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CONSULTING | RESEARCH | GRADING

Power Operation and Maintenance Industry

Industry Research- Sai Urja Indo Ventures Limited

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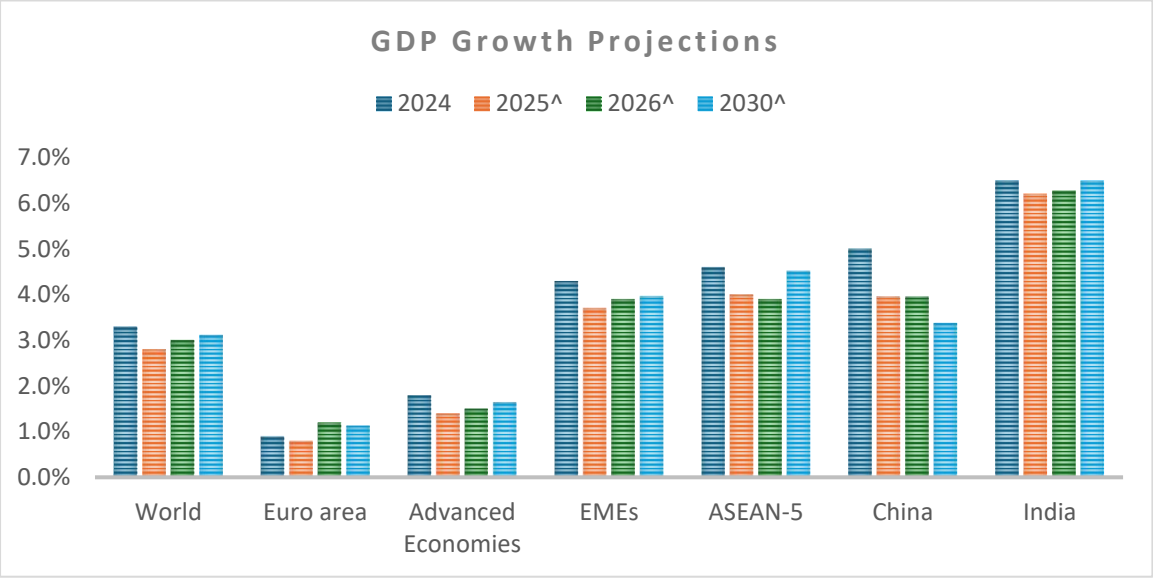
Global Economy

The global economy continues to face significant challenges following a series of adverse shocks in recent years. Rising trade tensions, persistent policy uncertainty, and increasing geopolitical risks are weighing heavily on economic growth and contributing to a deterioration in growth prospects across most of the world's economies. A major contributor to this slowdown is the resurgence of U.S. protectionist trade policies and higher tariffs under President Donald Trump's administration which disrupted global supply chains and dampened investor confidence. Uncertainties surrounding the tariff implications is keeping the global outlook fragile. Since the downside risks to the outlook predominate, the International Monetary Fund (IMF) revised its global growth projections downwards to 2.8% in 2025 from its earlier projections of 3.2%. Similarly for 2026 the projections are revised to 3.0% from 3.3%. A modest recovery is expected from 2027 onwards, still projections remain below the earlier forecasts.

According to IMF, the progress on the last mile of disinflation seems to have stalled, while headline inflation in Advanced Economies (AEs) has moved closer to targets, core inflation has been slower to fall, particularly on account of persistent services inflation. Inflation in Emerging Market Economies (EMEs) displayed a mixed but generally easing trend.

According to World Bank's Global Economic Prospects June 2025 report, global growth is expected to weaken to 2.3% in 2025, with deceleration in most economies relative to last year. The slowdown is largely due to a substantial rise in trade barriers and the pervasive effects of an uncertain global policy environment.

Going ahead, if a more protectionist trade environment emerges, it is likely to lead to a sharp contraction in trade volumes. There was already a slowdown in global trade and manufacturing activity in the recent period due to heightened uncertainty in the trade policy.



^ Projections, ASEAN-5: Indonesia, Malaysia, Philippines, Singapore, Thailand.

Source: IMF World Economic Outlook Update, April 2025

Global Inflation

Global headline inflation has remained somewhat elevated over the past year, briefly edging higher in advanced economies in early 2025. Tariff induced upward pressure on prices has begun to build along supply chains, particularly in advanced economies, with manufacturing surveys pointing to rising input and output prices. Inflation expectations have picked up in 2025, especially in some major economies. Inflation projections in 2025-26 have been revised slightly lower in EMDEs on account of weaker demand for traded goods, while being revised notably higher in advanced economies, primarily the United States. According to World Bank, Global inflation is projected to average 2.9% in both 2025 and 2026, before easing to 2.5% in 2027, almost in line with the average inflation target. However, there is significant heterogeneity across countries, with inflation projections revised slightly lower in EMDEs in 2025 due to the impact of weaker demand for traded goods, while being revised significantly higher in advanced economies, primarily the United States

Global Trade

World trade volume estimates are revised downward sharply for 2025 and 2026 by the World Trade Organization (WTO) in April 2025 due to a surge in tariffs and trade policy uncertainty. Based on the latest developments including the suspension of “reciprocal tariffs” by the United States, the WTO estimates volume of world merchandise trade to decline by 0.2% in 2025 before posting a modest recovery of 2.5% in 2026. The new estimate for 2025 is nearly three percentage points lower than it would have been without recent policy shifts and marks a significant reversal from the start of the year. Risks to the forecast include the possible reinstatement of the currently suspended “reciprocal tariffs” proposed by the United States, as well as the spread of trade policy uncertainty to non-US trade relationships.

The impact of recent trade policy changes varies sharply across regions. In the adjusted forecast, North America now subtracts 1.7 percentage points from global merchandise trade growth in 2025, turning the overall figure negative. Asia and Europe continue to contribute positively but less than in the baseline scenario, with Asia’s contribution halved to 0.6 percentage points. The combined contribution of other regions – Africa, the Commonwealth of Independent States (CIS), including certain associate and former member states, the Middle East, and South and Central America and the Caribbean – also declines but remains positive. Accordingly, WTO expect world GDP at market exchange rates to grow by 2.2% in 2025 – 0.6 percentage points below the no-tariff-change baseline – before slightly recovering to 2.4% in 2026.

Looking ahead, trade tensions may ease if major economies succeed in reaching lasting agreements that address ongoing trade disputes while recurring geopolitical hurdles along with increased incidence of extreme climate events undermine the growth momentum. Global growth outlook remains fragile, and deterioration is broad-based across the world’s economies and follows sharp increases in trade tensions and policy uncertainty.

Regional Growth

In advanced economies, growth forecasts for 2025 have declined substantially since January, driven by downgrades in some of the world's largest economies. This reflects the shock dealt by the increases in trade barriers—even with the partial 90-day pause in U.S. tariff increases—and the associated policy uncertainty, financial volatility, and dampening effects on confidence. As a result, growth is expected to remain below potential growth estimates over the forecast horizon in some advanced economies, including in the United States and the euro area.

Emerging Market and Developing Economies (EMDE) growth is forecast to slow significantly in 2025, to 3.8%, with only a modest projected pickup in 2026-27. The expected rate of growth is well below pre-pandemic averages and the deterioration in EMDE growth prospects is driven in large part by economies with a high degree of trade and investment openness. Against the backdrop of a more challenging external environment, growth expected to slow in nearly 60% of EMDEs in 2025.

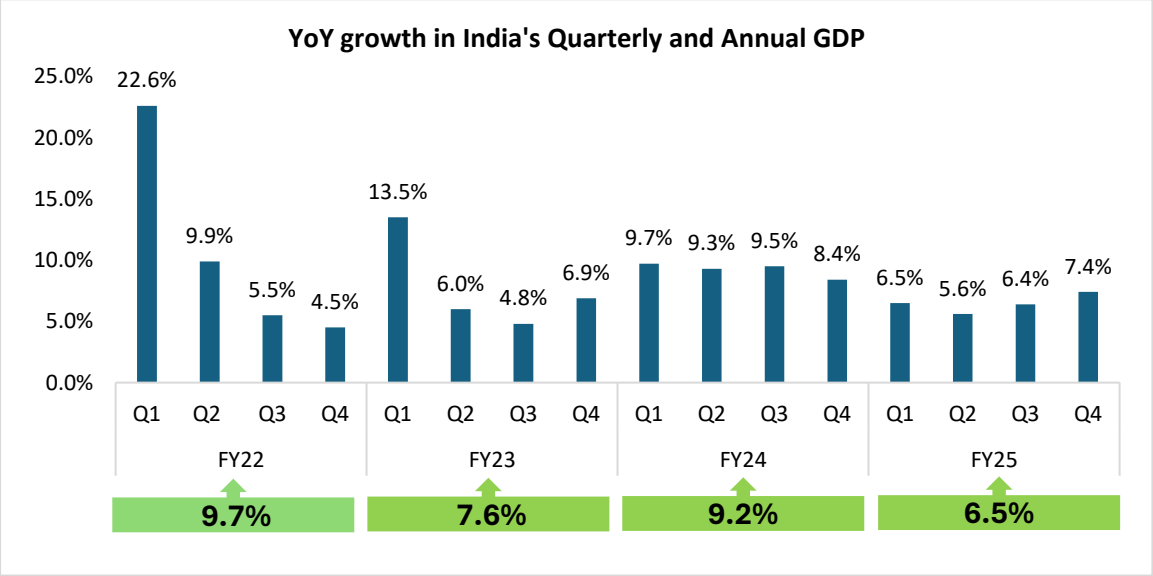
GDP Per Capita, Current Prices (USD per capita)					
	2010	**2015**	**2020**	**2025**	**2030^**
World	9,757	10,374	11,147	14,213	17,272
Advanced Economies	42,201	43,127	47,603	60,321	72,055
Emerging Market and Developing Economies	3,982	4,793	5,178	6,803	8,759
United States	48,586	57,007	64,454	89,105	105,371
United Kingdom	39,642	44,979	40,231	54,949	68,948
Germany	43,233	41,915	47,342	55,911	65,525
Japan	45,136	35,006	40,160	33,956	41,659
China	4,578	8,174	10,696	13,687	18,617
India	1,351	1,590	1,916	2,878	4,469
^ *Projections by IMF, WEO April 2025.* *Source: https://www.imf.org/*					

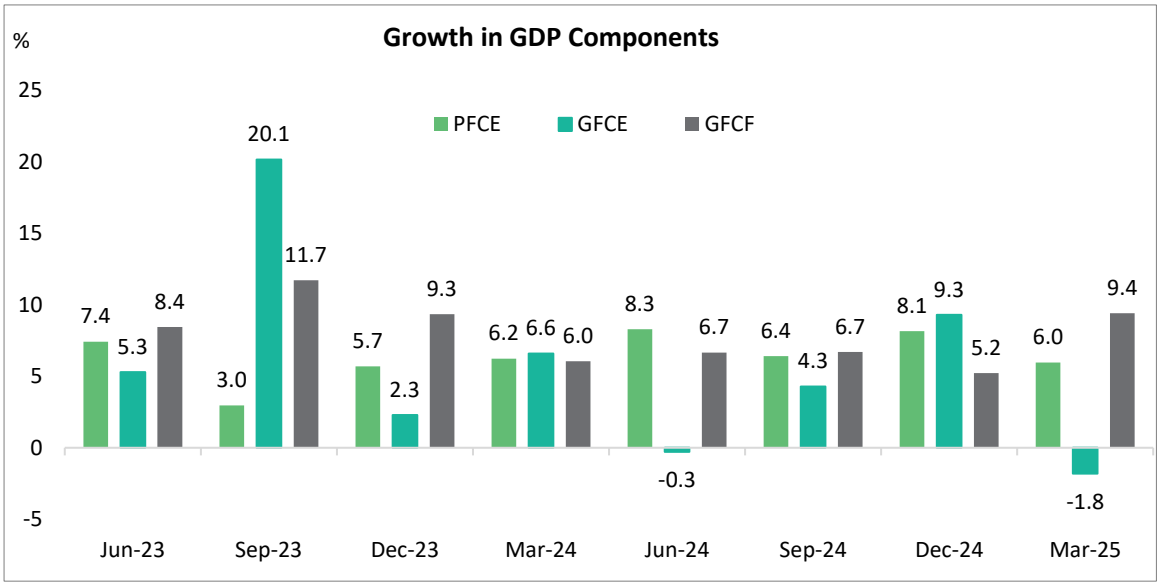
Global per capita income reflects significant disparities across regions and economies. The world average GDP per capita is estimated at approximately USD14,213 in 2025 while advanced economies enjoy much higher living standards, with an average per capita income of about USD60,321. In contrast, emerging market and developing economies have a markedly lower average, around USD6,800 per person. Among individual countries, the United States ranks among the highest for large economies, while China and India's GDP per capita trail behind despite showing rapid economic growth.

Indian Economy

India remains one of the world's fastest-growing major economies in 2025 and expected remain at top even in 2030, as per IMF projections. However, after a notable 9.2% GDP growth in FY2024, the economy has shown signs of moderation in early FY2025, partly due to global headwinds. In line with global growth projections, the International Monetary Fund (IMF) in its June report, has downgraded India's growth forecast for 2025 to 6.3%, down from 6.5%.

While the economy has shown endurance, the looming threat of reinstated U.S. tariffs which is currently suspended for 90 days, has added a fresh layer of uncertainty to the global trade landscape, prompting central banks and analysts alike to recalibrate their outlook. India's economy remains on a steady footing despite growing global volatility. The Q4FY2025 GDP estimates signal sharp increase in growth, although the downside risks emanating from the global environment, including uncertainty surrounding the global trade policies and geopolitical tensions, continued to impact the outlook.





Note: Data is provisional, Source: MoSPI

Major Drivers and Challenges for Growth

- Private Final Consumption Expenditure (PFCE), which reflects household spending is one of the key drivers of economic growth in India. It indicates an increase in disposable income and consumer spending.
- Easing monetary policy actions by the government and significant fall in inflation has Improved consumer sentiment.
- Increased government spending in the recent years, particularly since COVID-19 has played an important role in boosting economic activity.
- Due to strong government capex, the growth in Gross Fixed Capital Formation (GFCF) rose by 9.4% YoY. This indicates rising domestic private investment despite global uncertainty.
- Trump's tariff policies have significantly altered the global trade landscape. The initial announcement of reciprocal tariffs sparked widespread market volatility, with fears of a global trade contraction. However, the 90-day tariff suspension, announced on April 9, 2025, provides temporary relief for India, which initially faced a 26% tariff on its exports to the US. While India's economy is relatively insulated compared to more export-dependent nations, the tariffs introduce both challenges and opportunities that could shape growth in FY2026 and beyond.

Economic Growth (At Constant Prices 2011-12)						
Sectors	**Q1 (Jun)**	**Q2 (Sep)**	**Q3 (Dec)**	**Q4 (Mar)**	**FY2025**	**Share in Total GVA (FY2025)**
Agriculture, forestry and fishing	**1.5%**	**4.1%**	**6.6%**	**5.4%**	**4.6%**	**14.4%**
Industry	**8.5%**	**3.8%**	**4.8%**	**6.5%**	**5.9%**	**30.7%**
Mining and quarrying	6.6%	-0.4%	1.3%	2.5%	2.7%	2.0%
Manufacturing	7.6%	2.2%	3.6%	4.8%	4.5%	17.2%
Electricity, gas, water supply and other utility services	10.2%	3.0%	5.1%	5.4%	5.9%	2.4%
Construction	10.1%	8.4%	7.9%	10.8%	9.4%	9.1%
Services	**6.8%**	**7.2%**	**7.4%**	**7.3%**	**7.2%**	**54.9%**
Trade, hotels, transport, storage and communication	5.4%	6.1%	6.7%	6.0%	6.1%	18.5%
Financial services, real estate and professional services	6.6%	7.2%	7.1%	7.8%	7.2%	23.8%
Public administration, defence and other services	9.0%	8.9%	8.9%	8.7%	8.9%	12.7%
Gross Value Added (GVA)	**6.5%**	**5.8%**	**6.5%**	**6.8%**	**6.4%**	**100%**
Gross Domestic Product (GDP)	**6.5%**	**5.6%**	**6.4%**	**7.4%**	**6.5%**	-
Note: Data is provisional *Source: MoSPI*						

Sectoral Performance and Outlook

Services make up close to 55% of the GVA and industries contribute around 30% and the rest is from agriculture. The jump in real GDP growth for Q4 FY2024 was due to a strong performance in service sector which also showed consistent growth in all its subcategories throughout the financial year. Manufacturing sector contribution to overall GDP is expected to increase due to recent policy reforms by the government aimed towards boosting manufacturing in India and improve manufacturing competitiveness.

- Agriculture sector reported stable growth in FY2025 and supporting rural demand. Given the favourable monsoon outlook for 2025, the farm output is likely to remain strong in FY2026.
- Industrial sector has shown strong recovery from its lows despite weaker exports and global trade pressures. The outlook for the manufacturing sector remains mixed due to ongoing global trade uncertainties and geopolitical tensions, which may impose supply chain disruptions. On the other hand, falling inflation and interest rates help revive domestic demand and support the growth in the industrial sector.
- Services sector which continued to lead growth, backed by demand, tech adoption, and government initiatives. The outlook remains positive driven by strong domestic demand and government initiatives.

Downside risks emanating from rising protectionism, global demand moderation, and geopolitical uncertainties resulted in RBI revising its FY2026 growth projections to 6.5% from the earlier estimate of 6.7%.

Power Sector in India

An Overview

The power sector in India contributes approximately 2.5% to 3% to India's GDP[1]. It serves as a backbone for industrial and economic activity and plays an important role in employment generation, both directly through generation, transmission, and distribution, and indirectly via construction, equipment manufacturing, and renewable energy ventures.

The sector is highly regulated, with various functions being distributed between multiple implementing agencies. There are three chief architects of the sector namely the Central Electricity Regulatory Commission (CERC), the Central Electricity Authority (CEA), and the State Electricity Regulatory Commissions (SERCs). The electricity sector in India has witnessed a lot of changes in the last three decades. As part of the process of economic liberalisation that began in 1991, the power sector was one of the first sectors of the economy to be "reformed." The thrust of these reforms was to financially and institutionally restructure the power sector to end state monopoly by introducing private generators and distributors of electricity.

The sectors growth was driven by rising electricity demand from rapid urbanisation, accelerating industrialisation, and a growing population. The shift towards renewable energy sources and the electrification of transport, and government-backed rural electrification programs are reshaping the dynamics of the power sector in India. The sector has attracted substantial investment, with India permitting 100% Foreign Direct Investment (FDI) under the automatic route, making it a hotspot for FDI and Foreign Portfolio Investment (FPI), particularly in renewables and grid infrastructure.

Its social development impact is significant with large scale rural electrification program like Saubhagya and Deen Dayal Upadhyaya Gram Jyoti Yojana improving education, healthcare and livelihoods in underserved areas. The power generation in India grew at a CAGR of 5.38% in the last 10 years to 1,734.38 billion kWh (kilowatt-hour) in FY2024[2]. In FY2025, India's electricity generation reached a record 1,824.21 billion kWh, marking a 5.18% rise over FY2024. While installed power capacity reached approximately 475 GW as of March 2025, with significant variation across states.

India's Power Supply Position

The power supply in India was primarily controlled by private companies in the pre independence era and limited to urban areas, leaving rural regions largely unelectrified. After the establishment of State Electricity Boards (SEBs) in the early 1950s, there has been a systematic growth of the power supply industry across India due to the development of multipurpose hydro projects and the installation of thermal and nuclear stations, which significantly increased power generation. The Electricity Act-2003 which came into effect in June 2003, consolidates laws relating to generation, transmission, distribution, trading and use of electricity and generally for taking measures conducive to development of electricity industry.

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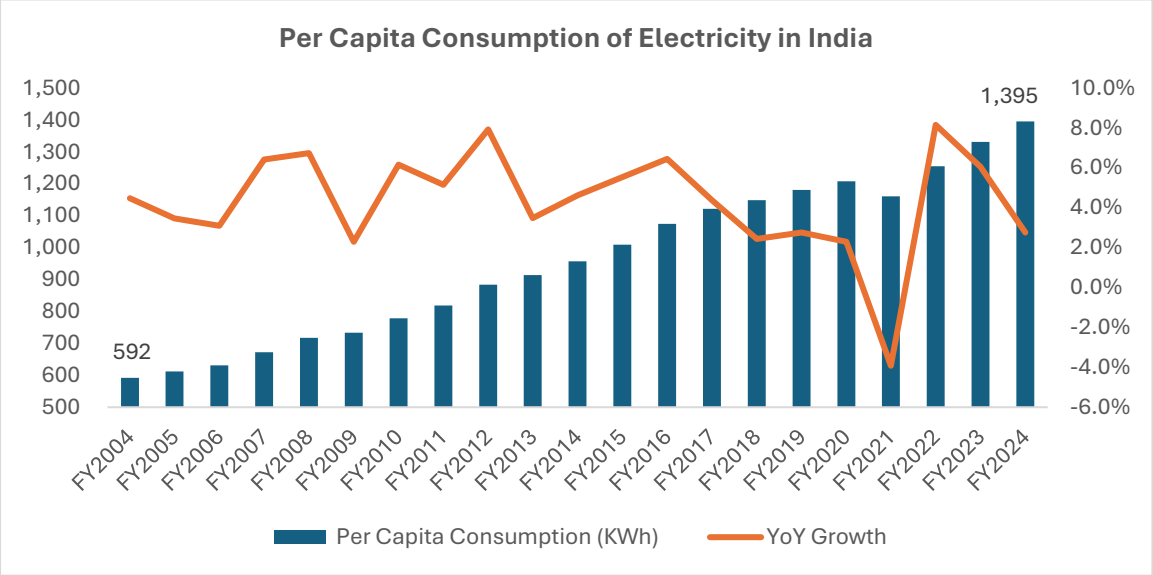
[1] *Derived using GDP (MoSPI's National Accounts Statistics 2025) and market size of power sector (Technavio Report Power Market in India 2024-2028, accessed through EMIS).*
[2] *iced.niti.gov.in*

Power Supply Position- FY2010 to 2024-25								
Year	Energy				Peak			
	Requirement	Availability	Surplus (+)/ Deficit (-)		Peak Demand	Maximum Demand Met	Surplus (+)/Deficit (-)	
	(MU)	(MU)	(MU)	*(%)*	(MW)	(MW)	(MW)	*(%)*
FY2010	830,594	746,644	-83,950	*-10.11%*	119,166	104,009	-15,157	*-12.72%*
FY2011	861,591	788,355	-73,236	*-8.50%*	122,287	110,256	-12,031	*-9.84%*
FY2012	937,199	857,886	-79,313	*-8.46%*	130,006	116,191	-13,815	*-10.63%*
FY2013	995,557	908,652	-86,905	*-8.73%*	135,453	123,294	-12,159	*-8.98%*
FY2014	1,002,257	959,829	-42,428	*-4.23%*	135,918	129,815	-6,103	*-4.49%*
FY2015	1,068,923	1,030,785	-38,138	*-3.57%*	148,166	141,160	-7,006	*-4.73%*
FY2016	1,114,408	1,090,850	-23,558	*-2.11%*	153,366	148,463	-4,903	*-3.20%*
FY2017	1,142,929	1,135,334	-7,595	*-0.66%*	159,542	156,934	-2,608	*-1.63%*
FY2018	1,213,326	1,204,697	-8,629	*-0.71%*	164,066	160,752	-3,314	*-2.02%*
FY2019	1,274,595	1,267,526	-7,069	*-0.55%*	177,022	175,258	-1,764	*-1.00%*
FY2020	1,291,010	1,284,444	-6,566	*-0.51%*	183,804	182,533	-1,271	*-0.69%*
FY2021	1,275,534	1,270,663	-4,871	*-0.38%*	190,198	189,395	-803	*-0.42%*
FY2022	1,379,812	1,374,024	-5,788	*-0.42%*	203,014	200,539	-2,475	*-1.22%*
FY2023	1,513,497	1,505,914	-7,583	*-0.50%*	215,888	207,321	-8,567	*-3.97%*
FY2024	1,626,132	1,622,020	-4,112	*-0.25%*	243,271	239,931	-3,340	*-1.37%*
FY2025	1,693,959	1,692,369	-1,590	*-0.09%*	249,856	249,854	-2	*0.00%*

Source: Central Electricity Authority (https://cea.nic.in/)

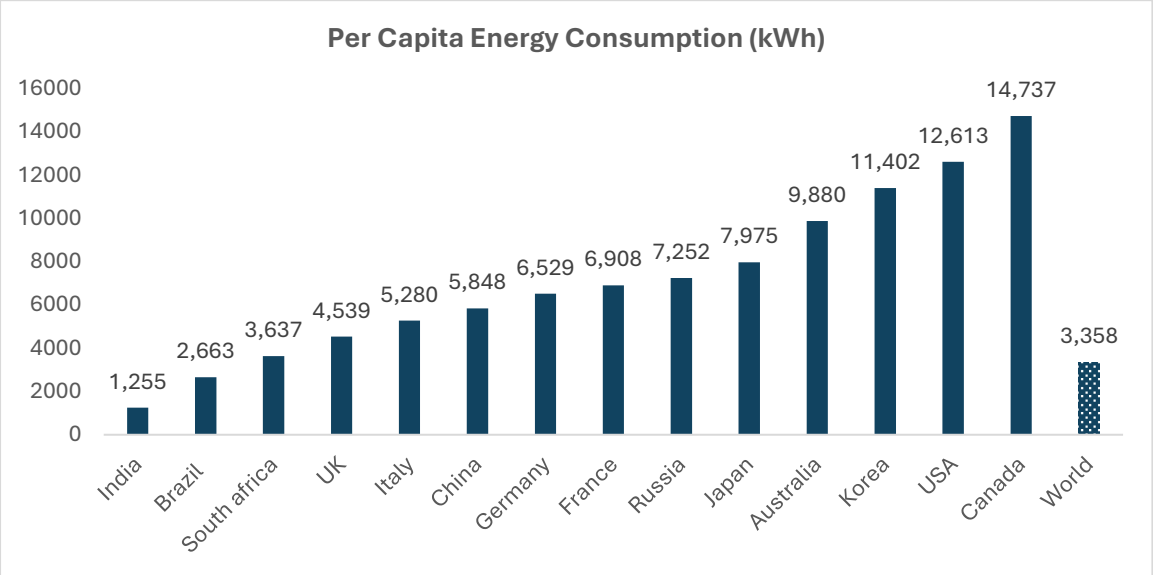
Per Capita Consumption

Despite the rapid industrial growth and urbanisation, India's per-capita energy consumption remains lower than many developed nations. The per-capita energy consumption has increased marginally from 612 KWh in FY2005 to 1395 KWh in FY2024 (CAGR 4.2%). Rising adoption of electric appliances by households, electric vehicles, accelerating rural electrification, expanding industrial and commercial activity, etc indicate potential for further expansion.



Source: Central Electricity Authority & PIB

Global Comparison (2021)

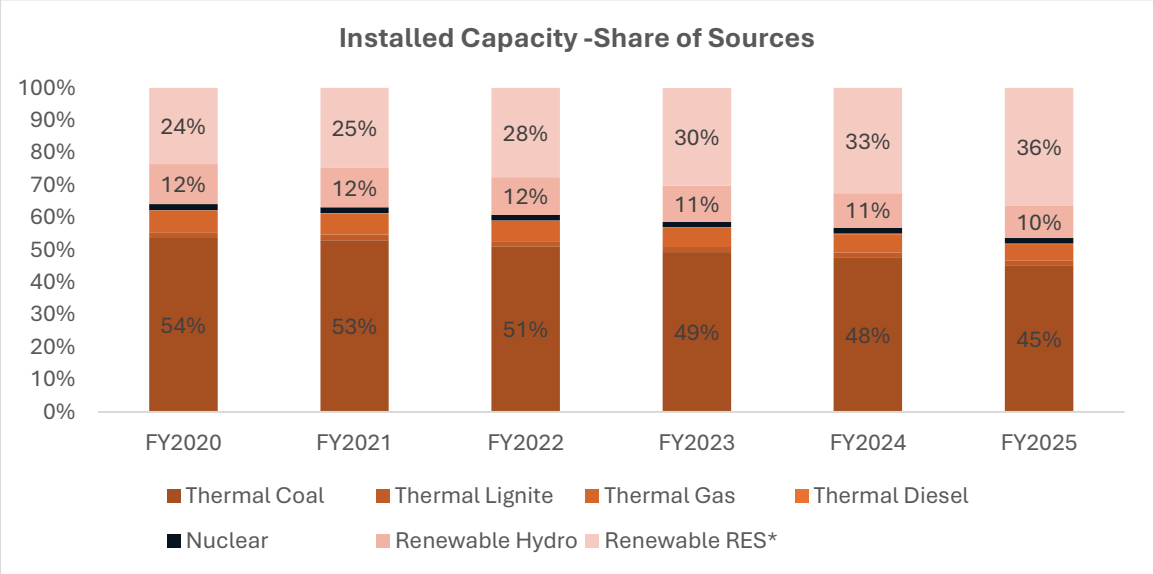


Source: Central Electricity Authority, Growth Book 2024

Power Capacity

Installed capacity grew at a CAGR of 5.1% in the last five years, and 7.5% (YoY) in FY2025. Coal and lignite-based installed power capacity has maintained its dominant position over the years and accounted for ~46% as of March 2025. The installed capacity through thermal based sources reached 245 GW in while, RE installations (including large hydroelectric projects), reached ~191 GW capacity as of March 2024 compared with 114 GW as of March 2018, constituting about 43% of total installed generation capacity. This growth has been led by solar power, which rapidly rose to ~60 GW from 22 GW during the same period.

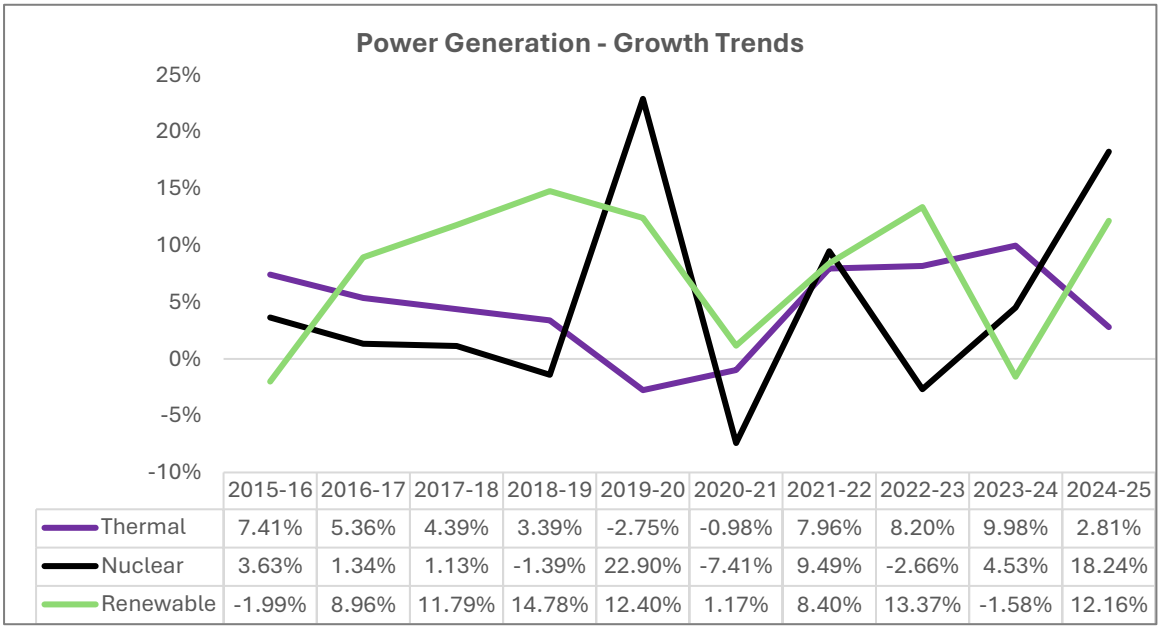
The Government of India has taken several steps and initiatives to promote and accelerate renewable energy capacity in the country to realise the commitment of 500 GW non-fossil energy capacity by 2030.



Installed Capacity-Mode wise Breakup (in Megawatt)								
Year	Thermal				Nuclear	Renewable		Total
	Coal	Lignite	Gas	Diesel		Hydro	RES*	
FY2020	198,525	6,610	24,955	510	6,780	45,699	87,028	370,106
FY2021	202,675	6,620	24,924	510	6,780	46,209	94,434	382,151
FY2022	204,080	6,620	24,900	510	6,780	46,723	109,885	399,497
FY2023	205,236	6,620	24,824	589	6,780	46,850	125,160	416,059
FY2024	210,969	6,620	25,038	589	8,180	46,928	143,645	441,970
FY2025	215,193	6,620	24,533	589	8,180	47,728	172,368	475,212

** RES (Renewable Energy Sources) includes small hydro power (≤ 25 MW), biomass power, solar and wind power, U&I (Urban & Industrial Waste) power.*

Source: Central Electricity Authority (https://cea.nic.in/)



	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21	2021-22	2022-23	2023-24	2024-25
Thermal	7.41%	5.36%	4.39%	3.39%	-2.75%	-0.98%	7.96%	8.20%	9.98%	2.81%
Nuclear	3.63%	1.34%	1.13%	-1.39%	22.90%	-7.41%	9.49%	-2.66%	4.53%	18.24%
Renewable	-1.99%	8.96%	11.79%	14.78%	12.40%	1.17%	8.40%	13.37%	-1.58%	12.16%

Source: Central Electricity authority

Distribution of Installed Capacity-Region wise

As per the CEA, Southern and Western states are at the forefront of renewable integration, while Northern and Eastern states rely more on thermal and hydro. Gujarat, Maharashtra, and Rajasthan are India's top states by installed power capacity, with Rajasthan and Gujarat especially dominant in solar and overall renewable energy. Gujarat and Rajasthan are also at the top for solar and wind, while Karnataka and Tamil Nadu also have significant wind portfolios. Rajasthan, Gujarat, Maharashtra, Karnataka, and Andhra Pradesh are leading in renewable capacity additions.

Domestic Distribution of Installed Capacity by States in MW as on 31 March 2025

State	Mode-wise Breakup							Total
	Thermal				Nuclear	Renewable		
	Coal	Lignite	Gas	Diesel		Hydro	RES* (MNRE)	
Gujarat	17,159	1,400	5,932	-	1,035	772	31,403	57,701
Maharashtra	26,064	-	3,513	-	1,069	3,332	19,354	53,332
Madhya Pradesh	15,963	-	332	-	492	3,224	8,593	28,603
Chhattisgarh	12,222	-	-	-	136	264	1,708	14,330
Central - Unallocated	2,835	-	198	-	438	-	-	3,471
Dadra and Nagar Haveli and Daman and Diu	587	-	110	-	29	-	52	778
Goa	492	-	68	-	42	2	58	662
Total (Western Region)	**75,323**	**1,400**	**10,151**	**-**	**3,240**	**7,593**	**61,169**	**158,876**
Tamil Nadu	12,835	1,959	1,027	212	1,448	2,178	23,112	42,772
Karnataka	9,948	486	370	25	698	3,632	20,228	35,388
Andhra Pradesh	12,031	189	3,847	37	127	1,674	10,504	28,409
Telangana	11,599	61	832	-	149	2,480	5,283	20,403
Kerala	2,236	325	534	160	362	1,964	1,889	7,470
Central - Unallocated	1,666	434	-	-	450	-	-	2,550
Puducherry	141	118	33	-	86	-	55	432
NLC	-	66	-	-	-	-	-	66
Total (Southern Region)	**50,456**	**3,640**	**6,642**	**434**	**3,320**	**11,927**	**61,072**	**137,490**
Rajasthan	12,624	1,580	775	-	557	2,028	33,725	51,288
Uttar Pradesh	23,235	-	1,030	-	289	3,544	5,722	33,820
Punjab	8,214	-	150	-	197	3,827	2,174	14,562
Haryana	8,638	-	582	-	101	2,382	2,450	14,153
Delhi	3,649	-	2,115	-	103	752	397	7,017
Himachal Pradesh	145	-	-	-	29	3,437	1,215	4,826
Uttarakhand	628	-	734	-	31	2,169	975	4,538
Jammu & Kashmir and Ladakh	577	-	304	-	68	2,340	318	3,607
Central - Unallocated	1,543	-	291	-	237	841	-	2,913
Chandigarh	45	-	15	-	8	103	79	250
Total (Northern Region)	**59,298**	**1,580**	**5,995**	**-**	**1,620**	**21,426**	**47,057**	**136,975**
West Bengal	8,683	-	80	-	-	1,466	771	11,000
Odisha	5,351	-	-	-	-	2,179	804	8,335
Bihar	7,283	-	-	-	-	73	539	7,895
DVC	3,037	-	-	-	-	214	-	3,251
Jharkhand	2,607	-	-	-	-	177	224	3,008
Central - Unallocated	1,836	-	-	-	-	86	-	1,922
Sikkim	77	-	-	-	-	643	63	782
Total (Eastern Region)	**28,875**	**-**	**80**	**-**	**-**	**4,838**	**2,401**	**36,194**
Assam	875	-	742	-	-	522	233	2,371
Arunachal Pradesh	37	-	47	-	-	545	155	784
Meghalaya	52	-	110	-	-	417	73	652
Tripura	56	-	487	-	-	68	37	649
Central - Unallocated	113	-	64	-	-	140	-	316
Manipur	47	-	82	36	-	87	19	271
Mizoram	31	-	60	-	-	98	76	265
Nagaland	32	-	74	-	-	66	36	208
Total (North- Eastern Region)	**1,242**	**-**	**1,665**	**36**	**-**	**1,944**	**629**	**5,516**
Andaman & Nicobar	-	-	-	93	-	-	35	128
Lakshadweep	-	-	-	27	-	-	5	32
Total (Islands)	**-**	**-**	**-**	**120**	**-**	**-**	**40**	160
India Installed Capacity	**215,193**	**6,620**	**24,533**	**589**	**8,180**	**47,728**	**172,368**	**475,212**

Source: CEA

Segmentation

The power sector in India is segmented both by the stages of the electricity supply chain and by the types of energy sources used for generation. Electricity is produced in power plants using various energy sources, including coal, natural gas, oil, nuclear, hydro, wind, and solar. Power plants convert primary energy (such as fuel or kinetic energy) into electrical energy using generators (devices that move conductors through magnetic fields to create current). Electricity generated at power plants is sent over long distances via high-voltage transmission lines. Transmission networks move electricity from generating stations to substations, maintaining efficiency and minimizing energy loss during transportation. Transformers at substations adjust the voltage for further distribution. After stepping down the voltage at substations, electricity is delivered through distribution networks to end users such as homes, businesses, and industries.

The generation and transmission of electricity are critical to the economy for several reasons:

- Industrial operations depend on a steady power supply for production, processing, and logistics.
- Service sectors, including banking, healthcare, and IT, require uninterrupted electricity for daily functioning.
- Households depend on electricity for basic needs, quality of life.
- Efficient transmission ensures that electricity reaches consumers with minimal loss, keeping energy costs lower and reliability higher.
- The electrical grid's reliability and reach underpins everything from transportation systems to emergency services, enabling overall economic growth and societal development.

The power generation segment is dominated by conventional (coal, lignite, natural gas, oil, hydro and nuclear power) sources, while non-conventional sources (such as wind, solar, and biomass and municipal waste) also growing as solar power is rapidly gaining traction due to supportive government policies and increasing demand for renewable energy.

The operations of the power industry (**Power Generation, Transmission and Distribution)** are described below, using thermal energy to illustrate the key processes.

Generation:

In a thermal power plant coil is burnt to produce high temperature and high-pressure steam in a boiler. The steam is passed through a steam turbine to produce rotational motion. The generator, mechanically coupled to the turbine, thus rotates producing electricity. Chemical energy stored in coal after a couple of transformations produces electrical energy at the generator terminals.

Components of Thermal power plant

- Coal handling plant
- Stoker
- Pulverizer
- Boiler
- Superheater
- Economizers & Air preheater
- Reheater

- Deaerator
- Condenser
- Primary air fan
- Turbine (prime mover)
- Draft fan & chimney
- Electo-static precipitator
- Cooling tower
- Ash handling plant
- Electrical equipment
- Generator
- Transformers
- Switch yard

Transmission: High Voltage (HV) and Extra High Voltage (EHV) transmission is the next stage from power plant to transport A.C. power over long distances at voltages like; 220 kV & 400 kV. Where transmission is over 1000 kms, high voltage direct current transmission is also favoured to minimise the losses. Sub-transmission network at 132 kV, 110 kV, 66 kV or 33 kV constitutes the next link towards the end user. Distribution at 11 kV / 6.6 kV / 3.3 kV constitutes the last link to the consumer, who is connected directly or through transformers depending upon the drawl level of service. The transmission and distribution network include sub-stations, lines and distribution transformers. High voltage transmission is used so that smaller, more economical wire sizes can be employed to carry the lower current and to reduce losses. Sub-stations, containing step-down transformers, reduce the voltage for distribution to industrial users.

Distribution: The distribution system is the electrical system between the substation fed by the Transmission system and the consumer meters. It generally consists of feeders, distributors, and service mains

(i) Feeders

A feeder is a conductor which connects the sub-station (or localized generating station) to the area where power is to be distributed. Generally, no tappings are taken from the feeder so that current in it remains the same throughout. The main consideration in the design of a feeder is the current carrying capacity.

(ii) Distributor

A distributor is a conductor from which tappings are taken for supply to the consumers. The current through a distributor is not constant because tappings are taken at various places along its length. While designing a distributor, voltage drop along its length is the main consideration since the statutory limit of voltage variations is ± 6% of rated value at the consumers' terminals.

(iii) Service Mains

Service mains are generally a small cable which connects the distributor to the consumer terminals.

There is no difference between a transmission line and a distribution line except for the voltage level and power handling capability. Transmission lines are usually capable of transmitting large quantities of electric energy over great distances. They operate at high voltages. Distribution lines carry limited quantities of power over shorter distances. Voltage drops in line are in relation to the

resistance and reactance of line, length and the current drawn. For the same quantity of power handled, lower the voltage, higher the current drawn and higher the voltage drops. The current drawn is inversely proportional to the voltage level for the same quantity of power handled. The power loss in line is proportional to resistance and square of current. (i.e. PLOSS=I2R). Higher voltage transmission and distribution thus would help to minimize line voltage drop in the ratio of voltages, and the line power loss in the ratio of square of voltages.

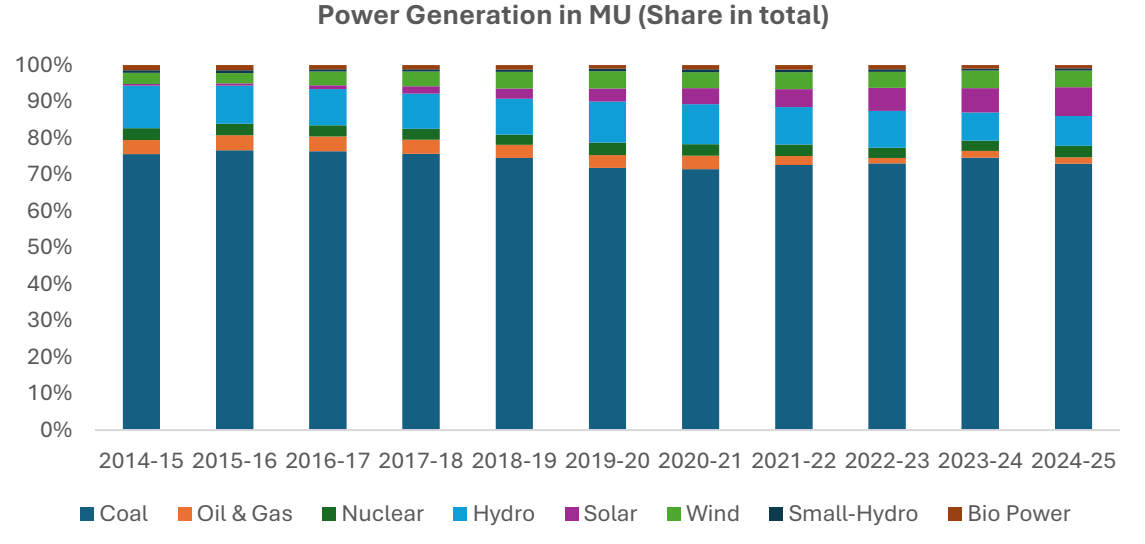
By Type

Thermal Energy: Thermal power plants use fuels such as coal, lignite, gas, or diesel to produce heat in a boiler. This heat converts water into steam, which is then used to drive a turbine. The turbine is connected to a generator that converts the mechanical energy into electrical energy. Thermal energy accounted for 80.8% of total energy mix in FY2016, but this share has fallen to 74.8% in FY2025, largely due to increase in power generation through renewable energy sources. Coal accounted for 75.6% of total energy mix in FY2015 which is slightly fallen to 73.0% in FY2025.

Nuclear Energy: Nucellar power plants uses uranium to make nuclear reaction in reactor which in turns produces heat. The share of nuclear energy mix in total power generation has slightly decreased from 3.2% in FY 2016 to 3.1% in FY2025. This decrease is primarily due to the absence of new nuclear plant installations during this period, as nuclear facilities are relatively expensive to construct and operate compared to other power generation options.

Renewable Energy: Renewable energy power plants generate electricity by harnessing naturally replenishing energy sources such as solar radiation, wind, hydro, biomass. Renewable energy including hydro accounted for 16.0% of total energy generation in FY2016 which has increased to 22.1% in FY 2025. Hydro power including small hydro accounted for 69.3% of total renewable energy generation in FY2015 which has been fallen to 39.7% in FY2025. Solar power accounted for 4.0% of total renewable energy mix in FY2016 which has been increased to 35.7% in FY2025.

By Source



Source: ICED

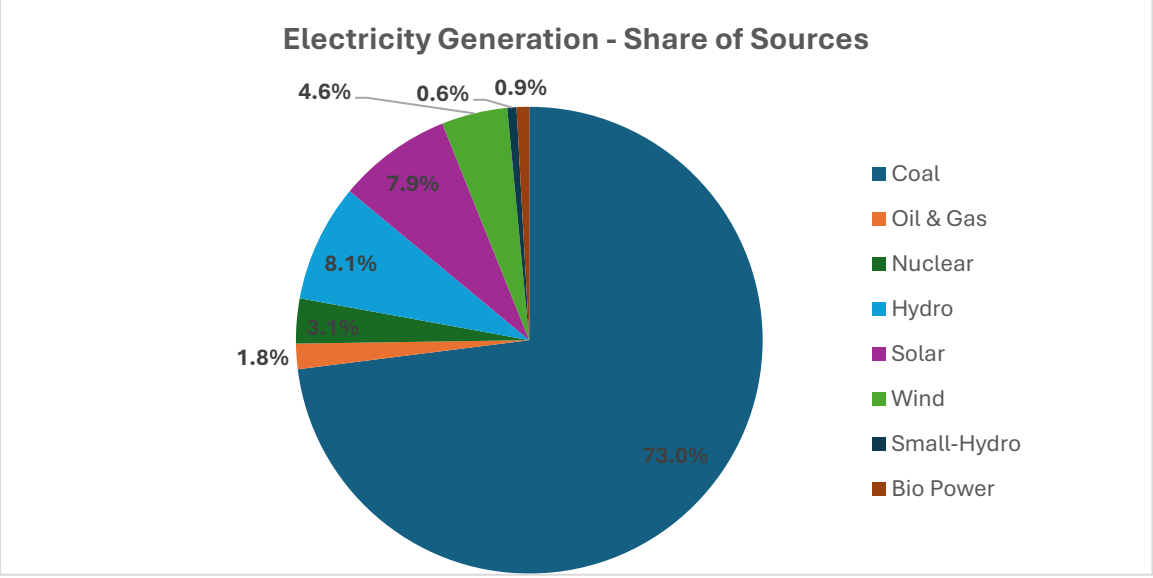
Generation, Transmission & Distribution - An Analysis

Generation

India's overall power generation grew at a Compound Annual Growth Rate (CAGR) of 5.14% between FY2016 and FY2025. During the same period, thermal power generation (comprising coal, gas, and oil) expanded at a CAGR of 4.50%, while nuclear power grew slightly faster at 4.61%. Notably, renewable energy sources, including hydropower, experienced the highest growth, registering a CAGR of 7.77%. This indicates that while all segments contributed to the overall increase in power generation, renewables and hydropower drove the fastest expansion, outpacing both thermal and nuclear energy growth rates in the last 10 years.

The annual growth in the energy generation in FY2025 has been 5.18%, slightly higher than average growth of last 10 years.[3] Coal remains a major source of electricity generation, though its share is gradually declining as renewables expand. From 74.52% in FY2019 the share of coal in electricity generation has fallen to 73.0%, while renewables share increased from 19.1% to 22.1% during the same period.

As per CEA's Operation Performance Monitoring Division, energy generation from sources other than solar, wind, small hydro and bio power, reached 15,69,204.57 MU in FY2025 achieving 95.2% of the target of 16,48,000 MU. For FY2026, the target has been increased by 5.0% to 17,25,000 MU.



Source: ICED, NITI Aayog

[3] *ICED, NITI Aayog*

Electricity Generation (MU)							
Sources	**FY2019**	**FY2020**	**FY2021**	**FY2022**	**FY2023**	**FY2024**	**FY2025**
Coal	1,022,265	994,197	981,443	1,078,581	1,182,096	1,294,852	1,331,867
Oil & Gas	50,049	48,641	51,168	36,230	24,115	31,697	32,023
Nuclear	37,813	46,472	43,029	47,112	45,861	47,937	56,681
Hydro	134,894	155,769	150,300	151,627	162,099	134,054	148,634
Solar	39,268	50,131	60,402	73,484	102,014	115,975	144,150
Wind	62,036	64,646	60,150	68,640	71,814	83,385	83,347
Small-Hydro	8,703	9,451	10,258	10,464	11,171	9,485	11,568
Bio Power	16,752	14,108	16,437	18,325	18,554	16,989	15,944
Total	**1,371,779**	**1,383,417**	**1,373,187**	**1,484,463**	**1,617,723**	**1,734,375**	**1,824,214**
Growth (in %)	***5.24***	***0.85***	***-0.74***	***8.1***	***8.98***	***7.21***	***5.18***

Source: ICED, NITI Aayog

Transmission

State-owned entities manage India's transmission segment, with Power Grid Corporation playing a key role. The length of power line circuits in India has seen substantial growth over the decades, reflecting the country's expanding electricity demand.

India’s inter-regional transmission capacity has risen from 14 GW in 2007 to 95 GW in 2019 and by January 2025, this capacity has further grown to approximately 119 GW, enabling more efficient transfer of electricity across regions and supporting the integration of renewable energy sources into the national grid.

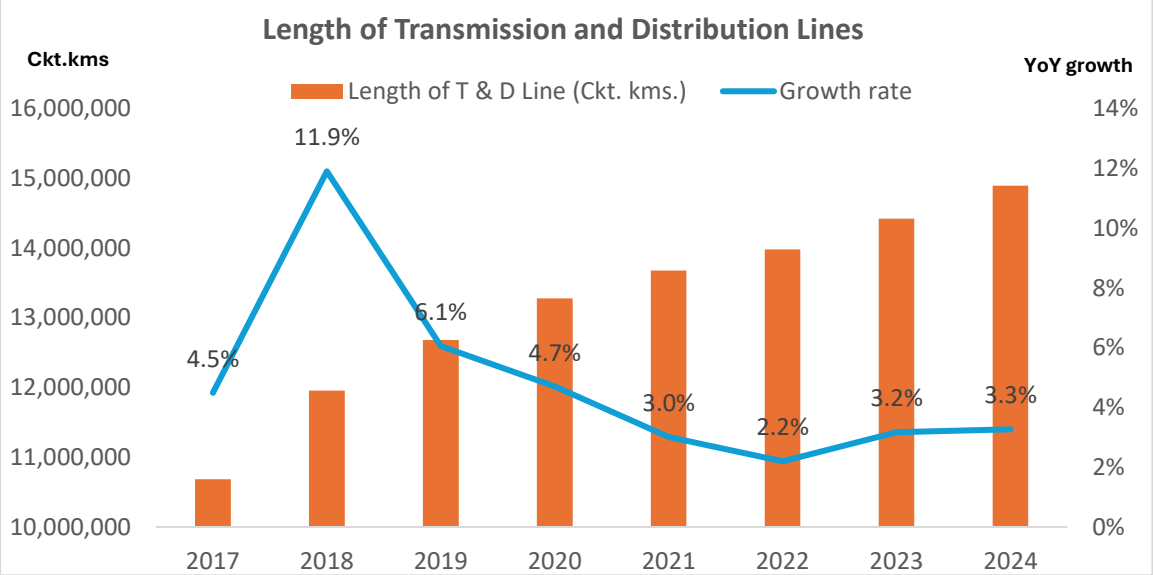
Increasing generation capacity (especially from renewable sources), and the need to strengthen interregional power transfer and grid reliability are the drivers of this growth, while challenges such as Right-of-Way (RoW) constraints and land acquisition issues are the major constraints.

As of March 31, 2025, India's total transmission line network stood at 494,374 circuit kilo meters (ckm), a modest 1.8% increase from the previous year. But there was a notable slowdown in annual addition of transmission lines which is only 8,830 ckm, compared to the historical average of around 19,123 ckm per year between FY 2016-2024

Policy initiatives such as the PM Gati Shakti Master Plan and the National Electricity Plan have set ambitious targets, with plans to add about 1.91 lakh ckm of transmission lines by 2032 to support India’s development goals and energy transition.

Transmission in Circuit Kilometre (ckm)		
Year	**Transmission Lines**	**Transmission Lines Addition**
FY2019	413,407	22,437
FY2020	425,071	11,664
FY2021	441,821	16,750
FY2022	456,716	14,895
FY2023	471,341	14,625
FY2024	485,544	14,203
FY2025	494,374	8,830

Source: ICED, NITI Aayog



Source: CEA Growth Book, 2024

Distribution

The power distribution reflects both the size of state economies and their natural resource endowments, especially for renewables. In India, power distribution is primarily handled by state-owned companies (Discoms), with private entities operating in major cities like Delhi and Mumbai.

The government is prioritising the distribution sector within the electricity supply chain, with a strong focus on improving the financial health and operational performance of Distribution Companies (DISCOMs) and State Electricity Boards (SEBs). This is being done to support India's growing energy needs and to ensure reliable and quality power supply.

Liquidity infusion package announced under Aatma Nirbhar Bharat for the power sector

The finances of many DISCOMs in India have faced significant stress, worsened by the COVID-19 pandemic and the resulting lockdown, which hindered revenue as consumers struggled to pay bills. Despite maintaining power supply as an essential service, liquidity issues surged. To address this crisis, the Government introduced a liquidity infusion package under the Aatma Nirbhar Bharat initiative, allowing DISCOMs to secure concessional loans from PFC and REC, backed by State guarantees, to settle their dues with various power generation and transmission companies. Ministry of Power released guidelines on 14th May 2020 for States to access concessional loans from PFC and REC under the Aatma Nirbhar Bharat package. By FY2023, loans worth Rs. 1.33 Lakh Cr were sanctioned, with Rs. 112456 Cr disbursed.

Revamped Distribution Sector Scheme

The Government of India launched the Revamped Distribution Sector Scheme (RDSS) to support DISCOMs in improving operational efficiency and financial stability through performance-based financial aid, with an investment of Rs 3.04 lakh crore over five years (FY2022 to FY2026). It includes Rs 0.98 lakh crore in budgetary support to reduce AT&C losses to 12-15%, close the ACS-ARR gap, and improve power supply quality by FY 2024-25. Under the RDSS, almost 50% of investments target prepaid smart metering and advanced metering infrastructure (AMI) via a TOTEX model. Smart meters improve utility cash flow by enabling communication, enhancing forecasting, optimizing

procurement, and reducing costs, aiming to close the ACS-ARR gap and lower AT&C losses. Capital investment under the RDSS initiative focuses on loss reduction, system strengthening, and modernization. Loss reduction efforts encompass replacing bare conductors with AB cables, implementing HVDS systems, and executing feeder bifurcation. System strengthening includes building new substations and upgrading capacities, while modernization emphasizes technologies such as SCADA, DMS, and GIS for improved distribution systems. The initiative is monitored by an inter-ministerial committee chaired by the Secretary (Power), which has conducted 32 meetings, approving action plans and DPRs for 52 Discoms across 32 States/UTs. The approved DPR for Distribution Infrastructure has an outlay of Rs. 1,25,226 Crores. Additionally, smart metering initiatives across 28 States/UTs total Rs. 1,30,474 Crores, with a GBS of Rs. 24,139 Crores and significant meter installation planned.

Government Initiatives

Energy Conservation Campaign

The Bureau of Energy Efficiency is an agency of the Government of India, under the Ministry of Power, created in March 2002 under the provisions of the nation's 2001 Energy Conservation Act. The agency's function is to encourage the efficient use of energy in India by developing programs to support it. Its primary objective is to reduce energy intensity in the economy.

Ultra Mega Power Projects (UMPPs)

The Ministry of Power launched the Ultra Mega Power Projects (UMPPs) scheme in 2005-06 to develop large-scale power plants of approximately 4,000 MW or more at both coal pithead and coastal locations. These projects are designed to meet the electricity needs of multiple states by leveraging economies of scale to deliver power at competitive rates. The Central Government facilitates UMPPs through tariff-based competitive bidding, adopting supercritical technology on a build, own, and operate (BOO) model. The Central Electricity Authority (CEA) acts as the technical partner, while the Power Finance Corporation (PFC) serves as the nodal agency for implementation

Restructured Accelerated Power Development and Reforms Programme (R-APDRP)

The Ministry of Power launched the R-APDRP in July 2008. The program aims to strengthen the sub-transmission and distribution network in urban areas; along with the metering of distribution transformers/feeders/consumers in the urban areas. The scheme plans to reduce AT&C losses, establish IT-enabled energy accounting/auditing systems, and improve the billing of energy based on metered consumption, and its collection.

National Smart Grid Mission

The National Smart Grid Mission was launched in 2015 to accelerate Smart Grid deployment in India. NSGM has its own resources, authority, and functional and financial autonomy to plan and monitor implementation of the policies and programs related to smart grids in the country.

NSGM functions with a four-tier hierarchical structure:

1. Governing Council (GC), headed by Minister of Power
2. Empowered Committee (EC), headed by Secretary (Power)
3. Technical Committee (TC), headed by Chairperson CEA
4. NSGM Project Management Unit (NPMU)

UJWAL DISCOM Assurance Yojana (UDAY)

UDAY is a scheme for the financial turnaround of Power Distribution Companies (DISCOMs) launched in November 2015, with the objective to improve the operational & financial efficiency of State Power Distribution Companies (DISCOMs).

This scheme covers 32 states and all Union Territories and aims to increase annual tariffs, adjust quarterly fuel costs, reduce interest burden, rationalize coal prices, lower fuel costs through coal swapping, minimize time bound losses, and others.

Saubhagya Scheme

The Pradhan Mantri Sahaj Bijli Har Ghar Yojana (Saubhagya) launched in October 2017 aims to achieve universal household electrification in India. Additionally, the scheme also aims to provide last-mile connectivity and electricity to all unelectrified rural households and offer last-mile connectivity to economically poor unelectrified households in urban areas (excluding non-poor urban households). The scheme also includes solar photovoltaic (SPV) standalone systems for unelectrified households in remote areas where grid extension is not feasible.

National Policy on Biofuels – 2018

The policy was initiated by the Ministry of Petroleum and Natural Gas in 2018. The policy focuses on utilising and promoting domestic feedstock for biofuel production to substitute fossil fuels. It aims to enhance national energy security, mitigate climate change, and create sustainable employment opportunities. The policy also encourages the use of advanced technologies for biofuel generation.

India Energy Modelling Forum (IEMF)

In October 2020, the government announced the creation of an inter-ministerial committee under NITI Aayog to lead research and studies on energy modelling. The IEMF was jointly launched by NITI Aayog and the United States Agency for International Development (USAID).

Integrated Power Development Scheme (IPDS)

The main objective of the scheme is the strengthening of sub-transmission and distribution networks in the urban areas, metering of distribution transformers/feeders/consumers, enterprise resource planning (ERP), IT enablement of balance urban towns, Real Time-Data Acquisition System (RT-DAS) projects, and others.

Mission on Advanced and High-Impact Research (MAHIR)

The government has launched MAHIR with a view to leverage emerging technologies in the power sector and make the country a manufacture hub. MAHIR aims to facilitate indigenous research, and the development and demonstration of the latest and emerging technologies in the power sector. The mission will be funded by pooling financial resources of the Ministry of Power, Ministry of New and Renewable Energy, and the Central Public Sector Enterprises. Any additional funding needed will be mobilized from the Indian government's budgetary resources.

Independent Transmission Projects

The Ministry of Power has initiated a Tariff-Based Competitive Bidding Process to develop and strengthen the transmission system with private sector participation. The goal is to enhance transmission capacity in India and attract potential investors. This involves completing preliminary

tasks such as route identification, survey work, land acquisition processes, seeking forest clearances (if needed), and conducting the bidding process.

Key Recent Developments

- ✓ **April 2025 -** West Bengal Chief Minister Mamata Banerjee laid the foundation stone for an Rs 160 billion, 1,600 MW JSW power plant in Salboni. The project is expected to create direct 2000 jobs and marks a major push in the power sector, with five more plants and Rs 480 billion in planned investments to boost capacity to 18,000 MW in Bengal.
- ✓ **February 2025** - Tata Motors and Tata Power have partnered to develop a 131 MW wind-solar hybrid project that will supply renewable energy to six manufacturing plants in Maharashtra and Gujarat. The initiative will generate 300 million renewable units annually, offset 200,000 tons of CO_2, and support Tata Motors' goal of 100% renewable energy by 2030.
- ✓ **February 2025** - EDF India and Actis have partnered to launch a smart metering platform in India. The initiative supports the national goal of deploying 250 million smart meters by 2025, enhancing grid efficiency and sustainability. It combines EDF's technical expertise with Actis's investment capabilities to achieve long-term impact.
- ✓ **February 2025** - India's 2025–26 Budget launches a transformative Nuclear Mission to expand nuclear capacity from 8,180 MW to 22,480 MW by 2031–32 with Rs 200 billion allocated for Small modular reactor R&D, it targets 100 GW by 2047, encourages private participation, and aligns with India's 2070 net-zero goals.
- ✓ **December 2024 -** IndiGrid, a consortium including British International Investment (BII) and Norfund, has launched EnerGrid, an Rs 25.55 billion platform to develop greenfield transmission and battery energy storage projects in India. Each partner has committed Rs 8.52 billion to the initiative. IndiGrid will acquire the projects after they become operational, supporting India's USD 1.2 Trillion net-zero mission.

Major Player in Power Sector

Major Players by Installed Capacity (other than Solar and Wind Energy)		
Major Players	**Installed Capacity in MW**	**Share in Total***
NTPC Limited	51,488.00	38.8%
Adani Power Limited	12,310.00	9.3%
Maharashtra State Power Generation Limited	10,872.00	8.2%
Nuclear Power Corporation of India Limited	8,780.00	6.6%
Rajasthan Rajya Vidyut Utpadan Nigam Limited	8,455.35	6.4%
Uttar Pradesh Rajya Vidyut Utpadan Nigam Limited	8,455.00	6.4%
Damodar Valley Corporation	6,544.00	4.9%
NHPC Limited	6,251.20	4.7%
Karnataka Power Corporation Limited	5,390.05	4.1%
Gujarat State Energy Corporation Limited	5,160.00	3.9%
M.P. Power Generating Corporation Limited	4,570.00	3.4%
Tamil Nadu Generation and Distribution Corporation Limited	4,320.00	3.3%
Total-Major Players	**1,32,595.60**	**28.1%**
** Individual share in total installed capacity of major players. Total share of major players in total installed capacity. Source: ICED, NITI Aayog*		

Top 15 Power Plant by Capacity Installed (Other than solar and wind energy)				
Name of the Project	**Company Name**	**Capacity in MW**	**Source**	**State**
Vindhyachal STPS	NTPC Limited	4,760	Coal	Madhya Pradesh
Mundra TPS	Adani Power Limited	4,620	Coal	Gujarat
Mundra UMTPP	Tata Power Limited	4,000	Coal	Gujarat
Sasan UMTPP	Reliance Power Limited	3,960	Coal	Madhya Pradesh
Tirora TPS	Adani Power Limited	3,300	Coal	Maharashtra
Talcher or Kaniha Talcher STPS	NTPC Limited	3,000	Coal	Odisha
Rihand STPS	NTPC Limited	3,000	Coal	Uttar Pradesh
Sipat STPS	NTPC Limited	2,980	Coal	Chhattisgarh
Chandrapur (Maharashtra) STPS	Maharashtra State Power Generation Co. Ltd.	2,920	Coal	Maharashtra
Suratgarh STPS	Rajasthan Rajya Vidyut Utpadan Nigam Ltd.	2,820	Coal	Rajasthan
Barh STPP	NTPC Limited	2,640	Coal	Bihar
Anpara TPS	Uttar Pradesh Rajya Vidyut Utpadan Nigam Limited	2,630	Coal	Uttar Pradesh
Ramagundam STPS	NTPC Limited	2,600	Coal	Telangana
Korba STPS	NTPC Limited	2,600	Coal	Chhattisgarh
Vijayawada or Dr. Narla Tata Rao TPS	Andhra Pradesh Power Generation Limited	2,560	Coal	Madhya Pradesh
Source: ICED, NITI Aayog				

Outlook

According to estimates by the CEA, India's power requirement to grow to reach 817 GW by 2030. The proportion of renewable energy generation is projected to rise from 22.1% to 44.0% by FY2030, whereas the share of thermal is anticipated to decrease from 74.7% to 52.0%. India holds the fourth position globally in installed renewable energy capacity, including large hydro and in both wind power capacity and solar power capacity. The country has elevated its goal at COP26 to secure 500 gigawatts of energy from non-fossil fuel sources by 2030. As of March 2025, India possesses an overall installed capacity of 220.10 GW for renewable energy sources, which includes large hydropower. The distribution is detailed as: Wind energy at 50.04 GW, solar energy at 105.65 GW, biomass/co-generation at 10.74 GW, small hydropower at 5.10 GW, waste-to-energy at 0.84 GW, and large hydropower at 47.73 GW. This varied combination emphasises India's major progress in enhancing renewable energy facilities for a more sustainable energy future.

Operation and Maintenance Industry

Overview

Operation and maintenance (including overhaul) encompass the processes, services and materials involved in ensuring the continued functionality, safety and efficiency of equipment, infrastructure and facilities. Maintenance, Repair and Operations (MRO) is integral to operations across various industries, supporting the upkeep of machinery, electrical systems and physical environments.

The operation and maintenance (including overhaul) market consists of revenues earned by entities (organisations, sole traders and partnerships) that include goods such as spare parts, consumables, tools and equipment, as well as services such as inspection, diagnostics and repair. O&M activities are crucial for minimising downtime, extending the lifecycle of assets and maintaining compliance with safety and operational standards. O&M is used by businesses and organisations in diverse sectors, including manufacturing plants, construction sites, commercial buildings and specialised industries such as aerospace and defence. Its uses range from routine maintenance to emergency repairs, ensuring equipment reliability and operational continuity.

O&M products and services are often complementary to operational technologies and substitute certain capital expenditures by extending the lifespan of existing assets. Regular maintenance helps avoid unscheduled equipment failures that can halt production. O&M practices can significantly reduce operational costs by minimising waste and optimising resource use. Well-maintained equipment reduces the risk of accidents and injuries in the workplace. Effective MRO contributes to longer asset lifespans and reduces environmental impact through better resource management.

The O&M market includes sales of products and services that support maintenance, repair, and operational activities across various sectors, including industrial, electrical, facility and other

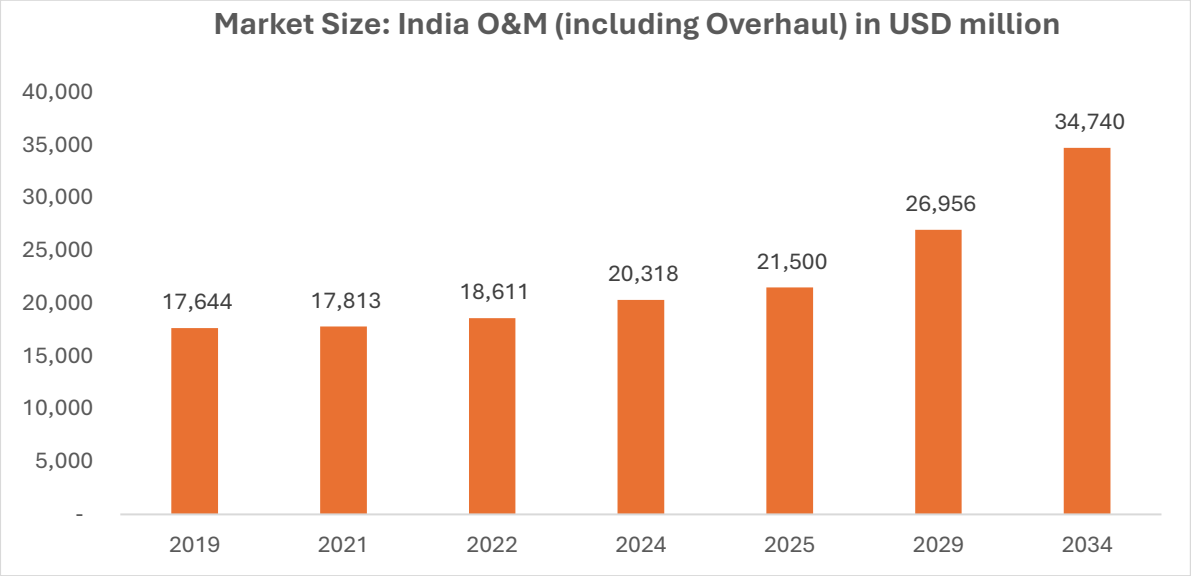
types. The O&M market consists of maintenance, repair and operational support for industrial equipment and facilities, like bearings, motors and pumps, as well as services such as equipment diagnostics and part replacements, catering to industries like power, manufacturing, mining and utilities. It also includes maintaining systems such as circuit breakers, transformers, cables, and control systems, which are essential for operational safety and efficiency as well as focuses on upkeep and repairs of buildings and infrastructure, including HVAC, lighting, plumbing, janitorial supplies, and general building maintenance to ensure safe and functional environments. The market also caters to niche applications such as IT hardware maintenance, transportation fleet repairs, and specialised safety equipment, providing comprehensive support across diverse operational needs.

Market Trends

The global O&M (including overhaul) market was valued at approximately USD 721.12 billion in 2025 and is projected to reach around USD 972.17 billion by 2034, with a compound annual growth rate (CAGR) of 3.37%. The O&M market in India too grew at CAGR 4% in the last five years and estimated to reach USD 34.7 billion by 2030.

India O&M (including overhaul)

Market Size



Source: EMIS, Global Maintenance Repair And Operations Market Report 2025

Power O&M Services: The power O&M market consists of revenues earned by entities by providing operation and maintenance services for energy operation, as well as regular maintenance, routine repairs, replacement and upgrades of energy equipment and devices. The maintenance and operations include various services offered to manage assets that are used to supply energy.

Top 10 Players in India - Power O&M

1. ADV Powercon Pvt. Ltd
2. Flowtherm Engineering Pvt. Ltd
3. N.S Thermal Energy Private Limited
4. Neptunus Power Plant Services Pvt. Ltd
5. Pavo Power Engineering Pvt. Ltd
6. Power Mech Projects Limited
7. Sai Urja Indo Ventures Limited
8. SKV Energy Services Pvt. Ltd
9. Solon India Pvt. Ltd
10. Sopan O&M Co. Pvt. Ltd.

Key Services

1. **Maintenance Services**
   This segment focuses on the regular upkeep, repair, and replacement of equipment and components to ensure optimal performance and prevent breakdowns.

Key Activities:

- ✓ **Preventive Maintenance:** Scheduled inspections and maintenance tasks to prevent equipment failures.
- ✓ **Corrective Maintenance:** Repairs and replacements performed in response to identified issues or failures.
- ✓ **Predictive Maintenance**: Using data and analytics to predict potential failures and address them proactively.

2. **Operational Management**
   This segment involves the day-to-day management and operation of power plants to ensure they run efficiently and meet performance targets.

Key Activities:

- ✓ **Operational Monitoring:** Continuous monitoring of plant operations to ensure optimal performance.
- ✓ **Performance Optimisation:** Implementing strategies to enhance the efficiency and output of power plants.
- ✓ **Compliance Management:** Ensuring operations adhere to regulatory and safety standards.

3. **Overhaul**
   This is ideally performed as a preventative measure to avoid unplanned maintenance, thereby ensuring reliable and satisfactory availability of the power generating plant.

Key Activities:

- ✓ **Overhaul of major Equipment:** Detailed overhaul of equipment including but not limited to structural replacement, restoration, upgrading and modification of existing equipment's.
- ✓ **Cleaning and Washing:** It includes cleaning and washing of major equipment.

4. **Manpower Supply**
   This segment focuses on providing skilled and unskilled workforce to the company.

Key Activities:

- ✓ **Workforce Recruitment and Deployment:** Hiring, training, and assigning workforce, both skilled and unskilled to meet the workforce requirement of the company.
- ✓ **Skill Development and Training:** Providing training programs to workforce to increase their efficiency and effectiveness.
- ✓ **Temporary and Contract Staffing:** Managing flexible staffing solutions for peak periods, emergencies, or specific projects, including shift rotations and on-site supervision.

Demand and Supply

Value Chain of the Industry

- ✓ **Planning and Setup-** Initial phase involving the planning and establishment of O&M processes and systems.
  - **Key Activities:** Developing maintenance schedules, setting up monitoring systems, and establishing operational protocols.
- ✓ **Routine Maintenance** Regular maintenance activities conducted to ensure the smooth operation of equipment and systems.

- **Key Activities**: Conducting inspections, performing scheduled maintenance tasks, and updating maintenance records.

✓ **Operational Management** Day-to-day management of plant operations to ensure optimal performance.
- **Key Activities:** Monitoring operational parameters, adjusting processes for efficiency, and managing staff.

✓ **Repair and Replacement** Addressing equipment failures and replacing worn-out components to maintain plant functionality.
- **Key Activities:** Diagnosing issues, performing repairs, and sourcing and installing replacement parts.

✓ **Performance Optimization** Implementing strategies to enhance the efficiency and output of power plants.
- **Key Activities:** Analysing performance data, making process improvements, and deploying advanced technologies.

✓ **Compliance and Safety Management** Ensuring that operations adhere to regulatory standards and safety protocols.
- **Key Activities:** Conducting safety audits, implementing compliance measures, and training staff on safety practices.

Demand Drivers

- ✓ Aging power plants: The coal-based power plant is around 15.41 years old and hydro based power plants are about 30 years, which requires frequent maintenance.
- ✓ Increase in installed capacity: India power installed capacity is expected to grow from 475.21 GW in FY2025 to 817 GW in FY2030, which is expected increase demand.
- ✓ Renewable energy expansion: Indian renewable energy installed capacity is expected to increase from 220.10 GW in FY2025 to 500GW in FY2030.
- ✓ Asset performance optimisation: There is efforts by industry players to improve PLF and provide stable and continuous energy.
- ✓ Cheaper outsourcing: For power generation companies it is cheaper to outsource O&M than to maintain O&M department internally.

Key Success Factors

- ✓ Operation of plant for optimum energy generation: O&M has to ensure that plant runs at optimum level i.e at optimum PLF and continuously with very less/no downtime.
- ✓ Maximum availability of plant that i.e. effective preventive and predictive maintenance:-O&M companies has to ensure that spare parts are available in stock and analyse the operation of plant for maximum generation.
- ✓ Skilled and trained workforce for operation and maintenance: O&M companies is required to have skilled and trained workforce to resolve any issue quickly to reduce downtime.
- ✓ Operation efficiency by maintaining optimal Plant load factor, heat rate and auxiliary power consumption to ensure optimum generation
- ✓ Use of digital tools and automation – SCADA systems, IOT sensors etc: By using these tools O&M companies can stimulate problem in plant before it happens (Preventive maintenance)
- ✓ Robust Safety and Regulatory Compliance: O&M players has to ensure compliance of law and regulations to avoid fine and penalties.

Key Factors Shaping Market

Description	Example	Impact
Digital Transformation and Industry 4.0		
The integration of digital technologies is revolutionising the O&M industry. Industry 4.0 technologies, including the Internet of Things (IoT), Artificial Intelligence (AI), and big data analytics, are increasingly being adopted to enhance operational efficiency and predictive maintenance capabilities.	• IoT Sensors: Used for real-time monitoring of equipment health and performance. • AI and Machine Learning: Employed to analyse data and predict maintenance needs, thereby reducing unplanned downtime. • Digital Twins: Creating virtual models of physical assets to simulate and optimise performance.	Increased operational efficiency, reduced maintenance costs, and extended asset life.
Remote Monitoring and Management		
The COVID-19 pandemic has accelerated the adoption of remote monitoring and management solutions. These technologies enable companies to oversee operations and maintenance activities from a distance, ensuring continuity even during disruptions.	• Remote Monitoring Systems: Allowing real-time tracking of equipment performance from off-site locations. • Virtual Inspections: Using drones and other remote tools to conduct inspections without the need for physical presence.	Impact: Increased operational resilience, reduced travel and on-site personnel requirements, and enhanced safety.
Increased Adoption of Renewable Energy O&M		
The growing adoption of renewable energy sources such as wind and solar is driving demand for specialized O&M services tailored to these technologies.	• Wind Farm Maintenance: Regular inspection and servicing of wind turbines to ensure optimal performance. • Solar Plant O&M: Cleaning and maintaining solar panels, monitoring energy output, and managing system components.	Increased operational efficiency, reduced maintenance costs, and extended asset life.
Emphasis on Predictive and Preventive Maintenance		
There is a shift from reactive to predictive and preventive maintenance approaches. By using data analytics and IoT, companies can predict equipment failures before they occur and schedule maintenance activities proactively.	• Predictive Maintenance Systems: Utilising historical and real-time data to forecast potential issues. • Preventive Maintenance Programs: Regularly scheduled inspections and maintenance tasks to prevent equipment breakdowns.	Reduced downtime, lower maintenance costs, and improved reliability of operations.
Focus on Sustainability and Green O&M Practices		
Sustainability is becoming a core focus in the O&M industry. Companies are adopting green practices to reduce their environmental footprint and comply with stringent regulatory standards.	• Energy-Efficient Operations: Implementing measures to reduce energy consumption in operations. • Waste Reduction Initiatives: Minimizing waste generated during maintenance activities. • Sustainable Materials: Using eco-friendly and sustainable materials for repairs and replacements.	Enhanced environmental performance, compliance with regulations, and improved corporate reputation.
Advanced Asset Management		
Advanced asset management strategies are being implemented to optimize the performance and lifespan of assets. This includes comprehensive tracking, lifecycle management, and strategic planning.	• Asset Management Software: Tools that provide detailed insights into asset performance, maintenance history, and lifecycle costs. • Lifecycle Management: Planning for the entire lifespan of assets, from acquisition to disposal.	Better decision-making, optimized asset utilization, and reduced total cost of ownership.
Focus on Health and Safety		
Health and safety remain top priorities, with increasing emphasis on creating safer work environments and adhering to regulatory standards.	• Safety Training Programs: Regular training sessions to ensure employees are aware of and adhere to safety protocols. • Safety Technologies: Implementing safety technologies such as wearables that monitor worker health and safety conditions.	Reduced workplace incidents, improved worker well-being, and compliance with health and safety regulations.
Expansion of Service Offerings		
O&M firms are expanding their service portfolios to include comprehensive solutions such as facility management, energy efficiency consulting, and retrofitting services.	• Facility Management Services: Providing end-to-end management of entire facilities, including maintenance, security, and utilities. • Energy Efficiency Consulting: Advising clients on how to optimize energy use and reduce costs.	Increased revenue streams, stronger client relationships, and enhanced value propositions.

Challenges and Opportunities

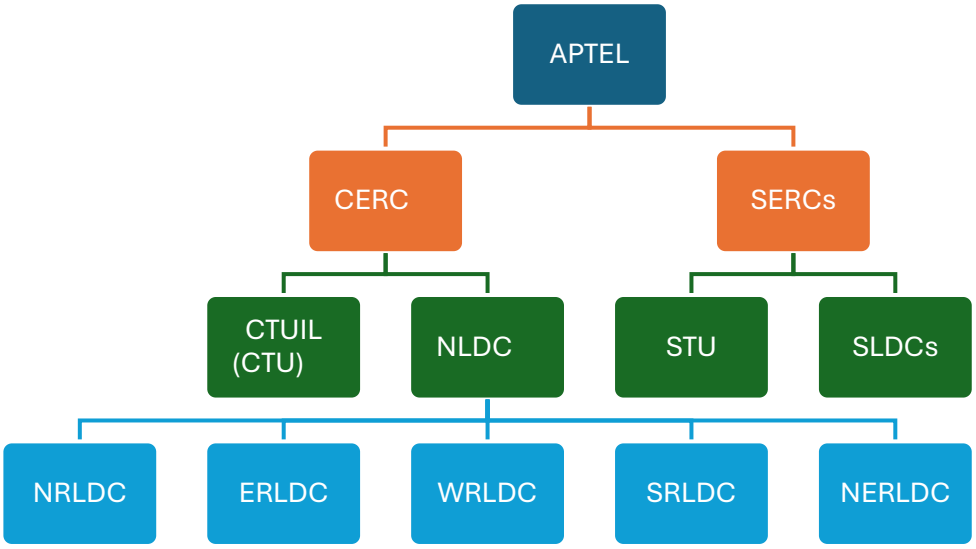
Regulatory frameworks impacting maintenance practices:

Laws & Regulations

1. CEA (safety requirements for construction, operation and maintenance of Electrical Plants and Electrical Lines) Regulations, 2011 -
2. Central Electricity Regulatory Commission –Renewable Energy Tariff Regulations, 2024
3. Central Electricity Regulatory Commission (Terms and Conditions of Tariff) Regulations, 2024.
4. The Electricity Act, 2003.
5. Indian Electricity Grid Code (IEGC),2006.
6. The Factories Act 1948, Wages Act 1936, Minimum Wages Act 1948, Employer's Liability Act 1938, Workmen's Compensation Act 1923, Industrial Dispute Act 1947, Maturity Benefit Act 1961, Employees State Insurance Act 1948, Contract Labor (Regulations & Abolishment) Act 1970

Regulatory Structure

Inter-state generation and transmission activities are done by National load dispatch centre and Intra state generation and transmission activities are done by state load despatch centre.



APTEL - The Appellate Tribunal for Electricity, CERC- Central Electricity Regulatory Commission, WRLDC- Western Regional Load Despatch Centre, ERLDC- Eastern Regional Load Despatch Centre, SRLDC- Southern Regional Load Despatch Centre, NLDC: National Load Despatch Centre (Now called as GRID-INDIA), NRLDC- Northern Regional Load Despatch Centre, NERLDC- North-Eastern Regional Load Despatch Centre. SLDCs- State Load Despatch Centres; CTU- Central Transmission Utility; STU- State Transmission Utility, SERCs: State Electricity Regulatory Commissions.

Evolving Technology

- **Leveraging Artificial Intelligence (AI) And Internet of Things (IoT) for Predictive Maintenance:** Major companies in the operation and maintenance (including overhaul) market are increasingly leveraging Artificial Intelligence (AI) and Internet Of Things (IoT) sensors to develop predictive maintenance services. This innovation enables real time monitoring and early fault detection, improving asset reliability and reducing downtime across industries.
- **Launch of Cloud Based Platforms Revolutionising MRO Efficiency and Service Management:** Major companies in the operation and maintenance (including overhaul) market are investing in cloud-based collaboration and project management platforms to improve efficiency. These platforms help streamline workflows, enhance communication among maintenance teams and reduce downtime, ultimately driving productivity and operational performance.

Effect of Implementation of Technology Upgrade in O&M Services in Power Plants

Technology driven solutions are continuously evolving and increasingly being adopted across the power generation sector to enhance operational efficiency and reduce downtime. For example, the integration of AI based predictive analytics enables the real -time analysis of vast operational datasets, helping to identify performance deviations, predict failures, and proactively recommend corrective measures using machine learning algorithms. For example, enSights' cloud-native O&M platform[4] cleans and standardises all asset data, enabling real-time fault detection. Its AI-driven features have led to substantial increases in system uptime, reduced unnecessary troubleshooting, and improved scalability for O&M teams. Companies report faster incident response, fewer manual interventions, and better asset longevity following such upgrades.

One of the most transformative advancements is the deployment of digital twin technology a virtual replica of physical assets that allows trained professionals to interact with and monitor equipment remotely. This reduces the need for on-site personnel for routine diagnostics, enabling targeted interventions only, when necessary, thus optimising resource deployment and improving safety.

Emerging applications such as demand response systems, hybrid energy storage, vehicle to grid integration, and virtual power plants are also being piloted across the sector, incorporating advanced technologies to increase system flexibility and reliability.

Furthermore, Machine Learning (ML) and Artificial Intelligence (AI) are being used to detect complex patterns, predict equipment malfunctions, and identify key operational variables that may be overlooked by traditional monitoring systems. For example, in AMPIN Energy transition[5] the company is using AI and ML to detect operational inefficiencies and failure trends based on subtle behavioural patterns the company uses correlation among inverter loading, temperature spikes and past failure logs, the system flags probable future issues. These innovations collectively support smarter, safer, and more efficient operation and maintenance practices across all types of power plants.

[4] *Revolutionising Clean Energy O&M with Automation and AI*
[5] *https://energy.economictimes.indiatimes.com/news/renewable/from-solar-panels-to-smart-grids-how-ai-is-powering-the-future-of-energy-operations/120486906*

Porter Five Forces

Bargaining power of supplier: The bargaining power of supplier in the power plant operation and maintenance industry for skilled manpower is high as there is shortage in skilled labour in Power plant O&M, whereas bargaining power of supplier for unskilled manpower is low.
Bargaining power of buyer: The bargaining power of buyer in the power plant operation and maintenance industry is very high as there are various provider of Operation and maintenance provider and switching cost is low unless there is some specific technical specialisation provided by these operation and maintenance providers. The utilities and independent power producer are price sensitive and have fixed tariff with some escalation fixed by Power purchase agreement thereby squeezing O&M providers to reduce costs.
Threat of new entrant: The threat of new entrant is moderate in Power plant operation and maintenance industry as there is need for skilled engineers, OEM partnership. The utilities and independent power producer prefer established names due to safety and compliance risks.
Threat of substitute: The threat of substitute is very high as large utilities and independent power producer prefer in house O&M to avoid vendor risks and maintain direct control. However, this needs a large workforce, training, is not viable for smaller independent power producer companies.
Threat of competition between existing players: The threat of competition between existing players is high as there is competitive bidding in operation and maintenance contracts. Power producing companies always look for lowest prices. It decreases the margins of O&M provider. There is no differentiation in service provided by operation and maintenance provider and switching cost is also low.

PESTLE – Operation and Maintenance

1. Political Factors

India's aggressive push toward achieving 500 GW of renewable energy installed capacity by 2030 has significantly shifted the country's energy mix from thermal dominance to a more renewable focused portfolio. This transition has required O&M strategies to evolve and adapt to the challenges of managing distributed and intermittent energy sources. To support this shift, the government has introduced a range of incentives and mandates including viability gap funding, accelerated depreciation, and Production Linked Incentive (PLI) schemes which have catalysed the development of new power assets that demand modern, performance linked O&M frameworks.

Government renewable targets and incentives are expanding the O&M market, driving demand for more advanced services. While incentives support growth but also require adapting to new compliance standards, hence O&M providers need to innovate for distributed renewable assets.

2. Economic Factors

Rising cost consciousness and increasing tariff pressure driven by declining tariffs such as solar power have compelled power producers to aggressively optimise operational costs. This has led to a growing reliance on third party O&M providers offering cost effective and performance driven services. Simultaneously, the industry has seen a fundamental shift from reactive to proactive and predictive maintenance approaches, giving rise to service-based business models where outcome-

oriented contracts such as availability linked payments and shared savings agreements are becoming the norm. Complementing this trend is the broader transition from capital expenditure (CAPEX) to operational expenditure (OPEX), as asset light strategies push plant owners to favour outsourced or hybrid O&M arrangements over traditional in-house teams.

Cost pressures and tariff declines force both asset owners and O&M providers to seek cost-efficient, outsourced, and outcome-based O&M services. This fuels growth of specialised third-party providers investing in digital and predictive solutions, while OPEX-focused models create steady revenue streams but demand stronger service delivery and risk management. Tariff pressures and OPEX focus drive cost-efficient, outsourced, and outcome-based O&M models, increasing recurring revenues and the need for digital solutions.

3. Social Factors

The transition toward smarter and more digitally integrated power plants has highlighted a significant shortage of skilled labour, particularly in the domain of digital operations and analytics. This has necessitated widespread reskilling initiatives and the adoption of digital onboarding platforms to bridge the skills gap. At the same time, there is a growing emphasis on workforce safety and well-being, driven by heightened regulatory oversight and public scrutiny of workplace hazards. In response, the industry is increasingly deploying technology-based safety solutions such as wearables and AR/VR (Augmented and Virtual Reality) enabled training modules. Furthermore, with rapid urbanization and increased dependence on uninterrupted power supply, public expectations have evolved toward zero tolerance for outages demanding real time diagnostics and swift, efficient O&M interventions to ensure reliability.

Skill shortages in digital O&M roles drive businesses to invest in training, reskilling, and digital onboarding to stay competitive. Heightened focus on safety and employee well-being leads to adoption of advanced safety technologies, with strong safety records becoming a key differentiator. Rising public demand for reliable power compels companies to provide rapid, real-time issue resolution through 24/7 support and advanced monitoring tools, raising the overall service quality expectations.

4. Technological Factors

The past decade has witnessed an explosion of smart technologies in the power sector, with widespread adoption of SCADA systems, programmable logic controllers (PLCs), IoT sensors, and smart meters across thermal, hydro, and renewable energy plants to enable real time remote condition monitoring. Simultaneously, the rise of artificial intelligence (AI) and machine learning (ML) has significantly advanced predictive maintenance, allowing operators to anticipate faults, enhance fuel efficiency, and prolong asset life. Since 2020, digital twin technology has become increasingly standard in utility scale plants, enabling remote diagnostics and reducing the need for manual inspections. Additionally, O&M teams are now managing more complex and integrated ecosystems involving grid edge technologies such as energy storage systems, EV infrastructure, and virtual power plants requiring a new level of digital coordination and technical capability.

Widespread adoption of advanced technologies such as SCADA, PLCs, IoT, and AI/ML is essential for O&M providers to remain competitive and relevant. Integrating digital twins lowers costs and boosts accuracy, enabling innovative services such as remote diagnostics and predictive maintenance as-a-service. As energy systems become more complex and interconnected, businesses that specialise in integration, data analytics, and comprehensive digital O&M solutions gain new growth opportunities and a competitive edge.

5.Environmental Factors

Stringent emission regulations and growing ESG (Environmental, Social, and Governance) mandates have significantly reshaped O&M practices in the power sector. Compliance requirements such as sulphur emission caps, fly ash utilisation rules, water reuse obligations, and net zero targets have compelled operators to adopt cleaner, more sustainable maintenance protocols. Simultaneously, the increasing frequency of climate related events such as floods, droughts, and heatwaves has underscored the need for climate resilient infrastructure and retrofitted O&M strategies, particularly in vulnerable thermal and hydropower plants. Additionally, as many older thermal power plants approach the end of their operational life, a new domain of O&M services has emerged, focused on plant decommissioning, site remediation, and responsible waste management.

Increasingly stringent environmental regulations and ESG mandates push O&M providers to adopt cleaner and more sustainable maintenance practices, creating business opportunities for providers with strong green credentials. Climate change-induced risks such as floods and heatwaves demand resilient infrastructure and adaptive O&M strategies, driving innovation in asset hardening and emergency responsiveness. Additionally, as aging thermal plants reach end-of-life, a new segment in plant decommissioning, site remediation, and responsible waste management emerges, necessitating new capabilities and partnerships. Overall, environmental imperatives are reshaping O&M business models toward sustainability, resilience, and lifecycle management. Compliance and ESG mandates create business for sustainable O&M offerings, climate resilience solutions, and decommissioning services for end-of-life assets.

6.Legal & Regulatory Factors

The regulatory landscape governing power plant O&M has become increasingly robust over the past decade. Since 2011, CEA safety regulations have mandated regular safety audits and equipment certifications, leading to standardized preventive maintenance practices across the sector. Complementing this, the Electricity Act and evolving CERC/SERC regulations have introduced tariff linked performance norms, technical minimum requirements, and strict grid compliance obligations, all of which have made operational efficiency a legal necessity. In parallel, labour laws such as the Contract Labour Act, ESI, and EPF norms have tightened enforcement, formalised the engagement of the contract workforce and ensuring better worker protections. Moreover, as digital technologies have become integral to plant operations, cybersecurity regulations introduced post 2017 have established stringent protocols for IT/OT system protection, including mandatory cybersecurity audits, significantly impacting the governance of modern O&M functions.

Strict safety audits, grid compliance, and equipment certifications make preventive maintenance mandatory, improving operational predictability but raising compliance costs. Tariff-linked

performance norms incentivise O&M providers to enhance efficiency and invest in quality improvements. Meanwhile, tighter labour and cybersecurity regulations increase compliance complexity and costs, but also professionalise the industry, protect stakeholders, and raise barriers for less qualified operators. Overall, these factors drive higher standards and cost structures while fostering a more reliable and secure O&M sector.

Comprehensive O&M Industry Insights & Trends

Power plant O&M Industry is linked to the installed capacity of power plants which is itself driven by overall electricity demand. As per NITI Aayog India energy security scenario (IESS) 2047 following is the forecasted electricity demand including captive and Electricity supply (utility) for India.

The installed capacity has been increased at CAGR of 5.13% from FY2020 to FY2025 i.e. from 3,70,106 MW in FY2020 to 4,75,212 MW in FY2025. Renewable energy accounts for 83.13% for installed capacity addition followed by coal at 15.86%. As per India's Renewable Electricity Roadmap 2030, the government has planned to have 500 GW of non-fossil fuel capacity by 2030 by increasing its share to 50% in total electricity generation capacity. Currently (FY2025), renewable energy accounts for 22.13% of total electricity generation at 220.10 GW. This suggests renewable energy is expected to grow at a CAGR of 17.83% by FY2030. As on FY2025, renewable energy consists of 46.32% of installed capacity, while its share in electricity generation is still at 22.13%. This is due to integration constraint in Grid system and the need for irregular storage capacity when power production is not possible, as renewable energy sources such as solar and wind are intermittent and cyclical.

Electricity Demand (Including captive) in TWh					
Year	**2027**	**2032**	**2037**	**2042**	**2047**
Industry	747.12	1042.86	1383.24	1812.89	2336.93
Buildings	596.92	847.1	1202.75	1707.26	2421.07
Agriculture	256.33	323.03	406.75	511.44	642.44
Telecom	64.16	83.65	106.67	131.59	162.1
Cooking	5.66	10.17	18.29	32.87	59.02
Transport	58.49	88.18	123.65	162.73	204.07
Miscellaneous	172.81	261.17	353.36	456.27	575.86
Total	**1901.49**	**2656.16**	**3594.71**	**4815.05**	**6401.49**

Electricity Supply (Utility) in TWh					
Year	**2027**	**2032**	**2037**	**2042**	**2047**
Gas	50.09	51.24	52.39	53.54	54.69
Coal	1303.75	1657.39	1984.84	2454.98	3212.71
CCS	0.00	8.59	17.18	25.77	34.36
Nuclear	72.70	106.82	156.96	230.62	338.86
Hydro	183.68	206.07	226.59	230.57	234.56
Solar	176.34	349.09	593.51	873.98	1143.87
Wind	126.85	237.66	464.8	770.11	1097.43
Bioenergy	20.41	22.13	24.26	26.96	29.39
Electricity Trade	0.40	5.68	13.72	17.51	22.35
Total	**1934.22**	**2644.67**	**3534.25**	**4684.04**	**6168.22**

Source: CEA

Ministry of Environment, Forest & Climate Change (MoEF&CC) had notified "Environment (Protection) Amendment Rules, 2015" for thermal power stations on December 7, 2015. All existing

thermal generating stations including new stations and stations under construction were required to comply with the new Standards within 2 years (i.e. by Dec. 2017). However, due to limited vendor capability and installation time of about 48 to 52 months as well as import challenges and exorbitant high prices, the TPPs were unable to meet the timeline., In view of this, subsequently MOEF&CC vide gazette notification dated 05.09.2022 has categorized thermal power plants in three categories having different timelines along with the environment compensation for non-compliance. CEA gives update on the implementation on quarterly basis on the same. The compliance of above changes in regulation is resulting in huge capital expenditure for power generating company thus creating a business opportunity for O&M providers.

Coal Based Power Plant Renovation and Modernisation and Life Extension

As per final report of the committee constituted for studying various aspects of Renovation and modernisation and life extension of coal-based power plant (2024-2033). CEA has identified 223 units with total capacity of 63,440 MW as potential candidates for R&M/LE works with age older than 20 years as of December 2022. R&M/LE works in these units have to be implemented in nine phases to avoid any major energy demand supply gap. CEA gives update on the implementation on quarterly basis on the same.

Age of Power Plant

Source	Sum of Capacity (MW)	Installed Capacity Commission	Installed Capacity Commission	Age*
		Age data is not available	***Age data is available***	
Bio Power	11,594.02	6,864.75	4,729.27	15.07
Coal	2,19,338.00	NA	2,19,338.00	15.41
Hydro	47,928.16	NA	47,928.16	30.18
Nuclear	8,780.00	NA	8,780.00	17.10
Oil & Gas	20,122.42	NA	20,122.42	20.05
Small Hydro	5,102.05	2,211.88	2,890.17	23.40
Solar	1,07,945.61	1,07,945.61	0.00	-
Wind	51,058.55	51,058.55	NA	NA
Total	**4,71,868.81**	**1,68,080.79**	**3,03,788.02**	-

**Age is calculated using weighted average formula that i.e. Age * Installed capacity/Total installed capacity source wise, for which age data is available.*

Note: Total age of power plant cannot be calculated on aggregate basis, as age of solar and wind energy plant is not available.

Source: ICED, NITI Aayog

Capital Expenditure on Consolidated Level (Rs crore)										
FY ended	**NTPC Limited**	**Power Grid Corporation of India Limited**	**Adani Power Limited**	**Adani Green Energy Limited**	**Tata Power Company Limited**	**Adani Energy Solutions Limited**	**JSW Energy Limited**	**NHPC Limited**	**Torrent Power Limited**	**Reliance Power Limited**
2015	28,290	22,456	3,072	NA	3,494	194	371	1,726	1,380	2,119
2016	32,091	22,584	1,975	NA	1,009	736	69	2,221	1,315	2,167
2017	33,991	24,429	854	917	883	1,360	372	1,587	2,450	60,061
2018	31,037	25,791	941	3,936	3,560	961	121	1,567	2,281	45,974
2019	33,494	15,313	1,212	2,869	3,576	1,199	233	1,360	1,989	4,860
2020	35,539	25,807	2,227	3,397	2,226	2,763	121	3,632	1,334	54,444
2021	33,982	11,284	3,618	6,143	3,336	3,952	435	2,058	1,296	13,396
2022	34,491	9,060	3,435	14,792	7,268	4,191	2,294	5,014	1,809	19,616
2023	31,986	9,212	3,244	3,376	7,656	4,702	4,236	4,975	3,089	38,449
2024	35,385	12,500	2,602	15,773	13,333	5,430	8,033	6,997	3,656	NA

Source: Consolidated financial statements, Annual Reports, EMIS

Hydro Based Power Plant Renovation and Modernization and Life Extension

Programme during the period 2022-27: The Renovation, Modernisation, Uprating and Life Extension works at 49 Hydro Electric Plants (HEPs) with an aggregate installed capacity of 8765.90 MW is programmed for completion during the year 2022-27 with its break up as 2228.8 MW through R&M at 14 HEPs, 5294.1 MW through Life Extension at 26 HEPs and 1,243 MW through Life Extension and Uprating at 09 HEPs. Out of these 49 Schemes, Eleven Schemes with an aggregate installed capacity of about 2590.8 MW have been completed till March 2025 which has resulted in benefit of 1301 MW through Life Extension and 90 MW through Uprating. The Renovation, Modernization, Uprating and Life Extension works at 32 Hydro Electric Plants (HEPs) with an aggregate installed capacity of 5161.20 MW is programmed for completion during 2027-32 through Life Extension and Uprating. CEA gives update on the implementation on quarterly basis on the same.

The Renovation and modernization and life extension of coal-based power plant (2024- 2033) and Hydro based power plant results in huge capital expenditure for power generating company thus creating a business opportunity for O&M providers. O&M services are also provided by EPC companies making it difficult for pure play O&M companies to get business from power generating companies.

Small Modular Reactor: Nuclear Power Corporation of India Ltd has floated a request for proposals to site two indigenously designed, 220 MW small modular reactors within industrial zones the reactors would be built using private industrial capital, operated by NPCIL, with ownership reverting to the state for a token Rs 1, while the companies would receive long term, cheap, clean power at prices beginning as low as Rs 0.60 per unit. India wants to increase its nuclear capacity to 22 GW by 2031 and to an ambitious 100 GW by 2047.

Battery Energy Storage Systems:

As per National Electricity Plan (NEP) 2023 of CEA (CEA), the energy storage capacity requirement is projected to be 82.37 GWh (47.65 GWh from PSP and 34.72 GWh from BESS) in year 2026 27. This requirement is further expected to increase to 411.4 GWh (175.18 GWh from PSP and 236.22 GWh from BESS) in year 2031 32. Further, CEA has also projected that by the year 2047, the requirement of energy storage is expected to increase to 2380 GWh (540 GWh from PSP and 1840 GWh from BESS), due to the addition of a larger amount of renewable energy in light of the net zero emissions targets set for 2070.

The Levelised Cost of Electricity (LCOE) for solar power has significantly declined over the past decade, making it cheaper than coal-based generation in many cases. This cost competitiveness has increased pressure on conventional power producers to reduce their cost structures, including operation and maintenance (O&M) expenses, to remain viable under tightening margins. As India advances toward its net zero target by 2070 and emphasizes a clean energy transition, the installed generation mix is expected to be dominated by low tariff renewable sources particularly solar and wind.

Given that renewable energy plants, especially utility scale solar, generally have lower O&M intensity and fewer moving parts than thermal units, the revenue potential for traditional O&M service

providers is likely to face structural headwinds. Consequently, the O&M industry must adapt by shifting towards value added services such as digital performance monitoring, asset optimization, and lifecycle extension strategies to maintain relevance and profitability in a low tariff environment".

Business Potential for the Entity

Power: Power sector is undergoing a significant shift from thermal based to renewable energy power infrastructure. This is aligned with Government of India's vision 2030 to have 500GW of renewable energy installed capacity and make India net zero by 2070 along with Renovation and Modernization and life extension of thermal and hydro power plant provides an opportunity for O&M service providers. However, even there is increase in installed capacity of power plants majority will be in renewable where tariff rates are lower than electricity generated through thermal power plant that creates pressure on power companies leading to competitive pricing O&M market and these O&M contract are also provided by EPC companies making pure play O&M service provider to grow business.

Oil & Gas: India mineral oil & petroleum captive power installed capacity has grown between FY2019-2023 at CAGR 6.95%, for FY2023 coal being the most used fuel at 46.77% followed by gas at 46.68%. As per Green hydrogen policy 2022, Government of India directly influence the oil and gas industry in multiple ways, pushing the sector toward decarbonization, energy diversification, and technology transition. Indian refineries currently use grey hydrogen for desulfurization and other refining process. The green hydrogen policy encourages refineries to replace grey hydrogen with green hydrogen produced using renewable energy via electrolysis for adapting electrolysis-based hydrogen generation requiring advanced control systems, renewable integration thus creating an opportunity for O&M service provider.

Paper: India paper & paperboard market volume has grown between FY2019-2024 at CAGR of 0.50%. The paper industry installed capacity increased FY2019-2024 by CAGR of 2.28%. The paper industry uses coal as a source for power generation that is 87.79% of total installed capacity in FY2023**.** The aging coal reliant power infrastructure provides and opportunities for O&M service provider. However, the paper industry continues to operate under tight margins and subdued demand growth, implying that any O&M intervention must be cost effective and ROI driven to gain traction.

India Paper & Paperboard Market Volume (2019-24)

Year	Thousand tonnes	% Growth
2019	18,415.50	NA
2020	16,562.50	10.10%
2021	15,740.10	5.00%
2022	16,842.90	7.00%
2023	17,810.60	5.70%
2024	18,852.00	5.80%
CAGR: 2019–24		**0.50%**

Source: EMIS, Market Line Industry Reports India Paper & Paperboard, March 2025

Food and Beverage: India food products industry captive power installed capacity has grown between FY2019 and 2023 at CAGR 7.42%, with diesel being the most used source at 64.76% followed by coal at 20.59% in FY2023. The food products industry leaders such as PepsiCo and HUL are moving toward renewable energy in production, and its competitors /other companies in the

food product industry are likely to adopt similar practices thereby opening up growth opportunities for O&M service providers in renewable energy infrastructure.

Chemicals: India chemicals industry captive power installed capacity has grown between FY2019 and FY2023 at CAGR 5.82%. During FY2023 coal being the most used source at 45.20% followed by diesel at 32.13%. The chemical industry leaders shown a negative growth in captive power installed capacity because of shifts towards renewable energy because of sustainability and cost efficiency. As industry is moving towards renewable energy these creates growth opportunities for O&M service providers in renewable energy infrastructure.

Infrastructure: India's infrastructure sector is rapidly shifting toward sustainable energy under initiatives like the National Infrastructure Pipeline and PM Gati Shakti. This creates strong demand for renewable energy and O&M service providers. Metro systems, ports, airports, and industrial corridors increasingly require reliable, clean captive power solutions. There is growing interest in solar, hybrid, and green hydrogen systems to meet energy and ESG goals. Ageing power infrastructure also offers opportunities for modernization and performance improvement services. BOOT and BOO models are gaining popularity to reduce upfront capital costs. The expansion of EV charging and hydrogen infrastructure in logistics and transport adds further potential. Overall, clean energy integration and O&M support are becoming critical across India's infrastructure projects.

Iron & Steel: India's iron and steel sector, a key contributor to industrial growth, is under pressure to decarbonize and improve energy efficiency in line with national sustainability goals. The industry remains heavily reliant on coal based captive power and heat intensive processes, creating opportunities for renewable energy and O&M service providers. Integration of solar and hybrid power systems can help reduce energy costs and carbon emissions, especially in integrated steel plants and rolling mills. Modernization of captive power units, waste heat recovery, and energy optimization are emerging focus areas. There is also growing interest in green hydrogen for direct reduced iron (DRI) production, supported by evolving policy frameworks.

Agrochemical: India's agrochemical sector, vital for supporting agricultural productivity, is witnessing a shift toward cleaner and more sustainable manufacturing practices. Traditionally energy intensive and reliant on fossil fuels, agrochemical plants are exploring renewable energy integration such as solar, biomass, and green hydrogen for captive power generation to reduce operational costs and emissions. This transition opens opportunities for O&M and clean energy service providers to offer solutions like solar rooftop systems, process heat optimization, and hybrid power setups. Additionally, modernization of ageing utility systems and compliance with stricter environmental norms (air, water, and hazardous waste) create demand for performance improvement and emissions control services. As global buyers increasingly link procurement to ESG performance, energy efficient operations and decarbonization measures are becoming essential for agrochemical manufacturers.

Data Centres: India data centre industry crossed the 1 GW milestone, growing at a robust pace of 24% CAGR since 2019. This strong growth was driven by increasing demand from Cloud service providers. India enjoys the advantage of one of the lowest data usage costs and the world's second largest mobile user market, leading to strong digital growth. The Indian data centre industry grew from 350 MW in 2019 to 1030 MW in 2024. As the power requirement of these data centre increases these data centre operating companies are developing their own captive power plant for continuous electricity supply for example.

- ✓ In November 2024, Equinix Partners done an agreement with CleanMax to Develop 33 MW Captive Renewable Power Projects to Decarbonize its Data Centres in India.
- ✓ In February 2025, India's CtrlS Datacentres, a data centre operator, has unveiled a 125 MWp captive solar farm, Green Volt 1, in Nagpur, Maharashtra.

As captive power plant of these data centre companies increases it provides an opportunity to O&M players to expand its business.

Captive Power Plant Installed Capacity: Source Wise (MW)					
Particulars	**FY2019**	**FY2020**	**FY2021**	**FY2022**	**FY2023**
Biomass	0	0	0	0	28
Coal	47679	51543	47760	45303	46783
Diesel	15571	12775	17563	18649	18080
Gas	8787	7316	7361	5685	6359
Hydro	103	131	131	135	132
Solar	1064	1525	2202	3769	3478
Wind	2003	2950	3491	3192	3541
Total	**75207**	**76239**	**78508**	**76732**	**78401**

Source: ICED, NITI Aayog

Industry-wise Captive Power Installed Capacity (MW)					
Particulars	**FY2019**	**FY2020**	**FY2021**	**FY2022**	**FY2023**
Aluminium	7254	7486	8673	9097	9808
Automobiles	1233	1402	1962	2777	1899
Cement	6052	7244	7549	6014	7090
Chemical	5473	5933	5012	4455	4305
Collieries	196	190	351	303	282
Electrical Engineering	5959	4068	5585	1770	1652
Fertiliser	1202	1403	1248	1412	1473
Food Products	1010	1458	1181	1306	1345
Heavy Engineering	546	514	640	633	627
Iron & Steel	14238	15017	15165	16025	15462
Jute	147	150	145	136	61
Light Engineering	1036	1515	1057	815	1149
Mineral Oil & Petroleum	4891	5217	6713	6250	6399
Mining & Quarrying	488	701	720	608	474
Miscellaneous	7711	4772	5166	6686	7059
Non- Industry	0	0	4080	4694	4715
Non-Ferrous	1371	1000	1147	1059	824
Paper	1677	1875	1846	1830	1835
Plastic	241	274	281	291	308
Rubber	1282	1416	633	634	477
Sugar	8028	8549	5315	5967	6906
Textiles	5173	6060	4043	3972	4250
Total	**75208**	**76244**	**78512**	**76734**	**78400**

Source: ICED, NITI Aayog

Competitive Landscape

Major players in the industry

- Sai Urja Indo Ventures Limited
- Neptunus Power Plant Services Private Limited
- Power Mech Projects Limited
- Lakshya Powertech Limited
- SKV Energy Services Private Limited
- Solon India Private Limited
- Sopan O And M Company Private Limited

SWOT Analysis

Strength

- Diversified Operation & Maintenance Services across Electrical Mechanical and Control & Instrumentation, rendered in various units of a power plant including Main Plant or BTG/Boiler Turbine Generator, Balance of Plant units like Coal Handling Plant, Ash Handling Plant, Flue-Gas De-Sulpherization Plant, Transmission Lines along with associated townships and substations.
- Technical capabilities which enable them to participate in tenders for like services in other process industries such as steel, fertilizer, oil and gas, and cement.
- Pan India presence.
- Experienced management.

Weaknesses

- Company operations concentrated in the power generation industry, specifically in conventional thermal energy coal-powered power plants.

Opportunities

- India aims for 817 GW of installed capacity that will lead to exponential demand for O&M services.
- Data centre operating companies are developing captive power plants for steady and continuous flow of energy thereby resulting in demand for O&M services.
- Adoption of IoT, AI, and analytics in power plant maintenance can unlock a new premium segment of O&M services.

Threat

- As majority of installed capacity additions will be made in renewable energy, particularly solar, creating a threat for the company as it has less exposure towards O&M services of solar plant.
- Falling tariff rates of solar energy will also affect margin for O&M companies.
- Increasingly strict pollution control norms and emission regulations can lead to premature shutdown or costly retrofits of old thermal energy plants.

Peer Comparison

Particulars		Sai Urja Indo Ventures Limited					Neptunus Power Plant Services Private Limited				
	2025	2024	2023	2022	2021	2020	2024	2023	2022	2021	2020
Sales in Rs. crores	65.52	45.61	28.39	26.51	26.47	26.59	67.24	92.87	76.38	96.48	120.15
Total income in Rs. crores	65.82	45.88	28.51	26.51	26.47	26.62	70.57	94.97	77.81	97.44	121.45
Net profit after tax in Rs. crores	3.13	1.39	0.07	0.82	1.00	1.35	7.51	8.71	6.54	4.52	7.01
Net profit after tax	4.8%	3.0%	0.3%	3.1%	3.8%	5.1%	11.2%	9.4%	8.6%	4.7%	5.8%
Sales growth	43.7%	60.7%	7.1%	0.1%	0.4%	5.6%	27.6%	21.6%	20.8%	19.7%	36.4%
Return on capital employed	65.4%	52.5%	6.5%	8.6%	10.1%	17.0%	17.2%	13.9%	13.1%	9.9%	15.8%
Employee cost to sales	86.0%	82.4%	90.6%	78.7%	14.5%	0.0%	11.7%	9.2%	10.1%	10.0%	6.9%
EBITDA margin	7.8%	6.4%	2.5%	3.5%	4.2%	5.5%	19.0%	11.7%	11.6%	6.8%	7.4%
Debt equity ratio	68.9%	45.5%	152.6%	81.1%	55.6%	53.1%	0.4%	0.0%	0.0%	14.2%	20.0%
Current ratio	1.13x	0.96x	0.93x	1.50x	5.32x	2.45x	4.24x	4.67x	4.05x	3.09x	2.97x
Working capital turnover	104.45x	90.69x	9.44x	3.01x	2.89x	11.50x	1.07x	1.57x	1.34x	1.86x	2.58x

Particulars	Solon India Private Limited					Sopan O & M Company Private Limited					Lakshya Powertech Limited				
	2024	2023	2022	2021	2020	2024	2023	2022	2021	2020	2024	2023	2022	2021	2020
Sales in Rs. crores	247.78	69.85	165.89	44.4	66.41	392.2	414.28	408.16	258.04	212	148.13	51.86	32.75	26.6	23.33
Total income in Rs. crores	251.16	74.72	168.98	44.91	66.41	398.02	417.39	410.78	259.9	214.57	149.22	51.88	32.82	26.61	23.35
Net profit after tax in Rs. crores	14.96	2.62	8.46	0.9	2.21	45.43	42.67	41.66	28.53	18.16	15.68	2.94	1.17	0.8	0.81
Net profit after tax	6.04%	3.75%	5.10%	2.02%	3.32%	11.58%	10.30%	10.21%	11.06%	8.57%	9.87%	10.58%	5.66%	3.58%	3.00%
Sales growth	254.74%	57.89%	273.64%	33.14%	64.55%	5.33%	1.50%	58.18%	21.72%	35.83%	185.63%	179.26%	58.35%	23.12%	14.01%
Return on capital employed	35.42%	7.27%	24.80%	5.49%	13.35%	26.79%	30.32%	37.98%	36.84%	31.28%	24.28%	63.60%	26.63%	21.99%	20.83%
Employee cost to sales	3.02%	10.42%	3.66%	11.62%	5.86%	20.86%	17.92%	15.36%	15.81%	17.79%	25.47%	40.00%	40.04%	38.10%	37.86%
EBITDA margin	8.50%	7.13%	7.65%	5.11%	6.26%	16.91%	14.84%	14.80%	16.36%	12.55%	14.91%	15.19%	8.92%	5.86%	5.22%
Debt equity ratio	49.05%	82.08%	92.66%	222.57%	256.42%	8.68%	5.81%	7.35%	11.62%	8.37%	28.19%	80.15%	192.47%	123.17%	141.86%
Current ratio	1.58x	2.32x	1.38x	1.42x	1.28x	2.43x	2.11x	1.83x	1.52x	1.68x	2.56x	1.53x	1.95x	1.93x	2.70x
Working capital turnover	7.78x	2.39x	6.80x	2.52x	4.06x	2.66x	3.95x	5.36x	6.77x	5.92x	1.84x	5.91x	3.55x	4.20x	4.32x

Note: Standalone financial statement of companies has been considered for peer comparison for all peer companies other than Power Mech Projects Ltd and Neptunus Power Plant Services Private Limited. For these two companies consolidated financial statement has been considered.

Source: EMIS

Outlook

O&M sector is closely linked to India's power sector. India's power requirement is expected to reach 817 GW by 2030. The proportion of renewable energy generation is projected to rise from 22.13% to 44% by FY2030, whereas the share of thermal is anticipated to decrease from 74.76% to 52%. Most of the new capacity addition is going to happen in renewable segment, and within that majority of energy mix will of solar energy. As compared to other source of power, solar energy power plant has high penetration of outsourcing of O&M services but as there is decrease in per kWh tariff of power generated through solar energy majorly because of cost of components. The decreased tariff will have an impact on margin of O&M players. In captive power generation with the rise of data centres the operators will look for stable and continuous flow of power to keep their data centres running for these data centres are developing their own power plant (via EPC contractor) for the energy needs these gives O&M contractor an opportunity to grow their business.

Engineering Procurement Construction & Commissioning in Power Sector

An Overview

EPC project covers design, civil works, equipment purchase installation, and commissioning. The scope of an EPC work in most cases now also include O&M (Operation and Management) services. EPC projects consider as supply (material) contracts and services contracts. In a comprehensive package, most of the EPC providers offer 3-5 years of O&M services after commissioning of the project and after expiry of the services.

Market Size- India

Year	2022	2023	2024	2025	2026	2027	2028
	Actual	Forecasted	Forecasted	Forecasted	Forecasted	Forecasted	Forecasted
USD million	6317	7629	9377	11773	15165	20164	27905

Source: EMIS, Technavio Power EPC Market in India 2024-2028.

Key Services

Particulars	Description
Civil	It includes construction of chimney, buildings, cooling tanks, land development, roads & boundary walls, erection and fabrication and substations.
Erection works	Erection, testing and commissioning including turbine-generator and boilers, heaters, cooling system, condensing system, SCR and FGD, substations.
Instrumentation	Instrumentation and process control requirement is high in case of power sector and various equipment involve: Distributed digital control monitoring, PLC based control, Control system of boiler, turbine & balance of plant.
Electrical	Electrical systems such as auxiliary transformers, generators, panels, electrostatic precipitators, switchgears and cabling, transmission lines, transmission towers, substations, electrification and distribution.
O&M and AMCs	O&M of power plants, O&M of transmission and distribution network and O&M of substations.

Top Players – EPC

1. Larsen & Turbo Limited
2. Tata Projects Limited
3. Adani Infra Limited
4. Bajaj Electricals Limited
5. Bharat Heavy Electricals Limited
6. BTL EPC Limited
7. Doosan Power Systems India Private Limited
8. Hindustan Construction Company Limited
9. KEC International Limited
10. Sterlite Electric Limited

Source: EMIS, Technavio Power EPC Market in India 2024-2028

Demand and Supply

Value Chain Analysis – EPC (Construction Materials)

Inputs

The inputs in the construction materials market include raw materials, labour, and manufacturing equipment. The key raw materials used in the industry include limestone, clay, gypsum, cement, sand, water, and natural clay minerals.

Inbound Logistics

The inbound logistics processes in the construction materials market include the activities associated with handling, warehousing, and disseminating raw materials. Other activities included under inbound logistics are inventory control, vehicle scheduling, and returns to suppliers.

Operations

The production of construction materials entails processes such as grinding, sizing, raw material combining, extrusion, chamfering, coating, drying, firing, setting, and packaging. Apart from the manufacturing process, the value chain of the construction materials market includes research, product and process development, and product design.

Outbound Logistics

The outbound logistics activities in the market include warehousing, material handling, delivery vehicle operations, and transportation or distribution of finished goods to the points of sale. Efficient outbound logistics services in the industry ensure timely and accurate delivery of products to the customers. Processes such as the distribution and sales of products are accomplished by traders (international and domestic), distributors, dealers, wholesalers, and retailers.

Marketing and sales

The marketing and sales activities in the construction materials market include advertising, branding, promotions, and selling. Several construction material manufacturing companies focus on improving their marketing activities by training their sales force and offering services, such as aftersales support, which enhance the value of their products. Recyclers include third party recyclers and an in-house team of manufacturers that engage in the recycling of various types of construction materials.

Service

This is the final stage that adds value to the item down the value chain. It comprises customer support services after the sale of the product for the maintenance of products. Efficient service programs also ensure the retention of customers. The better an organization's customer support, the greater is its brand identity, and the higher is the number of retained customers.

Support Activities

The support activities in the construction materials market include the purchase of resources and inputs, technology development, firm infrastructure development, and human resource management. It also includes the implementation of the latest technology solutions to ensure speed and accuracy during different processes and enhance the quality of the final product. Another

critical activity in the construction materials market is human resource development, as upskilling initiatives for employees can improve their overall performance and competence. Thus, a good supply network and the effective execution of all support activities will enable companies to position themselves strongly in the market and meet their strategic objectives.

Innovations

Factors such as the growing consumer demand for construction materials with unique properties and a crowded marketplace have made it imperative for manufacturers to invest in technology solutions and implement innovative strategies to optimise production for long term growth. Following is some of the innovative approaches adopted by manufacturers to ensure a sustainable market presence:

Introduction of smart construction materials equipped with sensor driven and mobile integration features, Launch of premium construction materials with advanced features.

Use of AI in construction, Launch of energy efficient construction materials, Development of innovative products such as self-healing concrete, modular bamboo, and 3D graphene for construction.

Demand Drivers

- ✓ Increase in installed capacity: India Power installed capacity is expected to grow from 475.21 GW in FY2025 to 817 GW in FY2030.
- ✓ Renovation and modernisation of aging power plant: - The coal-based power plant is approx. 15.41 years old and hydro based power plant are approx. 30 years requiring EPC.
- ✓ Fuel gas desulfurization: As per amended environment regulation power plants need to reduce and control carbon emissions for these power plant needs to install FGD creating a demand for EPC and O&M.
- ✓ Grid Modernization: - Indian grid modernization and calibration of grid for solar energy creates an opportunity for EPC and O&M companies.
- ✓ Transmission & Distribution (T&D) Expansion: - GOI plant for electrification of rural area and 24*7 electricity availability in country is resulting to expansion of T&D lines creating an opportunity for EPC and O&M companies.

Key Success Factors

- ✓ Compliance of project execution timeline: As power EPC are high value projects the successful completion of project within given timeline gives a brand name to EPC companies.
- ✓ Performance of equipment: A power generation companies require very less /no downtime of its plant.
- ✓ Cost of generation: To remain competitive and earn market share power generation companies want cost of generation to be less than its competitors which can happen if power plant is developed efficiently and can run optimally.

Porter Five Forces

Bargaining Power of Buyer

The bargaining power of buyers in the power EPC market is low as the buyer concentration, threat of backward integration by buyers were low and impact of product quality on buyers' output was high.

Threat of New Entrants

The threat of new entrants in the power EPC market is low in as the product differentiation was moderate, economies of scale of established vendors and regulatory control were high.

Threat of Substitutes

The threat of substitutes in the power EPC market is low as the availability of substitutes, buyers' cost of switching to substitutes, and differentiation of substitute products were low.

Bargaining Power of Supplier

The bargaining power of suppliers in the power EPC market is low as the supplier concentration, switching cost between suppliers, and threat of forward integration by suppliers were moderate.

Threat of Rivalry

The power EPC market in India consists of numerous vendors that offer power EPC solutions. Moreover, vendors need high capital investment to enter and survive in the market. This results in high exit barriers. However, the products offered by the vendors are moderately differentiated.

PESTLE – EPC

Political Factors

EPC demand in the power sector is largely driven by government led initiatives in electrification, renewable energy expansion, and infrastructure development. Majority of the contracts are awarded by public sector entities such as National Thermal Power Corporation Limited and Power Grid Corporation of India Limited making project flow and payment timelines sensitive to political influence. However, execution is often delayed due to regulatory bottlenecks, including environmental and forest clearances, land acquisition issues, and shifting import policies.

Economic Factors

EPC demand in the power sector closely follows capital expenditure and infrastructure investment cycles, with economic slowdowns often leading to project deferrals or cancellations. Since EPC contracts are typically milestone based, firms face long receivable cycles and significant working capital stress, making effective liquidity management essential. Additionally, project costs are highly

sensitive to fluctuations in commodity prices such as steel, copper, and cement and exposure to foreign exchange risks, especially when importing key components like solar modules and turbines.

Social Factors

Social factors significantly impact power sector EPC projects, with land acquisition challenges, community protests, and local employment demands often causing delays particularly in large thermal and transmission projects. Securing a social license to operate increasingly depends on strict adherence to workforce safety standards and fair labour practices. At the same time, rising urbanization, especially in Tier 2 and Tier 3 cities, is driving steady demand for substation and grid infrastructure, creating new opportunities for EPC contractors.

Technological Factors

Technological advancements are reshaping the power sector EPC landscape, requiring firms to shift from traditional thermal and hydro projects to newer formats such as solar, wind, hybrid, and grid scale battery storage. To remain competitive, EPC players are increasingly adopting digital tools like drones, Building Information Modeling (BIM), project tracking software, and prefabrication techniques, which enhance execution quality and cost efficiency. Additionally, the growing focus on smart grid development including digital substations, advanced energy management systems, and electric vehicle (EV) infrastructure is significantly expanding the scope and complexity of EPC work.

Environmental Factors

Environmental considerations are becoming increasingly critical in power sector EPC projects, with stricter regulations requiring compliance with air, water, noise, and waste standards particularly for thermal and hydro plants. This has led to the mandatory inclusion of systems such as flue gas desulphurization (FGD), ash handling units, and zero liquid discharge setups in project designs. Moreover, climate impact assessments factoring in risks from flooding, heatwaves, and extreme weather are now often required at the planning stage. In parallel, access to green financing and project awards is increasingly linked to environmental, social, and governance (ESG) performance, clean energy integration, and sustainable procurement practices.

Legal Factors

Legal challenges in power sector EPC projects are significant, with frequent issues related to delay penalties, change orders, and disputes over payments often requiring arbitration. Strong legal frameworks and effective dispute resolution mechanisms are essential to manage these risks. Compliance with increasingly stringent labor laws, safety regulations, and environmental approvals is critical, as violations can lead to project shutdowns or blacklisting. Additionally, sudden policy changes such as adjustments in import duties on solar equipment, updates to grid codes, or renegotiations of power purchase agreements (PPAs) add layers of legal uncertainty that EPC firms must carefully navigate.

Peer Comparison

Particulars	Tata Projects Limited					Adani Infra Limited				
	2024	2023	2022	2021	2020	2024	2023	2022	2021	2020
Sales in Rs. crores	17,760.61	16,947.62	13,679.37	12,187.38	10,687.05	868.14	748.65	735.27	2,244.01	1,062.08
Total income in Rs. crores	18,045.52	17,041.93	13,758.87	12,289.17	10,764.62	1,183.96	1,378.05	1,236.25	2,638.48	1,790.39
Net profit after tax in Rs. crores	81.97	856.30	618.98	127.22	108.77	86.41	8.90	8.54	12.11	5.17
Net profit after tax	0.46%	5.05%	4.52%	1.04%	1.02%	9.95%	1.19%	1.16%	0.54%	0.49%
Sales growth	4.8%	23.89%	12.24%	14.04%	20.35%	15.96%	1.82%	67.23%	111.28%	0.32%
Return on capital employed	0.38%	4.17%	3.41%	0.8%	0.74%	1.53%	0.11%	0.08%	0.11%	0.07%
Employee cost to sales	6.73%	6.08%	6.54%	6.22%	7.98%	14.52%	12.22%	8.82%	4.97%	6.02%
EBITDA margin	1.81%	4.57%	3.9%	3.9%	4.19%	12.9%	1.61%	1.63%	0.74%	0.66%
Debt equity ratio	182.49%	126.76%	175.91%	191.68%	234.83%	2303.61%	106.34%	204.88%	269.84%	75.84%
Current ratio	1.19x	1.13x	1.12x	1.15x	1.1x	1.76x	0.48x	0.78x	2.17x	0.53x
Working capital turnover	5.82x	7.75x	7.95x	6.3x	9.29x	2.07x	0.71x	1.56x	1.77x	1.3x

Particulars	Bajaj Electricals Limited					Bharat heavy Electricals Limited				
	2024	2023	2022	2021	2020	2024	2023	2022	2021	2020
Sales in Rs. crores	4,641.27	5,429.26	4,813.01	4,584.60	4987.23	23892.78	23,364.94	21,211.09	17,308.69	22027.44
Total income in Rs. crores	4,727.74	5,505.11	4,881.35	4,653.81	5,033.39	24,439.05	23,853.57	21565.63	17657.11	21,463.14
Net profit after tax in Rs. crores	131.08	216.19	124.41	188.96	10.29	282.22	477.39	444.71	2699.7	1468.35
Net profit after tax	2.82%	3.98%	2.58%	4.12%	0.00	1.18%	2.04%	2.1%	15.6%	0.07
Sales growth	14.51%	12.8%	4.98%	8.07%	25.33%	2.26%	10.15%	22.55%	19.36%	29.49%
Return on capital employed	3.42%	4.62%	3.12%	4.45%	0.23%	0.48%	0.8%	0.79%	4.89%	2.46%
Employee cost to sales	7.86%	7.85%	8.34%	8.61%	7.80%	23.56%	24.4%	26.02%	31.07%	25.31%
EBITDA margin	7.46%	7.99%	6.62%	8.12%	5.10%	4.85%	5.16%	5.14%	16.14%	1.52%
Debt equity ratio	4.53%	36.68%	29.72%	64.82%	109.99%	43.18%	25.79%	22.95%	23.48%	23.28%
Current ratio	1.21x	1.3x	1.2x	1.17x	1.11x	1.36x	1.29x	1.3x	1.39x	1.45x
Working capital turnover	10.32x	6.84x	11.03x	10.47x	14.87x	2.59x	3.47x	3.27x	2.17x	2.12x

Particulars	BTL EPC Limited					Doosan Power Systems India Private Limited				
	2024	2023	2022	2021	2020	2024	2023	2022	2021	2020
Sales in Rs. crores	641.29	520.9	326.38	311.77	249.01	1,002.13	1,752.04	2,561.27	2,940.54	3,411.93
Total income in Rs. crores	645.26	524.52	331.25	318.67	252.6	1,040.29	1,756.97	2,567.94	2,996.80	3,425.90
Net profit after tax in Rs. crores	37.6	17.06	6.71	3.99	2.57	751.62	742.29	598.81	234.34	2,177.69
Net profit after tax	5.86%	3.28%	2.06%	1.28%	1.03%	70.13%	40.15%	23.36%	8.00%	63.94%
Sales growth	23.11%	59.6%	4.68%	25.2%	23.44%	42.8%	31.59%	12.9%	13.82%	11.84%
Return on capital employed	4.92%	2.72%	1.34%	0.83%	0.56%	24.02%	17.12%	13.93%	4.77%	43.12%
Employee cost to sales	5.42%	6.06%	8.14%	6.89%	10.76%	25.36%	15.01%	10.9%	10.09%	9.11%
EBITDA margin	8.85%	5.59%	3.88%	4.04%	2.24%	68.84%	34.4%	21.98%	6.47%	62.32%
Debt equity ratio	50.74%	50.41%	50.64%	51.65%	50.9%	39.45%	54.78%	69.72%	162.15%	79.24%
Current ratio	1.24x	1.22x	1.34x	1.33x	1.25x	0.61x	0.6x	0.64x	1.05x	0.65x
Working capital turnover	6.01x	6.71x	3.61x	3.7x	3.93x	0.86x	1.33x	2.21x	23.64x	2.44x

Particulars	Hindustan Construction Company Limited					Larsen & Toubro Limited				
	2024	2023	2022	2021	2020	2024	2023	2022	2021	2020
Sales in Rs. crores	7,006.71	9,856.59	10,669.73	8,248.42	9,444.30	221,112.91	183,340.70	1,56,521.23	1,35,979.03	1,47,813.26
Total income in Rs. crores	7,139.37	9,912.33	10,821.86	8,334.99	9,521.87	225,270.94	1,86,269.87	158,788.31	1,39,408.38	1,45,452.36
Net profit after tax in Rs. crores	545.7	53.6	484.63	551.09	151.03	15,569.72	12,624.87	10,291.05	12,906.88	10,822.32
Net profit after tax	9.97%	5.11%	11.31%	4.15%	2.09%	7.04%	6.89%	6.57%	9.49%	7.44%
Sales growth	28.91%	7.62%	29.35%	12.66%	10.43%	20.6%	17.13%	15.11%	6.51%	7.57%
Return on capital employed	5.28%	0.21%	2.81%	4.77%	1.62%	4.58%	3.82%	3.22%	4.15%	3.51%
Employee cost to sales	9.14%	8.49%	8.73%	11.58%	10.41%	18.62%	20.3%	19%	18.21%	15.89%
EBITDA margin	11.47%	6.42%	12.6%	5.79%	9.76%	12.51%	12.92%	13.09%	14.01%	12.85%
Debt equity ratio	2727.62%	1100.24%	605.82%	576.27%	849%	118.69%	121.88%	138.68%	159.67%	195.42%
Current ratio	1.16x	1.09x	1.04x	0.97x	0.75x	1.23x	1.37x	1.30x	1.42x	1.25x
Working capital turnover	7.57x	16.27x	30.01x	21.88x	3.94x	5.46x	3.10x	3.26x	2.36x	4.09x

Particulars	Reliance Infrastructure Limited					KEC International Limited				
	2024	2023	2022	2021	2020	2024	2023	2022	2021	2020
Sales in Rs. crores	22,066.86	20,646.43	18,411.10	16,704.58	18,728.56	19,914.17	17,281.71	13,742.26	13,114.20	11,965.37
Total income in Rs. crores	22,519.20	21,161.14	19,132.55	17,664.80	20,972.33	19,966.58	17,313.03	13,755.69	13,144.12	11,976.47
Net profit after tax in Rs. crores	645.56	2,473.04	678.85	144.33	868.74	346.78	176.03	332.08	552.72	565.52
Net profit after tax	2.93%	11.98%	3.69%	0.86%	4.62%	1.74%	1.02%	2.42%	4.21%	4.73%
Sales growth	6.88%	12.14%	10.22%	10.81%	1.34%	15.23%	25.76%	4.79%	9.6%	8.77%
Return on capital employed	1.09%	4.05%	1.08%	0.23%	1.33%	1.82%	0.94%	2.03%	3.93%	4.39%
Employee cost to sales	5.05%	5.24%	5.9%	6.53%	5.59%	7.23%	7.85%	9.16%	8.5%	9.23%
EBITDA margin	11.34%	8.4%	13.85%	20.01%	17.74%	6.36%	4.98%	6.67%	8.93%	10.41%
Debt equity ratio	137.68%	144.48%	123.19%	183.63%	203.11%	93.81%	86.14%	85.73%	62.11%	92.07%
Current ratio	0.36x	0.35x	0.42x	0.44x	0.52x	1.11x	1.11x	1.13x	1.16x	1.13x
Working capital turnover	1.00x	0.93x	0.98x	0.82x	1.16x	12.08x	10.69x	8.66x	8.22x	9.22x

Particulars	Sterlite Electric Limited				
	2024	2023	2022	2021	2020
Sales in Rs. crores	4,917.89	3,278.65	5,197.48	2,092.39	3,004.32
Total income in Rs. crores	4,999.25	3,315.04	6,083.01	3,950.44	5,188.35
Net profit after tax in Rs. crores	315.06	225.88	440.14	869.77	941.66
Net profit after tax	0.2%	6%	8.47%	41.57%	31.34%
Sales growth	50%	36.92%	148.4%	30.35%	15.49%
Return on capital employed	0.07%	1.78%	4.81%	12.88%	10.3%
Employee cost to sales	2.56%	2.88%	4.75%	11%	8.14%
EBITDA margin	7.42%	8.76%	19.56%	60.1%	55.61%
Debt equity ratio	57.81%	305.54%	124.84%	253.15%	8777.34%
Current ratio	1.08x	0.95x	1.16x	0.92x	0.57x
Working capital turnover	22.11x	13.92x	10.03x	9.11x	1.42x

Note: *Consolidated financial statement of companies has been considered for peer comparison for all peer companies other than BTL EPC Limited and Adani Infra Limited for these company Standalone financial statement has been considered*

Source: EMIS

Peer Analysis

The EPC industry in India is highly fragmented with sales growing at a CAGR of ~ 5% for FY2020 and FY2025. This is in line with the increase in installed capacity of the power sector in the country. Despite this growth, the EPC industry operates on very thin profit margins, typically ranging from 2% to 5%, especially for companies that manage operations across the entire value chain, from power generation to distribution. For example, the Adani Group benefits from a competitive edge in the EPC market due to its vertical integration, which helps enhance its profit margins. Adani Infra Limited, a key subsidiary within the group and one of India's largest solar energy producers, is over leveraged as compared to other industry peers. However, as the group has stable cash flow and ability to pay debt, they manage the debt effectively. In contrast, Doosan Power Systems India Private Limited is facing significant financial challenges, suffering substantial losses primarily due to a steady decline in sales, yet able to achieve sales growth exceeding the industry average. Meanwhile, Reliance Infrastructure Limited, although posting small losses, but sales growth rate remained above the industry average.

EPC industry is closely linked to country's installed capacity of power sector, which is shifting towards renewable energy, primarily solar. Companies such as Adani Infra Limited, part of the Adani Group which is one of the biggest solar energy generation companies have a strong advantage due to their high level of vertical integration across the value chain. This integration positions them to generate steady cash flows and achieve better profit margins in the future.

Outlook

EPC sector is closely linked to India's power sector. India's power requirement is expected to grow and reach 817 GW by 2030. The proportion of renewable energy generation is projected to rise from 22.13% to 44% by FY2029-30, whereas the share of thermal is anticipated to decrease from 74.76% to 52%. The country has elevated its goal at COP26 to secure 500 gigawatts of energy from non-fossil fuel sources by 2030. As of March 2025, India's total installed capacity for renewable energy sources, including large hydropower, stands at 220.10 GW. While India's total installed power capacity stands at 475.21 GW, of which renewable energy accounts for 46%. To meet the country's power demand and achieve its COP26 commitments, India needs to add an additional 341.79 GW of installed capacity. Out of this new capacity, at least 279.90 GW, or 81.89%, is expected to come from renewable energy sources. This represents a 72.00% increase over the current installed capacity. Such a significant expansion presents enormous growth opportunities for EPC players with expertise in solar power plant development, enabling them to scale rapidly.
