Industry Report Power T&D and Transformer Components

12 December 2024

Disclaimer

*This study has been undertaken through extensive secondary research, which involves compiling inputs from publicly available sources, including official publications and research reports. Estimates provided by Dun & Bradstreet ("**Dun & Bradstreet**") and its assumptions are based on varying levels of quantitative and qualitative analysis including industry journals, company reports and information in the public domain.*

Dun & Bradstreet has prepared this study in an independent and objective manner, and it has taken all reasonable care to ensure its accuracy and completeness. We believe that this study presents a true and fair view of the industry within the limitations of, among others, secondary statistics, and research, and it does not purport to be exhaustive. The results that can be or are derived from these findings are based on certain assumptions and parameters/conditions. As such, a blanket, generic use of the derived results or the methodology is not encouraged.

Forecasts, estimates, predictions, and other forward-looking statements contained in this report are inherently uncertain because of changes in factors underlying their assumptions, or events or combinations of events that cannot be reasonably foreseen. Actual results and future events could differ materially from such forecasts, estimates, predictions, or such statements.

The recipient should conduct its own investigation and analysis of all facts and information contained in this report is a part and the recipient must rely on its own examination and the terms of the transaction, as and when discussed. The recipients should not construe any of the contents in this report as advice relating to business, financial, legal, taxation or investment matters and are advised to consult their own business, financial, legal, taxation, and other advisors concerning the transaction.

Table of Contents

Global Macroeconomic Scenario

The global economy, which grew by 3.3% in 2023, is expected to record a sluggish growth of 3.2% in 2024 before rising modestly to 3.3% in 2025. Between 2021 – 2022, global banks were carrying a historically high debt burden after COVID-19. Central banks took tight monetary measures to control inflation and spike in commodity prices. Russia's war with Ukraine further affected the global supply chains and inflated the prices of energy and other food items. These factors coupled with war-related economic sanctions impacted the economic activities in Europe. Any further escalation in the war may further affect the rebound of the economy in Europe.

While China, the largest manufacturing hub of world, was facing a crisis in the real estate sector and prices of properties were declining between 2020 - 2023, with the reopening of the economy, consumer demand is picking up again. The Chinese authorities have taken a variety of measures, including additional monetary easing, tax relief for corporates, and new vaccination targets for the elderly. The Chinese Government took several steps to help the real estate sector including cracking down on debt-ridden developers, announcing stimulus for the sector and measures to encourage the completion and delivery of unfinished real estate projects. The sector is now witnessing investments from developers and demand from buyers.

Global headline inflation is set to fall from an estimated 6.8% in CY 2023 to 5.8% in CY 2024 and to 4.4% in CY 2025. This fall is swifter than anticipated across various areas, amid the resolution of supply-related problems and tight monetary policies. Reduced inflation mirrors the diminishing impact of price shocks, particularly in energy, and their subsequent influence on core inflation. This decrease also stems from a relaxation in labour market pressure, characterized by fewer job openings, a slight uptick in unemployment, and increased labour availability, occasionally due to a significant influx of immigrants.

Global GDP Growth Scenario

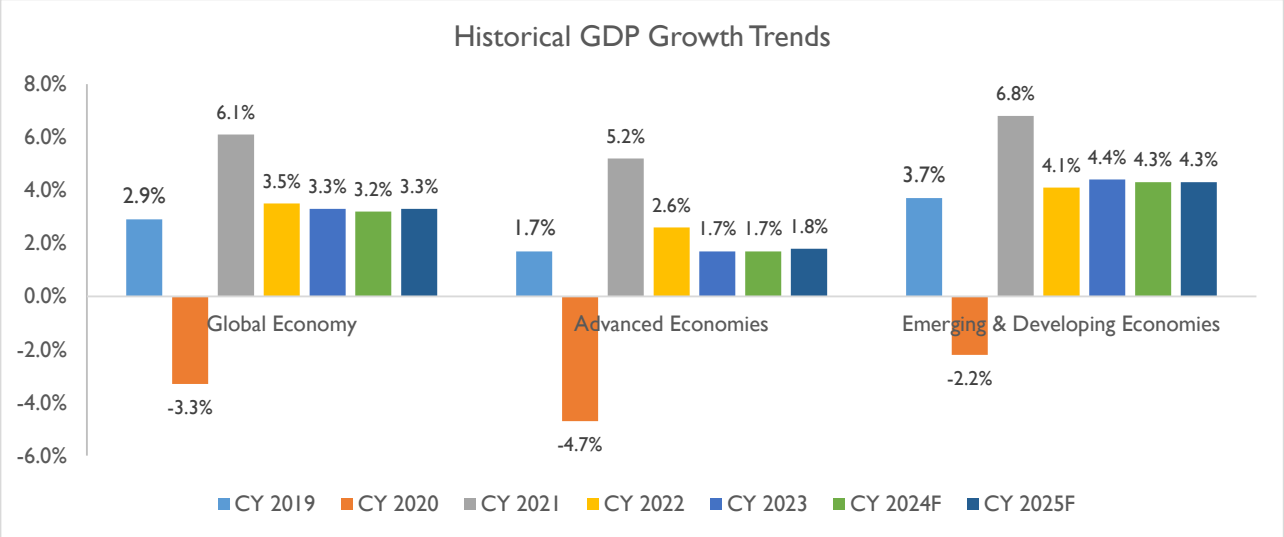
The global economy started to rise from its lowest levels after countries started to lift the lockdown in 2020 and 2021. The pandemic lockdown was a key factor as it affected economic activities resulting in a recession in the year CY 2020, as the GDP growth touched -3.3%.

In CY 2021 disruption in the supply chain affected most of the advanced economies as well as low-income developing economies. The rapid spread of Delta and the threat of new variants in mid of CY 2021 further increased uncertainty in the global economic environment.

Global economic activities experienced a sharper-than-expected slowdown in CY 2022. One of the highest inflations in decades, seen in 2022, forced most of the central banks to tighten their fiscal policies. Russia's invasion of Ukraine affected the global food supply resulting in a further increment in the cost of living.

Further, despite initial resilience earlier in 2023, marked by a rebound in reopening and progress in curbing inflation from the previous year's highs, the situation remained precarious. Economic activity lagged behind its pre-pandemic trajectory, particularly in emerging markets and developing economies, leading to widening

disparities among regions. Numerous factors are impeding the recovery, including the lasting impacts of the pandemic and geopolitical tensions, as well as cyclically-driven factors such as tightening monetary policies to combat inflation, the reduction of fiscal support amidst high debt levels, and the occurrence of extreme weather events. As a result, global growth declined from 3.5% in CY 2022 to 3.3% in CY 2023.

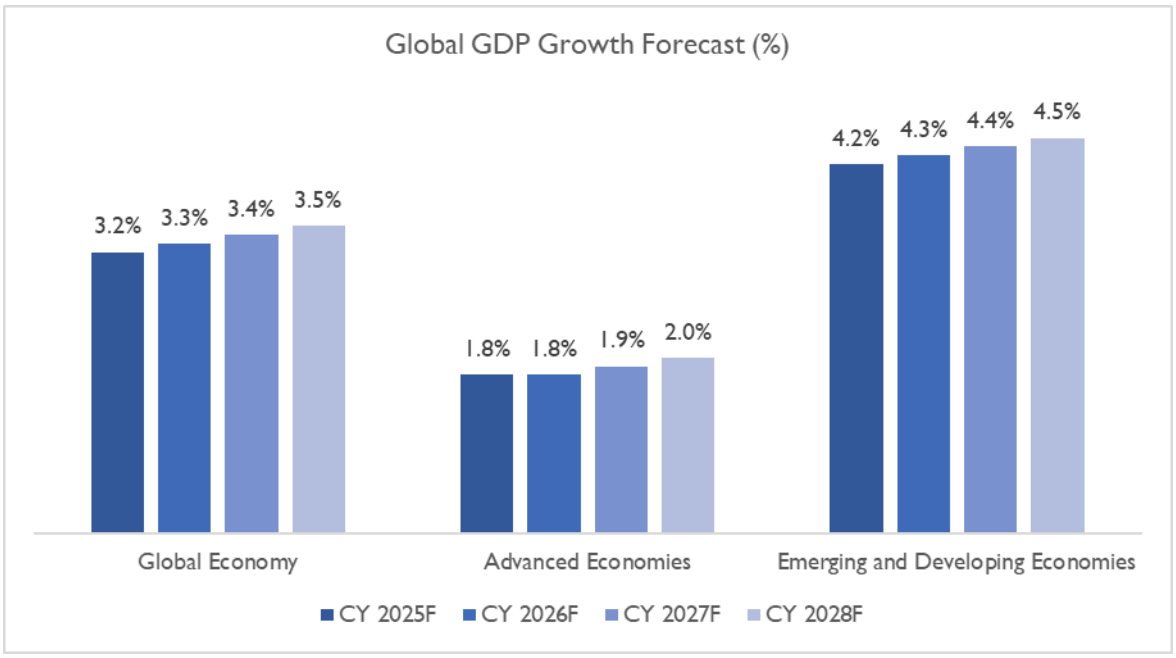


Source – IMF Global GDP Forecast Release July 2024

Note: Advanced Economies and Emerging & Developing Economies are as per the classification of the World Economic Outlook (WEO). This classification is not based on strict criteria, economic or otherwise, and it has evolved over time. It comprises of 40 countries under the Advanced Economies including the G7 (the United States, Japan, Germany, France, Italy, the United Kingdom, and Canada) and selected countries from the Euro Zone (Germany, Italy, France etc.). The group of emerging market and developing economies (156) includes all those that are not classified as Advanced Economies (India, China, Brazil, Malaysia etc.)

In the current scenario, global GDP growth is estimated to have recorded a moderate growth of 3.3% in CY 2023 as compared to 3.5% growth in CY 2022. While high inflation and rising borrowing costs are affecting private consumption, on the other hand, fiscal consolidation is affecting government consumption.

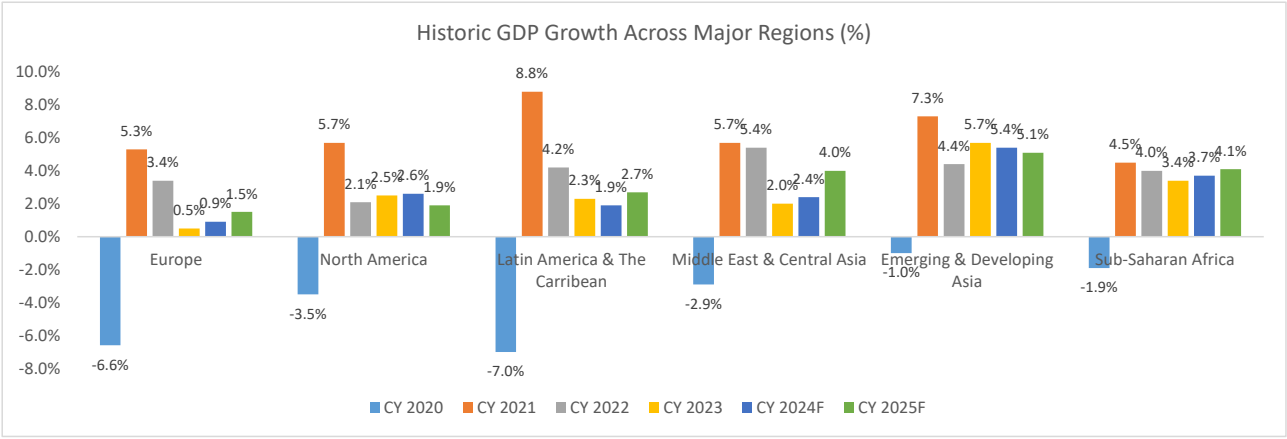
Slowed growth in developed economies will affect the GDP growth in CY 2024 and global GDP is expected to record a flat growth of 3.2% in CY 2024. The crisis in the housing sector, bank lending, and industrial sectors are affecting the growth of global GDP. Inflation forced central banks to adopt tight monetary policies. After touching the peak in 2022, inflationary pressures slowly eased out in 2023. This environment weighs in for interest rate cuts by many monetary authorities.



Source – IMF Global GDP Forecast Release 2024, D&B Estimates

GDP Growth Across Major Regions

GDP growth of major regions including Europe, Latin America & The Caribbean, Middle East & Central Asia, and Sub-Saharan Africa, were showing signs of slow growth and recession between 2020 – 2023, but leaving Latin America & The Caribbean, 2024 is expected to show resilience and growth. Meanwhile, GDP growth in Emerging and Developing Asia (India, China, Indonesia, Malaysia etc.) is expected to decrease from 5.4% in CY 2023 to 5.2% in CY 2024, while in the United States, it is expected to decrease from 2.5% in CY 2023 to 2.1% in CY 2024.

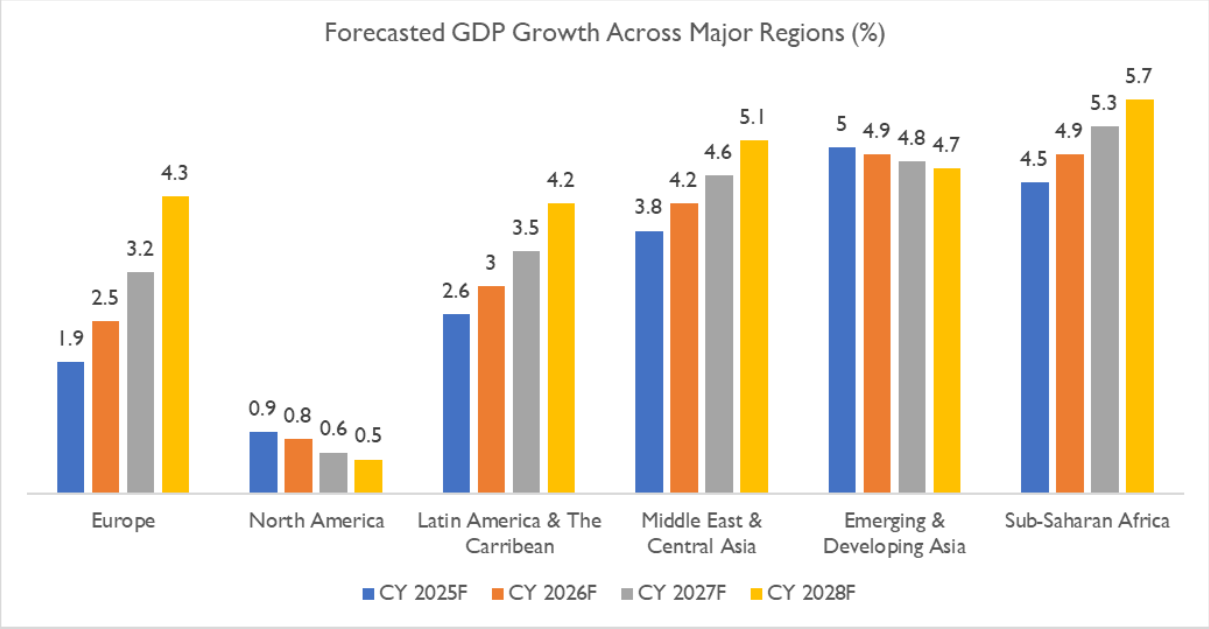


Source-IMF World Economic OutlookJuly 2024 update

Except for Emerging and Developing Asia, Latin America & The Caribbean and the United States, all other regions are expected to record an increase in GDP growth rate in CY 2024 as compared to CY 2023. GDP growth in Latin America & The Caribbean is expected to decline due to negative growth in Argentina. Further,

growth in the United States is expected to come down at 2.1% in CY 2024 due to lagged effects of monetary policy tightening, gradual fiscal tightening, and a softening in labour markets slowing aggregate demand.

Although Europe experienced a less robust performance in 2023, the recovery in 2024 is expected to be driven by increased household consumption as the impact of energy price shocks diminishes and inflation decreases, thereby bolstering real income growth. Meanwhile, India and China saw greater-than-anticipated growth in 2023 due to heightened government spending and robust domestic demand, respectively. Sub-Saharan Africa's expected growth in 2024 is attributed to the diminishing negative impacts of previous weather shocks and gradual improvements in supply issues.



Source-IMF, OECD, and World Bank, D&B Estimates

Global Economic Outlook

At the midpoint of the year, so far in 2024 we have seen divergence in outcomes and prospects around the world in terms of economic growth, inflation, and policy responses. On balance, global short-term economic prospects have improved over the course of the year. We expect this momentum to continue through the second half of 2024 and into 2025 as inflation eases further and monetary policy continues to loosen, supporting steady growth. Macroeconomic risks, in our view, have become more balanced.

The U.S. has performed better than other developed economies, particularly those in Europe where the consumer sentiment has been relatively weak – though the picture in Europe has been varied. A sustained recovery in tourism this year has boosted the economies of Greece and Spain, whereas Germany, France, and Italy have been held back by the slower recovery of manufacturing. Nonetheless, the European Central Bank (ECB) lowered the three key interest rates in June – for the first time since September 2019 – which will support stronger regional growth.

Growth in the Chinese Mainland has held up well so far this year despite challenges from the property market amid ongoing rebalancing, and the export cycle is supporting growth in the rest of Asia. In Latin America, larger economies, such as Brazil and Mexico, tend to be performing more moderately than smaller economies, such as Chile and Peru, indicating slower regional growth overall.

Globally, industrial production has been relatively sluggish because of restrictive trade policies, persistent supply chain disruptions, high interest rates, and anemic growth. We expect industrial production to gather steam later this year and into 2025 on the back of a gradual recovery in global trade, stimulated by stronger domestic demand for goods.

Policy responses have diverged so far this year and are set to remain so in the near term. Central banks have begun rate cutting cycles in several developed economies, including the Eurozone, Canada, Sweden, and Switzerland. However not every economy has followed suit. Disinflation has not been as predictable as it was in 2023, and underlying price pressures mean inflation is likely to remain bumpy this year – hence, policy will remain more restrictive than was anticipated at the start of the year. With relatively stronger economic growth and stickier inflation, the timing of the first interest rate cut by the U.S. Federal Reserve (the Fed) and the onward path of interest rates remains ambiguous.

The global economy is showing signs of stabilizing, yet growth will remain subdued this year before picking up pace in 2025. We forecast global growth of around 2.5% in 2024, half a percentage point softer than in the decade following the financial crisis. The weaker outlook reflects fiscal consolidation, lagged tight monetary policy, restrictive trade policies, and elevated levels of geopolitical uncertainty. Looking ahead to 2025, global growth is likely to pick up slightly to 2.8% as the impact of these factors declines and stronger growth becomes more entrenched.

Emerging economies look set for softer growth in general this year. On a regional basis, growth is likely to be markedly slower in Eastern Europe, but only slightly softer in Asia Pacific and Latin America, with growth only moderately slower in key economies such as the Chinese Mainland, India, and Brazil. Outcomes in developed economies are also mixed but largely remain subdued because of tight policy settings.


DUN & BRADSTREET INFORMATION SERVICES INDIA PVT LTD
MUMBAI

India Macroeconomic Analysis

GDP Growth Scenario

India's economy showed resilience with GDP growing at 8.2% in CY 2023. The GDP growth in CY 2023 represents a return to pre pandemic era growth path. Even amidst geopolitical uncertainties, particularly those affecting global energy and commodity markets, India continues to remain one of the fastest growing economies in the world.

Country	Real GDP Growth (CY 2023)	Projected GDP Growth (CY 2024)	Projected GDP Growth (CY 2025)
India	8.20%	7.00%	6.50%
China	5.20%	5.00%	4.50%
Russia	3.60%	3.20%	1.50%
Brazil	2.90%	2.10%	2.40%
United States	2.50%	2.60%	1.90%
Japan	1.90%	0.70%	1.00%
Canada	1.20%	1.30%	2.40%
Italy	0.90%	0.70%	0.90%
France	1.10%	0.90%	1.30%
South Africa	0.70%	0.90%	1.20%
United Kingdom	0.10%	0.70%	1.50%
Germany	-0.20%	0.20%	1.30%

Source: World Economic Outlook, July 2024

Countries considered include - Largest Developed Economies and BRICS (Brazil, Russia, India, China, and South)

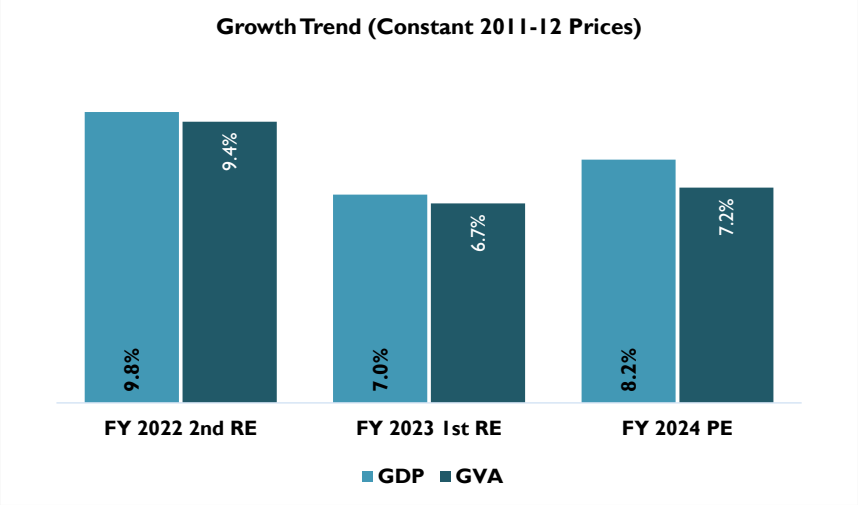
Countries have been arranged in descending order of GDP growth in 2023).

There are few factors aiding India's economic recovery – notably its resilience to external shocks and rebound in private consumption. This rebound in private consumption is bringing back the focus on improvements in domestic demand, which together with revival in export demand is a precursor to higher industrial activity. Already the capacity utilization rates in Indian manufacturing sector are recovering as industries have stepped up their production volumes. As this momentum sustains, the country may enter a new capex (capital expenditure) cycle. The universal vaccination program by the Government has played a big part in reinstating confidence among the population, in turn helped to revive private consumption.

Realizing the need to impart external stimuli, the Government stepped up its spending on infrastructure projects which in turn had a positive impact on economic growth. The capital expenditure of the central government increased by 37.4% increase in capital expenditure (budget estimates), to the tune of INR 10 trillion in the Union Budget 2023-2024. The announcement also included a 30% increase in financial assistance to states at INR 1.3 trillion for capex. The improvement was accentuated further as the Budget 2024-2025 announced an 11.1% increase in the capital expenditure outlay at INR 11.11trillion, constituting 3.4% of the GDP. This has provided much-needed confidence to the private sector, and in turn, attracted private investment.

On the lending side, the financial health of major banks has witnessed an improvement which has helped in improving the credit supply. With capacity utilization improving, there would be demand for credit from the corporate sector to fund the next round of expansion plans. The banking industry is well poised to address that demand. Underlining the improving credit scenario is the credit growth to the micro, small, and medium enterprise (MSME) sector as the credit outstanding to the MSME sector by scheduled commercial banks in the fiscal year 2024 grew by 14% to INR 10.31 trillion compared to INR 9.02 trillion as on 24 March 2023. The extended Emergency Credit Linked Guarantee Scheme (ECLGS) by the Union Government has played a major role in improving this credit supply.

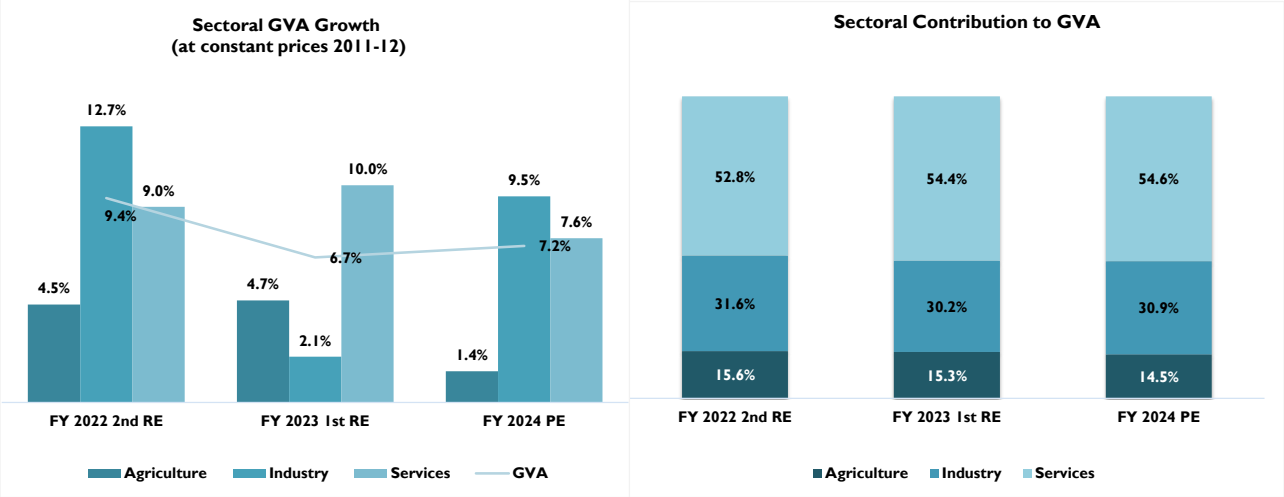
As per the provisional estimates 2023-24, India's GDP in FY 2024 grew by 8.2% compared to 7.0% in the previous fiscal on the back of solid performances in manufacturing, mining, and construction sectors. The year-on-year increase in growth rate is also partly due to by a strong growth in investment demand led by public capital expenditure.



Source: Ministry of Statistics & Programme Implementation (MOSPI), National Account Statistics, 2023-24

RE stands for Revised Estimates, SAE stands for Second Advance Estimates

Sectoral Contribution to GVA and annual growth trend



Source: Ministry of Statistics & Programme Implementation (MOSPI)

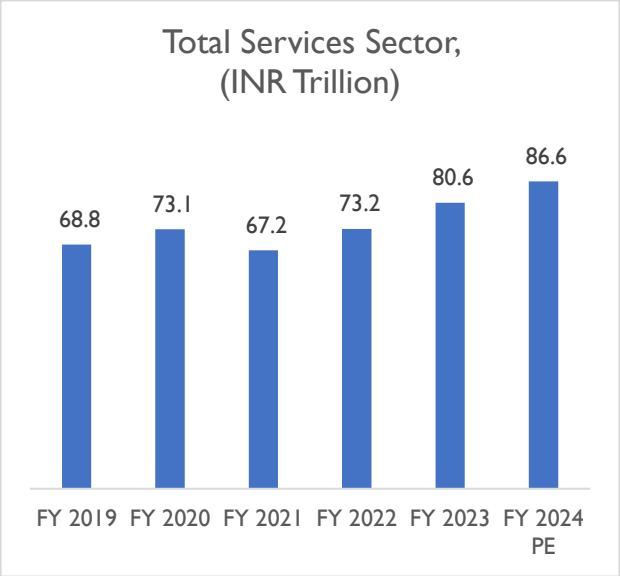
Sectoral analysis of GVA reveals industrial sector recovered sharply registering 9.5% y-o-y increase in FY 2024 against 2.1% in the previous fiscal. In the industrial sector, growth across major economic activity such as mining, manufacturing and construction sector rose significantly and it registered a growth of 7.1%, 9.9% and 9.9% in FY 2024 against a y-o-y change of 1.9%, -2.20%, and 9.44% in FY 2023, respectively. Utilities sector observed a marginal moderation in y-o-y growth to 7.5% against 9.44% in the previous years.

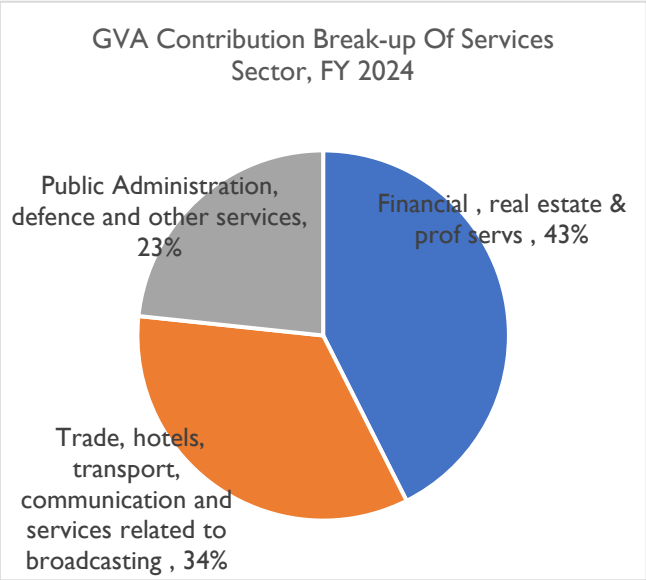
Talking about the services sector's performance, with major relaxation in covid restriction, progress on COVID-19 vaccination and living with virus attitude, business in the service sector gradually returned to normalcy in FY 2023. Economic recovery was supported by the service sector as individual mobility returned to the pre-pandemic level. The trade, hotel, transport, communication, and broadcasting segment continued to strengthen in FY 2023 and grow in FY 2024, although the growth hasn't shown substantial increases. In FY 2024, services sector grew by 7.6% against 10% y-o-y growth in the previous year.

Expansion in Service Sector

Services sector is a major contributor to the country's overall economic growth. In absolute terms, services sector GVA has increased from INR 68.78 trillion in FY 2019 to INR 86.6 trillion in FY 2024 (as per the provisional estimated), registering a CAGR of nearly 5%. Within Services sector, the GVA by financial, real estate and professional services-the largest contributing segment observed 6.3% CAGR while Public Administration, defence and other services[1] observed 4.5% CAGR and Trade, hotels, transport, communication, and services related to broadcasting witnessed 3.1% CAGR between FY 2019-24.

[1] Other services include Education, Health, Recreation, and other personal services.





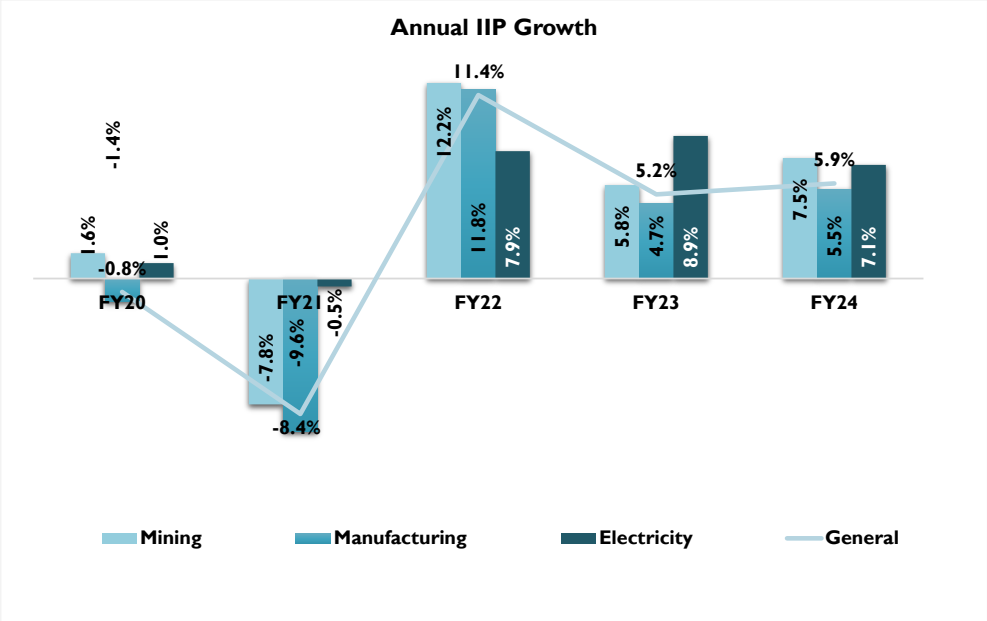
Sources: MOSPI, CMIE Economic Outlook and Dun & Bradstreet Research Estimates[2]

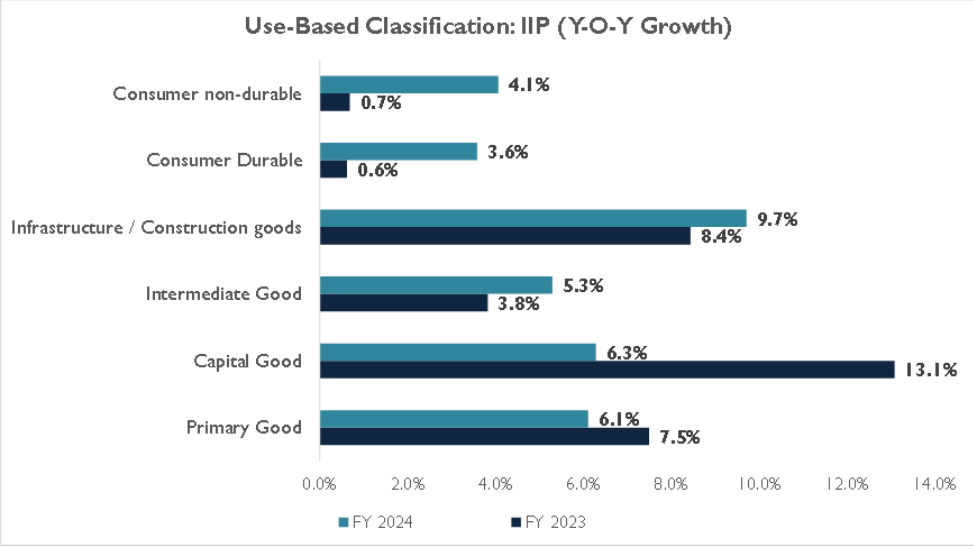
India's HSBC Services Purchasing Managers' Index**,** an important indicator to track service sector performance, measured 60.3 in July 2024 against 60.5 in the previous month. Since August 2021, the services sector has consistently remained above the threshold of 50, which distinguishes growth from contraction.

IIP Growth

Industrial sector performance as measured by IIP index; in FY 2024 it is growing at 5.9% (against 5.2% in FY 2023). Previously IIP index exhibited temporary recovery in FY 2022 from the low of Covid induced slowdown in industrial growth during FY 2020 and FY 2021. Manufacturing index, with 77.6% weightage in overall index, grew by 5.5% in FY 2023 against 4.7% y-o-y growth in FY 2022 while mining sector index too grew by 7.5% against 5.8% in the previous years. Mining & manufacturing both shown improvement according to previous except the Electricity sector Index, witnessed an improvement of 7.1% against 8.9% in the previous year.

[2] Projection as Based on CMIE Growth rate till FY 2029 and FY 2030 is based on Dun & Bradstreet assumption.

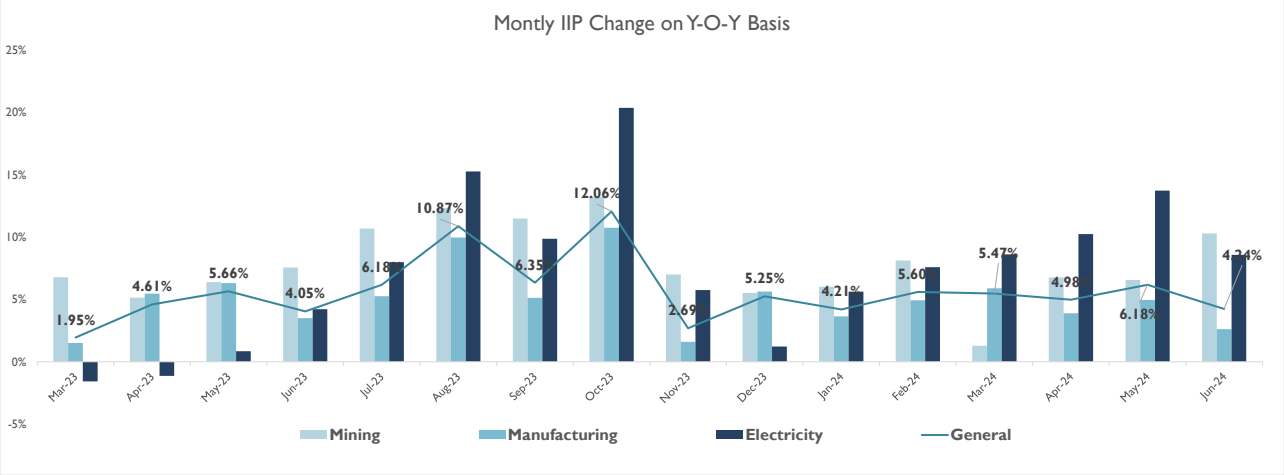




Source: Ministry of Statistics & Programme Implementation (MOSPI)

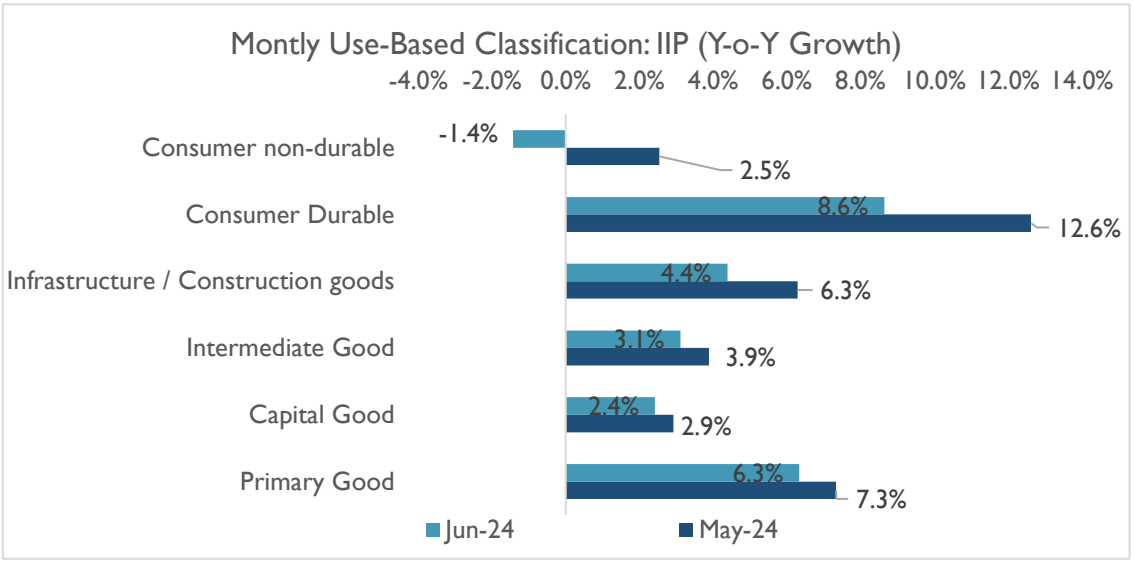
As per the use-based classification, most of the segments has shown growth for FY 2024 as compared to FY 2023. Capital good and primary goods were segments which faced less growth as compared to previous year. The contracting IIP data points towards adverse operating business climate as global headwinds, high inflation, and monetary tightening cumulatively impacted the broader industrial sector performance. In contrast all the segments except the above two have shown growth.

Monthly IIP Growth Trend



Source: Ministry of Statistics & Programme Implementation (MOSPI)

In the current fiscal FY 2025, the monthly IIP measured index has reported steady improvement over the last fiscal. However, the IIP index slowed to a 5-month low and just grew by 4.24% y-o-y in June against 6.18% in the previous month on the back of slowing growth in the manufacturing section. In June 2024, the manufacturing index growth slowed to 2.6% against 6.3% y-o-y growth in June 2023 and 5% in May 2023 while the electricity sector index and mining index exhibited substantial improvement and they grew by 8.6% and 10.3% in June 2024 against 0.9% and 6.4% growth in April 2023, respectively.

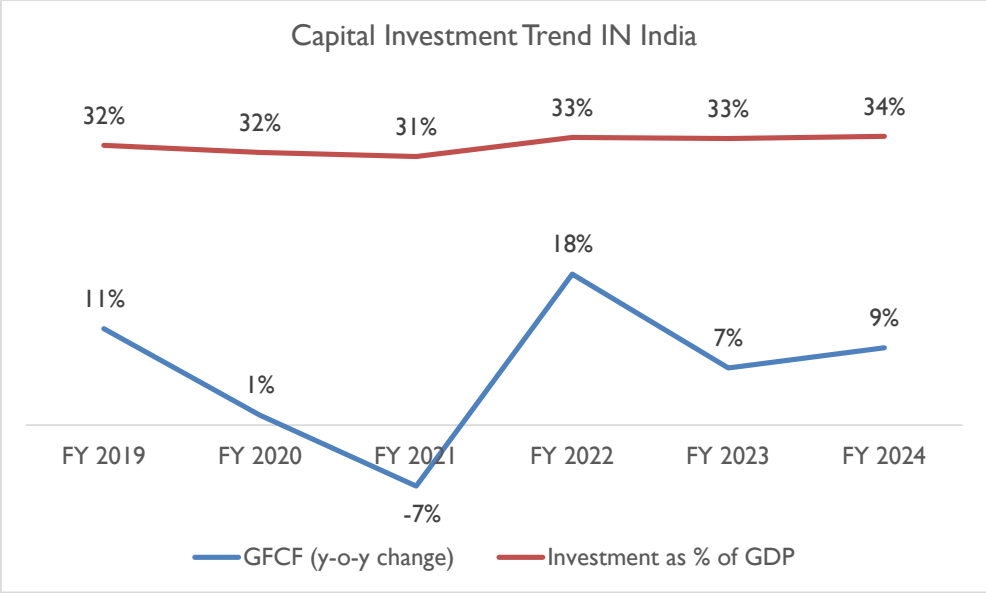


Sources: MOSPI

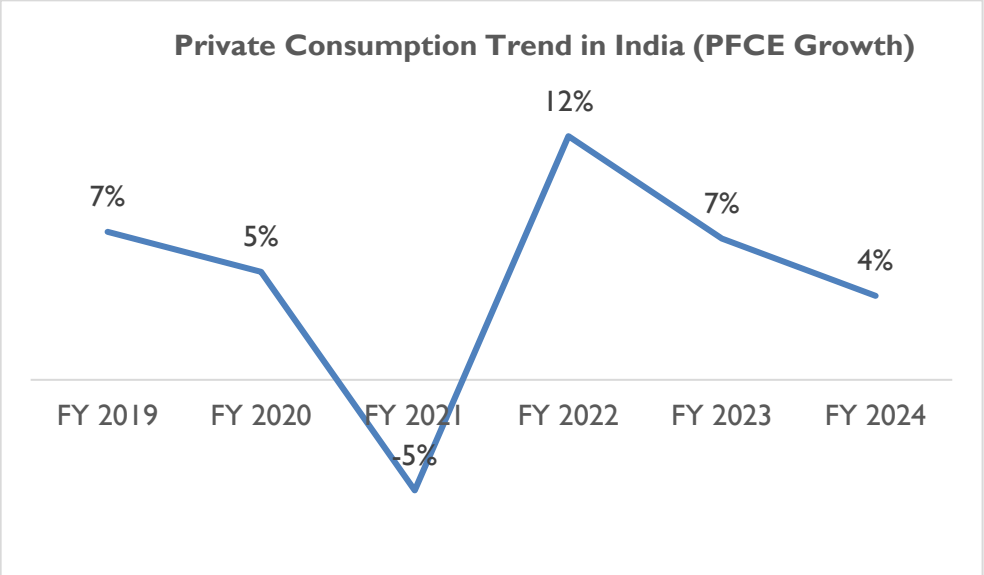
As per the use-based classification, growth in all segments slowed in June 2024 as compared to the previous month. Consumer non-durable declined by 1.4% in June 2024 against 2.5% increase in the previous month. In May 2024, all segments showed a substantial increase in growth.

Investment & Consumption Scenario

Other major indicators such as Gross fixed capital formation (GFCF), a measure of investments, gained strength during FY 2024 as it grew by 9% on a y-o-y basis against 7% yearly growth in the previous fiscal, while GFCF to GDP ratio measured an all-time high settled higher at 34%.



Sources: MOSPI



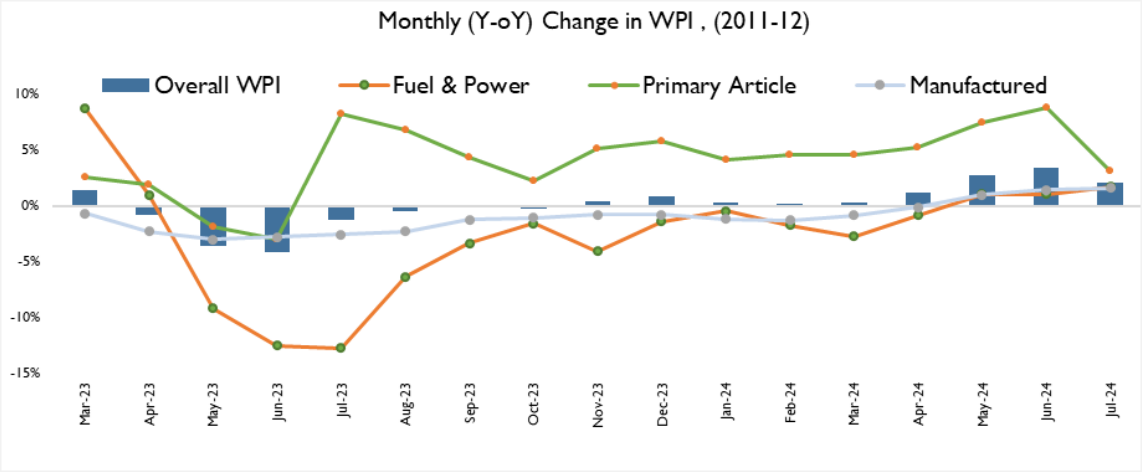
Sources: MOSPI

Private Final Expenditure (PFCE) a realistic proxy to gauge household spending, observed decelerated and registered 4% y-o-y growth in FY 2024 against 7% in FY 2023.

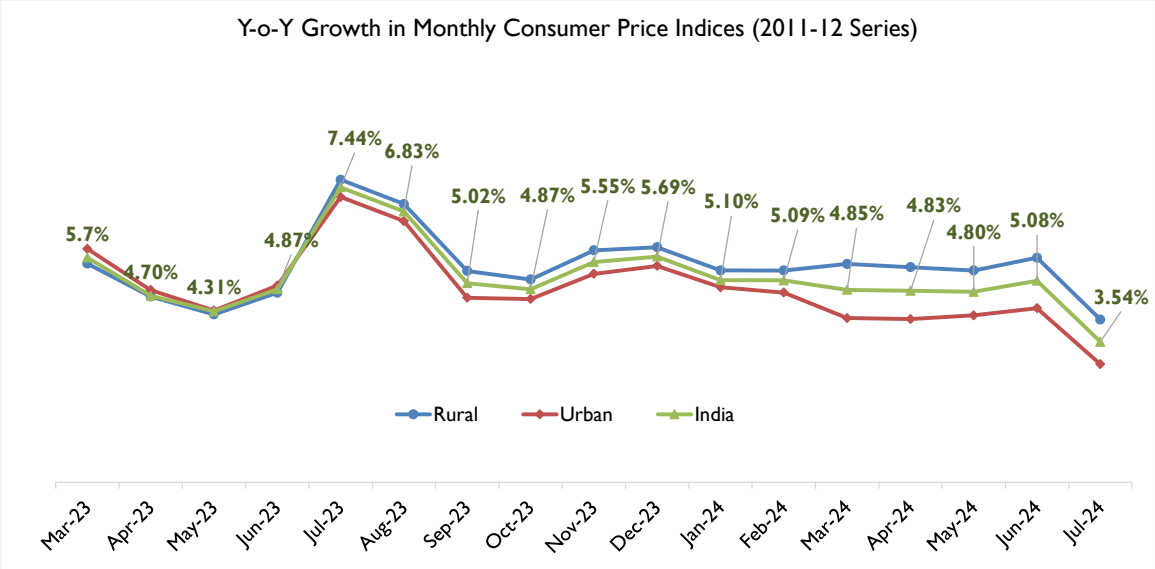
Inflation Scenario

The inflation rate based on India's Wholesale Price Index (WPI) exhibited significant fluctuations across different sectors from March 2023 to July 2024. Overall WPI saw a sharp decline to -1.2% in July 2023,

primarily driven by steep drops in Fuel & Power and Manufactured Products, reflecting reduced global demand and falling input costs. However, a recovery was noted by June 2024, with WPI reaching 3.4%, supported by a strong rise in Primary Articles and a rebound in Fuel & Power prices. By July 2024, while Primary Articles growth moderated to 3.1%, the WPI remained positive at 2.0%, indicating stabilization in the market after earlier volatility.



Source: MOSPI, Office of Economic Advisor.



Source: CMIE Economic Outlook

Retail inflation rate (as measured by the Consumer Price Index) in India showed notable fluctuations between March 2023 and July 2024. Rural CPI inflation peaked at 7.63% in July 2023, before declining to 4.10% in July 2024. Urban CPI inflation followed a similar trend, rising to 7.20% in July 2023 and then dropping to 2.98% in July 2024. Overall, the national CPI inflation rate increased to 7.44% in July 2023 but moderated to 3.54% by July 2024, indicating a gradual easing of inflationary pressures across both rural and urban areas over the period. CPI measured below 6% tolerance limit of the central bank since September

2023. As a part of an anti-inflationary measure, the RBI has hiked the repo rate by 250 bps since May 2022 to the current 6.5% while it has been holding the rate at 6.5% since 8 Feb 2023.

India's Growth Outlook

India's economy has exceeded expectations, registering an 8.2% growth in FY24. High-frequency indicators such as automobile sales, e-way bills, cargo traffic, and exports signal sustained growth momentum into Q2 FY25. However, the rural demand outlook is tied to the monsoon, where inconsistent rainfall could impact the agriculture sector and inflation. The government is proactively boosting grain storage capacity to mitigate these risks. On the credit front, the Reserve Bank of India (RBI) has kept the policy rate unchanged, with inflation expected to average around 5% in FY25. Despite stable policy rates, lending rates may rise due to the incomplete transmission of earlier hikes, while strong credit growth in the private sector suggests potential capacity expansion. Supply-side challenges persist, particularly in food storage infrastructure. The government has launched a massive initiative to enhance grain storage capacity by 70 million tonnes over the next five years. The recent long-term agreement for operating Iran's Chabahar Port is also set to bolster trade and supply chain resilience.

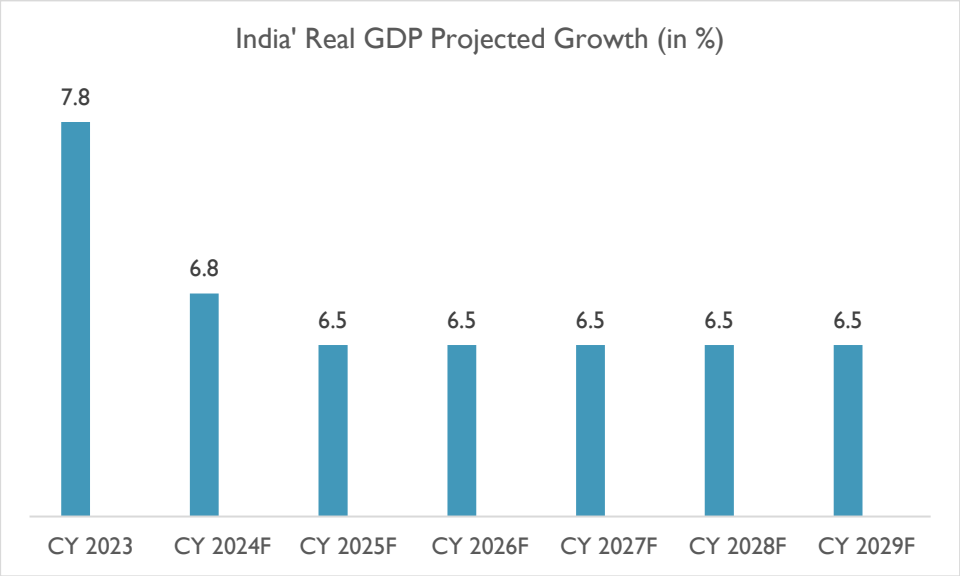
In terms of trade, India's recent agreements, particularly with the European Free Trade Association (EFTA) and Oman, are opening new markets and opportunities for exports. The proposed mega-distribution hub in the UAE by 2025 will further support India's global trade ambitions, particularly in Africa, Europe, and the US.

Politically, the continuation of the National Democratic Alliance (NDA) government signals sustained reforms, with optimism around labour and land reforms. The government is also taking steps to control retail inflation by managing food prices and import duties. The external environment remains cautious, with geopolitical tensions, particularly in Gaza, posing potential risks to global stability.

Overall, India's short-term growth outlook remains positive, underpinned by strong domestic demand, proactive government measures, and expanding global trade relationships, despite some challenges in the rural economy and supply chain infrastructure.

India's Projected Economic Growth

Looking ahead to 2024, India's projected GDP growth of 6.8% in 2024 stands out as the fastest among major emerging markets, significantly outpacing China's 4.6%, and Brazil's 2.2%. This robust growth trajectory is expected to sustain at 6.5% annually from 2025 to 2029, reflecting strong economic fundamentals and continued momentum.



Source: IMF

This decent growth momentum in near term (CY 2024) is accompanied by a slowdown in inflation, as well as various other factors in the medium to long term that will support the economy. These include enhancements in physical infrastructure, advancements in digital and payment technology, improvements in the ease of doing business and a higher quality of fiscal expenditure to foster sustained growth.

On the demand side, improving employment conditions and moderating inflation are expected to stimulate household consumption. Further, the investment cycle is gaining traction, propelled by sustained government capital expenditure, increased capacity utilization and rising credit flow. Additionally, there are positive signs of improvement in net external demand, as reflected in the narrowing merchandise trade deficit. Despite the supply disruptions, exports clocked positive y-o-y growth in December 2023 and January 2024.

From uplifting the underprivileged to energizing the nation's infrastructure development, the Government has outlined its vision to propel India's advancement and achieve a 'Viksit Bharat' by 2047 in the interim budget announced on 1st Feb 2024. Noteworthy positives in the budget include achieving a lower-than-targeted fiscal deficit for FY2024 and setting a lower-than expected fiscal deficit target for FY2025, proposing dedicated commodity corridors and port connectivity corridors, providing long-term financing at low or nil interest rates to the private sector to step up R&D (Research & Development) in the sunrise sectors.

Achieving a reduced fiscal deficit of 5.8% in FY2024 and projecting a lower than-anticipated fiscal deficit of 4.9% as announced in the interim budget in July 2024 for the current fiscal year (FY 2025) are positive credit outcomes for India. This showcases the country's capability to pursue a high-growth trajectory while adhering to the fiscal glide path. There has been a significant boost to capital expenditure for two consecutive years; capital expenditure – which is budgeted at 3.4% of GDP (INR 11.1 trillion/USD 134

billion) for fiscal year 2024-25 – is at a 21-year high (3.3% of GDP in fiscal year 2023-24. The enhancement of port connectivity, coupled with the establishment of dedicated commodity corridors (energy, mineral and cement), is poised to enhance manufacturing competitiveness. This strategic move aims to fulfil India's export targets and reduce logistics costs.

India's optimistic economic outlook is underpinned by its demographic dividend, which brings a substantial workforce that boosts labor participation and productivity. The burgeoning middle class and urbanization contribute to increased domestic consumption, driven by rising incomes and purchasing power. Extensive investments in infrastructure, encompassing roads, railways, ports, and digital connectivity, are enhancing productivity and efficiency, with government initiatives like the Smart Cities Mission and PM Gati Shakti creating a conducive growth environment. This digital transformation, catalyzed by initiatives such as Digital India, is fostering a tech-driven economy marked by enhanced internet penetration, digital payments, and e-governance, thereby fueling growth in sectors like fintech, e-commerce, and digital services. The push to position India as a global manufacturing hub through Make in India and PLI (Production Linked Incentive) schemes is further boosting industrial output, exports, and domestic production capabilities. Compared to other major emerging markets facing demographic and economic challenges, India's combination of demographic strengths, policy reforms, and strategic initiatives positions it as a standout performer and a significant driver of global economic growth in the foreseeable future.

Some of the key factors that would propel India's economic growth.

Strong Domestic Demand

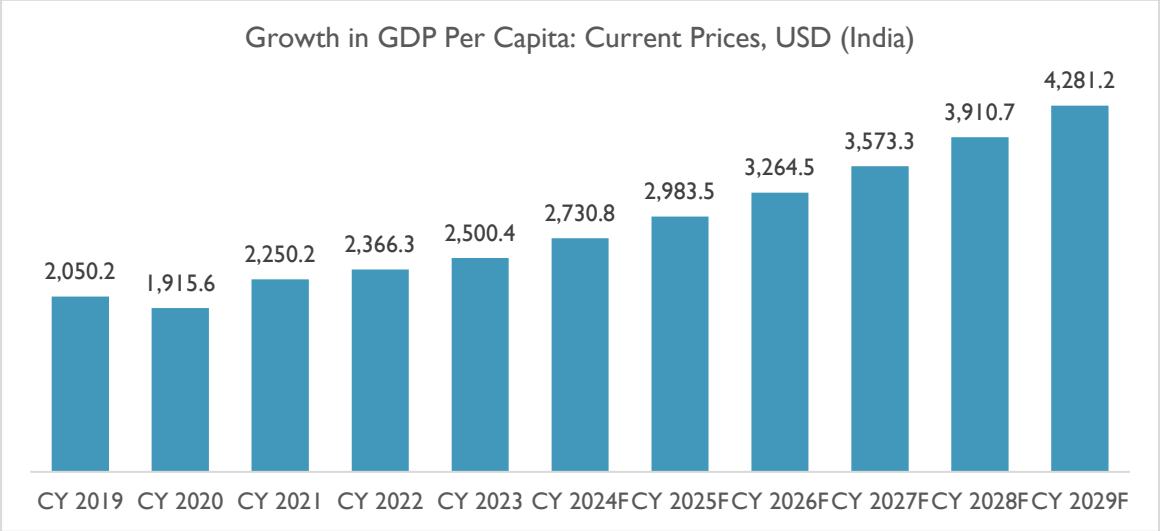
Domestic demand has traditionally been one of the strong drivers of Indian economy. After a brief lull caused by Covid-19 pandemic, the domestic demand is recovering. Consumer confidence surveys by Reserve Bank / other institutions points to an improvement in consumer confidence index, which is a precursor of improving demand. India has a strong middle-class segment which has been the major driver of domestic demand. Factors like fast paced urbanization and improving income scenario in rural markets are expected to accelerate domestic demand further. PFCE as a percentage of GDP increased to 58% during FY 2022 and FY 2023 while in FY 2024 it settled at 56%. There are two factors that are driving this domestic demand: One the large pool of consumers and second the improvement in purchasing power. As per National Statistics Office (NSO), India's per capita net national income (at constant prices) stood at INR 1.06 lakhs in FY 2024 against 99,404 in FY 2023 and 87,623 in FY 2018. This increase in per capita income has impacted the purchasing pattern as well as disposable spending pattern in the country. Consumer driven domestic demand is majorly fueled by this growth in per capita income.

India's Per capita GDP trends

India is poised to become the world's third-largest economy with a projected GDP of USD 5 trillion within the next three years, driven by ongoing reforms. As one of the fastest-growing major economies, India

currently holds the position of the fifth-largest economy globally, following the US, China, Japan, and Germany. By 2027-28, it is anticipated that India will surpass both Germany and Japan, reaching the third-largest spot. This growth is bolstered by a surge in foreign investments and a wave of new trade agreements with India's burgeoning market of 1.4 billion people. The aviation industry is witnessing unprecedented orders, global electronics manufacturers are expanding their production capabilities, and suppliers traditionally concentrated in southern China's manufacturing hubs are now shifting towards India.

To achieve its vision of becoming the world's third-largest economy by 2027-28, India will need to implement transformative industrial and governmental policies. These policies will be crucial for sustaining the consistent growth of the nation's per capita GDP over the long term.



Source: IMF

From CY 2024-29, India's per capita GDP is projected to grow at a compound annual growth rate of 9.4%. This growth will be driven by the service sector, which now accounts for over 50% of India's GDP, marking a significant shift from agriculture to services.

Digitization Reforms

Ongoing digitization reforms and the resultant efficiency gains accrued would be a key economic growth driver in India in the medium to long term. Development of digital platforms has helped in the seamless roll out of initiatives like UPI (Unified Payments Interface), Aadhaar based benefit transfer programs, and streamlining of GST (Goods and Services Tax) collections. All of these have contributed to improving the economic output in the country. Some of the key factors that have supported the digitization reforms include – the growth in internet penetration in India together with drop in data tariffs, growth in smartphone penetration, favorable demographic pattern (with higher percentage of tech savvy youth population) and India's strong IT (Information Technology) sector which was leveraged to put in place the digital ecosystem. All these factors are expected to remain supportive and continue to propel the digitization reforms in India.

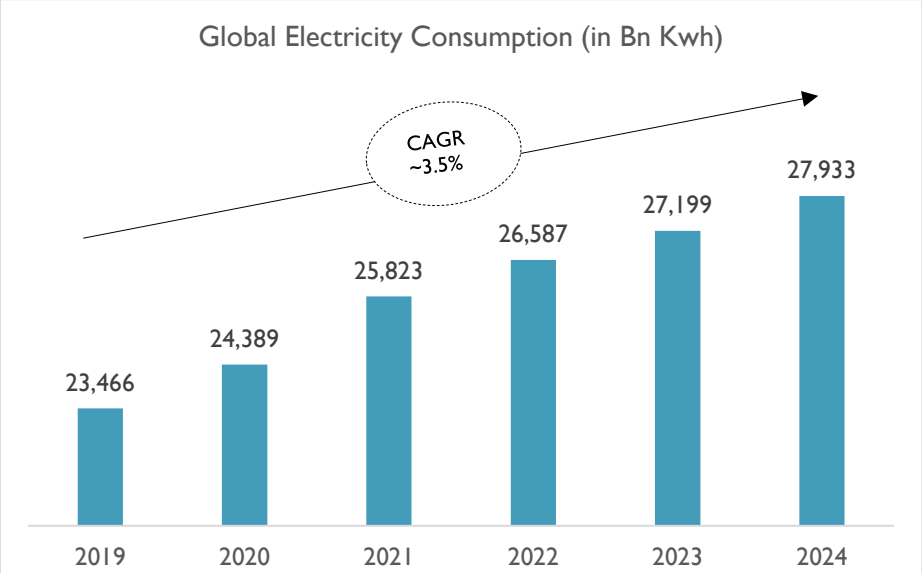
Increased adoption of digital technology and innovation, inclusive and sustainable practices, business-friendly and transparent regulations, and heightened corporate research and development (R&D) investments will further bolster the country's growth. These factors will collectively support employment growth across both private and public sectors, including micro, small, and medium enterprises (MSMEs).

Electricity Landscape

Per Capita Electricity Consumption

Global Electricity Consumption Landscape

Globally, electricity consumption per person varies widely across regions, with developed economies consuming significantly more than developing ones. The disparity reflects differences in economic development, industrialization, and access to energy. In developed economies such as the U.S. and Canada, high per capita electricity consumption is driven by energy-intensive lifestyles, industrial activities, and the increasing adoption of electric vehicles. Emerging economies like China have experienced a significant rise in consumption due to rapid industrialization, urbanization, and technological advancements. Meanwhile, several European countries, despite having high consumption levels, are prioritizing renewable energy sources and energy efficiency to minimize the environmental impact of their electricity usage.



Source: Energy Information Administration, D&B Desk Research

The global electricity consumption has shown consistent growth from 2019 to 2024. In 2019, total consumption stood at 23,466 billion kilowatt-hours (KWh), which increased to 24,389 billion KWh in 2020, reflecting a slight rise despite the global slowdown due to the pandemic. The recovery in 2021 is more pronounced, with consumption jumping to 25,823 billion KWh, driven by renewed economic activities and industrial demand. By 2022, the global electricity consumption further climbed to 26,587 billion KWh, indicating steady growth at a Compound Annual Growth Rate (CAGR) of approximately 3.5% over the period. This upward trend is expected to continue, with consumption forecasted to reach 27,199 billion KWh in 2023 and 27,933 billion KWh by 2024.

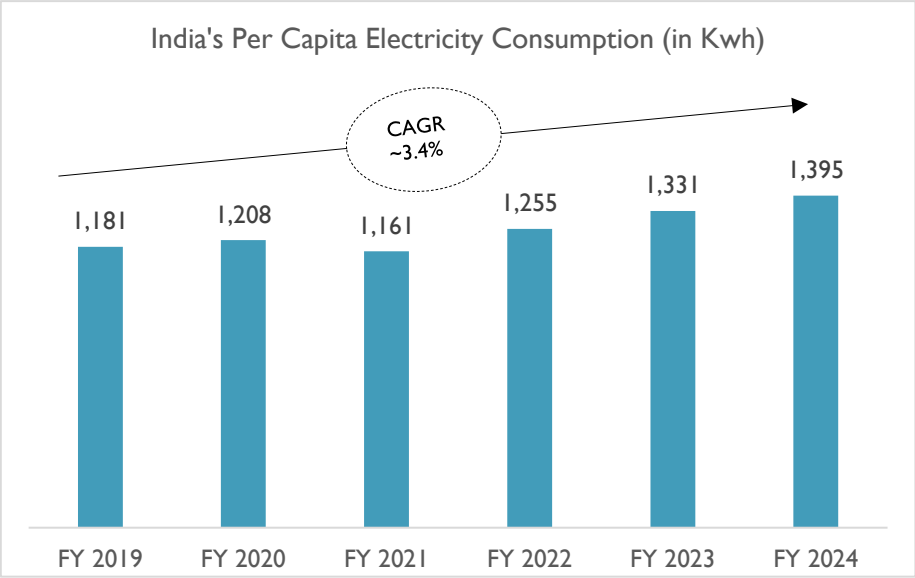
This growth is primarily attributed to rising energy demand from both developed and emerging economies, increased electrification, and industrial expansion. Moreover, the increasing integration of electric vehicles,

technological advancements, and growing urbanization contribute significantly to the surge in electricity consumption. However, this steady rise also underscores the need for greater adoption of renewable energy sources and energy-efficient technologies to ensure sustainable energy usage globally.

India's Per Capita Electricity Consumption

India's per capita electricity consumption has been steadily increasing over the years, reflecting its rapid industrialization, urbanization, and efforts to electrify rural areas. Despite this growth, India's consumption remains lower than the global average, reflecting the vast population and ongoing energy access challenges.

Electricity consumption growth in India includes extensive rural electrification efforts through initiatives such as Saubhagya and the Deen Dayal Upadhyaya Gram Jyoti Yojana, which have provided electricity access to millions of rural households. Additionally, the expansion of industries, particularly in manufacturing, cement, steel, and textiles, has significantly fuelled industrial demand. The rapid pace of urbanization, along with increasing appliance ownership and evolving consumption patterns, has further driven higher electricity usage in residential sectors. Despite these advancements, India's per capita electricity consumption remains considerably lower than that of many developed nations, largely due to its vast population and diverse socio-economic conditions.



Source: Central Electricity Authority

India has demonstrated a notable upward trend in per capita electricity consumption over recent fiscal years, reflecting a broader expansion in energy use among its population. The per capita consumption, measured in kilowatt-hours kWh, exhibited a consistent increase from FY 2019 to FY 2024, with an overall CAGR of 3.4%. This growth trajectory signifies an ongoing rise in electricity demand, likely driven by economic development, increased industrial activity, and improving access to electricity across various regions.

In FY 2019, the per capita consumption stood at 1,181 kWh. This figure saw a modest increase to 1,208 kWh in FY 2020. Despite a slight dip to 1,161 kWh in FY 2021, the consumption rebounded to 1,255 kWh in FY

2022. This upward trend continued into FY 2023, with per capita consumption reaching 1,331 kWh. The latest data for FY 2024 indicates a further rise to 1,395 kWh.

This steady increase in per capita consumption underscores India's expanding energy needs. The CAGR of 3.4% suggests a sustained growth in electricity consumption, which can be attributed to several factors. These include a growing population, urbanization, industrialization, and improvements in living standards. The rise in consumption also reflects the ongoing efforts to enhance electricity access and infrastructure across the country.

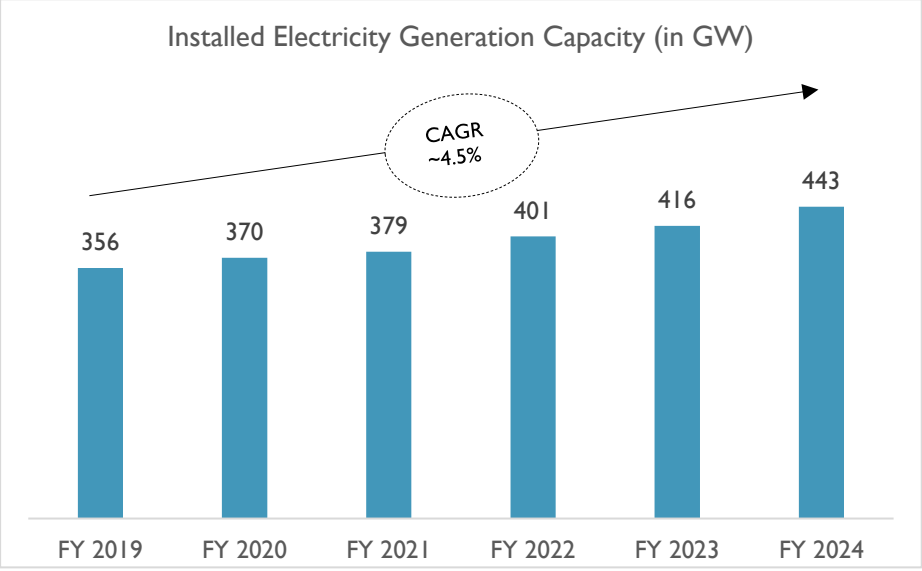
Installed Capacity and Generating Capacity

Electricity demand in India has grown exponentially on the back of rapid urbanization, and large-scale industrialization. The two factors have increased the pool of consumers, as well as increased the per head unit consumption. This developing demand landscape have led to a rapid scale up in generation sector – with capacity addition happening across thermal, hydroelectric, nuclear, and renewable energy.

Installed Capacity

India's power sector is characterized by a diverse mix of energy sources, with a significant reliance on thermal power and a growing emphasis on renewable energy sources (RES). The installed capacity of the country, is 442.83 gigawatts (GW), reflects a substantial investment in various power generation technologies. Among these, Thermal constitutes the largest share, accounting for ~54% of the total installed capacity. This dominance underscores the continued reliance on fossil fuels, such as coal and natural gas, to meet the country's substantial electricity demand.

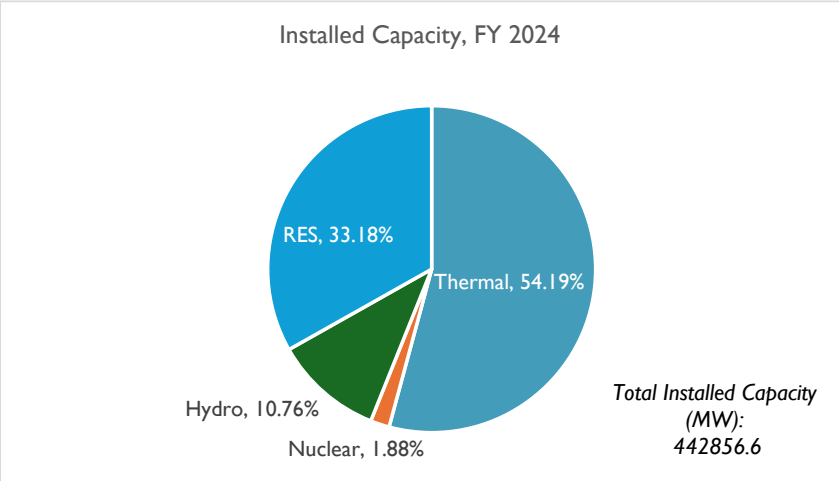
India's installed electricity generation capacity grew steadily from 356 GW in FY 2019 to 443 GW in FY 2024, reflecting a Compound Annual Growth Rate (CAGR) of 4.5%. This consistent increase highlights the country's efforts to expand its energy infrastructure to meet rising demand. Notable annual growth occurred between FY 2022 and FY 2024, with the capacity reaching 416 GW in FY 2023 and 443 GW in FY 2024. The growth is driven by investments in both conventional and renewable energy, supporting India's energy security and diversification goals.



Source: Central Electricity Authority, Ministry of Power

Renewable energy sources, including solar, wind, and biomass, represent ~33% of the installed capacity, highlighting India's commitment to expanding its clean energy infrastructure. Hydro power contributes ~11% to the installed capacity, while nuclear power plays a minor role, constituting only ~2%. This distribution

indicates a strong foundation in conventional energy sources, with a significant and growing segment devoted to renewables.

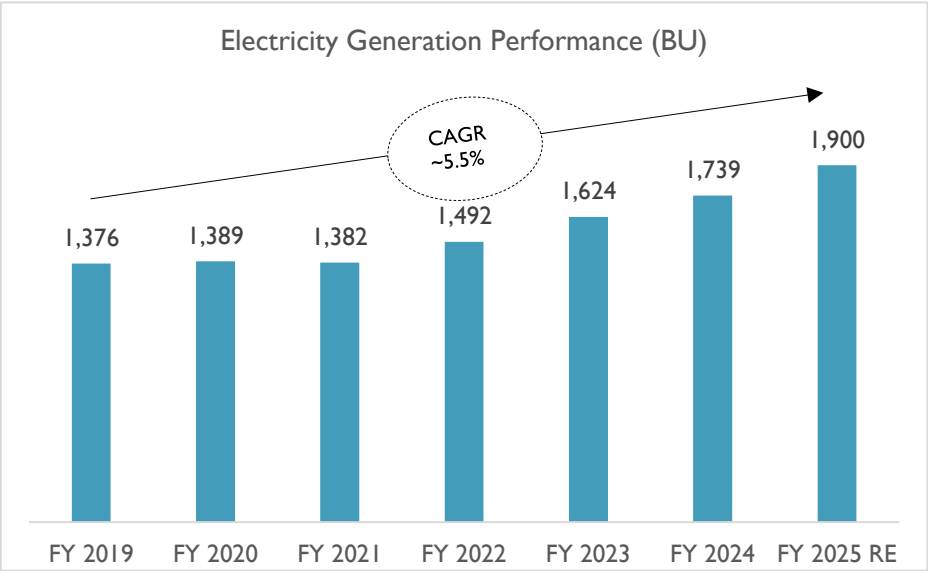


Source: Central Electricity Authority

India's power sector is evolving, with a growing emphasis on renewable energy sources and a continued reliance on thermal power. The shift towards greater renewable energy generation reflects the country's commitment to sustainable development while addressing the challenges of balancing energy demand with environmental goals.

Generation Capacity

India's electricity generation performance has demonstrated a steady and growth trend over recent fiscal years, reflecting an expanding capacity and increasing demand for electricity. The generation performance, measured in billion units (BU), shows a clear upward trajectory from FY 2019 to FY 2024, with an overall Compound Annual Growth Rate (CAGR) of 5.5%. In FY 2019, the total electricity generation was 1,376 BU. This figure experienced a modest increase to 1,389 BU in FY 2020 and then slightly rose to 1,382 BU in FY 2021. A more significant rise was observed in FY 2022, where generation reached 1,492 BU. The growth continued into FY 2023, with generation reaching 1,624 BU, and the latest data for FY 2024 shows a further increase to 1,739 BU.



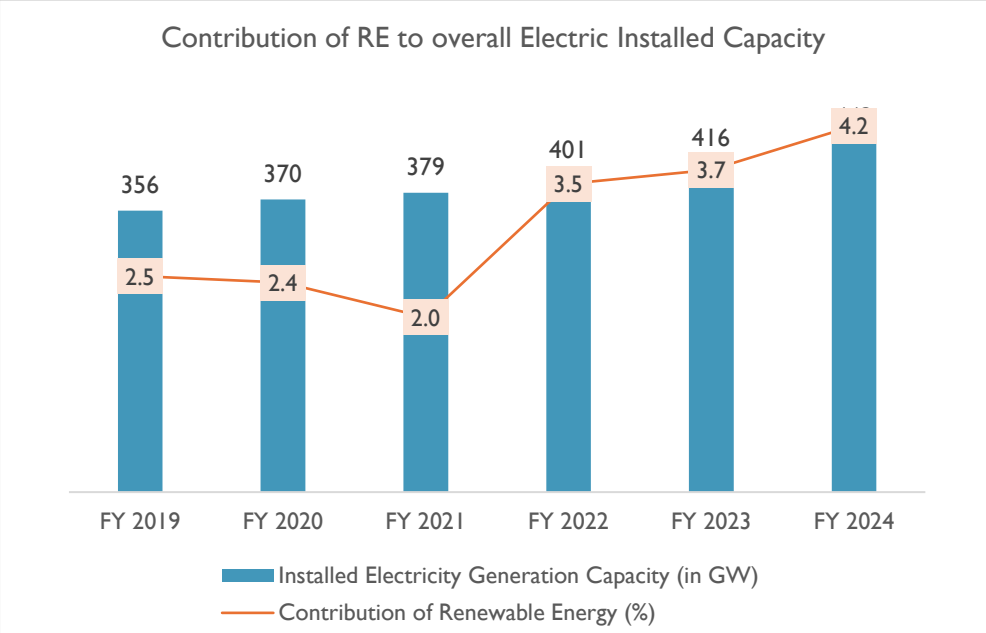
Source: Ministry of Power

The projected generation for FY 2025 is estimated to be 1,900 BU, indicating a continued upward trend. This projection suggests a sustained growth in electricity generation, driven by increasing energy needs and expanding generation capacities. The CAGR of 5.5% highlights a robust and consistent growth rate in electricity generation. This growth can be attributed to various factors, including improvements in power generation infrastructure, higher utilization of existing capacity, and the addition of new generation projects. It also reflects the country's ongoing efforts to meet the rising electricity demand driven by population growth, urbanization, and economic development.

The steady increase in electricity generation performance underscores the effectiveness of India's energy policies and investment in the power sector. As the generation figures rise, they also indicate a positive impact on the country's energy security and economic development. Continued investments in both conventional and renewable energy sources are likely to support this growth trend and further enhance the electricity generation capacity. The electricity generation performance reveals a strong and positive trend, reflecting India's expanding power sector and its ability to meet growing electricity demand. The consistent growth in generation capacity is indicative of a well-functioning energy sector poised to support the country's future development needs.

Contribution of RE to Overall Installed Capacity

India's installed electricity generation capacity has shown steady growth from 356 GW in FY 2019 to 443 GW in FY 2024, reflecting a sustained expansion in the country's power infrastructure. This increase is driven by the growing energy demands of a rapidly industrializing and urbanizing nation. The rise in capacity has been supported by significant investments in both conventional and renewable energy sectors, with efforts to enhance grid infrastructure and improve energy security. The jump from 401 GW in FY 2022 to 443 GW in FY 2024 indicates an accelerated pace of installation, in line with India's commitment to meeting its growing power requirements.

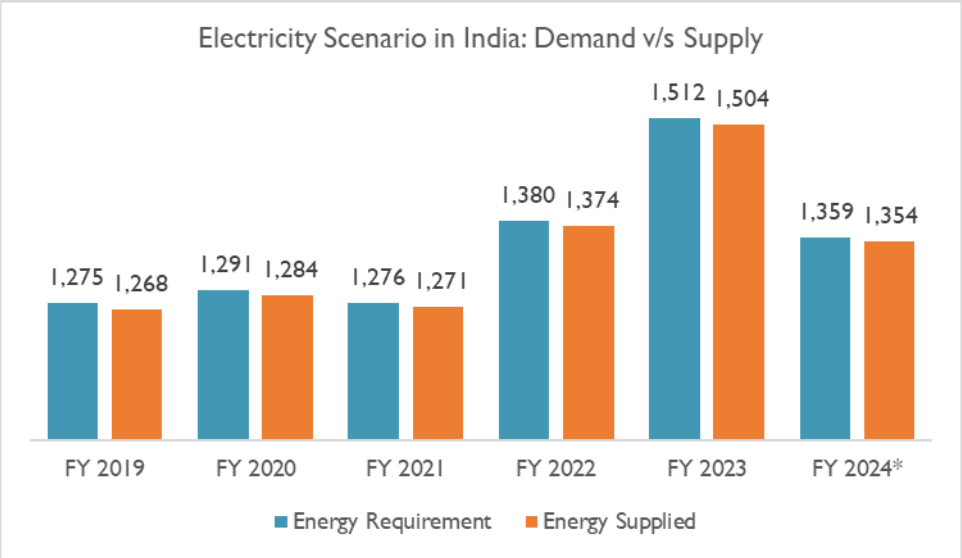


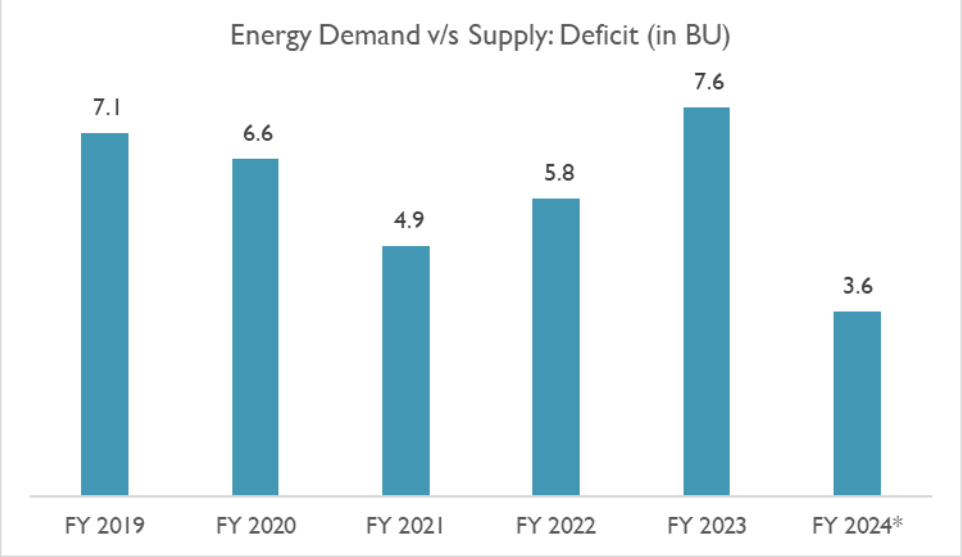
Source: MNRE and CEA, D&B analysis.

Simultaneously, the contribution of renewable energy to the total electricity generation has also risen, although at a varied rate. Despite a dip in FY 2021 to 2.0%, the renewable energy share rebounded strongly, reaching 4.2% in FY 2024. The increasing share of renewables, especially over the last few fiscal years, is indicative of the country's enhanced focus on clean energy sources as part of its climate commitments. The increase from 3.5% in FY 2022 to 4.2% in FY 2024 underscores the significant role renewable energy is beginning to play in India's overall energy mix, as the nation aims to reduce its dependence on fossil fuels and promote sustainable development.

Electricity Demand

India has been experiencing one of the highest rates of growth in energy demand, globally. Rapid industrialization and urbanization have created strong demand. Annual demand reached approximately 1,512 billion units (BU) in FY 2023, and further to 1,359 BU in FY 2024 (as of January 2024), increasing by a CAGR of nearly 3.5% between FY 2019 and 2023. As against this demand, the total electricity generated in the country (from all sources) reached approximately 1,504 BU, creating a energy deficit of nearly 7.6 BU.



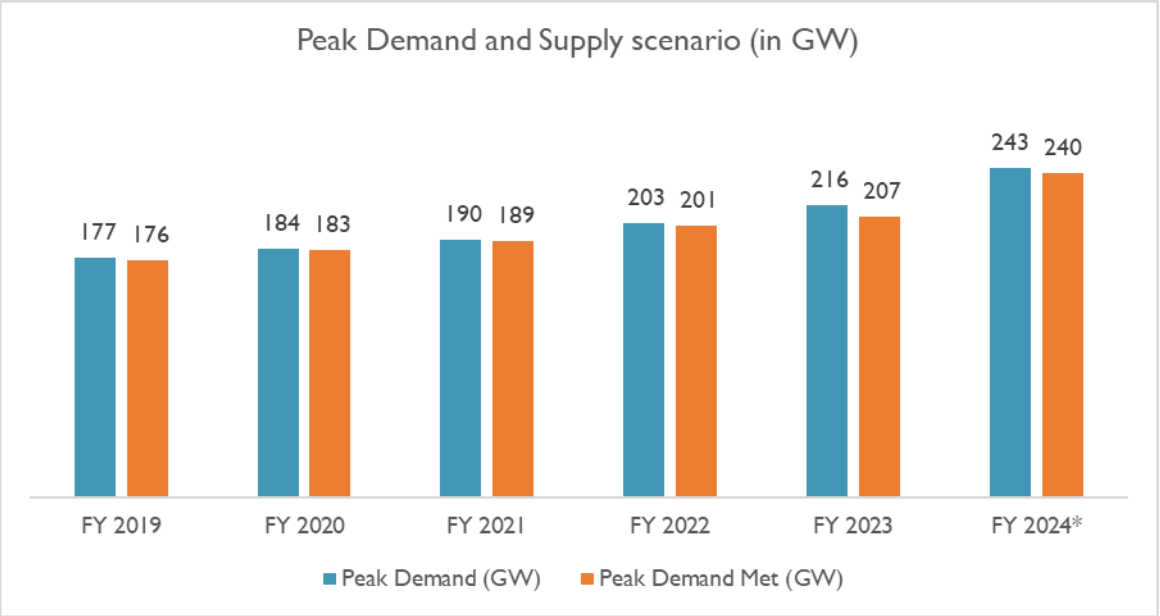


Source: Central Electricity Authority, Ministry of Power

*Provisional as of January 2024

The peak demand in FY 2023 reached 216 GW, a 6.3% y-o-y rise over FY 2022. In comparison, Peak supply was only 207 GW. The deficit in the supply has been on a rise since FY 2021. As of FY 2023, the deficit in supply reached 8.7 GW, as compared to 0.8 GW in FY 2021. During the 5-year period between FY 2019 – FY 2023, the peak demand in the country increased at a CAGR of 5.6%.

As of January 2024 (FY 2024), the peak demand reached 243 GW, while supply was 240 GW. During this period (April 2023 – January 2024), the supply deficit remained on the lower end, standing at 3.3 GW.



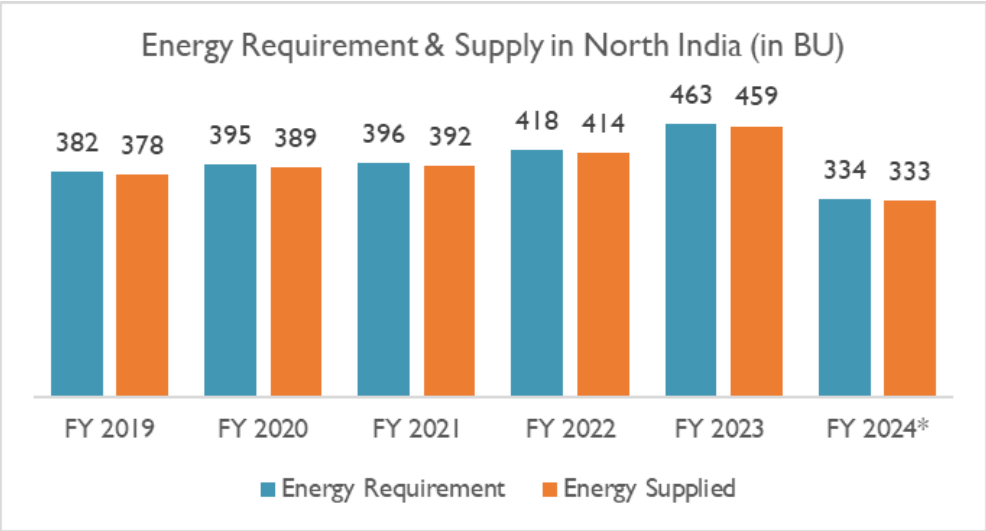
Source: Central Electricity Authority, Ministry of Power

*Provisional as of January 2024

Scenario in North India

As one of the most populous regions in the country, North India encompasses states such as Uttar Pradesh, Rajasthan, Punjab, Haryana, and Delhi, among others. Due to the dense population, rapid urbanization, and industrial growth observed in the Northern region, the energy requirement is substantial. The energy demand in this region is primarily driven by residential, commercial, and industrial sectors. To meet this growing energy requirement, the region relies on a mix of thermal power plants, hydroelectric projects, renewable energy installations, and power imports.

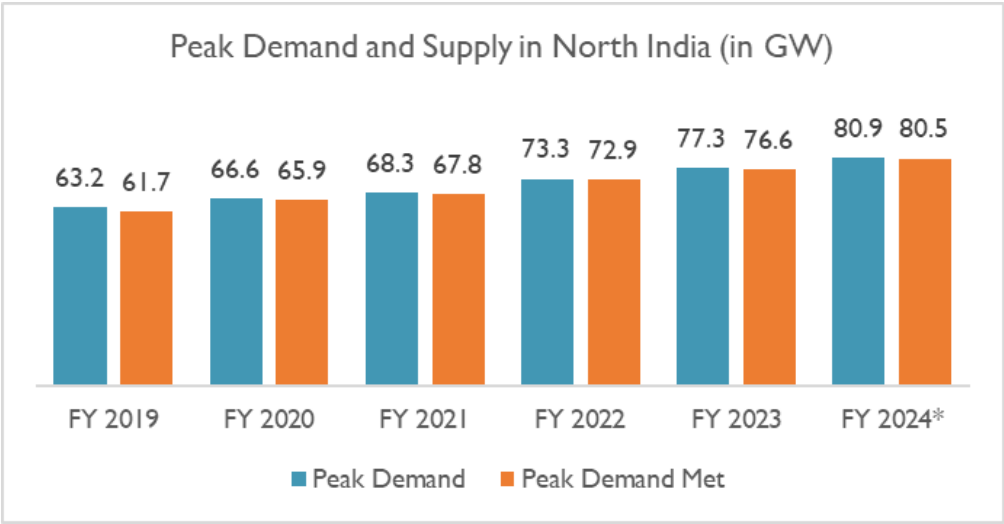
Energy requirement in North India reached approximately 334 BU in FY 2024 (until November 2023) while energy supplied stood at 333 BU, creating a deficit of nearly 1 BU. In FY 2024 (until November 2023), both energy requirement and energy supply in North India accounted for nearly 30% of pan India energy requirement. Between the period FY 2019 and 2023, the energy requirement in the region has increased by a CAGR of nearly 4.9%, while supply has grown at the same rate (CAGR of 5%) to keep track with demand. However, the energy deficit in the region has been increasing the for the past couple of months, increasing from 3.8 BU in FY 2021 to nearly 4.4 BU in FY 2023. In this regard, FY 2024, until November 2023, has performed significantly better, with this period recording a deficit of only 1 billion unit.



Source: Central Electricity Authority, Ministry of Power

*Provisional until Nov 2023

The peak power demand in North India region reached 80.9 BU in FY 2024, while supply was nearly 80.5 BU thereby creating a peak deficit of nearly 0.4 BU. The peak power deficit in the region was the highest in FY 2023 over the past four years. This points to a mismatch in demand and supply scenario.



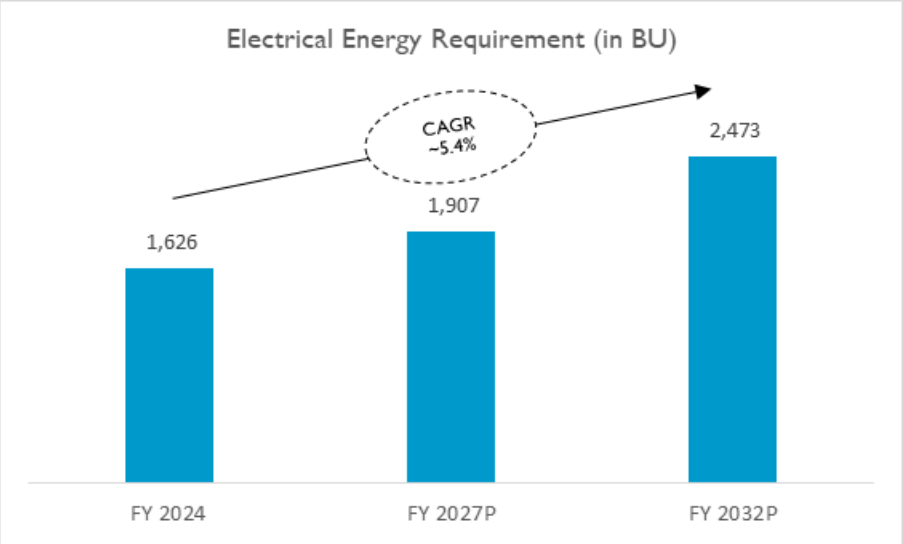
Source: Central Electricity Authority, Ministry of Power

*Provisional until Nov 2023

Growth Forecast

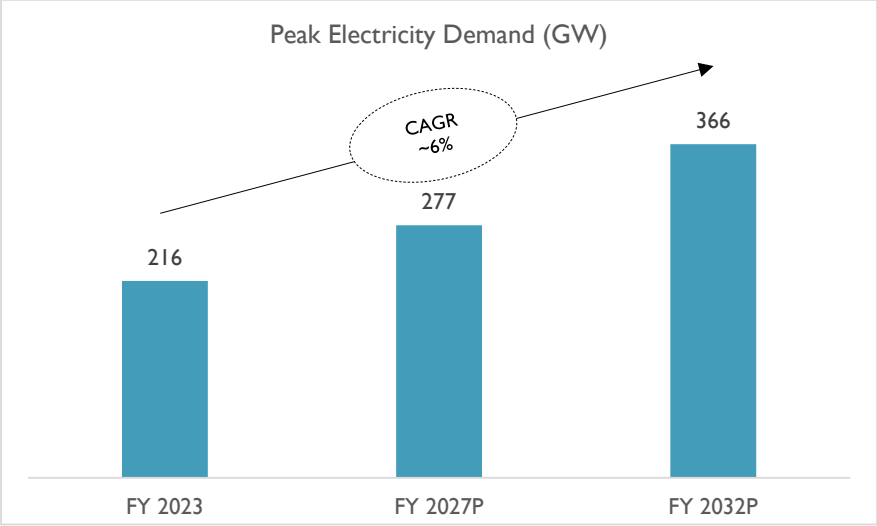
Growth in Electricity Demand

India has been experiencing a significant and steady increase in the demand for power and electricity, driven by its rapidly growing population, urbanization, and industrialization. With these factors in play, the projected electrical energy requirements are expected to surge at a CAGR of ~5.4% from FY 2024 to FY 2032, Increasing from 1,626 billion units (BU) in FY 2023 to 1,907 BU in FY 2027 and further to 2,473 BU in FY 2032. This surge in demand reflects the nation's increasing reliance on electricity for various sectors such as residential, commercial, and industrial.



Sources: CEA, (Electric Power Survey, 2022)

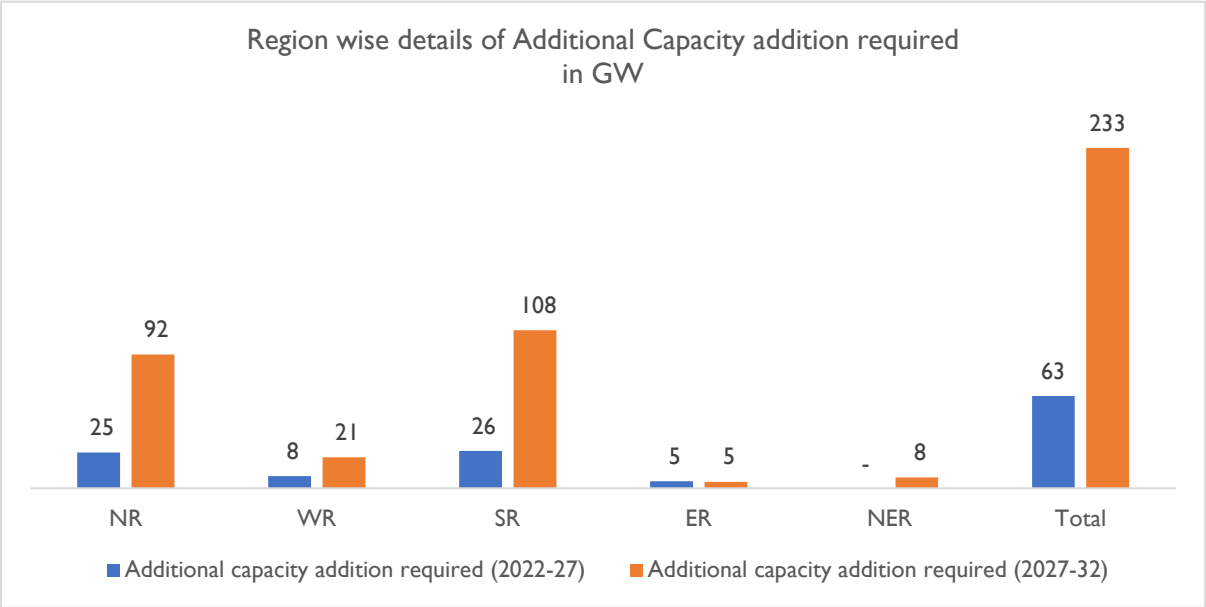
Furthermore, the peak electricity demand is estimated to rise from 216 GW in FY 2023 to 277 GW in FY 2027 and further to 366 GW in FY 2032, growing at a CAGR of ~6% from FY 2023 to FY 2032.



Sources: CEA, (Electric Power Survey, 2022)

These projections highlight the need for robust infrastructure development, energy conservation measures, and sustainable energy sources to meet the escalating power requirements while ensuring uninterrupted and reliable access to electricity for all segments of society.

To add to it, apart from capacity already under-construction, it is estimated that a total of 63 GW of additional capacity will be required between FY 2022 and 2027 while nearly 233 GW of additional capacity would be required between FY 2027 – 32, if the expected demand growth is to be met.

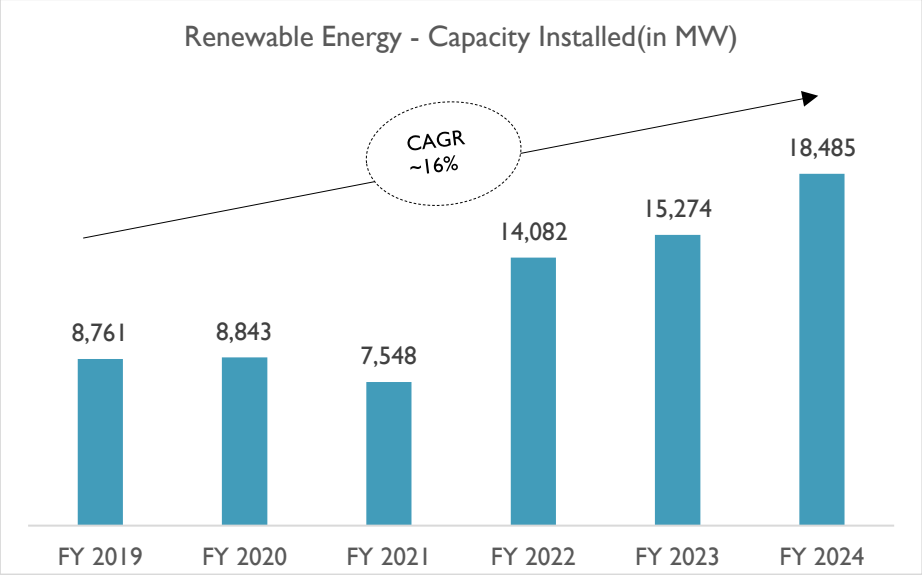


Source: National Electricity Plan 2022

Renewable Energy

Installed Capacity in India

India has made remarkable progress in expanding its renewable energy installed capacity, reflecting a strong commitment to sustainability and a greener energy future. Over recent years, the country has focused on harnessing renewable resources such as solar, wind, and biomass, leading to a significant transformation in its energy landscape. The installed capacity for renewable energy in India has demonstrated impressive growth. From FY 2019 to FY 2024, the installed capacity has increased substantially, growing from 8,761 megawatts (MW) to 18,485 MW. This represents a robust Compound Annual Growth Rate (CAGR) of 16.1%. The data highlights a notable expansion in renewable energy infrastructure, driven by substantial investments and supportive policies.



Source: Ministry of New and Renewable Energy

Note: Renewable Energy Capacity does not include Large Hydro Power

In FY 2019, the installed capacity stood at 8,761 MW. This figure saw a slight increase to 8,843 MW in FY 2020. However, FY 2021 experienced a decline to 7,548 MW, which was likely due to various challenges faced by the sector. Despite this dip, the capacity surged to 14,082 MW in FY 2022, and further grew to 15,274 MW in FY 2023. The latest data for FY 2024 shows a significant rise to 18,485 MW, underscoring the sector's strong recovery and continued growth.

This growth trajectory is a testament to the effectiveness of India's renewable energy policies and the country's commitment to reducing reliance on fossil fuels. Solar power has seen dramatic increases, driven by ambitious targets and investments. Wind power also plays a crucial role, with several large-scale projects enhancing the country's renewable capacity. Additionally, the expansion of biomass energy and other renewable resources further supports this growth. The substantial increase in installed renewable energy

capacity brings multiple benefits, including enhanced energy security, job creation, and a reduction in greenhouse gas emissions. It also supports rural development and improves electricity access in remote areas, contributing to overall sustainable development.

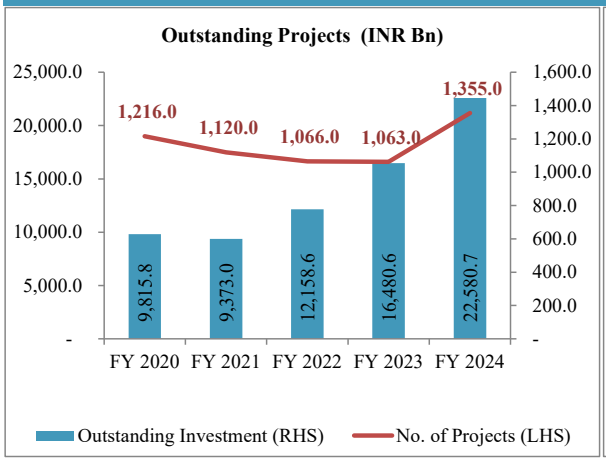
Looking ahead, India is well-positioned to continue this growth trend in renewable energy capacity. Advancements in technology, coupled with ongoing investment and supportive policies, are expected to further accelerate the sector's expansion. This momentum solidifies India's role as a global leader in the transition to a sustainable energy future and reinforces its commitment to addressing climate change challenges. The growth in renewable energy installed capacity in India is a significant achievement, reflecting the country's dedication to clean energy and its proactive approach to building a sustainable and resilient energy system for the future.

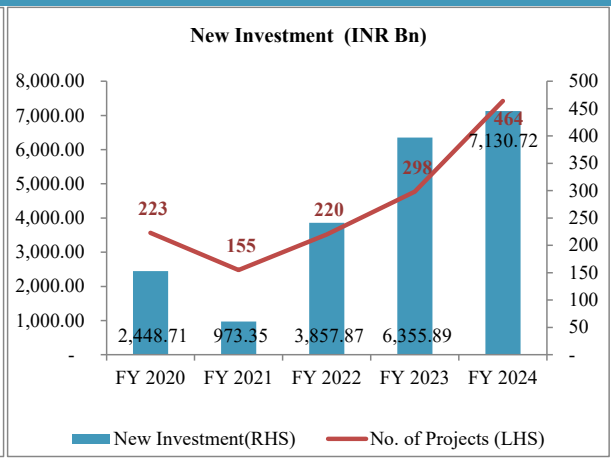
Capital Expenditure Capex on Renewable Electricity in India

India's investment landscape in renewable electricity has demonstrated a robust and dynamic growth trajectory over the past five years. The planned capital expenditure (Capex) for renewable electricity projects reflects a strong commitment to expanding and advancing the country's renewable energy infrastructure. From FY 2020 to FY 2024, the total value of outstanding renewable energy projects is projected to escalate from INR 9,815.8 billion to INR 22,580.7 billion. This represents an impressive 130% growth, highlighting a significant surge in investment that underscores India's dedication to transitioning towards cleaner energy sources.

New investments in the renewable sector have experienced a remarkable upswing, further emphasizing the accelerating pace of development. Starting from INR 2,448.71 billion in FY 2020, new investments are expected to climb to INR 7,130.72 billion by FY 2024, marking an extraordinary 191% increase over the period. This dramatic rise in new investments not only signifies a growing confidence in the renewable energy sector but also points to an accelerated adoption of renewable technologies.

Investment Trend in Renewable electricity





Source: CMIE, D&B Research

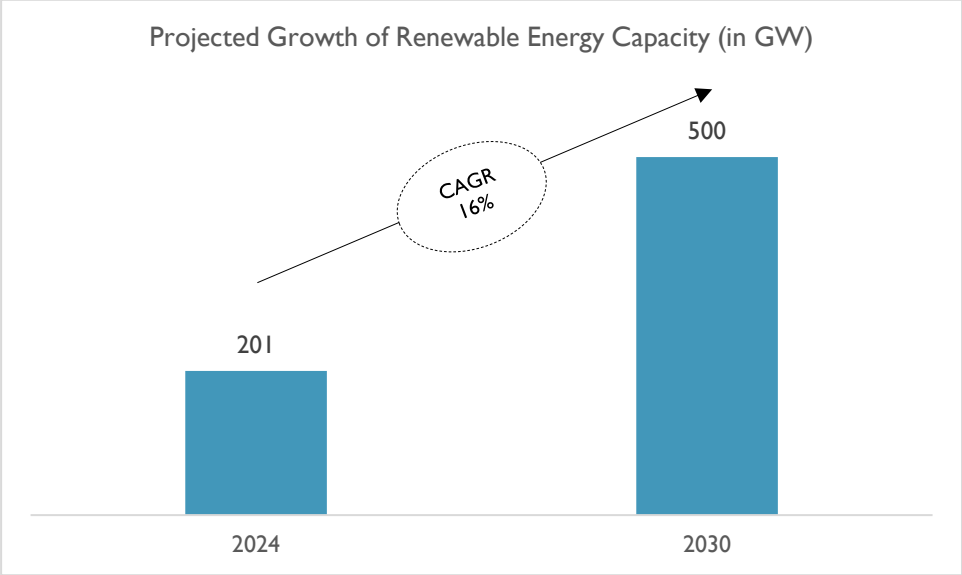
The number of renewable electricity projects also reflects this upward momentum. Outstanding projects are anticipated to increase from 1,216 in FY 2020 to 1,355 in FY 2024. New investments will see a substantial rise in project count from 223 in FY 2020 to 464 in FY 2024. This expansion in the number of projects indicates a broadening scope and scale of activities within the renewable energy sector. Year-on-year growth trends from FY 2022 onwards highlight a steady and positive trajectory for both outstanding and new investments. This consistent growth suggests that the sector has navigated initial hurdles and is now on a solid path of progression.

The substantial increase in planned Capex is indicative of India's strategic push towards a sustainable energy future. This trend is likely to spur technological advancements, generate employment opportunities, and contribute significantly to the country's sustainable development goals. While challenges such as project

execution, grid integration, and financing may arise, the positive investment trend also opens avenues for innovation, improved energy security, and potential leadership in the global renewable energy market. The planned Capex on renewable electricity in India presents a very promising outlook. The significant growth in both the value and number of projects reflects a determined effort to foster a greener energy future and positions India as a key player in the global renewable energy landscape.

Growth Forecast

India has crossed a major milestone in its renewable energy journey, with the country's total renewable energy capacity surpassing 200 GW as of October 10, 2024, according to the Central Electricity Authority (CEA). Renewable energy now accounts for 46.3% of India's total installed electricity generation capacity, which has reached 452.69 GW. Solar energy leads with 90.76 GW, followed by wind power at 47.36 GW, and hydro at 51.99 GW, including both large and small hydro projects. States such as Rajasthan, Gujarat, Tamil Nadu, and Karnataka are at the forefront of this push, contributing significantly to the country's renewable portfolio.



Source: Central Electricity Authority

Note: Renewable Energy Capacity include Large Hydro: 46.92 GW

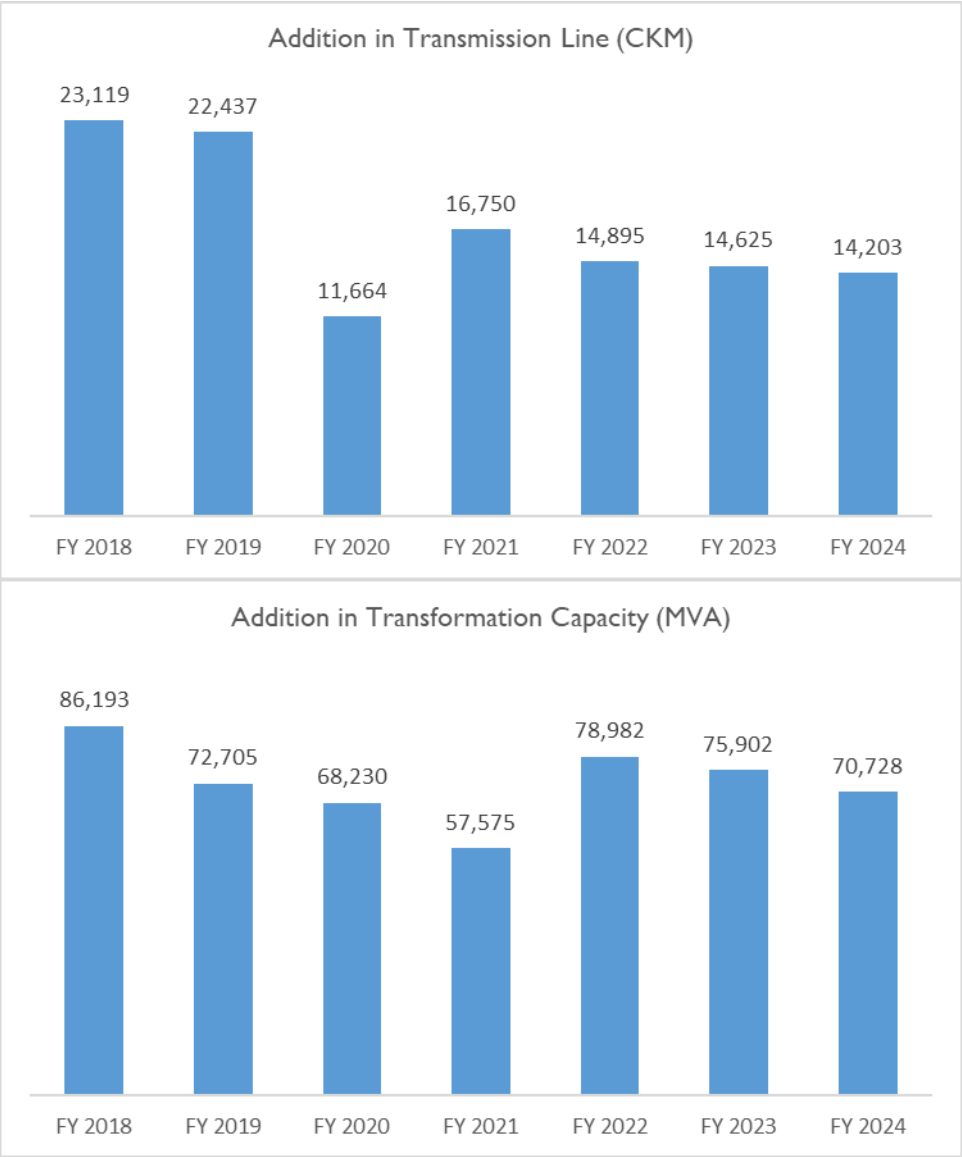
This achievement reflects India's strong commitment to clean energy, driven by key government initiatives such as the National Green Hydrogen Mission, PM-KUSUM, and the PLI Scheme for Solar PV Modules. The government has set an ambitious target of achieving 500 GW of non-fossil fuel-based electric capacity by 2030, supported by a renewable energy bidding trajectory of 50 GW per year and 100% FDI allowance. Other efforts include waivers on inter-state transmission charges for solar and wind projects and the establishment of offshore wind projects along the Gujarat and Tamil Nadu coasts, ensuring that India remains on course to further its green energy transition.

Electricity Transmission & Distribution Infrastructure in India

The power transmission and distribution infrastructure of India is a critical component of the country's electricity sector. The transmission infrastructure consists of high-voltage transmission lines and substations that transmit electricity over long distances from power plants to various regional grids. India has a vast network of transmission lines, including Extra High Voltage (EHV) and Ultra High Voltage (UHV) lines, which facilitate the bulk transfer of electricity.

With high energy requirement and last-mile electrification goals, India has made significant strides in expanding and modernizing its transmission and distribution networks over the years. In FY 2024 (January 2024), India added 9,985 circuit kilometres (ckm) of transmission line and increased its transformation capacity by 44,908 MVA. Over a period of last 5 years (FY 2019 – FY 2023), India has annually added an average of 16,074 ckm in transmission line, and 70,679 MVA in transformation capacity.

This aggressive capacity addition has helped India become one of the largest synchronous electricity grids in the world with a cumulative transmission line infrastructure of nearly 481,326 ckm and a transmission capacity of nearly 1,225,260 MVA.



Source: Central Electricity Authority, Ministry of Power

The addition of transmission lines (CKM) and transformation capacity (MVA) from FY 2018 to FY 2024, highlighting the correlation between infrastructure expansion and electricity transformation capacity. For instance, in FY 2018, an addition of 23,119 CKMs supported a transformation capacity of 86,193 MVA, whereas in FY 2024, 14,203 CKMs corresponded to a capacity of 70,728 MVA. The ratio of transmission line additions to transformation capacity across the years reveals that, on average, approximately 1 CKM supports around 3.6 MVA. This relationship provides a basis for understanding the capacity needs relative to transmission infrastructure growth.

To meet twice the transformation demand based on the current levels in FY 2024, which stands at 70,728 MVA, the system would need to support approximately 141,456 MVA. Using the average ratio of CKMs to MVA, this would require an addition of 14,203 CKMs of transmission lines to adequately cater to the doubled capacity requirement. Thus, to support a doubled transformation capacity demand of 141,456 MVA, 28,392 CKMs of transmission lines would be required.

Energy Demand vs. Transmission: Analysing the Disparity

Despite a significant increase in energy demand over the past few years and projections for continued growth, the power transmission and transformer industry has not experienced corresponding growth in transmission line additions and production. This discrepancy can be attributed to several factors. First, while energy consumption has surged, the rate of new transmission line construction has stagnated. For instance, in FY 2023-24, only 14,203 circuit kilometres (ckm) of transmission lines were added, reflecting a slowdown compared to previous years. Various challenges have impeded the timely execution of transmission projects, including land acquisition issues, regulatory hurdles, and implementation delays, which have caused significant postponements in project completions. Furthermore, the government's emphasis on integrating renewable energy sources into the grid has created a pressing need for an expanded transmission network. However, the development of this infrastructure has not kept pace with the growing renewable capacity, expected to reach 500 GW by 2030. Current planning indicates a vision for a more robust transmission system by 2032, aiming for 648,000 ckm of lines, yet existing investments and expansions have yet to translate into immediate growth in the sector. Additionally, market dynamics, such as a current focus on thermal capacity to meet base load requirements, may shift attention away from necessary investments in transmission infrastructure. Thus, while energy demand continues to rise, the power transmission and transformer industry faces significant barriers that hinder its growth, illustrating a disconnect between demand and actual capacity expansion.

Growth Forecast

Transmission & Distribution Scenario

Based on the projected increase in electrical energy requirements and peak electricity demand in India, there is a clear need for substantial growth in power transmission and distribution infrastructure. To meet the rising demand, significant investments and advancements in the power sector are being made. It is expected that the transmission and distribution infrastructure will experience a substantial expansion to accommodate the growing electricity requirements.

To support the projected energy demand of 1,907 billion units (BU) in FY 2027 and 2,472 BU in FY 2032 and the expected increase in peak electricity demand from 216 gigawatts (GW) in FY 2023 to 277 GW in FY 2027 and 366 GW in FY 2032, the power transmission and distribution network will need to be strengthened and expanded with significant augmentation of the distribution infrastructure. This will involve the construction of new transmission lines, substations, and transformers, as well as upgrades to existing distribution networks to enhance the capacity and efficiency of the grid. Additionally, the deployment of advanced technologies such as smart grids and grid automation will be necessary to ensure optimal power flow and monitoring.

Furthermore, the expected increase in additional capacity requirement will also require a transformation in the power transmission and distribution network with the installation of new transformers, distribution lines, and metering systems to handle the higher loads and ensure reliable power supply to consumers. Thus, growth in power transmission and distribution infrastructure in India is essential to meet the steadily increasing demand for electricity. The expansion of these networks will enable the efficient and reliable supply of power, supporting the nation's economic growth, industrial development, and achieving all power and energy goals.

Key Demand Drivers

India, with its vast population, rapid urbanization, and thriving industrial and commercial sectors, is experiencing a significant surge in the demand for electricity. The increased demand has enforced government to support commissioned power plants to sell electricity even in the absence of valid Power Purchase Agreement (PPA). Several factors are driving this increasing appetite for power. The major factors driving the growth of the sector are increasing urbanization, rising disposable income witnessing a lifestyle shift thereby, having an increasing consumption of electricity. To meet this burgeoning demand, it becomes imperative to bolster the transmission and distribution infrastructure across the nation.

Population Growth

India, with a population comprising approximately 17.2% of the global total, is experiencing significant demographic changes, as it became the most populous country in 2023, reaching around 1.428 billion individuals. Despite a noticeable slowdown in population growth over recent years, the country continues to witness an upward trend in its population. This growth necessitates a substantial increase in housing and residential units, thereby driving demand for electricity.

To accommodate the increasing population and the subsequent rise in housing demand, India must enhance its transmission and distribution (T&D) infrastructure. The current T&D framework may prove inadequate for supplying electricity to densely populated urban areas and remote rural regions with limited connectivity. Therefore, it is crucial to upgrade and expand the transmission and distribution networks to ensure a reliable and uninterrupted power supply, effectively addressing the challenges posed by the burgeoning population.

Urbanization

The increasing population in India is projected to create substantial demand for residential units, particularly in urban areas, serving as a significant driver for transmission and distribution (T&D) infrastructure. According to the Handbook of Urban Statistics 2022, the urban population has been steadily rising, with over 469 million urban dwellers in 2021, expected to exceed 558 million by 2031 and surpass 600 million by 2036. This rapid urbanization reflects a transformation within Indian cities, as millions migrate to urban centers in search of better opportunities and living standards. The growing number of nuclear families and evolving consumer preferences will further amplify the demand for housing, necessitating enhanced T&D capabilities to support this expansion. As urban areas require robust electricity infrastructure for residential, commercial, and industrial needs, the surge in housing development will significantly increase the demand for T&D services. To meet these requirements, India must upgrade and expand its T&D networks, ensuring they can adequately supply electricity to densely populated regions and newly established urban locales, thus guaranteeing reliable and uninterrupted power distribution.

Growth in demand from Industrial & Commercial Consumers

India is witnessing significant industrial and commercial growth across various sectors, positioning itself as a potential global manufacturing hub with increasing investments throughout the value chain. Key industries, including manufacturing, construction, information technology, and services, demand substantial electricity for their operations, while the rise of commercial establishments such as shopping malls, hotels, and offices further amplifies the need for robust transmission and distribution (T&D) infrastructure. The industrial sector accounts for approximately 43% of total power consumption, and per capita energy consumption has shown a compound annual growth rate (CAGR) of 3.78% from FY 2019 to FY 2023. This industrial expansion, coupled with rising per capita income, is driving increased electrification and per capita usage. From April 2022 to March 2023, power consumption reached 1,403.40 billion units (BU), exceeding the 1,316.76 BU recorded for the entire FY 2021-22. Additionally, the government's focus on infrastructure development to meet the demands of the growing population will further contribute to the sector's overall growth. To support this industrial and commercial expansion, there is an urgent need to reinforce the T&D infrastructure, as high-capacity power connections will be essential for industries and commercial entities. The current infrastructure presents an opportunity for enhancement to effectively manage the anticipated increase in load in the coming years. This underscores the importance of expanding and upgrading T&D networks to proactively meet the evolving demands of these sectors.

Growth in demand from retail consumers

With rising incomes and improving living standards, there is a growing demand for transmission and distribution (T&D) infrastructure to support increasing household electricity consumption. Households rely on electricity for lighting, cooking, heating, cooling, and operating various appliances and electronics. As more households gain access to electricity or upgrade to higher-powered appliances, the overall demand for T&D services rises. To effectively address this scenario, India must enhance its T&D infrastructure at the local level to accommodate the rising household consumption. This entails strengthening distribution networks, upgrading transformers, and installing additional distribution substations to ensure a reliable supply of electricity, particularly in rural and semi-urban areas. Such improvements will be essential to meet the evolving needs of households and support the country's ongoing development.

Infrastructure Development

India is heavily investing in massive infrastructure projects. This substantial increase in infrastructure development spending in India, as highlighted in the Budget 2024-25, is set to drive the demand for transmission and distribution of power in the country. With the government nearly tripling its infrastructure spending to Rs.11.1 lakh crore (US$ 134 billion), equivalent to approximately 3.6% of GDP, compared to previous years, there will be a significant boost in the construction of highways, railways, airports, and smart cities.

Furthermore, the continuation of the interest-free loan to state governments for infrastructure investment for an additional year, amounting to Rs. 75,000 crores incentivizes the states to undertake complementary policy actions and invest in infrastructure development. In addition, the establishment of the Urban Infrastructure Development Fund (UIDF) utilizing the priority sector lending shortfall to create urban infrastructure in Tier 2 and Tier 3 cities, with an annual outlay of Rs. 10,000 crore, further contributes to the demand for electricity.

As a result of the increased infrastructure spending and the implementation of various initiatives, there will be a surge in the demand for transmission and distribution infrastructure across the country. Upgrading and expanding the transmission lines, transformers, and distribution networks will be essential to ensure that the power generated from these new infrastructure projects can be effectively distributed to the end-users. The reinforcement of the transmission and distribution infrastructure will enable the reliable and efficient supply of electricity, meeting the increased demands arising from the country's infrastructure development endeavours.

Increasing Demand from Agriculture

Agriculture is a vital sector in India, employing a significant portion of the population and driving the demand for robust transmission and distribution (T&D) infrastructure. As farmers increasingly adopt modern irrigation techniques, such as electric pumps, the need for T&D services in the agricultural sector intensifies. Furthermore, electricity plays a critical role in post-harvest processing and storage of agricultural produce, further contributing to the demand for reliable T&D solutions. To effectively address these needs, strengthening the distribution infrastructure in rural areas is essential. This includes expanding the network to reach remote agricultural regions, installing dedicated agricultural feeders, and ensuring a dependable electricity supply for irrigation and agro-processing units. Government initiatives like the Deen Dayal Upadhyaya Gram Jyoti Yojana (DDUGJY) and the Revamped Distribution Sector Scheme (RDSS) are already addressing these challenges, highlighting the importance of enhancing T&D capabilities to support the agricultural sector's growth and modernization.

Government Initiatives

The Indian government has been actively implementing various schemes and initiatives, such as the Pradhan Mantri Sahaj Bijli Har Ghar Yojana (Saubhagya), Deen Dayal Upadhyaya Gram Jyoti Yojana, and the Revamped Distribution Sector Scheme, to provide electricity access to all citizens. These initiatives focus on electrifying rural areas and households that currently lack electricity access, thereby significantly increasing the demand for robust transmission and distribution (T&D) infrastructure, particularly in rural regions. To achieve the government's electrification goals, it is essential to enhance T&D infrastructure by extending transmission lines, establishing new substations, and strengthening distribution networks. This proactive approach will ensure that the growing demand for T&D services is met effectively, facilitating the delivery of electricity to underserved communities and supporting broader economic development.

Strengthening the Grid for Renewable Energy Integration

The increasing installed capacity of renewable energy (RE) sources, such as wind and solar, necessitates the development of a more robust grid network to effectively manage and distribute the growing electricity generated from these variable sources. To support this demand, the Indian government aims to significantly expand its power transmission network, targeting a total of 648,000 circuit kilometres (ckm) by 2032 to accommodate a peak electricity demand of 458 GW. The anticipated addition of 280 GW of variable renewable energy by 2030 highlights the need for upgraded transmission infrastructure to ensure efficient power evacuation and maintain grid stability. Furthermore, the integration of renewable energy sources requires enhanced inter-regional transfer capacities and the implementation of High Voltage Direct Current (HVDC) lines, which are essential for managing the fluctuating nature of renewable energy generation. This growing reliance on renewable energy sources directly drives the demand for improvements in Transmission and Distribution (T&D) infrastructure, underscoring the necessity for a stronger grid network to support India's ambitious energy transition goals.

Government Regulations

Deen Dayal Upadhyaya Gram Jyoti Yojana

The Deen Dayal Upadhyaya Gram Jyoti Yojana (DDUGJY), launched in December 2014, is a government scheme in India aimed at providing uninterrupted power supply to rural areas. It has three components under its umbrella:

1. **Separation of agriculture and non-agriculture feeders:** The main objective of this component is to separate the feeders in order to provide regulated supply of power to agricultural consumers and continuous power supply to non-agricultural consumers in rural areas.
2. **Strengthening and augmentation of sub-transmission & distribution (ST&D) infrastructure in rural areas**: The requirement for electricity in rural regions is growing steadily because of the expanding customer base and shifts in lifestyle and consumption habits. Consequently, it is important to enhance and reinforce the sub-transmission and distribution infrastructure to guarantee dependable and high-quality electricity provision in rural areas.
3. **Rural electrification**: The previous Rajiv Gandhi Grameen Vidyutikaran Yojana (RGGVY) program, which aimed to electrify villages and establish electricity distribution infrastructure in rural areas, has now been incorporated into the DDUGJY scheme.

The scheme had a total budget of INR 75,893 crores. Out of this, components (1) and (2) with a cost of Rs. 43,033 crores received a budgetary support of Rs. 33,453 crores from the Indian Government throughout the implementation period. The third component of the scheme had an approved cost of Rs. 39,275 crores, including a budgetary support of Rs. 35,447 crores.

The Ministry of Power provided guidance for the scheme, while the Rural Electrification Corporation Limited was responsible for its implementation. Initially, the government allocated 60% of the project cost to most states and reserved 85% for special states. Additional funding of 15% was granted by the government when the first milestones were achieved, with 5% of that amount being reserved for special states.

Achievements under DDUGJY RE:

Under the previous Rural Electrification (RE) program, as of December 31, 2021, a total of 1,365 projects with a combined budget of Rs. 66,380 crore were approved. The Government of India (GoI) released a grant of Rs. 53,414 crore to the states. The progress made in terms of implementation is as follows:

- 2,993 Sub-stations (Incl. augmentation of 2,101 Sub-Stations) commissioned
- 10.14 Lakh Distribution Transformers commissioned
- 7.83 Lakh CKm of LT Lines erected
- 4.73 Lakh CKm 11KV Lines erected
- 0.15 Lakh Ckm 33 & 66 KV HT Lines erected
- As reported by the States, all the inhabited un-electrified villages across the country, as per Census 2011, were electrified by 28th April, 2018.

Achievements under DDUGJY New:

By December 31, 2021, a total of 4,404 projects with a budget of Rs. 47,972 crore were approved, including various components. The GoI released a grant of Rs. 22,755 crore to the states. The physical progress achieved so far is as follows:

- 3,958 Sub-stations (including augmentation of 2,093 Sub-stations) commissioned
- 3.95 Lakh Distribution Transformers commissioned
- 1.23 Lakh CKms of new 11 KV line erected
- 2.96 Lakh CKms of LT Lines erected
- 0.28 Lakh CKms of HT Lines (33 & 66 KV Lines) erected
- 1.22 Lakh CKms of 11 KV Feeders segregated
- Energy Meters in 153.80 Lakh consumer premises, 2.53 Lakh Distribution Transformers & 0.13 Lakh 11 KV Feeders installed

Achievement under DDUGJY Addl. Infra

An amount of Rs. 14,179 crore had been sanctioned to 20 states upon their request for the creation of additional infrastructure exclusively for households covered under the Saubhagya scheme. As of December 31, 2021, a cumulative grant of Rs. 7,165.52 crore has been released by the Government of India to the states. The physical progress made is as follows:

- 228 Sub-stations (including augmentation of 220 Sub-stations) commissioned

- 2.19 Lakh Distribution Transformers commissioned
- 0.66 Lakh CKms of new 11 KV line erected
- 1.96 Lakh CKms of LT Lines erected

The scheme stands closed as on 31-03-2022. However, the power reforms and larger goal of rural electrification under DDUGYJ has been taken under RDSS.

Integrated Power Development Scheme

Ministry of Power, Government of India notified "Integrated Power Development Scheme" (IPDS) on 3rd December, 2014 with the aim to ensure 24×7 Power supplies for consumers, reduction in AT&C (aggregate technical and commercial) losses, and providing access to power to all households. IPDS has the following components under its umbrella:

1. **Strengthening of Sub-transmission and Distribution network in urban areas including provisioning of solar panels on Govt. buildings including Net-metering:** The Indian government has been offering financial assistance to State-owned Discoms/Power Departments through various programs. However, these departments have been unable to keep up with the increasing demand for electricity, resulting in significant gaps and deficiencies in the sub-transmission and distribution network. As a result, the sub-transmission and distribution network has become a hindrance in ensuring reliable and high-quality power supply to consumers.
2. **Metering of feeders / distribution transformers / consumers in urban areas:** The implementation of end-to-end metering is crucial for the power sector. Having effective metering for all consumers ensures accurate accounting, billing, assessment of load patterns, and proper infrastructure planning. It also enables the identification of areas with high losses, prompting corrective measures to reduce those losses.
3. **IT enablement of distribution sector and strengthening of distribution network**: In July 2008, the Ministry of Power, Government of India, launched the Restructured Accelerated Power Development and Reforms Programme (R-APDRP) with the aim of establishing baseline data, promoting accountability, reducing Aggregate Technical and Commercial (AT&C) losses to a level of 15% through strengthening and upgrading the sub-transmission and distribution network, and adopting Information Technology. The R-APDRP has now been integrated into the Integrated Power Development Scheme (IPDS).

The scheme has a total budget of Rs. 76,623 crore. Out of this, the estimated budget for components (1) and (2) is Rs. 32,612 crore, which includes a budgetary support of Rs. 25,354 crore from the Government of India throughout the implementation period.

The R-APDRP scheme, with a cost of Rs. 44,011 crore, including a budgetary support of Rs. 22,727 crore as approved by CCEA, will be carried forward to the new IPDS scheme, in addition to the budget allocation for components (1) and (2) mentioned above.

For the majority of states, the government has allocated 60% of the project cost, while 85% was allocated for special states. Upon achieving the initial milestones, the government provided an additional 15% of funds, with 5% specifically allocated to special states.

According to the February 2022 data from the Ministry of Power and New and Renewable Energy, projects worth Rs.30,802 Crore [with Government of India (GoI) Grant of Rs. 19,332 Crore] have been sanctioned under IPDS covering project components outlined herein, of which GoI grant of Rs.16,717 Crore has been released to the States. The distribution system strengthening works have been successfully completed in 544 circles.

The targets set and the achievements under IPDS 2014- 2022 strengthening project for major works are tabulated below

Items (Unit)	Target	Achievement
New Power Sub Station (Nos.)	999	994
HT Lines (cKm)	24,262	23,539
LT Lines (cKm)	10,769	10,409
AB Cable (cKm)	65,029	64,364
UG Cable (cKm)	21,551	21,336
Roof Top Solar Panels (kWp)	46,544	46,107

This scheme has been subsumed under RDSS, to be implemented as per its extant guidelines, and marked closed as of March 2022. No new projects will be sanctioned under this scheme but projects already sanctioned were eligible to receive funds up to 31st March 2022. However, projects sanctioned for Ayodhya, Uttar Pradesh under IPDS were allocated funds till 31st March 2023.

Revamped Distribution Sector Scheme

The Government of India has introduced the Revamped Distribution Sector Scheme (RDSS), which is a comprehensive initiative aimed at transforming the distribution sector. With a significant budget of Rs. 3,03,758 crore and an estimated financial assistance of Rs. 97,631 crore from the Central Government over a period of 5 years from Financial Year (FY) 2021-22 to FY 2025-26, the scheme focuses on reducing Aggregate Technical & Commercial (AT&C) losses to pan-India levels of 12-15% and eliminating the Average Cost of Supply (ACS)-Average Revenue Realized (ARR) gap by 2024-25.

The primary goal of the RDSS is to improve the operational efficiency and financial sustainability of power distribution companies (DISCOMs). It accomplishes this by providing financial assistance to DISCOMs based on their adherence to pre-qualifying criteria and their achievement of minimum benchmarks. The scheme is divided into two main components:

1. Part 'A' includes financial support for prepaid smart metering, system metering, and the upgradation of distribution infrastructure, while
2. Part 'B' focuses on training, capacity building, and other enabling and supporting activities.

Under the RDSS, DISCOMs must achieve a minimum score of 60% and fulfill specific parameters to be eligible for funding. This encourages DISCOMs to undertake necessary reforms and enhancements in their operations and infrastructure. The scheme also integrates existing power sector reform programs, including the Integrated Power Development Scheme, Deen Dayal Upadhyaya Gram Jyoti Yojana, and Pradhan Mantri Sahaj Bijli Har Ghar Yojana, streamlining efforts under a unified program.

Through the RDSS, the government aims to strengthen the distribution sector, enhance supply infrastructure, and promote the adoption of prepaid smart metering systems. By reducing AT&C losses and closing the ACS-ARR gap, the scheme will improve the financial viability of DISCOMs, ensuring efficient and reliable electricity delivery to consumers. This comprehensive approach will contribute to the overall development and growth of the power distribution sector in India, benefiting both DISCOMs and electricity consumers nationwide.

Achievements

The reform measures implemented under the RDSS, in conjunction with other initiatives by the Ministry, have led to a significant decrease in AT&C losses of DISCOMs from 22.32% in the fiscal year 2021 to 16.44% in the fiscal year 2022. This reduction in AT&C losses has subsequently narrowed the gap between Average Cost of Supply (ACS) and Aggregate Revenue Requirement (ARR) from Rs. 0.69/kWh in FY2021 to Rs. 0.15/kWh in FY2022.

Furthermore, the AT&C losses in the power sector have further decreased to 15.41% (provisional) in FY 22-23. The direct implication of this achievement is a tangible improvement in the ACS-ARR gap, ultimately benefiting end consumers by ensuring the provision of quality power supply.

National Grid: One Nation - One Grid

The "One Nation One Grid" initiative of the Government of India is an ambitious initiative aimed at integrating and unifying the power grids across the country into a single national grid. The policy's objective is to enable the seamless transmission and sharing of electricity across states and regions, ensuring efficient utilization of power resources and promoting grid stability.

Under this policy, the different regional power grids in India, such as the Northern, Western, Eastern, and Southern grids, are interconnected to form a synchronized and interconnected power transmission network. The integration of these grids allows for the transfer of surplus power from one region to another, ensuring a reliable and consistent power supply across the country.

The achievement of this goal was realized with the commissioning of the 765kV S/c Raichur – Sholapur line on December 31, 2013. This milestone paved the way for the integration of the regional grids and laid the foundation for a unified and synchronized power transmission network across the country.

The central agency responsible for the development and strengthening of the transmission network is POWERGRID. Their focus lies in establishing inter-state and inter-regional transmission links to enhance the capacity of the national grid. This proactive approach ensures optimal utilization of India's diverse and unevenly distributed energy resources.

In the fiscal year 2021-22 alone, the country witnessed the addition of 7,200 MW of inter-regional (IR) transmission capacity. This continuous expansion of the transmission infrastructure has resulted in a cumulative capacity of 1,225,260 MVA as of January 2024. These developments reflect the commitment of the government to reinforce the national grid and facilitate the seamless transfer of power across regions.

The implementation of the National Grid system signifies India's commitment to developing a robust and unified power transmission infrastructure. Through the continuous strengthening of inter-state and inter-regional transmission links, the country aims to achieve optimal utilization of resources, enhance grid stability, and foster competition in the power market. These efforts are vital for meeting the growing electricity demand, promoting renewable energy, and ensuring reliable and affordable power supply for all.

Green Energy Corridor

The Green Energy Corridor initiative in India focuses on the development of transmission corridors and associated infrastructure to facilitate the integration of renewable energy into the power grid. It aims to address the challenges of integrating large-scale renewable energy generation by strengthening the transmission network by upgrading existing transmission lines, constructing new high-capacity lines, and establishing substations and transformers.

The initiative aims to balance power supply and demand by transmitting surplus renewable energy from regions with high generation potential to areas with high consumption. It also aims to improve grid stability and reliability, minimize transmission losses, and enable open access and market mechanisms for renewable energy trading.

The 12th Plan Period facilitated the integration and transmission of 32,713 MW of renewable energy capacity. The scheme initially estimated a total funding requirement of Rs. 34,141 Crore for the development of transmission infrastructure and control systems in states with abundant renewable resources such as Andhra Pradesh, Gujarat, Himachal Pradesh, Jammu and Kashmir, Karnataka, Maharashtra, Rajasthan, Madhya Pradesh, and Tamil Nadu.

The Green Energy Corridor project requires an estimated cost of Rs. 12,693.94 Crore for intra-state transmission systems and Rs. 15,455 Crore for inter-state transmission systems (revised figures). The funding for intra-state transmission schemes involves 20% equity from the State Government, 40% grant from the National Clean Energy Fund (NCEF), and 40% soft loan. Inter-state transmission schemes, on the other hand, are funded with 30% equity from PGCIL (Power Grid Corporation of India Limited) and 70% soft loan.

To support the funding of green energy corridors, a loan agreement has been signed between PGCIL and KfW Germany for a soft loan of Euro 500 million. Additionally, PGCIL has obtained a loan from ADB (Asian Development Bank) for the implementation of transmission schemes under Green Energy Corridor-Part D. Various states including Tamil Nadu, Rajasthan, Himachal Pradesh, Andhra Pradesh, Gujarat, and Madhya Pradesh have signed loan agreements with KfW Germany for financial assistance in implementing intra-state transmission projects.

Green Energy Corridor (GEC) Phase I

GEC-1, was approved by the Cabinet Committee on Economic Affairs (CCEA) in 2015. This scheme involves the implementation of intra-state transmission lines and sub-stations in eight renewable energy-rich states: Andhra Pradesh, Gujarat, Himachal Pradesh, Karnataka, Madhya Pradesh, Maharashtra, Rajasthan, and Tamil Nadu. The project aims to evacuate approximately 24 GW of renewable energy power, with around 16.4 GW already commissioned and connected to the grid. The project's total cost is Rs. 10,141.68 crore, funded by 40% central grant from MNRE (Rs. 4,056.67 crore), 40% loan from KfW Germany (EUR 500 million), and 20% equity by the State Transmission Utilities (STUs). As of October 31, 2022, 8,651 ckm of transmission lines and 19,558 MVA of substations have been constructed, with Rajasthan, Madhya Pradesh, and Tamil Nadu having completed all their projects. The commissioning timeline for projects under GEC-1 was extended until March 2023.

Green Energy Corridor (GEC) Phase II

GEC-II was approved by the CCEA in January 2022. This scheme targets the implementation of intra-state transmission lines and sub-stations in seven states: Gujarat, Himachal Pradesh, Karnataka, Kerala, Rajasthan, Tamil Nadu, and Uttar Pradesh. The project's objective is to evacuate approximately 20 GW of renewable energy power in these states with addition of 10,753 circuit kilometres (ckm) of transmission lines and 27,546 Mega Volt-Amperes (MVA) capacity of sub-stations. The project cost is Rs. 12,031.33 crore, with

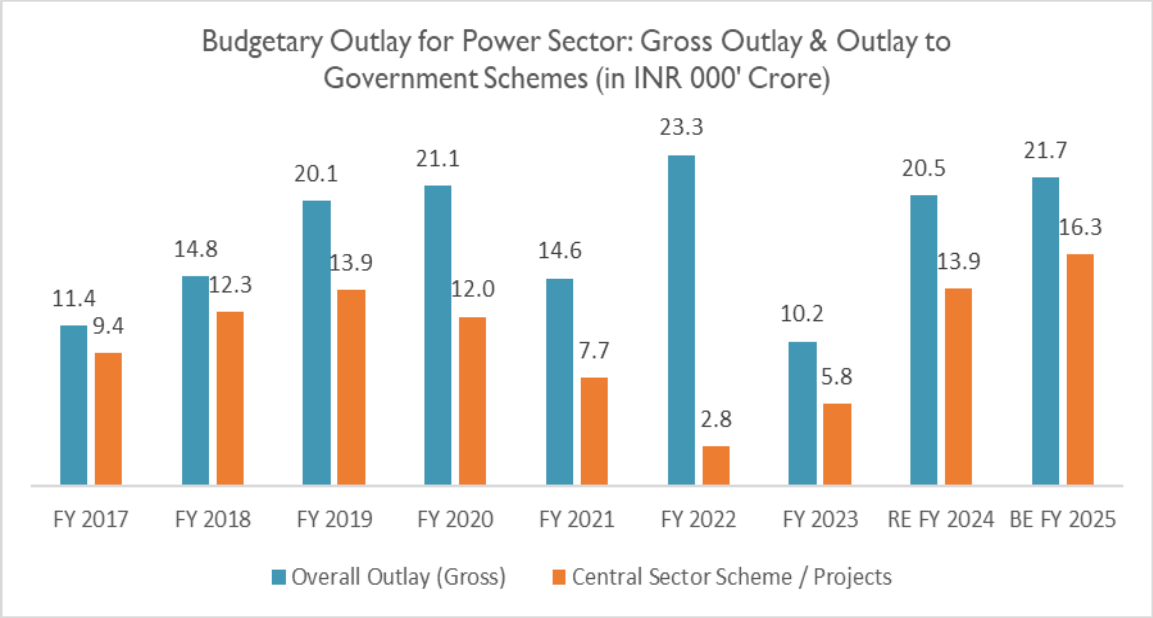
33% central financial assistance from MNRE (Rs. 3,970.34 crore) and the remaining 67% available as a loan from KfW/REC/PFC. The State Transmission Utilities (STUs) in these states are currently preparing the packages and issuing tenders for the project implementation. The scheduled commissioning timeline for projects under GEC-2 is March 2026.

The State-wise brief of the projects under the scheme is as under:

State	Estimated project cost (INR Crore)	Length of transmission lines envisaged (ckm)	Capacity of substations envisaged (MVA)	RE addition envisaged (MW)
Gujarat	3636.73	5138	5880	4000
Himachal Pradesh	489.49	62	761	317
Karnataka	1036.25	938	1225	2639
Kerala	420.32	224	620	452
Rajasthan	880.92	1170	1580	4023
Tamil Nadu	719.76	624	2200	4000
Uttar Pradesh	4847.86	2597	15280	4000
Total	**12,031.33**	**10753**	**27546**	**19431**

Budgetary Outlay for Power Sector

The recent interim budget (FY 2024-25) witnessed a significant growth in budgetary allocation for ongoing Government schemes. Although power sector has always remained a key focus area of successive Governments, there was a moderate decline in budget outlays for existing schemes during FY 2022 and FY 2023. In its latest budget, the Government reversed this trend by increasing its outlay - underlining a renewed commitment to infrastructure development and central sector initiatives, reflecting the government's efforts to boost economic growth and address key developmental needs.



Union Budget, Government of India

Realizing the challenges faced by the T&D segment, the budget provides special emphasis on Reform Linked Distribution Scheme – which was launched to improve the operational efficiency & financial stability of stakeholders in distribution segment. The program saw an outlay of INR 14,500 crore in budget FY 2025, an increase of nearly 40% from the outlay that was provided during the previous budget (RE 2023-24).

Engineering, Procurement, and Construction (EPC)

EPC refers to a prominent contracting agreement in the construction industry where a single contractor assumes full responsibility for the project's engineering, procurement, and construction. This model streamlines project execution by transferring substantial risks from the owner to the contractor, making it an attractive option for developers who seek cost certainty and reduced engagement in project management.

EPC contracts typically involve several key characteristics:

- Single Point of Responsibility: The contractor manages all project aspects, simplifying oversight for the client.
- Fixed Price and Cost Certainty: Often structured as a lump sum, these contracts reduce financial risk and enable better budget management.
- Risk Transfer: Significant project risks, including design and construction-related uncertainties, are transferred to the contractor.
- Turnkey Delivery: The contractor delivers a fully operational facility, allowing the client to commence operations without further modifications.
- Performance Guarantees: Contractors commit to meeting specific performance standards, assuring quality and operational efficiency.

Scope of EPC Services in Power Transmission and Distribution

EPC (Engineering, Procurement, and Construction) services in the power transmission and distribution sector encompass a wide range of activities that are crucial for the development and operation of electrical power grids. These services involve the planning, design, construction, and commissioning of various infrastructure components, ensuring a seamless and efficient flow of electricity. Key areas covered by EPC services in power transmission and distribution include:

- ***Substation Construction***: EPC contractors design, build, and commission substations, which are essential for transforming and distributing electricity. This involves the installation of transformers, switchgear, and other electrical equipment.
- ***Transmission Line Construction***: EPC services extend to the construction of high-voltage transmission lines, which transport electricity over long distances. This includes the installation of towers, conductors, and insulators.
- ***Distribution Network Development***: EPC contractors are responsible for designing and building distribution networks, which deliver electricity to end-users. This involves the installation of distribution transformers, feeders, and other components.
- ***Grid Modernization and Expansion***: EPC services are crucial for upgrading existing power grids and expanding their capacity to meet growing demand. This involves the rehabilitation of aging infrastructure, installation of new equipment, and integration of renewable energy sources.

- ***Project Management***: EPC contractors provide comprehensive project management services, overseeing all aspects of the project from planning and design to construction and commissioning. This ensures that projects are completed on time, within budget, and to the required quality standards.

  EPC services play a vital role in ensuring the reliability and efficiency of power transmission and distribution systems. By providing a one-stop solution for all aspects of project development, EPC contractors help to streamline the process and reduce project risks. As the demand for electricity continues to grow, the importance of EPC services in the power sector will only increase.

Construction industry in India

Overview

The construction sector is a key component of the Indian economy with linkages across more than 200+ sub sectors. Construction, the second largest economic activity in India (after agriculture) contributes around ~9.1% to the national GDP. Further, India is poised to become the third largest construction market in the next 2-3 years on the back of stable economic growth as the real estate sector has emerged to be a critical engine in the country's growth story. As per a Knight Frank report, the construction sector, along with the output generated from real estate services and ownership of dwellings, contributes nearly 18% to the economy's total output.

It is the second largest employment generator in India with nearly 71 million workforce which is expected to cross 100 million by 2030. High employability of the sector is due to chain of backward and forward linkages that the sector has with other sectors of the economy. It provides impetus to other manufacturing sectors like cement, bitumen, iron and steel, chemicals, bricks, paints, tiles among others. A unit increase in expenditure in construction sector has a multiplier effect on other sectors with a capacity to generate income as high as five times in other sectors.

India's construction industry is on a phenomenal growth trajectory, projected to reach a staggering USD 1.4 trillion by 2025, accounting for 8%-10% of India's GDP. This represents a significant leap from its current size of approximately USD 820 billion, showcasing the dynamism and potential of this sector. Cities are a major driver for the construction industry as more than 40% of the population is expected to live in urban India (compared to the current 33%), leading to a demand for 25 million additional mid-end and affordable units by 2030. Further, the Smart Cities Mission targeted at 100 cities is aimed at improving the quality of life through modernized/ technology driven urban planning.

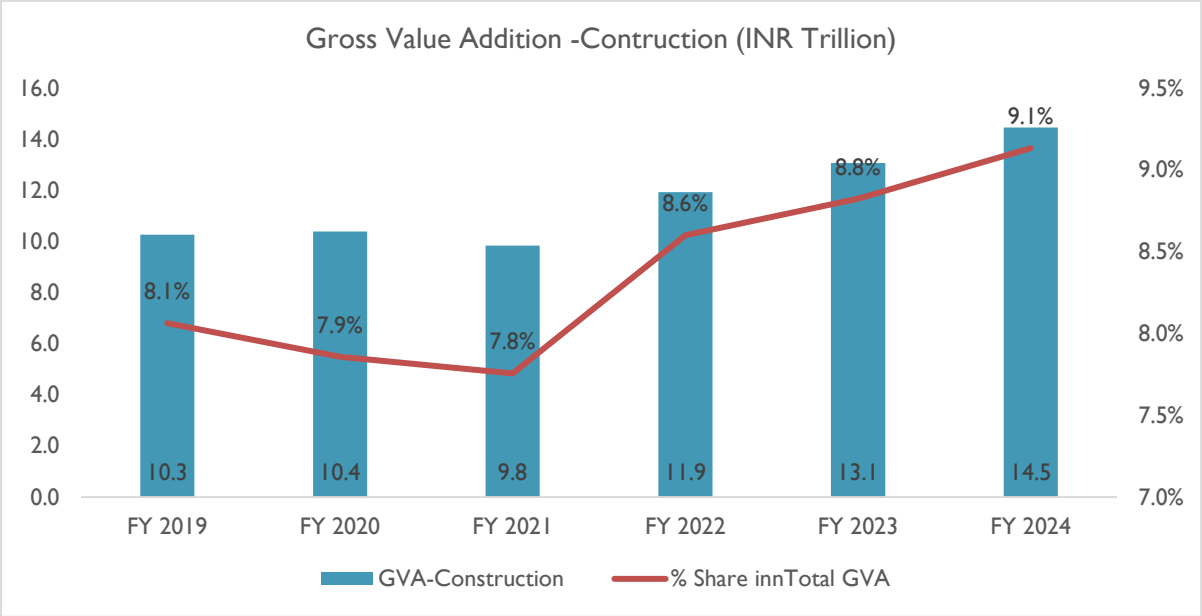
The Indian government's ambitious Gati Shakti National Master Plan plays a pivotal role in propelling the construction industry forward. This comprehensive roadmap aims to seamlessly integrate infrastructure development across various sectors, creating a national logistics network that will boost efficiency and reduce costs.

The Bharatmala Pariyojana initiative complements Gati Shakti by focusing specifically on developing a world-class highway network spanning over 83,000 kilometers. This ambitious project comprises several expressways, ring roads, and economic corridors, aiming to improve connectivity, boost regional development, and facilitate trade. The booming construction industry is a significant job creator, directly employing millions of workers across various disciplines like engineering, construction, architecture, and skilled labor. Additionally, the sector indirectly supports numerous job opportunities in associated industries like manufacturing, transportation, and logistics.

Historical growth trend in construction industry

Contribution to national economy by the construction sector has steady improved over the years, and by FY 2024 it is estimated to account for nearly 9.1% of national Gross Value Added (GVA). In actual terms, the GVA by construction sector reached approximately INR 14.5 trillion in FY 2024.

This positive development is based on increased government spending on infrastructure as well as faster than expected demand growth in the real estate sector. The housing sector especially is seeing stable demand, on the back of low loan rates, deductions in stamp duty announced by several state Governments as well as drop in property price volatility.



Source: Ministry of Statistics & Programme Implementation (base year 2011-12)

The government has identified infrastructure as a priority sector to bolster GDP growth. Various reforms have been introduced from time to time to attract investment in infrastructure. Infrastructure sector was opened to private participation post-liberalization in 1991 and currently up to 100% FDI under automatic route is allowed in most sectors/activities.

100% FDI under automatic route is allowed in construction-development projects which would include development of townships, construction of residential/commercial premises, roads or bridges, hotels, resorts, hospitals, educational institutions, recreational facilities, city and regional level infrastructure, townships.

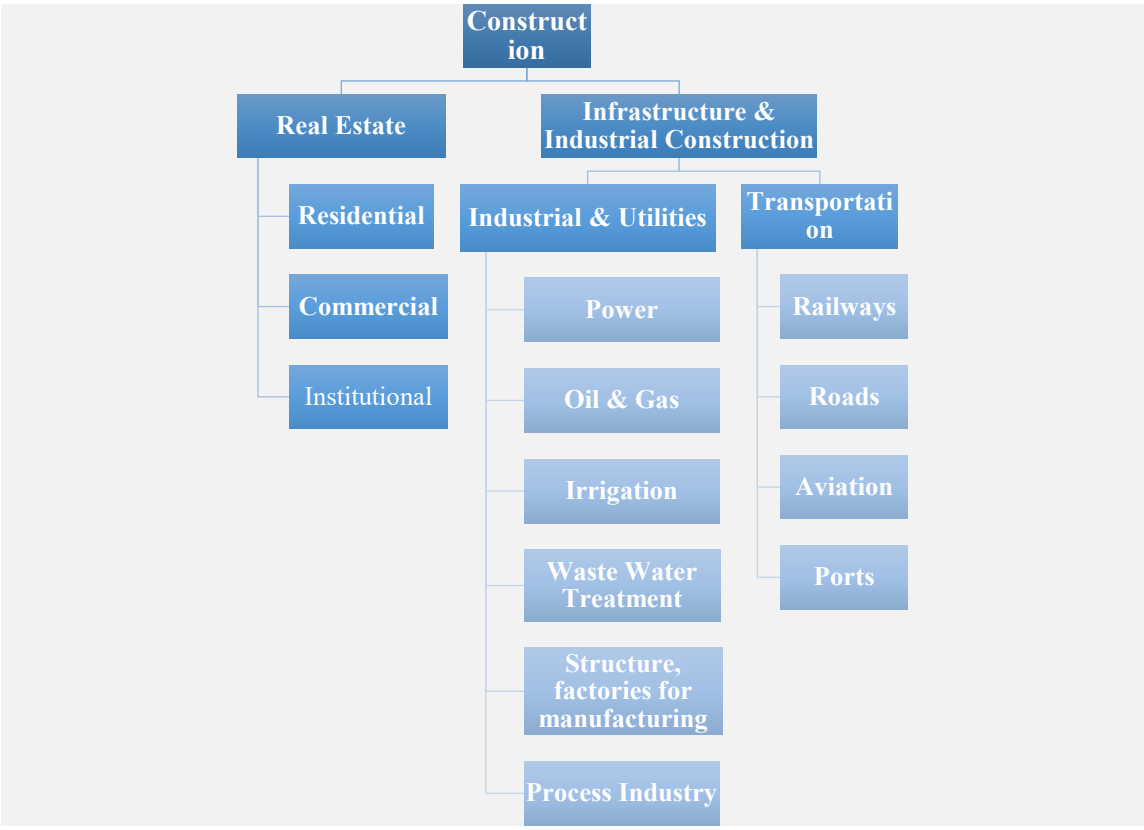
India has emerged as a safe investment destination in the last decade. The construction development segment (townships, housing, built-up infrastructure, and construction-development projects) is the seventh largest FDI recipient with its share in total FDI inflows standing at nearly 4% (at the end of March 2024) and cumulatively amounted to INR 3,407 billion from Apr 2000 – March 2024.

Segment	FY 2021 INR Bn	FY 2022 INR Bn	FY 2023 INR Bn	FY 2024 INR Bn	Cumulative FDI From Apr 2000-March 2024 INR Bn

Construction Development *Townships, housing, built-up infrastructure and construction-development projects*	31.17	9.32	11.96	21.13	1,313.21
Construction (Infrastructure) Activities	582.40	241.78	135.88	350.76	2,395.55

Key Segments of the Indian Construction Industry

Construction sector includes a broad spectrum of activities including planning & design to actual construction. The sector is broadly divided into two: real estate construction and Industrial & infrastructure construction.



Real Estate

Residential Construction: Building Homes for a Growing Nation

It is the largest Segment, representing approximately 60% of the industry, residential construction plays a dominant role. Rapid urbanization driven by a burgeoning middle class and economic growth fuels demand for new housing units, particularly in Tier 1 and Tier 2 cities. Government initiatives like Pradhan Mantri Awas Yojana (PMAY) aim to bridge the housing gap and provide affordable homes for low-income families. Preference for smaller apartments, smart homes, and integrated townships with amenities is gaining traction among the residents.

Commercial Construction: Skyrocketing Demand for Office and Retail Space

This segment is fuelled by Economic Growth i.e., Increasing business activity and foreign direct investment drive demand for office space in major cities. Growth of e-commerce and changing consumer preferences necessitate modern retail centres and logistics infrastructure. Emerging trend of Co-working and Coworking Spaces catering to the burgeoning freelance and start-up culture. Green buildings and energy-efficient technologies are gaining traction as environmental consciousness rises.

Infrastructure Construction: Connecting India: Roads & Highways, Railways, Airports, and Ports

The sector bears strategic importance in contributing towards country's economic growth. It is a key driver of economic growth and national development. Infrastructure development can be referred to as a set of basic services, facilities, and physical installations required for smooth functioning of quality life in a country. Growth in infrastructure serves as an indicator of level of urbanization as well as overall development in the country. It encompasses the development and maintenance of essential infrastructure like roads, highways, railways, airports, ports, waterways, etc. This segment plays a crucial role in:

- *Connecting people and places*: Efficient transportation networks facilitate movement of goods and people, boosting trade and commerce.
- *Stimulating economic activity*: Infrastructure projects create jobs, attract investments, and spur development across various sectors.
- *Improving quality of life*: Access to clean water, sanitation, and reliable electricity enhances living standards and promotes overall well-being.

Key Segments of Infrastructure Construction:

Roads & Highways: India has a road network spanning approximately 6.6 million kms, making it the second largest in the world. This network – which comprises of national highways, state highways, district roads, and rural road – carries approximately 65% of country's freight traffic and nearly 90% of passenger traffic. However, it needs significant expansion and upgrades. The government initiatives like Bharatmala Pariyojana and Sagarmala aim to improve connectivity and logistics efficiency.

Railways: The Indian Railways network is the fourth largest globally, undergoing modernization with dedicated freight corridors and high-speed rail projects. The modernization of railway stations in India encompasses a wide range of initiatives aimed at enhancing infrastructure, amenities, and services to provide passengers with a world-class travel experience. This includes the construction of modern waiting halls, waiting rooms, restrooms, and passenger lounges equipped with amenities such as Wi-Fi connectivity, charging points, and digital display boards providing real-time information about train schedules and arrivals. Additionally, efforts are underway to improve accessibility for passengers with disabilities by installing ramps, elevators, and other facilities to ensure equitable access to railway services.

Airports: Expansion and modernization of airports to cater to growing air traffic and promote regional connectivity. India plans to build and upgrade over 100 airports, expanding air connectivity and catering to growing passenger demand.

Ports: With a coastline of approximately 7,517 km, India's coastline offers immense potential for port development, facilitating international trade and boosting maritime connectivity. India has 12 major ports and approximately 200 minor ports as of July 2024. Indian ports handle 95% of the total international trade volume of the country where the 12 major ports of India handled 53% of the total cargo and the minor ports accounted for 47% of the cargo traffic in FY2024. Various initiatives are being taken by central bodies to improve maritime transport in India by reducing turnaround time, enhance operational efficiency, improve capacity utilization, increase inland waterways, and lower costs. Sagar Mala Project and Maritime India Vision 2030 are few of the largest sector specific policies being implemented across the country aimed at bringing India to the forefront of the global maritime transport.

Global transformer industry

The global transformer industry plays a crucial role in supporting the electrical power infrastructure worldwide. Transformers are indispensable devices that convert voltage levels to enable efficient transmission and distribution of electricity. They are used in various applications, from power generation plants to residential areas, ensuring a reliable and uninterrupted supply of electricity. The industry is driven by several factors, including economic growth, urbanization, and the increasing demand for electricity. As countries develop and cities expand, the need for transformers grows to meet the rising energy consumption. Additionally, the shift towards renewable energy sources and the electrification of transportation are further driving demand for transformers. Major players in the global transformer market include multinational corporations like ABB, Siemens, GE, Schneider Electric, and Mitsubishi Electric, known for their technological expertise and global reach. However, the industry also faces challenges such as rising raw material costs, intense competition from emerging markets, and rapid technological advancements. Despite these challenges, the global transformer industry is expected to continue expanding, driven by the persistent demand for electricity and the need for efficient and reliable power distribution solutions.

Indian Transformer Industry

Transformer along with power transmission lines forms the core of a power transmission & distribution (T&D) infrastructure and an important part of substation infrastructure. A **substation** transforms or regulates voltage levels. It contains various equipment such as Transformers, Switches, Circuit breakers, Large metallic pipe called bus work, Support structures to terminate transmission lines and Communications equipment.

Transformers can be broadly categorized into following based on the output rating.

- **Power transformers:** Power transformers are used in transmission network of higher voltages for step-up and step down application. It should have a primary voltage rating of 33 kilo volt (kV) and above.
- **Distribution transformers**: Distribution transformers work at lower voltages. A distribution transformer is used to transform power voltage from transmission point to distribution of power to the end user.

Electricity generated at a power plant is transmitted to the nearest grid via step-up transformers and then to the state grid (via step-up or step-down transformers) and then to a power substation via step-down transformers. Finally, distribution transformers are used to transmit power from the sub-transmission point to end consumers.

- There are also specialized types of transformers. These are primarily used for welding, furnace etc. Special Transformers find application in industries like oil & gas, metal, steel for melting, refining, etc.
- Another classification of the transformer comprises current and voltage transformer (defined in unit volume), which together are referred as **instrument transformer**.

Based on application, transformers are also classified as industrial transformers or utility transformers. Based on technology, it can be divided into oil filled transformers and dry transformers.

Market Scenario

The Indian transformer industry is experiencing robust growth, driven by factors such as rapid urbanization, industrialization, and increasing demand for electricity. The estimated market size for FY 2024 is INR 333.3 billion, indicating a significant expansion in recent years. Several key trends are shaping the market landscape:

Infrastructure Development: India's ongoing infrastructure projects, including the construction of power plants, transmission lines, and distribution networks, are driving demand for transformers. The government's focus on smart cities and rural electrification initiatives is further fueling this growth.

Renewable Energy Expansion: The increasing adoption of renewable energy sources, such as solar and wind power, is creating a need for transformers to integrate these sources into the grid. This is contributing to the expansion of the transformer market.

Industrial Growth: India's thriving manufacturing sector, including automotive, electronics, and chemicals, is driving demand for electricity. This, in turn, is leading to increased demand for transformers for industrial applications.

Technological Advancements: Advances in transformer technology, such as the development of more efficient and compact designs, are enabling manufacturers to offer innovative products. This is driving the market towards higher-value products.

Government Policies: The government's focus on improving power infrastructure and promoting energy efficiency is creating a favorable environment for the transformer industry. Policies such as the National Electricity Policy and the National Solar Mission are supporting the growth of the market.

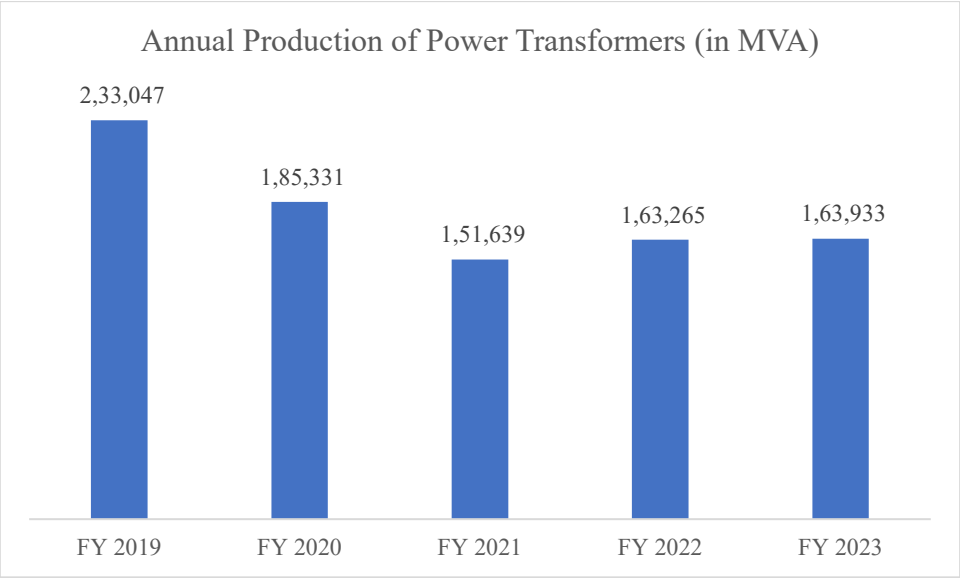
Despite the positive outlook, the Indian transformer industry faces challenges such as intense competition, rising raw material costs, and the need to comply with stringent quality standards. However, with the right strategies and investments, the industry is well-positioned to capitalize on the growing market opportunities and continue its expansion in the coming years.

Highest capacity addition in Indian power T&D industry happens in 220 kV and 400 kV voltage segment, with 765 kV having the smallest additions. However, pace of capacity addition in 765 kV segment is improving as power utilities shift to higher voltage level to transmit power with low operational losses. With this shift expected to continue, 765 kV segment would see the maximum addition in the years ahead.

Voltage Level	FY 2015	FY 2016	FY 2017	FY 2018	FY 2019	FY 2020	FY 2021
220 kV	12,084	24,804	5,292	5,487	21,145	21,140	21,920
400 kV	14,970	17,045	10,012	13,813	30,560	24,590	23,955
765 kV	38,500	19,500	5,705	3,819	21,000	19,500	7,700
+/- 500 kV HVDC	-	-	2,574	-	-	-	-
+/- 800 kV HVDC	-	1,500	-	-	-	3,000	3,000
All India	65,554	62,849	23,583	23,119	72,705	68,230	56,575

Source: Central Electricity Authority, Ministry of Power

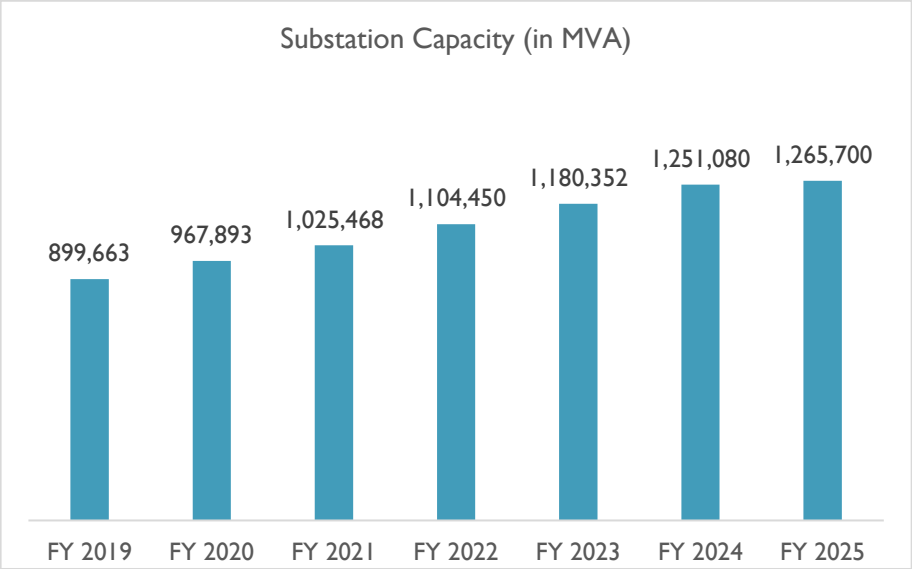
The slowdown in transmission capacity addition in the power T&D segment have led transformer manufacturers to revise their annual production volume. Annual production of transformers fell from a high of approximately 233,047 MVA in FY 2019 to an estimated 163,933 MVA in FY 2023. The decline in FY 2020 could be solely attributed to the economic slowdown, while in FY 2021 disruption in production due to Covid-19 restrictions further deteriorated the prevalent unfavourable environment.



Source: Center for Monitoring Indian Economy (CMIE)

Substations in India: Historical Growth and Voltage-Wise Distribution

Over the past several years, India's substation capacity has experienced robust growth, reflecting the expansion of the country's power infrastructure to meet increasing electricity demand. From FY 2019 to FY 2024, the total substation capacity has grown from 899,663 MVA to 1,251,080 MVA, representing a substantial increase. This growth equates to a Compound Annual Growth Rate (CAGR) of 5.9%, demonstrating a consistent investment in strengthening and expanding the country's power distribution network.



Source: Niti Aayog, India Climate & Energy Dashboard

In FY 2019, the total substation capacity was 899,663 MVA. This capacity increased to 967,893 MVA in FY 2020 and further rose to 1,025,468 MVA in FY 2021. The upward trend continued with the capacity reaching 1,104,450 MVA in FY 2022. By FY 2023, the total capacity had grown to 1,180,352 MVA. The most recent data for FY 2024 shows a significant jump to 1,251,080 MVA, with projections for FY 2025 estimating a capacity of 1,265,700 MVA. This growth underscores the ongoing efforts to enhance power distribution and support the country's increasing energy needs.

Voltage-Wise Substation

As of July 2024, India's substation distribution reveals significant variations across different voltage levels and sectors. At the 220 kV level, most substations are state-owned i.e. 455,599 with Central and Private sectors contributing 14,521 and 1,957 substations, respectively. For the 400 kV level, the Central sector leads with 212,420 substations, followed closely by the State sector with 221,653 and the Private sector with 28,350. The 500 kV level shows a smaller number of substations, with the Central sector having 9,500, the Private sector 2,500, and the State sector 1,500. At 765 kV, the Central sector dominates with 238,700 substations, while the Private and State sectors have 31,000 and 28,000 substations, respectively. Lastly, at the 800 kV

and 320 kV levels, the Central sector has 18,000 and 2,000 substations, with no contributions from the Private or State sectors at these voltage levels.

Voltage Level	Central	Private	State
220 kV	14,521	1,957	455,599
400 kV	212,420	28,350	221,653
500 kV	9,500	2,500	1,500
765 kV	238,700	31,000	28,000
800 kV	18,000	-	-
320 kV	2,000	-	-

The growth in substation capacity over the years and the bifurcation of substations across various voltage levels reflect India's commitment to expanding and modernizing its power infrastructure. The increasing capacity and strategic distribution of substations are critical to ensuring a reliable and efficient power supply across the country, supporting both current and future energy demands.

Demand Drivers

The demand for power transformers is directly dependent on expansion as well as modernization of power transmission capacity. Government objective of 100% electrification as well as higher demand for uninterrupted power from industrial and domestic consumers have led to sustained investment in increasing the transmission capacity in the country.

In addition, integration of renewable power into national grid along with need for smart transmission – due to the rise of electric charging stations and digitization & automation across industrial consumers have created the need for smart transformers that can control power transmission in an intelligent way. To meet this emerging need utilities will have to upgrade the transmission capability, by installing smart transformers that can independently regulate voltage, along with intelligent monitoring and diagnostic features.

These two developments will be the key demand drivers in the power transformer industry in the coming years.

From an end user perspective, initiatives like increasing electrification of railway infrastructure, growth in demand from industrial consumers due to large scale industrial growth, and higher demand from domestic consumers as the usage of electrical appliances goes up will create higher demand for power. This will in turn require expansion and upgradation of transmission capability creating demand for power transformers.

Growth in transmission infrastructure

The Ministry of Power has made significant strides in enhancing India's transmission infrastructure under Prime Minister Shri Narendra Modi's leadership. The recently finalized National Electricity Plan (2023-2032) aims to expand the transmission network from 485,000 circuit kilometres (ckm) in 2024 to 648,000 ckm by 2032, accommodating a projected peak demand of 458 GW. This ambitious plan, with a total estimated cost of approximately INR 9.15 trillion, includes the addition of nine High Voltage Direct Current (HVDC) lines, boosting inter-regional transfer capacity from 119 GW to 168 GW. Recently, the Ministry approved 50.9 GW of transmission capacity, focusing on renewable energy evacuation, while also achieving the electrification of 83,596 Particularly Vulnerable Tribal Group (PVTG) households. Despite challenges like land acquisition and regulatory hurdles, the Ministry's initiatives aim to ensure energy security and facilitate the integration of renewable sources into the grid, marking a pivotal step towards a sustainable energy future for India.

Integration of renewable energy / variable renewable energy (VRE)

India is aggressive increasing its installed generation capacity in renewable space, with total installed generation capacity in renewable space reaching nearly 96 GW (as on 31st May 2021). This accounted for nearly one fourth of the total installed generation capacity in India. During the month of April 2021, approximately 10.7 BU of power was generated from renewable sources, accounting for 11% of total power generation in the country during the month.

Solar and wind energy dominate Indian renewable energy domain, and generation centers are often located in far off location. This creates the need for a robust transmission infrastructure to facilitate of transfer of power from origin to destination. Moreover, the variable nature of power generated and the need for power evacuation meant the transmission infrastructure creates a strong demand for power transformers that will beef up the transmission capability.

The integration of Variable Renewable Energy (VRE) is pivotal for India's transition to a sustainable energy future, aiming for 500 GW of renewable capacity by 2030. The National Electricity Plan (2023-2032) addresses this by expanding the transmission network to 648,000 circuit kilometres (ckm) and approving 50.9 GW of transmission capacity for VRE. With a focus on evacuating 280 GW of VRE to the Inter-State Transmission System (ISTS) by 2030, the plan emphasizes investments in advanced grid technologies and energy storage solutions. By overcoming integration challenges, India can maximize its renewable potential, reduce emissions, and secure energy for its growing economy.

Demand from railway electrification initiatives

In railway transportation, transformers are used to reduce the voltage level received from overhead lines to make it suitable to power essential train functions like traction, lighting, brakes and heating & ventilation. Indian Government has announced a plan to achieve 100% rail electrification by 2023 and make Indian railways a net zero carbon emitter by 2030. As part of that, railways are investing in aggressively scaling up freight capabilities and is electrifying the remaining lines. This initiative has seen Indian railways floating several tenders for procuring transformers, with leading global supplies like ABB securing multi million dollar contracts. With a significant percentage of railway network yet to be electrified, the opportunities created by rail electrification is immense.

Demand from industrial sector

Industrial production has increased by leaps and bounds in the last decade alone, on the back of increasing demand. Billions of rupees worth of investments has gone into expand production capacity as well as modernizing the manufacturing infrastructure across all sectors. The growth in industrial production has increased the electricity consumption. Along with increase in power generation, this development also required improving the transmission infrastructure to bring down the voltage to levels that is combatable for usage. Similarly, electricity demand has increased from domestic households too, with increase in electrified homes as well as growth in the number of electronic and electrical appliances used.

Regulatory Scenario

Indian capital goods sector has been completely decontrolled to allow a level playing field for private companies. No industrial license is required for entry into this sector. Similarly, the quantum of payment for technology transfer, design & drawing, royalty etc to foreign collaborator has no limit. Up to 100% foreign direct investment is permitted in the sector and there are no restrictions/limits on import-export activities.

Removal of restrictive industrial licensing norms, easing regulations for private companies to enter the sector as well as relaxation of foreign direct investments (FDI) are few of the regulatory initiatives. In the FDI front, the Government currently allows up to 100% FDI under automatic route in most of the segments within the capital goods sector.

National Goods Policy, announced in 2016, is expected to be the key regulatory framework that would guide domestic capital goods manufacturing industry in the coming years. Primary objective of the policy includes increasing the annual production value of capital goods in the country to INR 750,000 Crore by 2025, up from INR 230,000 Crore that was prevailing in FY 2015. This policy, along with Make in India scheme, and the Atmanirhar Bharat Abhayan (in May 2020) is expected to fuel the capital goods industry in India in the coming years.

Future Scenario

The Indian transformer industry is experiencing a period of robust growth, driven by a confluence of factors. The market size is projected to expand significantly from INR 333.3 billion in FY 2024 to INR 522.98 billion by FY 2030 at a CAGR of ~8%. This growth trajectory is underpinned by the escalating demand for electricity, a consequence of rapid urbanization, industrialization, and a burgeoning economy.

Government initiatives are also playing a pivotal role in fostering the industry's growth. The government's emphasis on infrastructure development, renewable energy, and smart grids is creating a conducive environment for the transformer industry. These initiatives are driving investments in power transmission and distribution networks, renewable energy projects, and energy-efficient technologies, thereby stimulating demand for transformers.

Moreover, advancements in transformer technology are poised to fuel market expansion. Innovations in design, materials, and manufacturing processes are enabling the development of more efficient, reliable, and compact transformers. These technological advancements are enhancing the performance and capabilities of transformers, making them more attractive to customers and driving demand.

While the industry faces challenges such as competition and rising raw material costs, the overall outlook remains optimistic. The increasing demand for electricity, coupled with supportive government policies and technological advancements, presents significant opportunities for growth. The Indian transformer industry is well-positioned to capitalize on these opportunities and emerge as a global leader in the coming years.

Transformer Components Industry

Product overview

Transformers are essential devices in electrical power systems due to their ability to efficiently transfer electrical energy between different voltage levels. This capability is crucial for various applications, including long-distance power transmission, local distribution, and industrial processes. By stepping up or stepping down voltages, transformers enable the optimal transmission and utilization of electrical energy. This not only improves efficiency but also ensures safety and reliability in power systems. Each component plays a crucial role in the efficient and safe operation of these devices.

Component	Description
Core	The core is the magnetic heart of a transformer. It is typically made of laminated steel sheets, which help reduce eddy current losses. The core's shape and material determine the transformer's efficiency and magnetic properties.
Windings	Windings are coils of insulated copper or aluminum wire wrapped around the core. There are two types of windings: primary and secondary. The primary winding receives electrical power from the source, while the secondary winding delivers the transformed power to the load. The number of turns in each winding determines the voltage ratio of the transformer.
Insulation	Insulation is essential to prevent electrical short circuits between windings and the core. It is typically made of paper, oil, or synthetic materials. The quality and type of insulation directly affect the transformer's reliability and lifespan.
Bushings	Bushings are electrical connectors that provide a safe and reliable connection between the transformer and the external electrical system. They are typically made of porcelain or epoxy resin and

	are designed to withstand high voltages and environmental conditions.
Cooling System	Transformers generate heat during operation. A cooling system is necessary to dissipate this heat and prevent the transformer from overheating. Cooling systems can be air-cooled, oil-cooled, or water-cooled, depending on the size and power rating of the transformer.
Oil	In oil-filled transformers, oil serves as both a coolant and an insulating medium. It helps to transfer heat from the core and windings to the cooling system and provides additional insulation.
Tap Changer	Some transformers have a tap changer, which allows for adjusting the voltage ratio of the transformer. This is useful for maintaining a constant voltage level in the secondary circuit, even when the load or source voltage fluctuates.
Breakers	Breakers are protective devices that can interrupt the flow of current in the transformer if a fault occurs. They help to prevent damage to the transformer and the surrounding electrical system.

Types of Core Material and their applications in transformers

Transformers rely on magnetic cores to channel and concentrate the magnetic flux generated by the windings. The choice of core material significantly impacts the transformer's efficiency, size, and cost. Three common types of core materials are Cold Rolled Grain Oriented (CRGO) steel, amorphous core, and magnetic core.

Cold Rolled Grain Oriented (CRGO) Steel

CRGO steel is a specialized material renowned for its exceptional magnetic properties, making it a preferred choice for transformer cores. The manufacturing process involves cold rolling steel sheets and then annealing them in a magnetic field. This treatment aligns the iron crystals in a specific direction, significantly enhancing the material's magnetic characteristics. The aligned grains minimize energy losses due to eddy currents, leading to higher efficiency and lower operating temperatures in transformers. CRGO steel's combination of

high magnetic permeability and low core losses makes it particularly suitable for large power transformers, where energy efficiency and reliability are paramount.

Global and Indian Players

Category	Company	Overview
Global Players	**Thyssenkrupp**	Thyssenkrupp is a leading global producer of electrical steel and has established its first CRGO steel plant in India, located in Nashik, Maharashtra. This facility has a production capacity of 50,000 tonnes annually, making it a significant player in the Indian CRGO market.
	NLMK Group	NLMK Group, a major global steel producer, is expanding its operations in India by setting up a CRGO steel manufacturing facility in Maharashtra. The new plant will have a production capacity of 64,000 tonnes per annum, addressing about 20% of India's current demand for CRGO steel.
	JFE Steel	JFE Steel, a prominent Japanese steel manufacturer, is collaborating with JSW Steel to form a joint venture in Karnataka, India. This partnership aims to produce a comprehensive range of CRGO steel products to meet the increasing demand for electrical steel in the region.
Indian Players	**Steel Authority of India Limited (SAIL)**	Steel Authority of India Limited (SAIL) is a major steel producer in India and is involved in the CRGO steel market. SAIL's overall production includes various steel products, with capacities in flat products relevant to electrical steel. The company is likely focusing on expanding its capabilities in response to rising domestic demand for CRGO steel. SAIL is looking forward to enhancing its CRGO production to reduce reliance on imports and better meet local needs.
	Jindal Steel & Power Limited (JSPL)	Jindal Steel & Power Limited (JSPL) is actively involved in the production of Cold-Rolled Grain-Oriented (CRGO) steel, essential for transformer and electrical applications. JSPL is enhancing its production capabilities for value-added steel products, including CRGO. The company's facilities are equipped to produce a range of steel grades. JSPL's focus on advancing its capabilities aligns with the growing demand for CRGO steel in the market.

	TATA Steel	Tata Steel is advancing CRGO steel production in India through collaborations with the Indian government and research institutions. The company is involved in developing indigenous CRGO technology with the Department of Scientific and Industrial Research (DSIR) and the National Metallurgical Laboratory (NML). A pilot plant is planned at NML in Jamshedpur to produce CRGO steel using new, locally developed processes, supported by a detailed report from Mecon.

Amorphous Core

Amorphous cores are constructed from non-crystalline alloys, often comprising iron, nickel, and boron. Unlike crystalline materials with a regular atomic structure, amorphous alloys exhibit a random arrangement of atoms. This unique structure effectively reduces eddy current losses, resulting in significantly higher efficiency compared to traditional CRGO steel, especially at higher frequencies. Amorphous cores are commonly employed in high-frequency transformers, such as those found in electronic devices and power supplies. Their superior efficiency and reduced heat generation contribute to improved performance and extended lifespan in these applications.

Magnetic Core

Magnetic cores can be fabricated from a variety of materials, including iron, silicon steel, and ferrites, each with distinct magnetic properties that suit specific applications. Iron cores are often utilized in low-frequency transformers due to their high saturation flux density, allowing them to handle larger magnetic loads. Silicon steel cores are well-suited for medium-frequency transformers, offering a balance between magnetic properties and cost. Ferrites, a class of ceramic materials, are commonly employed in high-frequency applications due to their low eddy current losses and high electrical resistivity. The selection of the appropriate core material depends on the transformer's

Market Scenario of CRGO Transformer Components in India

The market for CRGO transformer components in India has been steadily expanding in recent years, driven by the nation's rapid industrialization, urbanization, and increasing demand for electricity. CRGO steel, a high-quality electrical steel, is a crucial component in transformers, essential for power transmission and distribution.

With an estimated market size of INR 66.7 billion[3] in FY 2024, CRGO transformer components have witnessed significant growth. This growth is attributed to several factors, including:

- ***Infrastructure Development:*** India's ongoing infrastructure projects, such as smart cities, industrial parks, and transportation networks, have led to a surge in demand for transformers.
- ***Renewable Energy Expansion:*** The growing emphasis on renewable energy sources, such as solar and wind power, has necessitated the installation of numerous transformers for grid integration and local distribution.
- ***Industrial Growth:*** The expansion of various industries, including manufacturing, automotive, and electronics, has increased the demand for electrical power, driving the need for transformers.
- ***Technological Advancements*:** Advances in transformer technology, such as the development of more efficient and compact designs, have contributed to the growth of the market.

Despite the positive outlook, the market for CRGO transformer components in India faces certain challenges. The availability of high-quality CRGO steel at competitive prices is a critical factor. Additionally, the increasing competition from imported components and the need to comply with stringent quality standards can pose challenges for domestic manufacturers.

To capitalize on the growing market opportunities, Indian manufacturers are focusing on:

- ***Capacity Expansion:*** Investing in new production facilities to meet the rising demand for CRGO transformer components.
- ***Technological Upgradation:*** Adopting advanced manufacturing techniques and quality control measures to improve product efficiency and competitiveness.
- ***Research and Development:*** Investing in research and development to develop innovative products and solutions that cater to the evolving needs of the market.
- ***Strategic Partnerships:*** Collaborating with domestic and international players to strengthen supply chains and access new markets.

Overall, the market for CRGO transformer components in India is poised for continued growth, driven by the nation's economic development and increasing demand for electricity. By addressing the challenges and

[3] D&B Research Estimates, Industry Articles

capitalizing on the opportunities, Indian manufacturers can play a significant role in meeting the growing demand for these essential components.

CRGO Steel Scenario in India

India is grappling with a severe shortage of Cold Rolled Grain Oriented (CRGO) steel, a critical material used in the production of distribution and power transformers that are essential to the country's power grid. The shortage arises from the requirement to meet Bureau of Indian Standards (BIS) certifications and the absence of domestic manufacturing capacity until 2027.

This supply disruption has been worsened by the expiration or non-renewal of export licenses previously granted by the BIS to major exporters from China, a key supplier of CRGO steel to India. Several Chinese manufacturers have since halted exports to the Indian market, significantly curbing the flow of CRGO steel. India has traditionally relied on imports from China, South Korea, Japan, and Europe, all of which are required to meet BIS regulations under IS 3024 (2006).

As a result, the limited availability of CRGO steel is anticipated to drive prices higher, creating additional challenges for India's transformer manufacturing industry. With an annual demand for 325,000 tons of CRGO steel, the shortage is especially severe for the Hi-B grade, which is crucial for high-efficiency transformers. Globally, CRGO production stands at approximately 3 million tons, with China accounting for 45% of the supply. Industry leaders have called for easing import restrictions from Chinese mills such as Bao, Wisco, and Shougang to stabilize the supply chain and meet demand.

While a few Japanese and European suppliers continue to export CRGO steel to India, their capacity is limited and cannot sufficiently address the country's growing requirements. Government agencies and distribution companies (DISCOMs), which procure transformers made from CRGO steel, are already facing difficulties due to the constrained supply.

This shortage is likely to have a ripple effect across the energy sector, affecting the timely production of transformers and potentially increasing costs for DISCOMs. Without immediate solutions, the restricted availability of CRGO steel may slow down infrastructure development, leading to reduced consumption in the short term and forcing manufacturers to explore alternative materials or reduce production output. The industry continues to appeal for renewed import permissions to alleviate the supply shortage and ensure the stability of India's critical power infrastructure.

Key Applications of CRGO Steel

- Transformer Cores

The predominant application of CRGO steel is in the production of transformer cores, accounting for approximately 98% of its total usage. This includes large power transformers, distribution transformers, and smaller transformers. CRGO steel's high magnetic permeability allows transformers to operate more

efficiently by reducing energy losses, which directly contributes to improving overall power grid performance. The material also plays a vital role in minimizing eddy current losses, making it an ideal choice for energy transmission and distribution systems.

- Noise and Vibration Reduction

One of the unique attributes of CRGO steel is its reduced magnetostriction, which directly results in lower levels of noise and vibration during operation. This property is particularly advantageous in environments where noise reduction is critical, such as residential areas or facilities requiring quiet operation. By utilizing CRGO steel in transformer cores, manufacturers can ensure smoother and quieter device performance, enhancing the quality and efficiency of electrical systems.

- Lamination in Transformers

CRGO steel is also extensively used in transformer core lamination, a process where thin sheets of the material are layered to form the core. This technique minimizes material usage while maintaining optimal performance. The lamination of CRGO steel helps reduce magnetic losses by preventing eddy currents, further contributing to the energy efficiency of transformers. Laminated CRGO steel cores are a standard in modern transformer design, underscoring the material's importance in reducing power losses and enhancing durability.

- Energy-Saving Electrical Devices

Given its low core loss properties, CRGO steel is widely used in the production of energy-efficient electrical devices. Its ability to minimize energy wastage in transformers and electrical machinery supports the broader goal of energy conservation. By employing CRGO steel in energy-saving devices, manufacturers can lower operational costs while enhancing overall energy efficiency, which is increasingly important as global demand for efficient power systems grows.

- Winding in Motors and Generators

In addition to transformers, CRGO steel is critical in winding processes for motors and generators. The material’s excellent magnetic properties facilitate smoother winding, which is essential for manufacturing efficient electrical machines. The use of CRGO steel in motor windings improves the machines' overall performance and energy conversion, contributing to the efficiency of industrial and power generation applications.

- Current Transformers and Shunt Reactors

CRGO steel is also used in current transformers and shunt reactors, both of which are integral to electrical systems. Current transformers, which measure and control the flow of electricity, and shunt reactors, which help stabilize voltage levels, rely on the unique properties of CRGO steel to enhance their performance and

accuracy. In both applications, the material's low core loss and high permeability improve system reliability and efficiency.

- Power Generators

Power generators, particularly those used in energy production facilities, benefit from the application of CRGO steel in their cores. The material's magnetic characteristics ensure that power generators operate with minimal energy loss, which is crucial for maximizing energy output and maintaining operational efficiency. The role of CRGO steel in these generators further highlights its importance in the broader energy sector.

CRGO Steel Imported to India

India's CRGO steel import trends show a fluctuating pattern over recent year. In FY 2019, the country imported 278.2 thousand tonnes of CRGO steel, which marked the highest level in the observed period. However, this figure decreased significantly to 209.9 thousand tonnes in FY 2020, followed by a further decline to 164.2 thousand tonnes in FY 2021. A moderate recovery was seen in FY 2022, with imports rising to 195.0 thousand tonnes, although they dipped slightly again in FY 2023 to 191.4 thousand tonnes. In FY 2024, a notable surge occurred with imports reaching 236.5 thousand tonnes, and for the first quarter of FY 2025 (April-June 2024), the imports stood at 57.7 thousand tonnes, indicating continued demand for CRGO steel in the Indian market.

Source: Ministry of Commerce

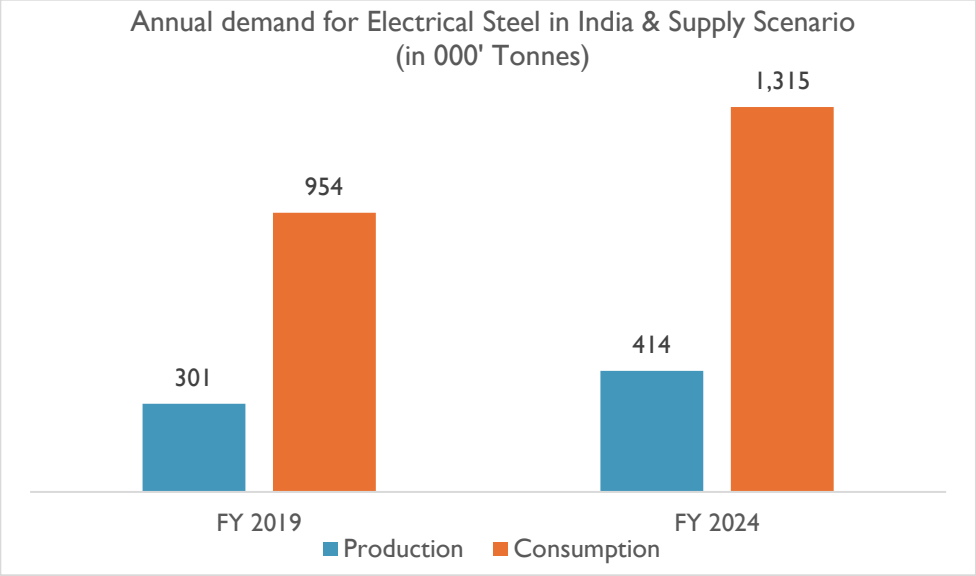
While imports have shown variability, exports of CRGO steel have been minimal, emphasizing India's reliance on foreign suppliers for this critical material. Exports reached a peak of 11.07 thousand tonnes in FY 2023, but they dropped to 4.88 thousand tonnes in FY 2024, with a merger 0.04 tonnes exported in the first quarter of FY 2025. This imbalance between imports and exports highlights India's ongoing demand for CRGO steel and the challenges posed by its limited domestic production capacity.

India is making strides in electrical steel production, but it still imports a significant portion to meet domestic demand. As of FY 2024, India produces about 1,315 tonnes of electrical steel annually, while it imports around 4.88 thousand tonnes. Companies such as Jindal Steel & Power, JSW Steel, and Tata Steel are key players driving domestic production, especially for energy-efficient applications like transformers and motors. These companies are also investing in research to develop advanced electrical steel products.

The market for electrical steel is expected to grow as India's renewable energy and automotive sectors expand. Despite the country's growing production, a challenge remains in securing key materials like silicon, which is heavily imported, affecting the cost structure of electrical steel production in India.

Annual demand for Electrical Steel in India & supply scenario

Electrical steel, a high-quality electrical steel used primarily in transformers, generators, and motors, has been witnessing a steady increase in demand in India. This surge is primarily driven by the nation's rapid industrialization, urbanization, and the growing emphasis on renewable energy sources.



Source: CMIE Industry Outlook

Production of electrical steel in India has been on the rise, with a notable increase from 301 thousand tonnes in FY 2019 to 414 thousand tonnes in FY 2024. However, the consumption of electrical steel has outpaced production during this period, indicating a growing demand-supply gap. In FY 2019, consumption stood at 954 thousand tonnes, while it rose to 1315 thousand tonnes in FY 2024.

This widening gap between supply and demand can be attributed to several factors. The increasing adoption of electric vehicles, coupled with the expansion of renewable energy infrastructure, has significantly boosted the demand for electrical steel. Moreover, the nation's infrastructure development projects, such as smart cities and transportation networks, have also contributed to the rising consumption of this specialized steel.

To address this growing demand-supply imbalance, India's steel industry is taking steps to enhance electrical steel production capacity. Investments in new production facilities and technological advancements are being made to ensure adequate supply to meet the country's growing needs. Additionally, efforts are being undertaken to improve the quality of domestically produced electrical steel to compete with imports.

However, the increasing demand for electrical steel, particularly in the context of India's ambitious renewable energy targets, presents a significant challenge. To bridge this gap, it will be crucial for the Indian steel industry to continue investing in capacity expansion, technological innovation, and quality improvement. Furthermore, government policies and incentives can play a vital role in supporting the growth of the electrical steel sector and ensuring a sustainable supply to meet the nation's evolving needs.

Key demand drivers

Infrastructure Development

India's rapid urbanization and industrialization have spurred significant investments in infrastructure projects. The construction of new power plants, transmission lines, and distribution networks necessitates a substantial number of transformers to ensure efficient power delivery. As India continues to modernize and expand its urban areas, the demand for transformers will remain high.

Renewable Energy Expansion

India's commitment to renewable energy has led to a surge in the installation of solar and wind power plants. These renewable energy sources require transformers to integrate their power output into the existing grid. As India transitions towards a cleaner energy mix, the demand for transformers will continue to grow.

Industrial Growth

India's thriving manufacturing sector, including automotive, electronics, and chemicals, is a major driver of economic growth. These industries require reliable and efficient power supply to operate effectively. Transformers play a crucial role in ensuring a stable and uninterrupted power supply to these industrial facilities.

Smart Grid Initiatives

The government's focus on developing smart grids, which enable more efficient and reliable power delivery, has created a demand for advanced transformers with intelligent features. These transformers can help optimize power distribution, reduce losses, and improve grid stability.

Rural Electrification

India's ongoing rural electrification programs aim to provide electricity to all households, including those in remote areas. This initiative requires a significant number of transformers to distribute power to rural communities. As more rural areas become electrified, the demand for transformers will continue to rise.

Economic Growth

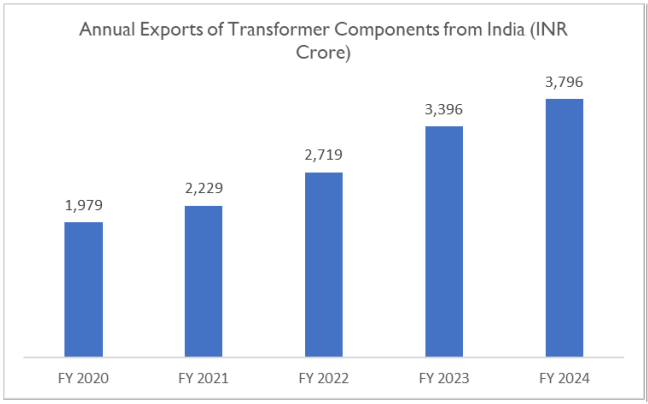
India's overall economic growth and rising living standards have led to increased demand for electricity in both residential and commercial sectors. As people's incomes rise and lifestyles improve, they consume more electricity, driving the need for transformers.

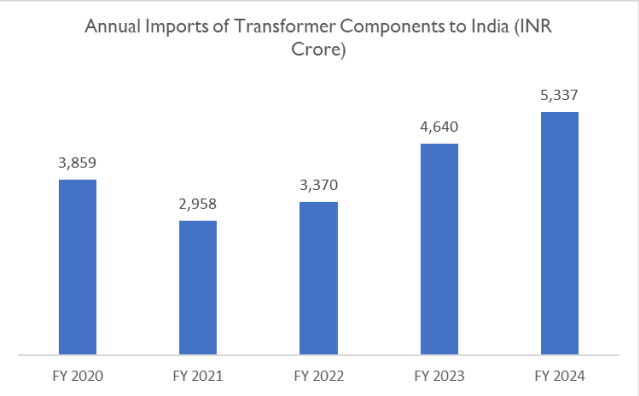
Government Policies

Government policies promoting energy efficiency and renewable energy have created a favorable environment for the transformer industry. These policies have encouraged investments in new transformer projects and technologies, while also fostering a sustainable energy future.

Import-Export Scenario of Transformer accessories & components

The Indian transformer component industry has witnessed a steady increase in both exports and imports in recent years. However, there is a widening gap between imports and exports, indicating a growing reliance on foreign suppliers for certain components.





Source: DGFT

Annual exports of transformer components from India have exhibited a consistent growth trend. In FY 2020, exports stood at INR 1979.03 crore, and they have steadily increased to INR 3796.16 crore in FY 2024. This growth is indicative of the increasing competitiveness of Indian manufacturers in the global market.

On the other hand, annual imports of transformer components to India have also been on the rise. While imports declined from INR 3859.17 crore in FY 2020 to INR 2957.55 crore in FY 2021, they have subsequently increased to INR 5336.66 crore in FY 2024. This suggests that despite the growth in domestic production, India still relies on imports to meet a significant portion of its demand for transformer components.

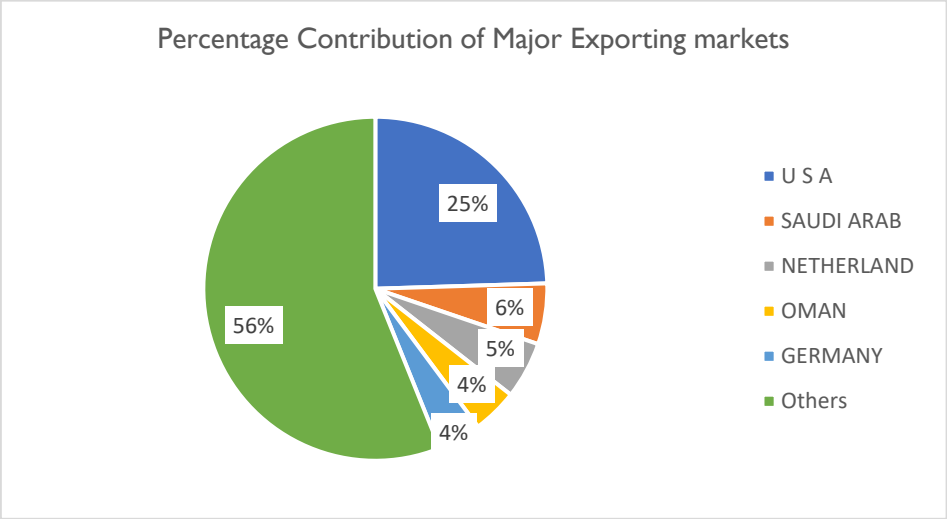
The growing gap between imports and exports can be attributed to several factors. One key reason is the increasing complexity and specialization of transformer components. Certain components, such as high-voltage winding conductors or advanced cooling systems, may require specialized manufacturing capabilities

that are not readily available domestically. Additionally, factors like cost competitiveness, lead times, and quality standards can influence the decision to import components.

To bridge this gap and reduce reliance on imports, the Indian transformer component industry needs to focus on addressing challenges and focusing on enhancing domestic capabilities, which will pave way for the Indian transformer component industry to reduce its reliance on imports and become more self-sufficient. This will not only contribute to the growth of the domestic manufacturing sector but also enhance the overall competitiveness of the Indian transformer industry in the global market.

Top Export Markets

The Indian transformer component industry has been making significant strides in the global market, with exports to various countries around the world.



Source: DGFT

The USA remains the largest export market for Indian transformer components, accounting for a substantial 25% of total exports. The strong economic growth and infrastructure development in the US have driven demand for high-quality transformers, making it a lucrative market for Indian manufacturers.

Saudi Arabia is another important export market for Indian transformer components, contributing 6% to the total exports. The country's ambitious infrastructure projects and growing energy sector have fueled the demand for transformers, providing opportunities for Indian manufacturers.

The Netherlands, a key player in the global energy sector, imports a significant quantity of transformer components from India. With its focus on renewable energy and grid modernization, the Netherlands has emerged as a valuable market for Indian manufacturers.

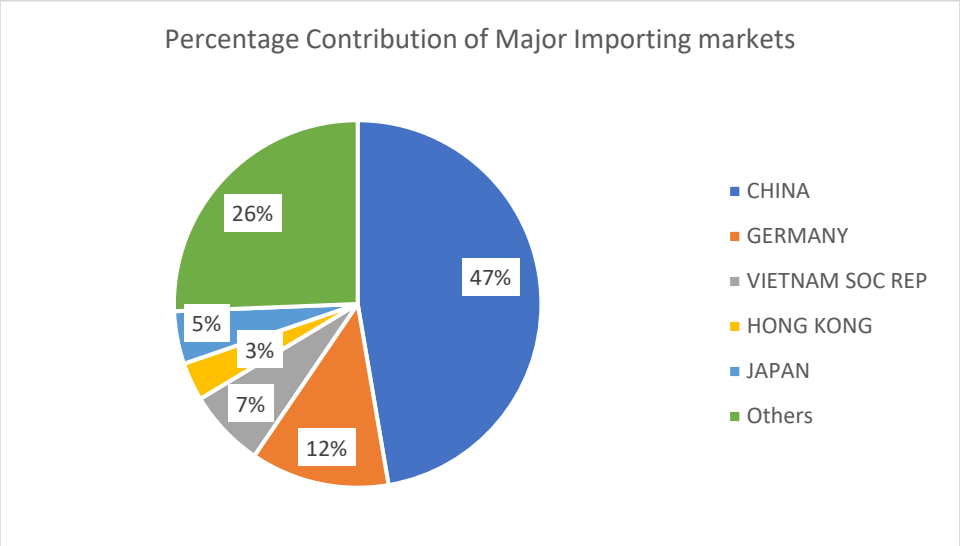
Oman, a developing economy with a growing industrial sector, is an emerging market for Indian transformer components. The country's infrastructure development projects and increasing demand for electricity have created opportunities for Indian manufacturers to supply transformers.

Germany, a leading industrial powerhouse, imports transformer components from India to meet its domestic demand. The country's focus on energy efficiency and renewable energy has driven the demand for high-quality transformers, providing a market for Indian manufacturers.

These five countries collectively represent a significant portion of India's transformer component exports, reflecting the growing global reach and competitiveness of the Indian industry. As India continues to enhance its manufacturing capabilities and improve product quality, it is expected to further strengthen its position in these and other international markets.

Top Import Markets

The Indian transformer component industry, while growing domestically, still relies on imports to meet a portion of its demand. The top 5 import markets for transformer components in India are:



Source: DGFT

China remains the largest source of imported transformer components for India, accounting for a significant 47% of total imports. China's vast manufacturing base and competitive pricing have made it a dominant player in the global transformer component market.

Germany, a leading industrial powerhouse, is another major supplier of transformer components to India. With its advanced manufacturing capabilities and high-quality products, Germany contributes 12% to India's transformer component imports.

Vietnam has emerged as a significant source of transformer components for India, accounting for 7% of total imports. Vietnam's growing manufacturing sector and competitive labor costs have made it an attractive destination for Indian importers.

Japan, known for its advanced technology and high-quality products, is a supplier of transformer components to India. While Japan's share of India's imports is 5%, it is a significant source of specialized components and technology.

Hong Kong, a major trading hub, is a source of transformer components for India, contributing 3% to the total imports. Hong Kong's strategic location and efficient logistics infrastructure make it a convenient gateway for importing components from other regions.

These five countries collectively represent a substantial portion of India's transformer component imports, reflecting the global nature of the industry. While India has been working to reduce its reliance on imports, these countries continue to play a vital role in meeting the domestic demand for transformer components.

Growth forecast

The CRGO transformer component industry in India is poised for significant growth in the coming years, driven by several factors. The market size is projected to increase from INR 66.66 billion in FY 2024 to approximately INR 104.60 billion in FY 2030[4] at a CAGR of ~8%.

Several key factors are contributing to this optimistic outlook. Firstly, India's ongoing infrastructure development, including the expansion of power grids, renewable energy projects, and industrialization, is driving a steady increase in demand for transformers. Secondly, the government's focus on smart grid initiatives and energy efficiency is creating opportunities for advanced transformer components.

Furthermore, the growing adoption of electric vehicles and the increasing penetration of renewable energy sources are expected to boost the demand for transformers. As India transitions towards a cleaner and more sustainable energy landscape, the need for efficient and reliable power distribution will drive the demand for high-quality transformer components.

Additionally, technological advancements in transformer design and manufacturing are enabling the production of more efficient and compact components. These advancements are expected to enhance the performance and reliability of transformers, further driving market growth.

To capitalize on this growth potential, Indian manufacturers are investing in research and development, capacity expansion, and quality improvement. By focusing on innovation and meeting the evolving needs of the market, the CRGO transformer component industry in India is well-positioned to achieve significant growth in the coming years.

Threats and Challenges

The transformer and transformer component industry in India, despite its growth potential, faces several challenges that could hinder its progress. Some of the key threats and challenges include:

Intense Competition: The global transformer market is highly competitive, with players from various regions vying for market share. Indian manufacturers must compete with established players from countries such as China, Germany, and the United States, which often have lower manufacturing costs and economies of scale.

[4] D&B Research and Estimates, Industry Articles

Raw Material Costs: The cost of raw materials, particularly copper and steel, can fluctuate significantly, impacting the profitability of transformer manufacturers. Rising raw material prices can reduce profit margins and make Indian products less competitive in the global market.

Regulatory Challenges: The transformer industry is subject to various regulatory requirements, including quality standards, safety regulations, and energy efficiency norms. Compliance with these regulations can be time-consuming and costly, adding to the operational challenges faced by manufacturers.

Technological Advancements: The rapid pace of technological advancements in the transformer industry, such as the development of advanced cooling systems and energy-efficient designs, can make it challenging for Indian manufacturers to keep up. Investing in research and development is crucial to remain competitive and meet the evolving market demands.

Supply Chain Disruptions: Global supply chain disruptions, such as those caused by geopolitical tensions or natural disasters, can impact the availability of raw materials and components, leading to production delays and increased costs.

Environmental Concerns: Increasing environmental regulations and concerns about the environmental impact of transformer manufacturing can pose challenges for the industry. Compliance with environmental standards and the adoption of sustainable practices are essential to ensure long-term sustainability.

Skilled Labor Shortage: The transformer industry requires skilled labor for design, manufacturing, and quality control. A shortage of skilled workers can hinder production efficiency and limit the industry's growth potential.

Addressing these challenges will be crucial for the long-term success of the Indian transformer and transformer component industry. By investing in research and development, improving manufacturing processes, and adapting to changing market dynamics, Indian manufacturers can overcome these obstacles and maintain their competitiveness in the global market.

Competitive Landscape

The Indian transformer component industry is characterized by a mix of organized and unorganized players, with varying levels of market fragmentation. While there are a few large, organized players with significant market share, the industry is still relatively fragmented, with numerous smaller, unorganized players operating in the market.

Competition from foreign players is intense, particularly from countries such as China, Germany, and the United States. These players often have lower manufacturing costs, economies of scale, and access to advanced technologies, making them formidable competitors. However, Indian manufacturers have been making strides in improving their competitiveness through investments in technology, quality, and capacity expansion.

Several factors influence competition within the Indian transformer component industry:

Price: Price is a significant factor driving competition, with manufacturers striving to offer competitive pricing to attract customers. However, quality and reliability are also important considerations, as buyers are increasingly seeking components that meet high standards.

Quality: The quality of transformer components is crucial for ensuring the efficient and reliable operation of transformers. Manufacturers that can deliver high-quality products have a competitive advantage.

Delivery Time: Timely delivery is essential in the transformer industry, as delays can impact project timelines and increase costs. Manufacturers with efficient supply chains and production processes can gain a competitive edge.

Customization: The ability to customize components to meet specific customer requirements can be a competitive advantage. Manufacturers that can offer tailored solutions can attract customers seeking unique products.

Technological Capabilities: Advanced manufacturing technologies and research and development capabilities can help manufacturers produce high-quality and innovative components.

Brand Reputation: A strong brand reputation can enhance a manufacturer's credibility and attract customers. Building a positive brand image through consistent quality and customer service is essential.

Overall, the Indian transformer component industry is becoming increasingly competitive, with both domestic and foreign players vying for market share. Manufacturers that can successfully navigate these competitive pressures by focusing on quality, innovation, and customer satisfaction will be well-positioned to thrive in the market.

Key Players Profiling

Company Name	Overview
Jay Bee Laminations	Established in 1988, Jay Bee Laminations Limited is a prominent manufacturer of CRGO Silicon steel cores for India's power and distribution transformer industry. With two manufacturing units in Noida (UP), the company specializes in producing CRGO and CRNGO steel cores used in transformers, inverters, reactors, and rectifiers. Jay Bee Laminations supplies to renowned manufacturers and operates with state-of-the-art facilities across 117,090 sq. ft., adhering to global quality standards. The company has over 250 customers, exports to more than 10 countries.

Vilas Transcore	Established in 1996 as a subsidiary of NJ Group under the leadership of Mr. Nilesh Patel, Vilas Transcore Limited has earned a prominent position in the CRGO processing industry. With over 27 years of experience, the company specializes in transformer lamination, toroidal cores, and CRGO slitted coils. Vilas Transcore is recognized for its reliable products, skilled workforce, and strong commitment to quality and customer satisfaction. The company maintains a global presence, exporting to countries such as the U.S., Canada, Turkey, and South Africa. Upholding values of excellence and integrity, Vilas Transcore aims to innovate and contribute to the electrical industry's growth.
KRYFS Power	KRYFS Power Components Ltd. is a leading transformer core manufacturer in India, with an annual capacity to convert 50,000 MT of CRGO electrical steel into transformer laminations and cores. Established in 1992, KRYFS has expanded its operations across 10 manufacturing facilities in India, offering a range of products from CRGO laminations and cores to transformers and transformer tanks. The company is known for its stringent quality control processes, advanced manufacturing technologies, and technical collaborations with global entities. It also engages in solar power generation, EPC transmission, and distribution services, contributing significantly to India's energy sector.
NLMK Group	NLMK Group is a leading global steel manufacturer, recognized for its vertically integrated business model with operations spanning mining and steelmaking in cost-efficient regions. It produces high-quality steel products, catering primarily to customers in Russia, North America, and the EU. NLMK's strategic advantage lies in its self-sufficiency in raw materials and energy, coupled with advanced technological production capabilities. The group holds a significant market share, accounting for 21% of Russian steel production in 2021, with an annual output of 14.5 million tonnes. NLMK employs 44,400 people and serves customers across 70 countries. Over the past decade, the company has invested $12.7 billion to enhance its operations.

Vardhman Stampings Pvt Ltd (VSPL)	Established in 1989, is a leading manufacturer of Cold-Rolled Grain-Oriented (CRGO) transformer laminations in India. With over 30 years of experience, the company is recognized as the fastest-growing and most future-oriented player in the CRGO sector. VSPL operates a state-of-the-art facility with a production capacity of over 30,000 MT per annum, the highest in India. Its emphasis on quality and innovation has earned it a loyal global clientele. Positioned as a key supplier in the Indian CRGO market, VSPL's expertise and focus on sustainability underscore its competitive strength.
Amod Stampings Pvt Ltd	Amod Stampings Pvt Ltd, established on April 3, 1995, in Baroda, Gujarat, is a key player in the Indian electrical steel sector, specializing in Cold-Rolled Grain-Oriented (CRGO) steel products. Amod Stampings manufactures CRGO steel laminations, transformer laminations, core coil assemblies, toroidal cores, and resin-molded transformers, positioning itself as a quality-driven supplier in the expanding electrical steel market.
Mahindra Intertrade Ltd	Mahindra Intertrade Ltd., operating under the brand Mahindra Accelo, is a prominent player in India's steel processing industry, particularly in Cold-Rolled Grain-Oriented (CRGO) steel products. Incorporated on March 20, 1978, the company is a key subsidiary of the Mahindra Group, specializing in CRGO laminations for transformers and high-grade steel products. With multiple manufacturing facilities across India and an international presence in Sharjah, UAE, Mahindra Accelo serves both domestic and global markets. The company is known for its strategic alliances, including collaborations with Japanese firms, and its commitment to sustainability by reducing carbon emissions and advancing the circular economy. Positioned as a leader in the electrical steel sector, Mahindra Accelo continues to drive innovation and contribute to the Mahindra Group's broader goals.

Financial Performance

Expense Snapshot

The financial performance of the Transformer industry has shown significant growth and dynamic changes in expenses over the period. Between FY 2019 and FY 2023, total sales have grown by a CAGR of 11%, indicating a robust expansion in the industry.

	Raw Material	Power & Fuel	Salary & Wage	SG&A	Interest
FY 2019	74.4%	0.9%	5.3%	2.6%	2.0%
FY 2020	73.8%	1.0%	6.4%	2.9%	2.3%
FY 2021	70.5%	1.0%	6.2%	2.8%	2.5%
FY 2022	74.1%	0.8%	5.3%	3.2%	1.6%
FY 2023	75.2%	0.7%	4.8%	2.7%	1.4%

Raw materials constitute the most significant expense for transformer component manufacturers, accounting for an average of 74.1% of total expenses during the period FY 2019-FY 2023. This highlights the industry's dependence on raw materials such as copper, steel, and insulation materials. Fluctuations in raw material prices can significantly impact the profitability of manufacturers.

Power and fuel expenses, while relatively small compared to raw material costs, have shown some variability over the years. These expenses have ranged from 0.7% to 1.0% of total expenses, indicating a moderate impact on overall costs

Salaries and wages account for an average of 5.3% of total expenses, suggesting a relatively low labor intensity in the industry. This could be attributed to the use of automation and efficient manufacturing processes.

SGA expenses, including marketing, sales, and administrative costs, have averaged around 2.9% of total expenses. This indicates a moderate level of spending on these activities.

Interest expenses have been relatively low, averaging around 1.9% of total expenses. This suggests that the industry has maintained a manageable level of debt financing.

Profitability Margins

	Operating Profit Margin	Net Profit Margin
FY 2019	10.3%	3.7%
FY 2020	10.5%	3.4%
FY 2021	12.1%	4.6%
FY 2022	12.9%	6.0%
FY 2023	12.7%	6.1%

The operating profit margin has shown a general upward trend, increasing from 10.3% in FY 2019 to 12.9% in FY 2022. This indicates improved profitability for the industry. The net margin, which takes into account interest and tax expenses, has also increased from 3.4% in FY 2019 to 6.1% in FY 2023. This suggests that the industry has been able to manage its financial costs effectively and generate higher profits.

Company Profile- Mangals Electricals Industries Limited[5]

Mangal Electrical Industries Limited, originally established as "Mangal Electrical Industries" under the Indian Partnership Act, 1932 on April 28, 1989, transitioned from a partnership firm to a private limited company on April 1, 2008, under Part IX of the Companies Act, 1956, becoming "Mangal Electrical Industries Private Limited." Subsequently, on July 25, 2024, it was converted into a public limited entity, now known as Mangal Electrical Industries Limited. The company specializes in processing transformer components, including transformer lamination, CRGO slit coils, amorphous cores, coil assemblies, core assemblies, wound cores, toroidal cores, and oil-immersed circuit breakers (ICBs). It also trades CRGO and CRNO coils, as well as amorphous ribbons. In addition, Mangal Electrical manufactures transformers with capacities ranging from single-phase 5 KVA to three-phase 10 MVA (medium power) units and provides EPC services for setting up electrical substations, catering to the power infrastructure sector.

The company is an Indian manufacturer renowned for producing high-quality transformer components. The company has developed a reputation for its expertise in the industry and its commitment to providing innovative and reliable solutions. Notably, Mangal Electrical Industries is both NABL and PGCIL Lab approved, underscoring its adherence to stringent quality standards.

Overview

- *Founded:* 1980
- *Headquarters:* Jaipur, Rajasthan, India
- *Products:* CRGO Slit Coils, CRGO Cut Laminations, CRGO Core Assemblies, Wound Cores, Amorphous Cores, Immersed Circuit Breakers
- *Certifications:* ISO 9001:2015 certified
- *Clients:* Renowned entities such as NTPC, PGCIL, Adani, Renew Power, and AVADA

Expertise and Services

Mangal Electrical Industries Ltd. offers a comprehensive range of services, including:

Custom Manufacturing: The company can tailor its products to meet specific customer requirements, ensuring optimal performance and efficiency.

[5] As per the information provided by company and public domain.

Research and Development: Mangal Electrical Industries is committed to innovation and invests in research and development to stay ahead of industry trends.

Quality Assurance: The company adheres to stringent quality control measures to ensure that its products meet the highest standards.

Key Strengths

- *Expertise in CRGO Products:* The company specializes in the manufacturing of CRGO (Grain-Oriented Electrical Steel) products, which are essential components in transformers.
- *Advanced Manufacturing Facilities*: Mangal Electrical Industries is equipped with state-of-the-art manufacturing facilities and machinery to ensure efficient production and high-quality output.
- *Customer Relationships:* The company is building relationships with its clients through its commitment to quality, reliability, and customer satisfaction.

Mangal Electrical Industries Limited continues to be in the transformer component manufacturing industry, offering innovative solutions and contributing to the growth of India's electrical sector.

Growth Forecast

The forecast for transformer demand between 2023 and 2030 reflects a consistent and stable requirement of 381 units annually, with the total transformer capacity maintained at 118,390 MVA each year. This steady demand highlights a well-coordinated and long-term approach to power infrastructure planning. By ensuring a constant supply of transformers, the power sector is positioned to meet the operational needs of the grid without interruptions. The stability in transformer capacity indicates that the industry is focused on sustaining robust power transmission infrastructure, which is crucial for maintaining grid reliability and supporting the growing energy needs of the country.

Year	Transformers (Units)	Transformer Capacity (MVA)	Reactors (Units)	Reactor Capacity (MVAR)
FY 2024	381	118,390	195	18,204
FY 2025	381	118,390	195	18,204
FY 2026	381	118,390	195	18,204
FY 2027	381	118,390	195	18,204
FY 2028	381	118,390	195	18,204
FY 2029	381	118,390	195	18,204
FY 2030	381	118,390	195	18,204

Source: Central Electricity Authority, Ministry of Power

From a manufacturing standpoint, the consistent demand for transformers presents a favourable environment for production planning and operational efficiency. Manufacturers can anticipate steady orders, allowing for long-term production strategies that reduce uncertainty. This predictability enables them to optimize their supply chains and potentially realize economies of scale, resulting in cost efficiencies. Moreover, the uniform

demand reduces the risk of overproduction or shortages, leading to better resource allocation and financial planning. By maintaining consistent manufacturing output, companies can ensure that they meet industry requirements while keeping operational costs in check.

The consistent investment in power transmission infrastructure reflects a strategic alignment with broader goals of enhancing grid reliability and capacity. This sustained focus on transformer demand ensures that the country is well-prepared for grid modernization and expansion initiatives. While the forecast does not incorporate potential advancements in transformer technology, it is essential to consider the evolving landscape, as future improvements in efficiency, materials, and design could impact the overall demand. Furthermore, high-voltage direct current (HVDC) projects, which will require significant converter transformer capacity, are expected to influence future transformer demand. Although not directly reflected in the table, these projects are a key component of the overall power infrastructure strategy and will play a vital role in shaping the transformer market in the coming years.

Peer Benchmarking

Key Indicators (INR Million)	Company Financials, FY 2024[6]				
	Mangal Electrical Industries Pvt Ltd	Mahindra Intertrade Ltd	Amod Stampings Pvt Ltd	Jaybee Laminations Pvt Ltd	Vilas Transcore Ltd
Revenue from Operations	4,495	33,408	4,868	3,029	3,097
EBITDA	464	1,942	528	322	347
PAT	215	1,330	264	194	231
EBITDA Margin (%)	10%	6%	11%	11%	11%
PAT Margin (%)	5%	4%	5%	6%	7%
ROA	9%	8%	10%	14%	11%
ROCE	30%	19%	33%	45%	20%
Net Worth	1,200	9,098	1,427	630	1,594
Long-term Debt	207	480	87	50	32
Debt Equity Ratio	0.17	0.05	0.06	0.08	0.02
Return on Equity	18%	15%	18%	31%	14%

Key Indicators (INR Million)	Company Financials, FY 2023						
	Mangal Electrical Industries Pvt Ltd	KRYFS Power Component Ltd	Mahindra Intertrade Ltd	Amod Stampings Pvt Ltd	Vardhaman Stampings Pvt Ltd	Jaybee Laminations Pvt Ltd	Vilas Transcore Ltd
Revenue from Operations	3,137	8,587	32,315	4,728	3,660	2,467	2,826
EBITDA	354	784	1,686	608	332	245	315
PAT	176	445	1,131	342	181	130	202
EBITDA Margin (%)	11%	9%	5%	13%	9%	10%	11%
PAT Margin (%)	6%	5%	3%	7%	5%	5%	7%
ROA	10%	7%	8%	12%	7%	11%	11%
ROCE	31%	19%	19%	48%	37%	47%	21%

[6] FY 2024 financial data for KRYFS Power Component Ltd and Vardhaman Stampings Pvt Ltd is unavailable.

Net Worth	702	3,450	8,222	1,164	522	436	1,370
Long-term Debt	335	104	34	52	341	69	36
Debt Equity Ratio	0.03	0.03	0.00	0.04	0.65	0.16	0.03
Return on Equity	25%	13%	14%	29%	35%	30%	15%

	Company Financials, FY 2022						
Key Indicators (INR Million)	Mangal Electrical Industries Pvt Ltd	KRYFS Power Component Ltd	Mahindra Intertrade Ltd	Amod Stampings Pvt Ltd	Vardhaman Stampings Pvt Ltd	Jaybee Laminations Pvt Ltd	Vilas Transcore Ltd
Revenue from Operations	2,184	5,048	24,513	2,651	2,762	1,633	2,330
EBITDA	216	567	2,042	291	246	128	289
PAT	61	342	1,439	116	103	58	179
EBITDA Margin (%)	10%	11%	8%	11%	9%	8%	12%
PAT Margin (%)	3%	7%	6%	4%	4%	4%	8%
ROA	3%	7%	10%	5%	6%	6%	10%
ROCE	20%	15%	26%	30%	33%	31%	21%
Net Worth	531	3,010	7,520	822	341	306	1,175
Long-term Debt	369	97	70	73	377	69	73
Debt Equity Ratio	0.70	0.03	0.01	0.09	1.11	0.22	0.06
Return on Equity	16%	11%	19%	14%	30%	19%	15%

The transformer sector in India continues to witness robust growth, driven by ongoing infrastructure development, the expansion of renewable energy projects, and a nationwide push towards grid modernization. Companies like Jaybee Laminations Pvt Ltd, Vilas Transcore Ltd, Mangal Electrical Industries Pvt Ltd, and others have shown consistent upward trends in revenues, reflecting the heightened demand for power generation and transmission solutions.

The industry's revenue growth from FY 2022 through FY 2024 can be attributed to government investments in infrastructure, renewable energy integration, and initiatives to improve energy efficiency. The increased need for advanced transformers to support solar, wind, and other renewable energy sources has further propelled demand. Modernization of aging grids and the integration of variable renewable energy (VRE) are also key drivers, creating opportunities for transformer manufacturers to provide higher capacity and technologically advanced products.

Operational efficiency improvements and economies of scale have led to steady EBITDA margin growth across the sector. Companies are optimizing production processes and expanding capacity to meet demand, which enhances profitability. This reflects the sector's ability to leverage cost management strategies, allowing firms to sustain or improve profit margins.

In terms of profitability indicators like ROCE and ROA, the sector has shown notable improvements. The financial health of many companies has strengthened, with reduced reliance on external debt financing and more efficient capital utilization. Many firms are funding expansions primarily through internal accruals or short-term borrowing, maintaining balanced and healthy debt-equity ratios.

Overall, the transformer industry is poised for continued growth, driven by infrastructure investments, modernization efforts, and the ongoing shift toward renewable energy. Companies are focusing on cost efficiency, capacity expansion, and technological advancements to remain competitive in this evolving market, all of which contribute to stronger financial performance.