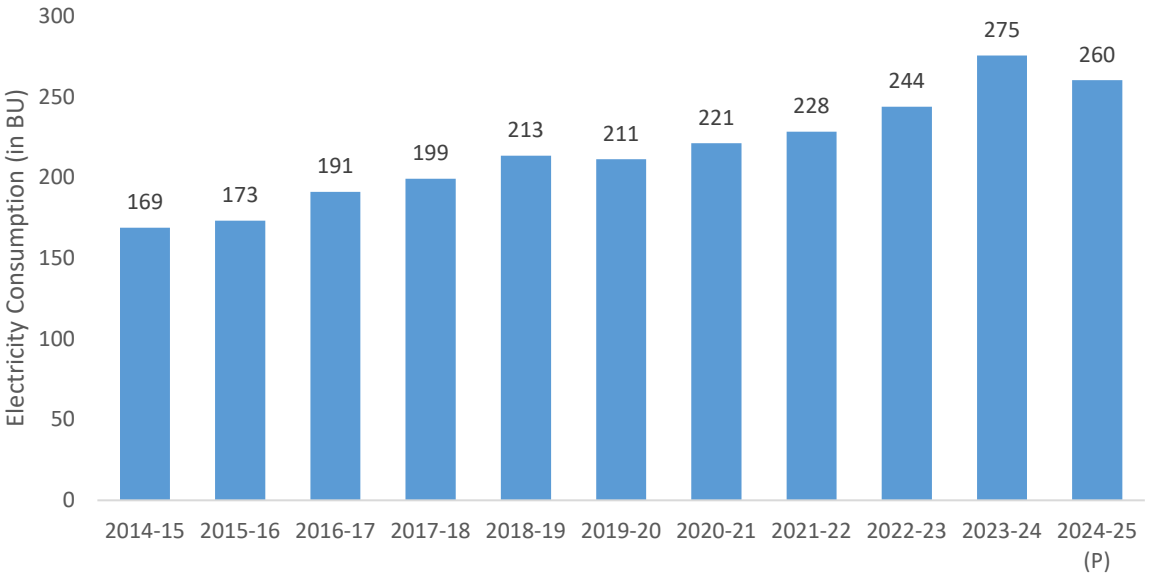


Figure 106: Electricity Consumption in the Agriculture Sector

Source: (CEA, 2024)

A major reason behind this rise is the expanding reliance on electric pumps for irrigation. Over the past few years, more farmland has moved from being rain-fed to having some form of irrigation support. Data shows this gradual shift: irrigation covered about 55 percent of the gross cropped area in 2021, and for the first time in 2022-23, over half of India's cultivable land had access to irrigation. The most recent land-use figures for 2023-24 also show that 63 percent of the net sown area received at least one round of irrigation during the year and 36.87 percent of the area was irrigated more than once (DES, 2024). But this expansion has largely been driven by groundwater, which now accounts for almost half of all irrigated land. Tube wells alone make up around 48 percent and its share has increased over the years, while the shares of canals (21 percent), other wells (15 percent) and tanks (4 percent) has reduced (DES, 2024). Even with these improvements, a significant portion - close to 44 percent - of farmland still depends entirely on rainfall. And with climate change making weather more unpredictable, farmers are likely to lean even more on groundwater when the monsoon falls short. Such factors can potentially increase the demand for electricity.

Petroleum Products and Natural Gas Usage

Table 18 shows the consumption of different fuels in the agriculture sector. The role of diesel in agriculture has been shrinking when viewed in the context of total energy use. With electricity now contributing nearly 81 percent of the sector's overall energy consumption, most of the day-to-day demand, especially for irrigation, is increasingly met through electric pump-sets. Diesel's share remains relatively small and is mostly concentrated in field machinery such as tractors, harvesters and some farm transport. This is reflected in the numbers: diesel consumption has moved from 3564 TMT in 2020-21 to 4251 MT in 2024-25 (P), showing fluctuations but no major long-term surge. Moreover, most of this diesel continues to be sourced through retail fuel outlets or resellers.

Table 18: Fuel Consumption in Agriculture Sector

	2020-21	2021-22	2022-23	2023-24	2024-25 (P)
LPG (TMT)	28	30	22	27	46
Diesel (TMT)	3564	3669	4074	4159	4251
Fuel Oil (TMT)	87	71	54	35	43
Natural Gas (MMSCM)	177	156	154	142	153

(P) - Provisional

Source: (MoPNG, 2025)

*Petcoke is also used in the agricultural sector. For 2024–25, the share of petcoke consumption in this sector has been derived from the *Monthly Industry-wise Consumption of Oil Products* report published by PPAC.

Other fuels such as fuel oil, LPG, petcoke and natural gas occupy only a marginal place in agricultural energy use. LPG use, though rising slightly, remains extremely small and is linked more to rural household or small processing activities than to farm operations. Similarly, the use of natural gas is also very limited.

This shift to electricity is supported by rural electrification efforts, expansion of electric pump-sets and schemes such as PM-KUSUM promoting solarization of water pumps and exploration of alternate non-fossil-based fuel sources for operating tractors and harvesters.

Chapter 6: Conclusion

India's energy system is at a decisive stage, shaped by steadily rising demand, continued dependence on fossil fuels, and a parallel acceleration of clean energy deployment. Rapid economic growth, urbanisation, and improving living standards have driven a sharp increase in energy use across sectors over the past decade. In 2024-25, India's total primary energy supply reached about 932 Mtoe, reflecting an increase of more than 45 percent compared to a decade earlier, while total final energy consumption stood at around 603 Mtoe. Despite significant expansion in renewable energy capacity, fossil fuels continue to dominate the energy mix, with coal and oil together accounting for nearly 87.5 percent of primary energy supply, underscoring the scale and complexity of the transition ahead.

At the same time, India has made notable progress in advancing cleaner energy pathways. By early 2025, non-fossil fuel sources accounted for about 50 percent of total installed electricity capacity, achieving a national climate target well ahead of schedule. Electricity demand has grown rapidly, with total consumption (including captive generation) increasing from 949 BU in 2014-15 to about 1,623 BU in 2024-25, driven by industrial activity, transport demand, rising appliance ownership, and expanding access to electricity. These developments highlight the need for a comprehensive and integrated understanding of how energy is produced, transformed, and consumed across the economy.

Against this backdrop, the India Energy Scenario 2024–25 aims to present a coherent, economy-wide picture of India's energy system by bringing together supply-side trends, sectoral demand patterns, and detailed energy flow analysis. By integrating updated data across fuels and sectors and aligning physical quantities with energy units, the report seeks to support informed assessment of India's evolving energy landscape and provide a robust analytical basis for planning and policy discussions as the country progresses towards its long-term development and climate objectives.

Strengthening Analytical Consistency and Sectoral Clarity

A key contribution of the India Energy Scenario 2024-25 lies in the methodological refinements introduced to improve the internal consistency of energy accounting and sectoral attribution. Building on the framework developed in earlier editions, this report places strong emphasis on reducing the share of energy reported under non-specified categories by improving the mapping of fuels to clearly identifiable end-use sectors. For instance, the treatment of petroleum products has been refined through improved disaggregation of diesel consumption that was previously grouped under retailer and reseller categories. This has enabled a more accurate allocation of fuel use across end-use sectors and has resulted in a notable increase in the reported share of the transport sector, which now accounts for around 22 percent of total final energy consumption compared to about 12 percent in the previous edition.

Further refinements have been undertaken for other fuels, including natural gas and LPG, to better reflect their sectoral consumption. Sector-wise allocation of natural gas has been strengthened using the BUR4 framework, enabling improved estimation of gas consumption in the residential and commercial sectors that was not captured earlier. Similarly, some LPG consumption has now been systematically allocated to the commercial sector, enhancing the completeness of sectoral energy accounting. As a result of these

methodological improvements, the share of energy reported under non-specified and "other" categories has declined from about 18 percent in the previous energy balance to around 4 percent in the current edition.

The report also strengthens sectoral demand estimates by incorporating additional datasets and analytical linkage. Industrial energy consumption has been disaggregated using data from programmes such as Perform, Achieve and Trade (PAT), improving allocation across energy-intensive subsectors and reducing the share of non-specified industries. In addition, the allocation of imported coal has been refined to better reflect its end use, with coal supplied to the power sector now appropriately accounted, rather than being aggregated with industrial consumption.

For the buildings sector, electricity consumption estimates have been enhanced using survey-based assessments. The residential buildings survey provides appliance-level insights into electricity use and captures variations across urban and rural households, improving the representation of consumption patterns that are not fully visible in conventional administrative datasets. Similarly, the commercial buildings survey has been used to analyse electricity demand across different building typologies and climatic zones. Together, these efforts improve the resolution of sectoral energy consumption estimates and provide a clearer picture of how energy is used across major end-use segments.

The current edition expands the coverage of biomass and biofuels within the analytical framework of the report. Estimates of biomass and biofuels consumption have been compiled for recent years and incorporated across major end-use sectors such as industry, buildings, and transport. Their inclusion provides a more complete account of energy use, particularly in sectors such as residential and industry, where bioenergy continues to play a meaningful role but has historically been less visible in conventional energy balances. At present, the analysis is limited to recent years; however, it establishes a basis for improving the treatment of bioenergy in future editions through the development of longer time series and deeper sectoral analysis.

The analysis also distinguishes between conventional fuels and their blended biofuel components, such as ethanol in petrol, biodiesel in diesel, and compressed biogas in natural gas, at the analytical level. This distinction is important because the supply-side figures for petrol, diesel and natural gas reported in official publications of the Ministry of Petroleum and Natural Gas do not include the blended biofuel component, whereas the corresponding consumption figures include these biofuels as part of total fuel use. While the quantities of biofuels are currently small and do not materially affect aggregate energy balances, this difference can lead to increasing inconsistencies between supply and demand estimates as blending levels rise over time. Identifying this mismatch at the analytical stage helps improve internal consistency in fuel accounting and provides a clearer basis for incorporating biofuels more explicitly in future energy balances.

Scope for Refinement

While the current edition represents a step forward in improving the consistency and granularity of energy accounting, it also highlights areas where further refinement is required. Future editions of the India Energy Scenario will aim to strengthen sectoral demand estimation, by expanding the use of data from energy efficiency programmes such as Perform, Achieve and Trade (PAT) beyond the Designated Consumer level towards more representative, all-India estimates across industrial subsectors. This is expected to support a better understanding of energy consumption across individual industries and further reduce the share of energy currently reported under non-specified industry categories.

Based on the recommendations of the Expert Committee on Energy Statistics constituted by MOSPI, future work will also focus on improving the estimation and allocation of coal consumption. This includes the use of grade-wise calorific values to enhance the accuracy of energy conversion, as well as the development of a more robust methodology for identifying coal end-use across sectors. Strengthening the mapping of coal types to their respective consuming sectors is expected to further reduce the share of energy reported under non-specified industries and improve the overall quality of the energy balance.

The current edition expands the coverage and analytical treatment of solid biomass and biofuels within the energy framework; however, further work is needed to deepen this analysis. The development of consistent historical time series remains an important area for future improvement. Subsequent editions will seek to strengthen the treatment of these fuels through expanded trend analysis, improved graphical representation alongside conventional fuels, and enhanced sectoral granularity. These efforts will support a more comprehensive understanding of bioenergy use across the economy and further improve the completeness of India's energy accounting framework.

Future publications will also seek closer alignment with the Biennial Transparency Report (BTR) to support consistency across national energy and emissions reporting frameworks. In addition, BEE proposes to undertake residential and commercial energy surveys on a periodic basis to better capture evolving consumption patterns and improve the robustness of demand-side estimates.

At the same time, efforts will be directed towards developing a more detailed energy balance that captures fuel-wise consumption across individual sectors, rather than presenting energy use only at aggregate levels. Such disaggregation is important for improving visibility of fuel use patterns across sectors and for strengthening the analytical basis for sector-specific assessment and planning. Continued efforts will also focus on improving overall analytical coverage by addressing remaining data gaps and strengthening the use of available administrative data and surveys.

Annexures

Table I: Grade Wise Production of Coking and Non-Coking Coal in India (in Million Tonnes)

Type	Grade Type	2017-18	2018-19	2019-20	2020-21	2021-22	2022-23	2023-24	2024-25
Production of Coking Coal	Steel-I	0.16	0.04	0.02	0.00	0.23	0.00	0.00	0.00
	Steel-II	0.05	0.00	0.13	0.01	0.00	0.06	0.10	0.15
	SC-I	0.18	0.25	0.25	0.22	0.00	0.25	0.22	0.22
	Wash-I	0.18	0.06	0.14	0.20	0.23	0.17	1.23	1.60
	Wash-II	4.55	4.34	2.30	2.37	2.50	3.78	3.44	5.08
	Wash-III	3.99	6.58	7.36	1.82	1.54	2.64	4.60	5.18
	Wash-IV	31.04	29.87	33.09	26.94	25.74	31.21	35.55	34.31
	Wash-V	0.00	0.00	9.64	12.80	20.17	22.48	21.21	19.81
	Wash-VI	0.00	0.00	0.01	0.43	1.29	0.17	0.48	0.11
Total Coking Coal		**40.15**	**41.13**	**52.94**	**44.79**	**51.70**	**60.76**	**66.82**	**66.47**
Production of Non-Coking Coal	G1	1.71	0.09	0.02	0.00	0.00	0.02	0.05	0.08
	G2	0.26	0.48	0.29	0.03	0.01	0.08	0.09	0.26
	G3	3.51	3.31	3.23	2.68	2.01	1.70	2.59	1.95
	G4	14.54	15.55	14.47	14.22	13.05	16.10	18.01	19.60
	G5	14.73	12.45	14.63	9.71	8.66	9.90	9.13	8.81
	G6	10.87	7.90	4.61	4.25	5.49	6.55	7.45	9.61
	G7	36.82	41.35	40.89	37.45	40.74	46.41	55.51	53.77
	G8	40.98	54.42	45.55	47.70	46.40	53.66	57.81	71.25
	G9	27.55	35.60	37.87	36.72	43.60	53.13	78.41	63.62
	G10	91.48	84.23	78.14	69.88	62.43	73.23	69.53	87.67
	G11	179.98	199.71	193.87	194.69	223.09	247.64	271.96	260.15
	G12	53.42	66.30	71.63	73.35	77.63	103.56	121.23	134.12
	G13	101.74	111.21	86.86	80.94	100.36	100.12	115.27	115.55
	G14	44.64	41.04	58.80	66.30	81.18	92.59	93.15	128.42
	G15	7.89	6.89	17.60	26.20	14.05	17.93	24.59	16.00
	G16	3.54	3.85	4.03	6.79	7.44	4.28	4.32	1.41
	G17	1.60	3.24	5.46	0.39	0.38	5.52	1.91	8.50
	Ungraded	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.31
Total Non-Coking Coal		**635.25**	**687.59**	**677.94**	**671.30**	**726.51**	**832.43**	**931.01**	**981.05**
Total Coal		**675.40**	**728.72**	**730.87**	**716.08**	**778.21**	**893.19**	**997.83**	**1047.5**

Source: MoC

Table II: Coal Import and Export from 2016-17 to 2023-24 (in Million Tonnes)

Year	Coking		Non Coking		Others		Total	
	Import	Export	Import	Export	Import	Export	Import	Export
2017-18	47.00	0.07	161.25	1.44	4.36	0.11	212.60	1.61
2018-19	51.84	0.06	183.51	1.25	4.59	0.03	239.93	1.33
2019-20	51.83	0.00	196.70	1.03	4.93	0.02	253.47	1.05
2020-21	51.20	0.00	164.05	2.94	2.46	0.03	217.71	2.97
2021-22	57.12	0.00	151.50	1.32	2.51	0.50	211.13	1.82
2022-23	56.05	0.03	181.62	1.14	3.63	0.03	241.30	1.20
2023-24	58.81	0.11	205.72	1.43	3.96	0.14	268.49	1.68
2024-25	57.58	0.21	186.05	1.71	4.88	0.12	248.50	2.03

Source: MoC

Table III: Overview of Electricity Supply (utility) in the States in 2024-25

State/UT	Installed Capacity (GW)	Share in Total Capacity (%)		Generation (BU)	Share in Total Capacity (%)	
		Non RE	RE		Non RE	RE
Andaman & Nicobar	0.13	73%	27%	0.37	91%	9%
Andhra Pradesh	30.02	60%	40%	72.87	79%	21%
Arunachal Pradesh	1.27	0%	100%	0.00	0%	100%
Assam	1.93	70%	30%	8.20	84%	16%
Bihar	9.60	94%	6%	60.76	99%	1%
Chandigarh	0.08	0%	100%	0.00	0%	100%
Chhattisgarh	25.52	93%	7%	166.43	98%	2%
Dadra & Nagar Haveli/Daman & Diu	0.05	0%	100%	0.00	0%	100%
Delhi	2.61	85%	15%	3.88	84%	16%
Goa	0.11	45%	55%	0.00	0%	100%
Gujarat	58.22	43%	57%	105.73	67%	33%
Haryana	8.21	70%	30%	30.44	93%	7%
Himachal Pradesh	12.20	0%	100%	0.00	0%	100%
Jammu & Kashmir	3.80	5%	95%	0.00	0%	100%
Jharkhand	6.00	93%	7%	38.81	99%	1%
Karnataka	34.67	31%	69%	51.95	52%	48%
Kerala	4.55	15%	85%	0.00	0%	100%
Ladakh	0.14	0%	100%	0.00	0%	100%
Lakshadweep	0.03	84%	16%	0.07	100%	0%

Madhya Pradesh	32.83	67%	33%	146.12	88%	12%
Maharashtra	51.67	57%	43%	145.02	85%	15%
Manipur	0.16	22%	78%	0.00	0%	100%
Meghalaya	0.40	0%	100%	0.00	0%	100%
Mizoram	0.14	0%	100%	0.00	0%	100%
Nagaland	0.11	0%	100%	0.00	0%	100%
Odisha	12.56	76%	24%	68.64	90%	10%
Pondicherry	0.09	0%	100%	0.20	94%	6%
Punjab	8.95	37%	63%	33.58	82%	18%
Rajasthan	47.12	63%	37%	73.42	56%	44%
Sikkim	2.34	28%	72%	0.00	0%	100%
Tamil Nadu	43.08	0%	100%	91.71	70%	30%
Telangana	17.93	41%	59%	56.97	82%	18%
Tripura	1.10	57%	43%	5.10	100%	0%
Uttar Pradesh	36.19	97%	3%	166.21	95%	5%
Uttarakhand	5.67	83%	17%	0.84	5%	95%
West Bengal	15.68	12%	88%	93.17	95%	5%

Source: CEA

Table IV: Industry-wise Captive Installed Capacity and Energy Generation as of 2023-24

Name of Industry	Installed Generating Capacity (GW)	Energy Generation (BU)
Aluminium	9.8	51.8
Automobiles	2.1	2.0
Cement	7.3	18.5
Chemical	5.9	16.3
Collieries	0.3	0.2
Electrical Engineering	1.7	2.7
Fertiliser	1.4	4.2
Food Products	1.6	1.8
Heavy Engineering	0.6	0.7
Iron & Steel	15.0	61.0
Jute	0.1	0.0
Light Engineering	1.2	0.9
Mineral Oil & Petroleum	5.1	20.7
Mining & Quarrying	0.4	1.2
Miscellaneous	12.6	10.7
Non Ferrous	1.2	5.0
Paper	1.9	7.2
Plastic	0.3	0.4
Rubber	0.5	0.3

Sugar	6.8	12.9
Textile	4.9	5.3
Non Industry	0.2	0.0
All India (Non-Utilities)	**80.9**	**223.9**

Source: CEA

Table V: Conversion Factors

Fuel Type	Unit	2020-21	2021-22	2022-23	2023-24	2024-25
Coal Production	KJ/Kg	16905	16822	16865	16943	16854
Coal Import	KJ/Kg	22473	23277	22257	22418	22522
Coal Export	KJ/Kg	28200	28200	28200	28200	28200
Coal Consumption in Power Sector	KJ/Kg	17001	16846	16939	17030	17192
Coal Consumption in Non-Power Sector	KJ/Kg	22093	21027	21877	22236	23695
Lignite	KJ/Kg	9546	9546	9546	9546	9546
Crude Oil	KJ/Kg	42789	42789	42789	42789	42789
LPG	KJ/Kg	47300	47300	47300	47300	47300
Naphtha	KJ/Kg	45000	45000	45000	45000	45000
Kerosene	KJ/Kg	42564	43752	43752	43752	43752
Diesel Oil (HSD + LDO)	KJ/Kg	43300	43334	43334	43334	43334
Fuel Oil	KJ/Kg	39178	41240	41240	41240	41240
Lubricants	KJ/Kg	42000	42000	42000	42000	42000
Bitumen	KJ/Kg	39000	39000	39000	39000	39000
Petrol/Motor Spirit	KJ/Kg	44800	44800	44800	44800	44800
ATF	KJ/Kg	44600	44600	44600	44600	44600
Petroleum Coke	KJ/Kg	32000	32000	32000	32000	32000
Other Petroleum Products	KJ/Kg	40000	40193	40193	40193	40193
Natural Gas (BCM to TJ)	Toe/MMSCM	924				
Electricity/ Electricity from RES	Toe/MWh	0.086				
Electricity from Nuclear	Toe/MWh	0.261				

Source: MoSPI

Table VI: Notified Threshold Limit for PAT Industries (in toe)

S. No.	Notified Sector	Threshold Energy Consumption (Mtoe/year)
1	**Aluminium**	7,500
2	**Cement**	
	(a) Integrated Cement Unit	30,000
	(b) Cement Grinding Unit	10,000
3	**Commercial Buildings / Establishments**	
	(a) Hotels	500
	(b) Airports	500
4	**Chlor-Alkali**	12,000
5	**DISCOMs**	All licensed
6	**Fertilizer**	30,000
7	**Iron & Steel**	20,000
8	**Pulp & Paper**	7,500
9	**Petroleum Refinery**	90,000
10	**Petrochemical (Cracker units)**	1,00,000
11	**Railways**	
	(a) Zonal Railways (Traction)	70,000
	(b) Workshops	750
12	**Textile**	3,000
13	**Thermal Power Plant**	30,000
14	**Petrochemical Manufacturing**	
	(i) Fibre Intermediates	50,000
	(ii) Polymers	10,000
	(iii) Detergent Intermediates	9,000
	(iv) Performance Plastics	3,000
	(v) Other Petrochemical Products	6,000
	(vi) Synthetic Rubbers	15,000
	(vii) Aromatics	20,000
15	**Sugar**	10,000
16	**Chemical**	
	(i) Alkali Chemical	3,000
	(ii) Inorganic Chemical	3,000
	(iii) Organic Chemical	3,000
	(iv) Pesticides (Technical)	3,000
	(v) Dyes and Pigments	3,000
	(vi) Pharmaceuticals (API)	3,000
17	**Ceramic**	5,000
18	**Glass**	10,000
19	**Zinc**	20,000

20	**Copper**	10,000
21	**Port Trust**	500
22	**Dairy**	2,500
23	**Automobile Assembly Unit**	3,000
24	**Tyre Manufacturer**	7,000
25	**Forging**	1,500
26	**Foundry**	5,000
27	**Refractories**	3,000

Source: BEE

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