CareEdge ANALYTICS & ADVISORY
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Industry Research Report on Solar Power EPC Sector

23 September 2025

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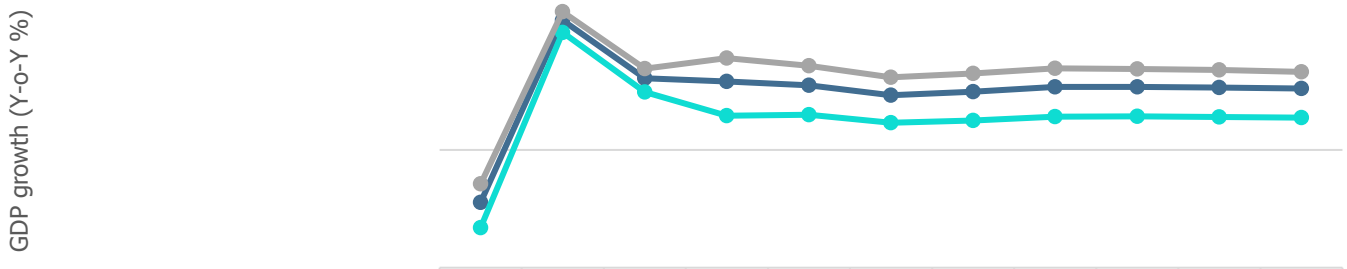
1. Economic Outlook

1.1 Global Macro-Economic Outlook

1.1.1 Current State of Global Economy and Outlook

Global growth, which reached 3.5% in CY23, stabilized at 3.3% for CY24 and projected to decrease at 2.8% for CY25. Global trade is expected to be disrupted by new US tariffs and countermeasures from trading partners, leading to historically high tariff rates and negatively impacting economic growth projections. The global landscape is expected to change as countries rethink their priorities and policies in response to these new developments. Central banks priority will be to adjust policies, while smart fiscal planning and reforms are key to handling debt and reducing global inequalities.

Chart 1: Global Growth Outlook Projections (Real GDP, Y-o-Y change in %)



	CY20	CY21	CY22	CY23	CY24	CY25P	CY26P	CY27P	CY28P	CY29P	CY30P
World	-2.7%	6.6%	3.6%	3.5%	3.3%	2.8%	3.0%	3.2%	3.2%	3.2%	3.1%
Advanced Economies	-4.0%	6.0%	2.9%	1.7%	1.8%	1.4%	1.5%	1.7%	1.7%	1.7%	1.7%
Emerging Market and Developing Economies	-1.7%	7.0%	4.1%	4.7%	4.3%	3.7%	3.9%	4.2%	4.1%	4.1%	4.0%

Source: IMF – World Economic Outlook, April 2025; Notes: P-Projection

1.1.2 Global GDP growth & inflation outlook

Table 1: GDP growth trend comparison - India v/s Other Economies (Real GDP, Y-o-Y change in %)

	Real GDP (Y-o-Y change in %)										
	CY20	CY21	CY22	CY23	CY24	CY25P	CY26P	CY27P	CY28P	CY29P	CY30P
India	-5.8	9.7	7.6	9.2	6.5	6.2	6.3	6.5	6.5	6.5	6.5
China	2.3	8.6	3.1	5.4	5.0	4.0	4.0	4.2	4.1	3.7	3.4
Indonesia	-2.1	3.7	5.3	5.0	5.0	4.7	4.7	4.9	5.0	5.1	5.1
Saudi Arabia	-3.6	5.1	7.5	-0.8	1.3	3.0	3.7	3.6	3.2	3.2	3.3
Brazil	-3.3	4.8	3.0	3.2	3.4	2.0	2.0	2.2	2.3	2.4	2.5
Euro Area	-6.0	6.3	3.5	0.4	0.9	0.8	1.2	1.3	1.3	1.2	1.1
United States	-2.2	6.1	2.5	2.9	2.8	1.8	1.7	2.0	2.1	2.1	2.1

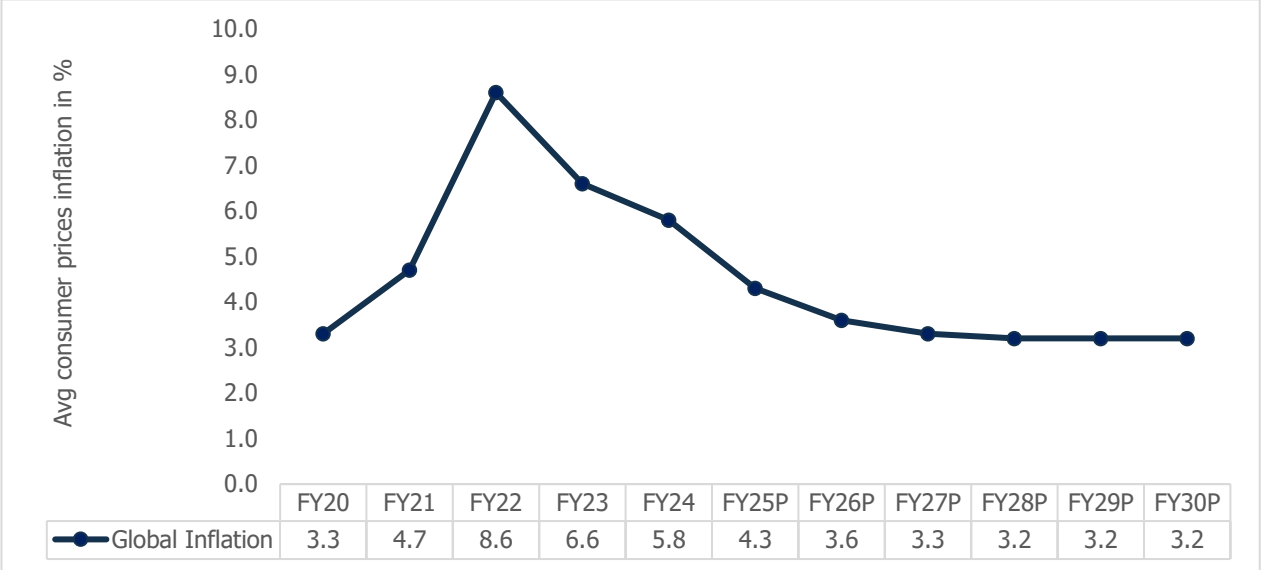
Source: IMF- World Economic Outlook Database (April 2025)

Note: P- Projections, E-Estimate; India's fiscal year (FY) aligns with the IMF's calendar year (CY). For instance, FY24 corresponds to CY23.

Inflation Outlook

According to IMF, global inflation is expected to decline more slowly than expected. It is forecasted to be 4.3% in CY25 and 3.6% in CY26. While inflation is projected to rise slightly in advanced economies, emerging markets may see a small decline in CY25. The ongoing global trade tensions can be one of the contributing factors for the projections for global inflation. Central banks are expected to adjust policies, while smart fiscal planning and reforms are going to be the key to handling debt and reducing global inequalities.

Chart 2: Global inflation outlook (Average consumer prices)



	FY20	FY21	FY22	FY23	FY24	FY25P	FY26P	FY27P	FY28P	FY29P	FY30P
Global Inflation	3.3	4.7	8.6	6.6	5.8	4.3	3.6	3.3	3.2	3.2	3.2

Source: IMF – World Economic Outlook, April 2025; Note: P-Projection, E-Estimated

1.1.3 GDP details of developed countries/ developing economies

Advanced Economies Group

Advanced economies, growth stood at 1.8% in CY24 and is projected to decline to 1.4% in CY25 with a marginal increase to 1.5% in CY26. The CY25 forecast revised down by 0.5 percentage points compared to the January 2025 WEO Update.

The **United States** growth is projected to ease to 1.8% in CY25, lower than the January 2025 forecast by 1 percent point. The revision reflects factors such as policy uncertainty, ongoing trade dynamics, and a slower pace of consumption demand. In CY26, growth is expected to remain moderate at 1.7%, influenced by trade measures and steady private consumption.

The **Euro Area's** growth is anticipated to ease slightly to 0.8% in CY25 due to the uncertainties in the trade tariffs and with a modest recovery in CY26 to 1.2% which is supported by consumption demand.

Emerging Market and Developing Economies Group

Emerging market and developing economies are forecasted to drop to 3.7% in CY25 and rise to 3.9% in CY26, with a continued momentum till CY30. The economic forecast for emerging and developing Asian countries is expected to decline to 4.5% in CY25 and increase to 4.6% in CY26.

China's GDP growth for CY25 has been revised down to 4.0% from 4.6%, reflecting the impact of newly implemented tariffs. The implied tariffs also offset the stronger momentum and planned fiscal expansion that took place from late CY24. The CY26 forecast is also lowered to 4.0% from 4.5%, due to ongoing trade policy uncertainty and the continued

effect of tariffs. In contrast, **India's** growth remains stable, with anticipated rates of 6.2% in CY25 and 6.3% in CY26. This growth is mainly supported by private consumption.

The **Indonesian** economy is expected to register growth of 4.7% in CY25 and CY26, however, an important concern for Indonesia is the trade fragmentation. **Saudi Arabia's** growth in CY25 is projected to have the growth rate to 3.0% on account of the extension of oil production cuts taking place in the country. Going forward, GDP is expected to grow at 3.7% in CY26. On the other hand, **Brazil's** growth is projected to be 2.0% in CY25 and CY26 due to the anticipated tightening of the labour market and ongoing restrictive monetary policy, growth is expected to slow down.

Despite the turmoil in the last 2-3 years, India bears good tidings to become a USD 5 trillion economy by CY27-CY28. According to the IMF dataset on Gross Domestic Product (GDP) at current prices, the nominal GDP projected to be at USD 4.2 trillion for CY25 and is projected to reach USD 5.1 trillion by CY27 and USD 6.8 trillion by CY30. India's expected GDP growth rate for coming years is almost double compared to the world economy. The Indian economy shows resilience amid global inflation, supported by a stable financial sector, strong service exports, and robust investment driven by government spending and high-income consumer consumption, positioning it for better growth than other economies.

Besides, India stands out as the fastest-growing economy among the major economies. The country is expected to grow at a range of 6.2%-6.5% in the period of CY25-CY30, outshining China's growth rate. By CY27, the Indian economy is estimated to emerge as the third-largest economy globally, hopping over Japan and Germany. Currently, it is the third largest economy globally in terms of Purchasing Power Parity (PPP) with a ~7.9% share in the global economy, with China on the top followed by the United States.

1.1.4 Growth drivers and key issues impacting the growth of the global economy

Growth Drivers impacting growth of Global economy

- **Technological Advancement:** Technological advancements are a key driver of global economic growth, transforming industries, enhancing productivity, and creating new market opportunities. The rapid adoption of Industry 4.0 technologies, including AI, IoT, and cloud computing, is optimizing manufacturing, improving decision-making, and enabling digital transformation across sectors such as healthcare, finance, and logistics. The expansion of 5G networks is accelerating connectivity, supporting smart cities, and boosting e-commerce penetration. Additionally, fintech innovations in digital payments, blockchain, and decentralized finance (DeFi) are reshaping global financial services, enhancing financial inclusion, and streamlining transactions. The transition to clean energy technologies, including solar, wind, and electric vehicles (EVs), is driving sustainable economic growth while reducing reliance on fossil fuels.

- **Infrastructure Development:** Infrastructure development is a fundamental driver of global economic growth, facilitating industrial expansion, enhancing connectivity, and boosting productivity. Investments in transportation networks, energy systems, and digital infrastructure create a strong foundation for economic activities, attracting investments and improving efficiency across industries. Mega projects such as China's Belt and Road Initiative (BRI) and the U.S. Infrastructure Investment Plan are driving large-scale infrastructure expansion, strengthening trade corridors, and supporting regional integration. The rapid urbanization and smart city initiatives worldwide are increasing demand for modernized transport, sustainable housing, and efficient utilities, further stimulating growth.

- **Rising consumer demand:** Rising consumer demand is a significant driver of global economic growth, fuelled by a rapidly expanding middle class, particularly in emerging markets across Asia and Africa. Increasing disposable incomes, urbanization, and changing consumption patterns are driving higher demand for consumer goods, real estate, healthcare, and financial services. The growth of e-commerce, digital payments, and fintech

solutions is further accelerating consumer spending, enabling greater market penetration and enhancing accessibility to goods and services. Additionally, rising aspirations and a shift towards premiumization are creating opportunities for businesses to expand into high-value segments such as luxury goods, branded apparel, and personalized financial products. The demand for housing, infrastructure, and mobility solutions is also increasing, driving investments in real estate, transportation, and smart city initiatives.

- **Global Trade and investment:** Expanding trade agreements, foreign direct investment (FDI), and supply chain diversification strategies are crucial growth drivers of the global economy. Countries are increasingly focusing on trade liberalization and regional economic partnerships, such as the Regional Comprehensive Economic Partnership (RCEP) and the United States-Mexico-Canada Agreement (USMCA), to strengthen cross-border economic ties. These agreements reduce tariffs, encourage smoother trade flows, and create new opportunities for businesses to access larger markets. FDI continues to play a central role, facilitating the flow of capital, technology, and expertise into emerging markets, while enhancing industrial growth and global competitiveness. In parallel, supply chain diversification strategies are being adopted to mitigate risks associated with over-reliance on specific regions, ensuring more resilient and efficient global production networks.

Key Issues impacting growth of Global economy

- **Population Growth and Migration Patterns:** Declining fertility rates in developed nations and shifting migration trends will impact labour force availability and economic output. Countries with aging populations, like China, face shrinking workforces, while nations with growing populations, like India, may boost their global economic standing.

- **Geopolitical Uncertainty:** Geopolitical uncertainty, marked by rising tensions between major economies such as the U.S.-China trade conflicts, Russia-Ukraine tensions, and instability in the Middle East, poses significant challenges to global economic growth. These geopolitical issues disrupt global supply chains, creating bottlenecks and delays in the production and delivery of goods. The uncertainty surrounding trade policies, sanctions, and military conflicts leads to increased market volatility, making it difficult for businesses to plan and forecast effectively. Additionally, geopolitical instability deters foreign direct investment (FDI), as investors seek safer, more predictable markets. The overall effect of these tensions is a dampened global economic outlook, as businesses face higher costs, reduced confidence, and diminished prospects for growth.

- **Inflationary pressure:** Inflationary pressures are a critical challenge to global economic growth, driven by supply chain disruptions, energy price volatility, and labour market imbalances. Rising prices erode purchasing power, reducing consumers' ability to spend on goods and services, which in turn dampens overall economic demand. Additionally, increased inflation leads to higher borrowing costs as central banks raise interest rates to curb price increases, further stifling both business investment and consumer spending. These inflationary pressures create a cycle of economic uncertainty, with businesses facing increased operational costs, reduced margins, and the need to adapt to changing market conditions.

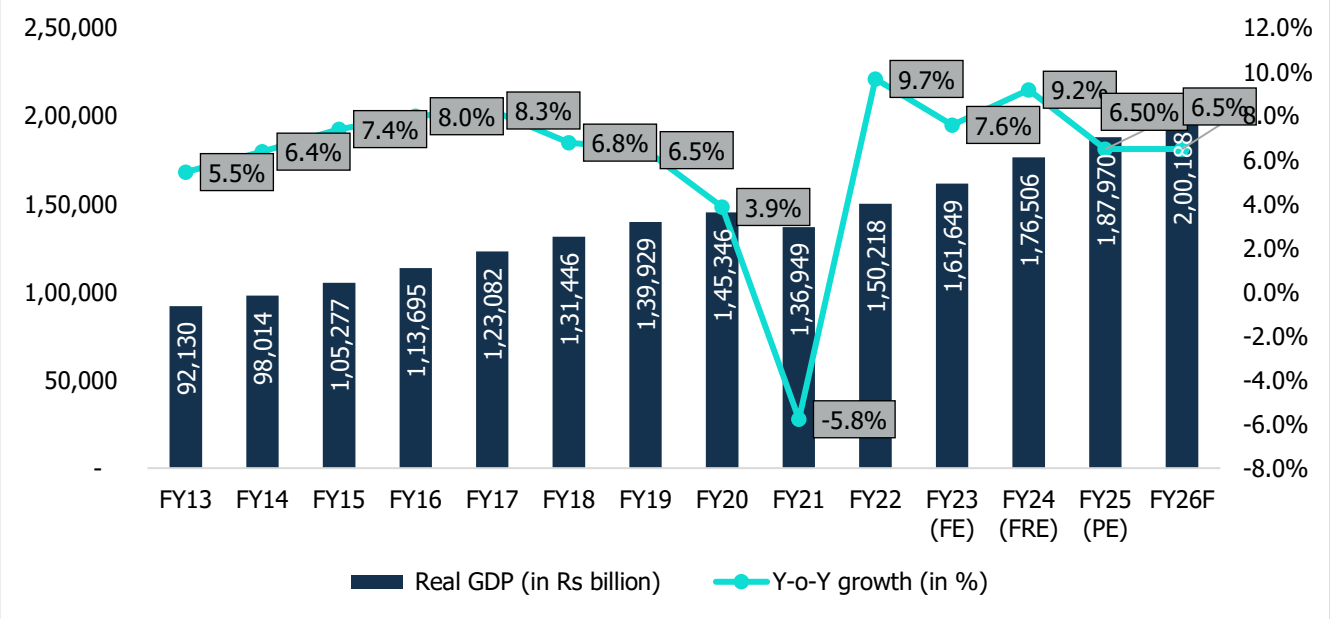
- **Interest Rate hikes:** Interest rate hikes by central banks worldwide, as part of efforts to combat rising inflation, present significant challenges to global economic growth. Higher interest rates increase the cost of borrowing, making it more expensive for businesses to secure financing for expansion and for consumers to obtain credit. This slowdown in investment activity can stifle innovation and economic development. The impact is particularly pronounced in emerging markets, where high debt burdens worsen the effects of rising borrowing costs, potentially leading to financial instability and slower growth. As central banks tighten monetary policy, the resulting economic pressures reduce overall demand, slow down consumer spending, and limit the flow of capital into growth sectors, creating headwinds for global economic recovery.

1.2 Indian Economic Outlook

1.2.1 India GDP trends and composition by sectors

Resilience to External Shocks remains Critical for Near-Term Outlook

Chart 3: Trend in Real Indian GDP growth rate



Source: MOSPI, Reserve Bank of India; Note: FE – Final Estimates, FRE- First Revised Estimates, PE – Provisional Estimates, F - Forecasted

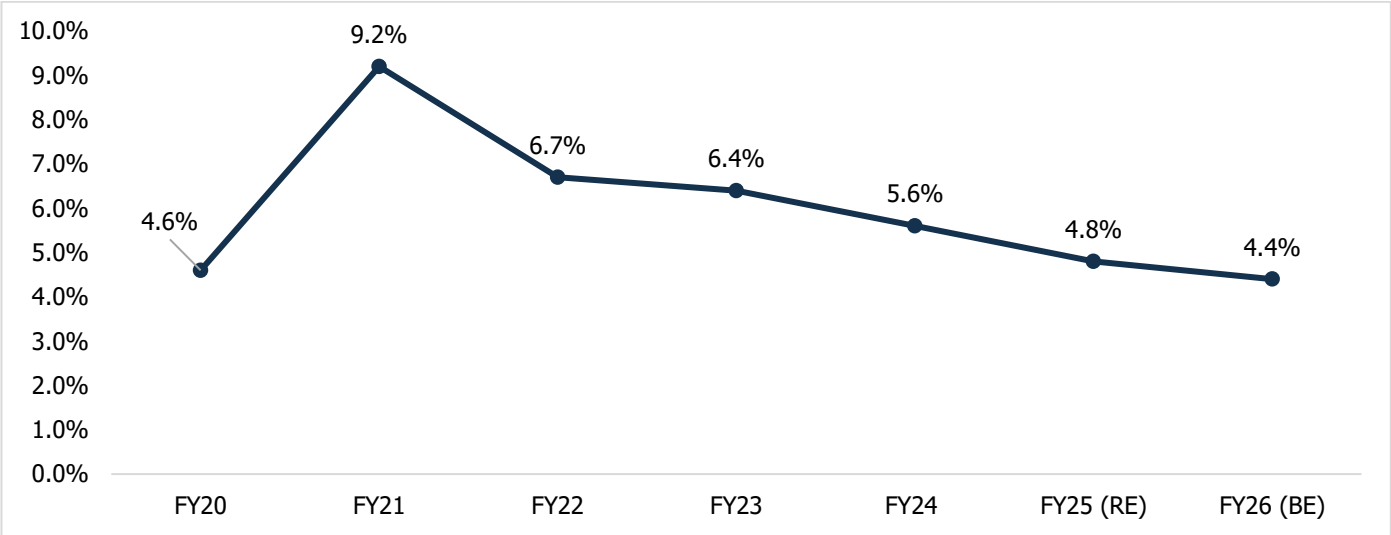
India's real GDP grew by 9.2% in FY24 (Rs 176,506 billion) which is the highest in the previous 12 years (excluding FY22, on account of end of pandemic) and as per provisional estimates, it grew at 6.5% in FY25 (Rs 187,970 billion), driven by double digit growth particularly in the Manufacturing sector, Construction sector and Financial, Real Estate & Professional Services. This growth is also led by private consumption increasing by 7.6% and government spending increasing by 3.8% Y-o-Y. Real GDP growth is projected at 6.5% in FY26 as well, driven by strong rural demand, improving employment, and robust business activity.

1.2.2 Performance of key macro-economic indicators

Fiscal deficit (as a % of GDP)

In FY21, India's fiscal deficit was 9.2% due to the impact of COVID-19, since then it has seen, a steady improvement is expected to reduce to 4.8% of GDP FY25 (RE), driven by strong economic growth and higher tax and non-tax revenues. The government aims for further fiscal consolidation, setting a target of 4.4% of GDP for FY26 to maintain fiscal prudence.

Chart 4: Gross Fiscal Deficit (% of GDP)

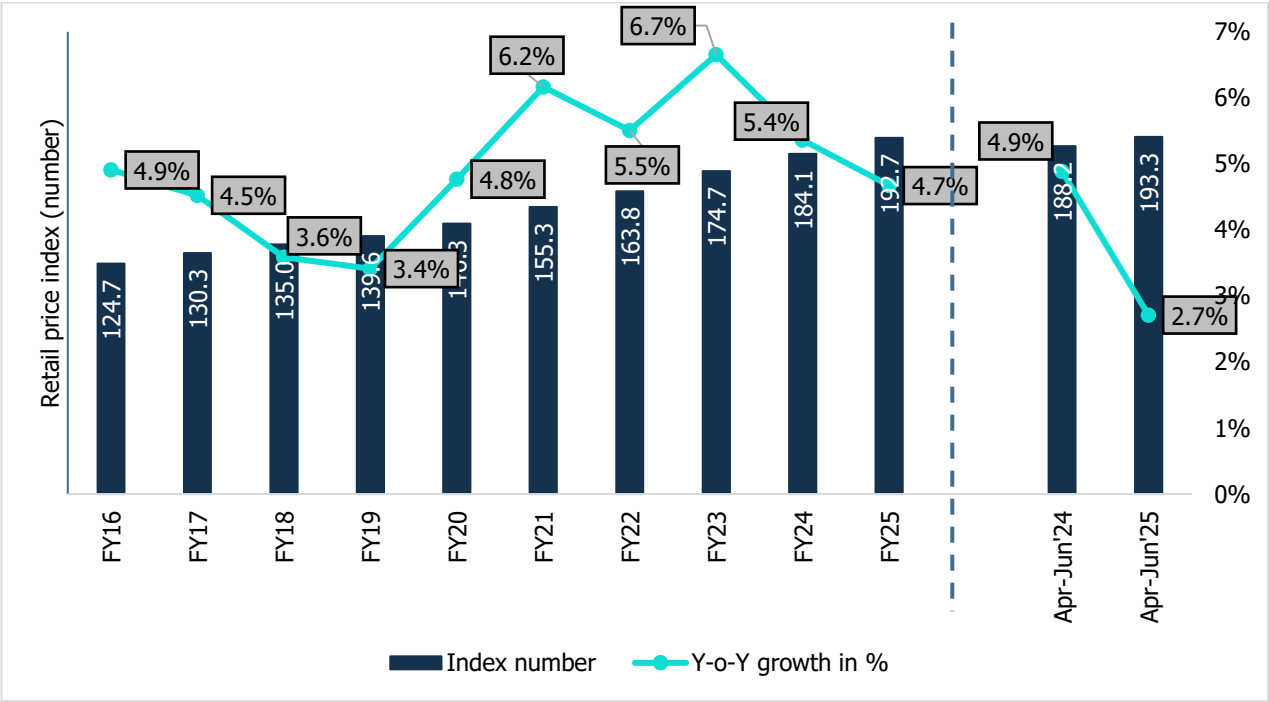


Source: RBI; Note: RE-Revised Estimates, BE-Budget Estimates

Consumer Price Index

The Consumer Price Index (CPI) for the April–June 2025 quarter recorded a combined inflation rate of 2.1%, marking the lowest quarterly retail inflation in six years. The moderation was driven by continued declines in prices of pulses, vegetables, fruits, cereals & cereal products, meat and fish, sugar & confectionery, and spices.

Chart 5: Retail Price Inflation in terms of index and Y-o-Y Growth in % (Base: 2011-12=100)

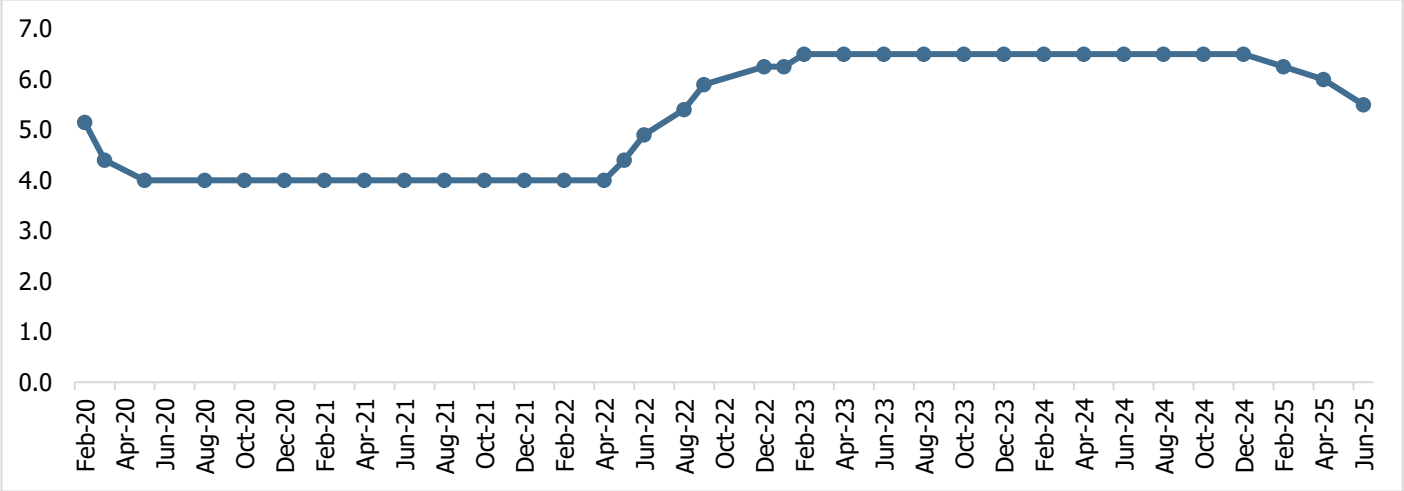


Source: MOSPI

The CPI is primarily factored in by RBI while preparing their bi-monthly monetory policy. At the bi-monthly meeting held in June 2025, RBI projected inflation at 3.7% for FY26 with inflation during Q1FY26 at 2.9%, Q2FY26 at 3.4% and Q3FY26 at 3.9% and Q4FY26 4.4%.

Considering the current inflation situation, RBI has cut the repo rate to 5.5% in the June 2025 meeting of the Monetary Policy Committee.

Chart 6: RBI historical Repo Rate



Source: RBI

Further, the central bank shifted its policy stance from 'accommodative' to 'neutral'. With a decline in food inflation, the headline inflation moderated to a six-year low to 3.2% in April 2025.

The economic growth outlook for India is expected to maintain momentum, supported by private consumption and continued growth in fixed capital formation. The uncertainty regarding the global outlook has reduced given the temporary tariff stay and optimism with trade negotiations. However, global growth and trade has been revised downward due to weakened sentiments and lower growth prospects.

The RBI has adopted for a non-inflationary growth with the foundations of strong demand and supply with a good macroeconomic balance. The domestic growth and inflation curve require the policies to be supportive with the volatile trade conditions.

1.2.3 GDP growth Outlook

FY26 GDP Outlook: Real GDP growth is projected at 6.5%, driven by strong rural demand, improving employment, and robust business activity. The agriculture sector's bright prospects, healthy reservoir levels, and robust crop production support this growth. Manufacturing is reviving, and services remain resilient, despite global uncertainties. Investment activity is gaining traction, supported by healthy balance sheets and easing financial conditions. However, risks from geopolitical tensions, global market volatility, and geo-economic fragmentation persist

Persistent geopolitical tensions, volatility in international financial markets and geo-economic fragmentation do pose risk to this outlook. Based on these considerations, the RBI, in its February 2025 monetary policy, has projected real GDP growth at 6.5% y-o-y for FY26.

Table 2: RBI's GDP Growth Outlook (Y-o-Y %)

FY26P (complete year)	Q1FY26P	Q2FY26P	Q3FY26P	Q4FY26P
6.5%	6.5%	6.7%	6.6%	6.3%

Source: Reserve Bank of India; Note: P-Projected

1.2.4 Growth value added (GVA) trends

India's industrial sector is expected to grow by 10.8% in FY24, reaching Rs 31.56 trillion, supported by positive business sentiment, falling commodity prices, and government initiatives like production-linked incentives. In FY25, growth is expected to slow down to 5.9% y-o-y, down from 10.8% in FY24. The growth is driven primarily by manufacturing, construction, and utility services. The slowdown can be attributed to the manufacturing segment likely to grow at 4.5%, lower than the previous year's 12.3%.

Table 3: Industrial sector growth (Y-o-Y growth) -at Constant Prices

At constant Prices	FY19	FY20	FY21	FY22	FY23 (FE)	FY24 (FRE)	FY25 (PE)
Industry	**5.3**	**-1.4**	**-0.9**	**11.6**	**2.0**	**10.8**	**5.9**
Mining & Quarrying	-0.9	-3.0	-8.6	7.1	2.8	3.2	2.7
Manufacturing	5.4	-3.0	2.9	11.1	-3.0	12.3	4.5
Electricity, Gas, Water Supply & Other Utility Services	7.9	2.3	-4.3	9.9	11.5	8.6	5.9
Construction	6.5	1.6	-5.7	14.8	10.0	10.4	9.4
GVA at Basic Price	**5.8**	**3.9**	**-4.2**	**8.8**	**7.4**	**8.6**	**6.4**

Source: MOSPI; Note: FRE – First Revised Estimates, FE – Final Estimates, PE- Provisional Estimates

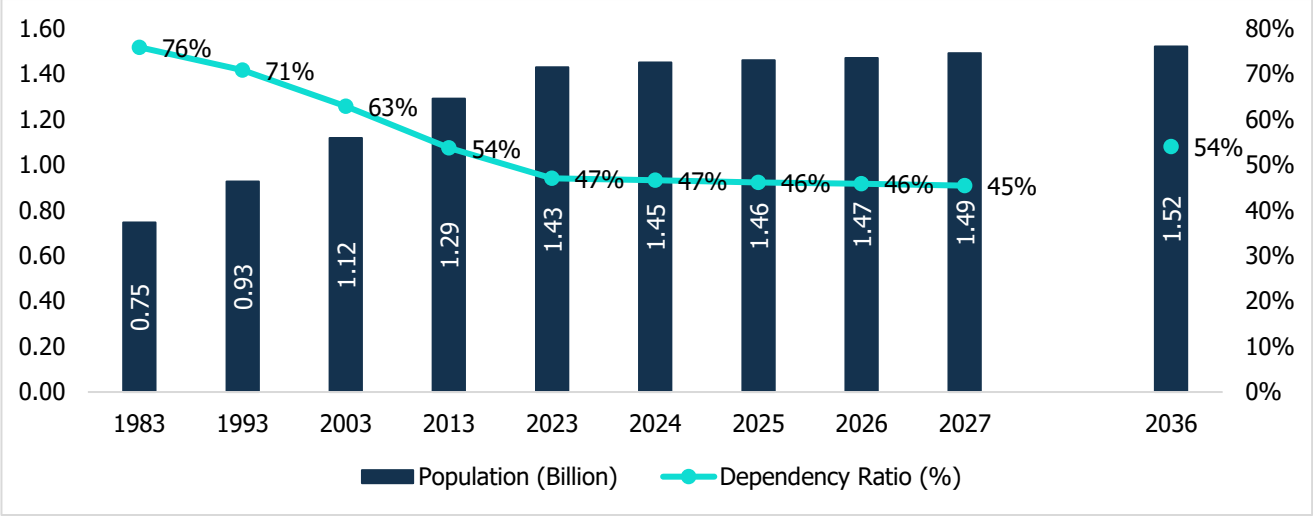
1.2.5 Demographic overview

Population growth and Urbanization

The trajectory of economic growth of India and private consumption is driven by socio-economic factors such as demographics and urbanization. According to the world bank, India's population in 2022 surpassed 1.42 billion, slightly higher than China's population (1.41 billion) and became the most populous country in the world.

Age Dependency Ratio is the ratio of dependents to the working age population, i.e., 15 to 64 years, wherein dependents are population younger than 15 and older than 64. This ratio has been on a declining trend. Declining dependency means the country has an improving share of working-age population generating income, which is a good sign for the economy. It was as high as 76% in 1983, which has reduced to 47% in 2023. However, this ratio is expected to rise again to 54% by 2036, driven by an increase in the elderly population as life expectancy improves.

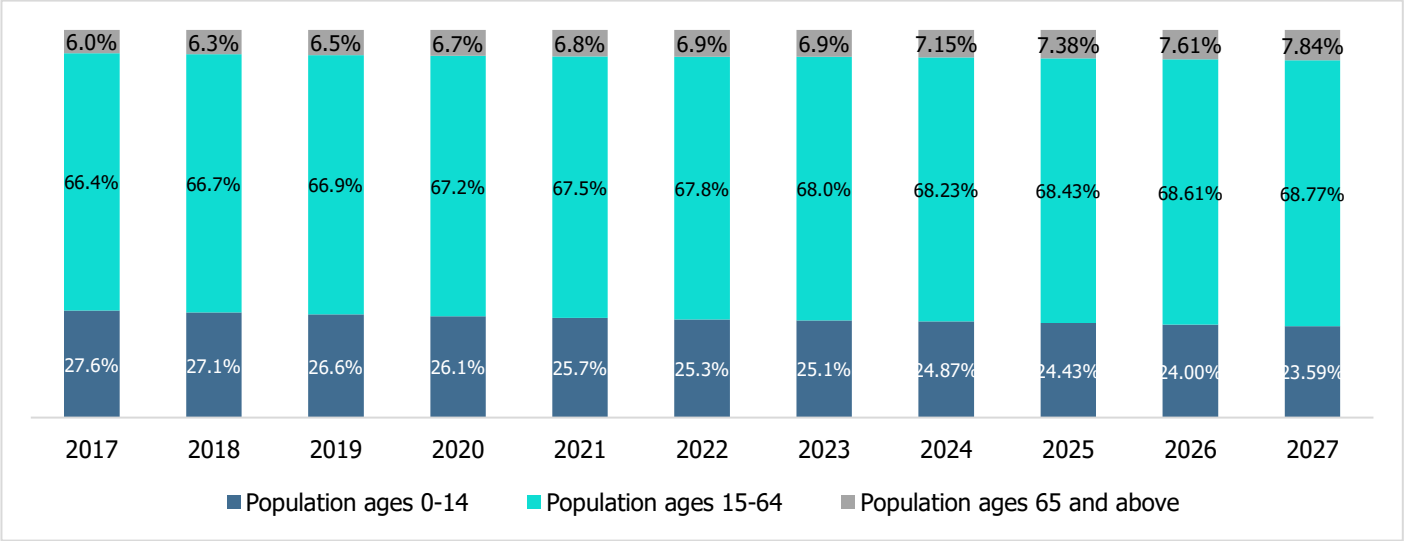
Chart 7: Trend in Population growth vis-à-vis dependency ratio in India



Source: World Bank Database, MOSPI

Despite a projected rise in the dependency ratio to 54% by 2036, India's young and growing workforce, especially in newly urbanised towns, will continue to drive income growth and consumer demand. This presents strong opportunities for sectors like consumer electronics, transportation, and railways. Rising employment, urbanisation, and government investment in rural development and digital infrastructure will further boost demand, while increased tech adoption supports long-term consumption growth across both urban and rural markets.

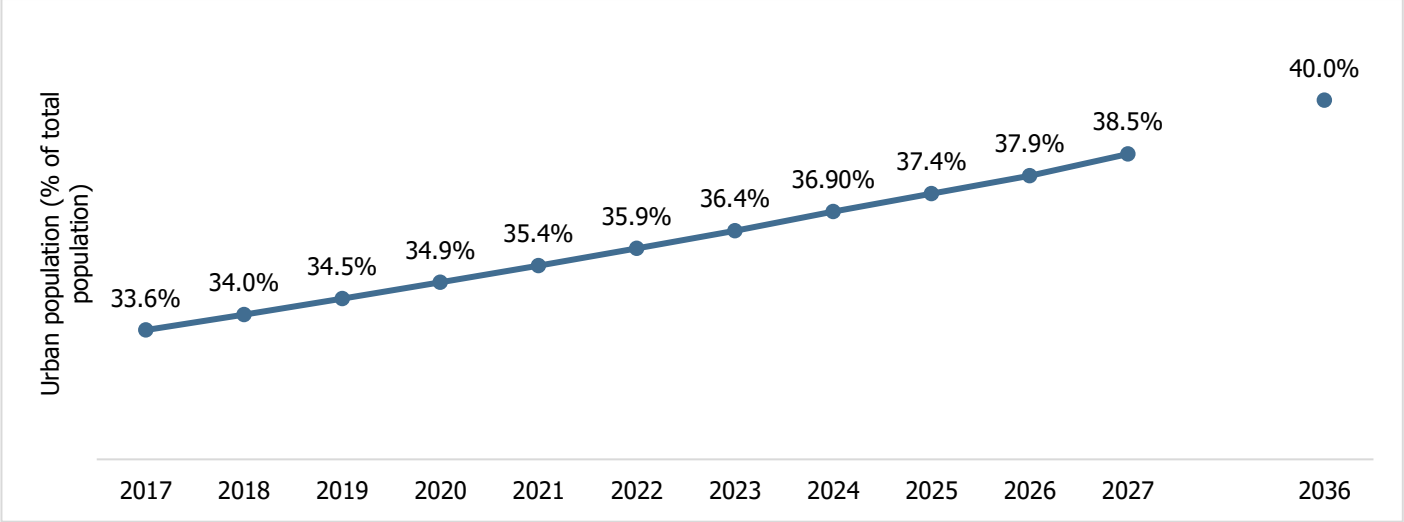
Chart 8: Age-Wise Break Up of Indian population



Source: World Bank Database; Note: 2025 onward figures are projections

The urban population is significantly growing in India. The urban population in India is estimated to have increased from 413 million (32% of total population) in 2013 to 519.5 million (36.4% of total population) in the year 2023. India is undergoing a significant urban transformation, with the urban population projected to rise to 40% by 2036. This shift is driven by factors such as improved living standards, increased employment opportunities in urban areas, and government initiatives aimed at urban development. This rapid urbanisation might necessitate substantial investments in infrastructure, housing, and transportation.

Chart 9: Urbanization Trend in India



Source: World Bank Database

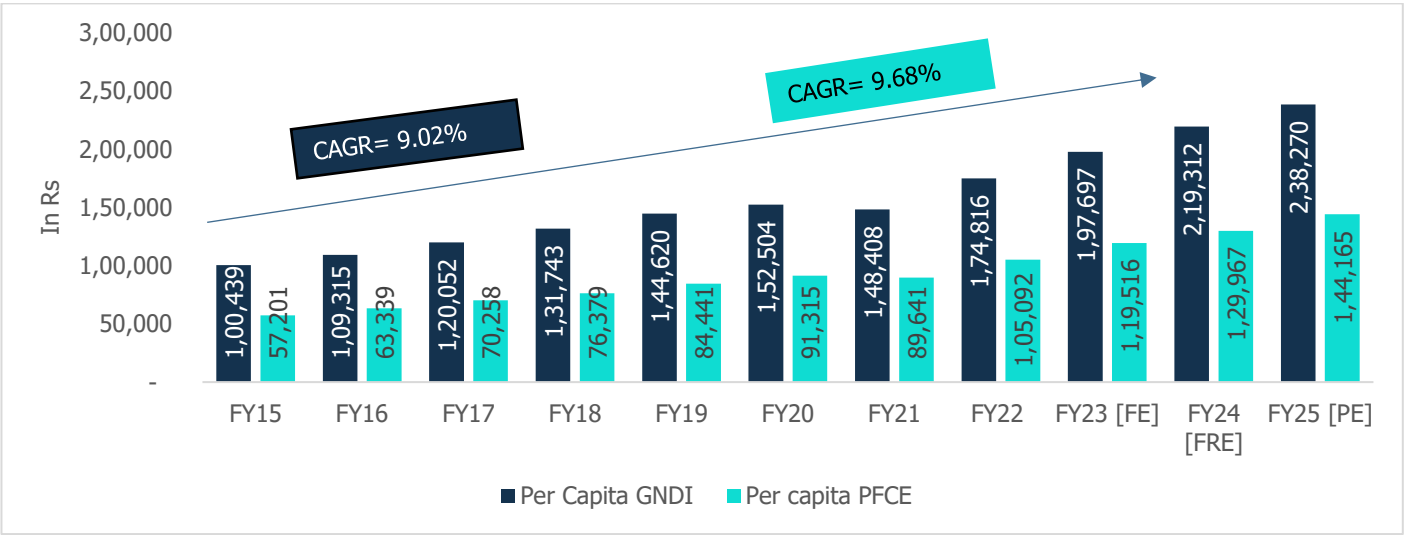
1.2.6 Per capita income trends of the economy

Increasing Disposable Income and Consumer Spending

Gross National Disposable Income (GNDI) is a measure of the income available to the nation for final consumption and gross savings. Between the period FY15 to FY25, per capita GNDI at current prices registered a CAGR of 9.02%. More disposable income drives more consumption, thereby driving economic growth.

With increase in disposable income, there has been a gradual change in consumer spending behaviour as well. Per capita Private Final Consumption Expenditure (PFCE) which is measure of consumer spending has also showcased significant growth from FY15 to FY25 at a CAGR of 9.68%.

Chart 10: Trend of Per Capita GNDI and Per Capita PFCE (Current Price)



Source: MOSPI; Note: FRE – First Revised Estimates, FE – Final Estimates, PE- Provisional Estimates

1.2.7 Key government policies driving economic growth

AtmaNirbhar Bharat Policy

- Launched in May 2020, Atmanirbhar Bharat Abhiyan aims to enhance India's self-reliance with a Rs. 20 trillion economic stimulus.
- The initiative is built on five pillars: economy, infrastructure, systems, demographics, and demand, promoting sustainable growth.
- It includes key reforms across sectors to improve efficiency, boost employment, and strengthen domestic capabilities.

Production Linked Incentive (PLI) Scheme

- Launched in March 2020, the Production Linked Incentive (PLI) scheme aims to enhance domestic manufacturing and create jobs through significant investments.
- With an outlay of Rs. 1.97 trillion, it targets 14 key sectors, including electronics, pharmaceuticals, and automotive.
- The scheme focuses on attracting investments, improving efficiency, and boosting production to make Indian manufacturers globally competitive.

Make in India

- Launched in 2014, Make in India aims to position India as a global manufacturing and entrepreneurial hub by enhancing industrial capabilities and fostering innovation.
- The initiative aims to shift the government's role from regulator to facilitator, promoting partnerships with businesses.
- It targets 25 sectors for development, encouraging foreign direct investment, streamlining regulations and investing in modern infrastructure to enhance the ease of doing business in India.

Goods and Services Tax (GST)

- The Goods and Services Tax (GST), implemented in India on July 1, 2017, replaced a complex tax system with a unified regime, categorizing goods and services into various tax slabs while exempting essentials.
- It has benefited the manufacturing sector by reducing production costs and enhancing competitiveness through the Input Tax Credit mechanism.
- For the services sector, it has varied effects, increasing consumer spending in some areas while boosting demand in others, and improving operational efficiency, particularly in hospitality.

Pradhan Mantri Awas Yojana

- The Pradhan Mantri Awas Yojana (PMAY) aims to provide affordable housing for all by December 2024, offering support such as interest subsidies, financial assistance for self-construction, and public-private partnerships.
- The 2024-25 Union Budget allocated Rs. 84,6707.5 million for the scheme, benefiting Economically Weaker Sections, Low Income Groups, and Middle-Income Groups through the PMAY-Urban and PMAY-Gramin initiatives.
- PMAY promotes innovative construction technologies and affordable rental housing to improve living conditions nationwide.

Emergency Credit Line Guarantee Scheme

- The Emergency Credit Line Guarantee Scheme (ECLGS), part of the AtmaNirbhar Bharat Package, was launched to support MSMEs with working capital during the COVID-19 pandemic, increasing its initial allocation from Rs. 3 trillion to Rs. 4.5 trillion.
- ECLGS offers a 100% guarantee to lenders against borrower default, with multiple phases catering to various sectors like manufacturing, healthcare, and hospitality, ensuring broader access to credit.

2 Indian Power Sector

Power is a vital component of infrastructure development and plays a crucial role in a country's economic growth and overall well-being. A robust and well-developed power infrastructure is essential for sustaining the growth of the Indian economy.

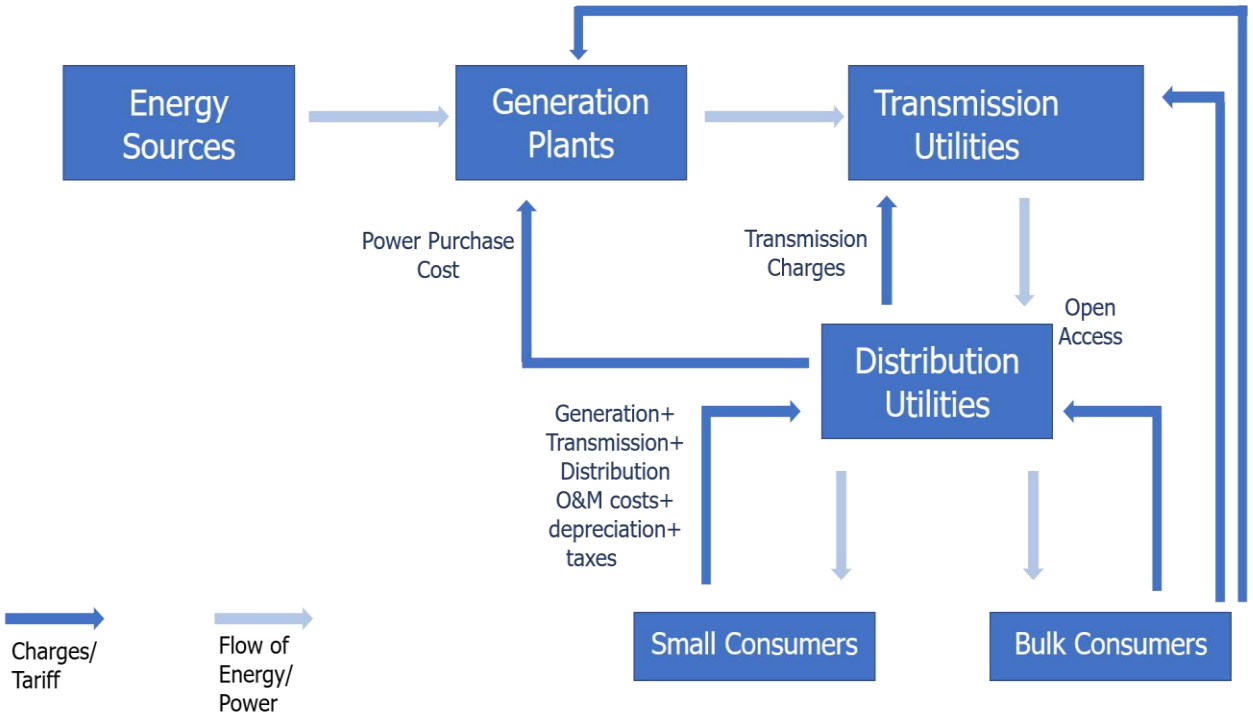
The power industry is divided into three segments:

- Generation
- Transmission
- Distribution

Generation is the process of producing electricity from different sources like thermal energy (coal, diesel etc.), nuclear, and renewable sources such as sunlight, wind, natural gas, etc., in generating stations or power generation plants. Transmission utilities transport large amounts of electricity from power plants to distribution substations via a grid at high voltages. Whereas the retail electricity distribution, the distribution of electricity to consumers at lower voltages, constitutes the distribution segment.

The structure of the power industry is depicted in the figure below.

Chart 11: Structure of Power Sector in India



Source: CareEdge Research

2.1 Evolution of Power Sector and Its Structure in India

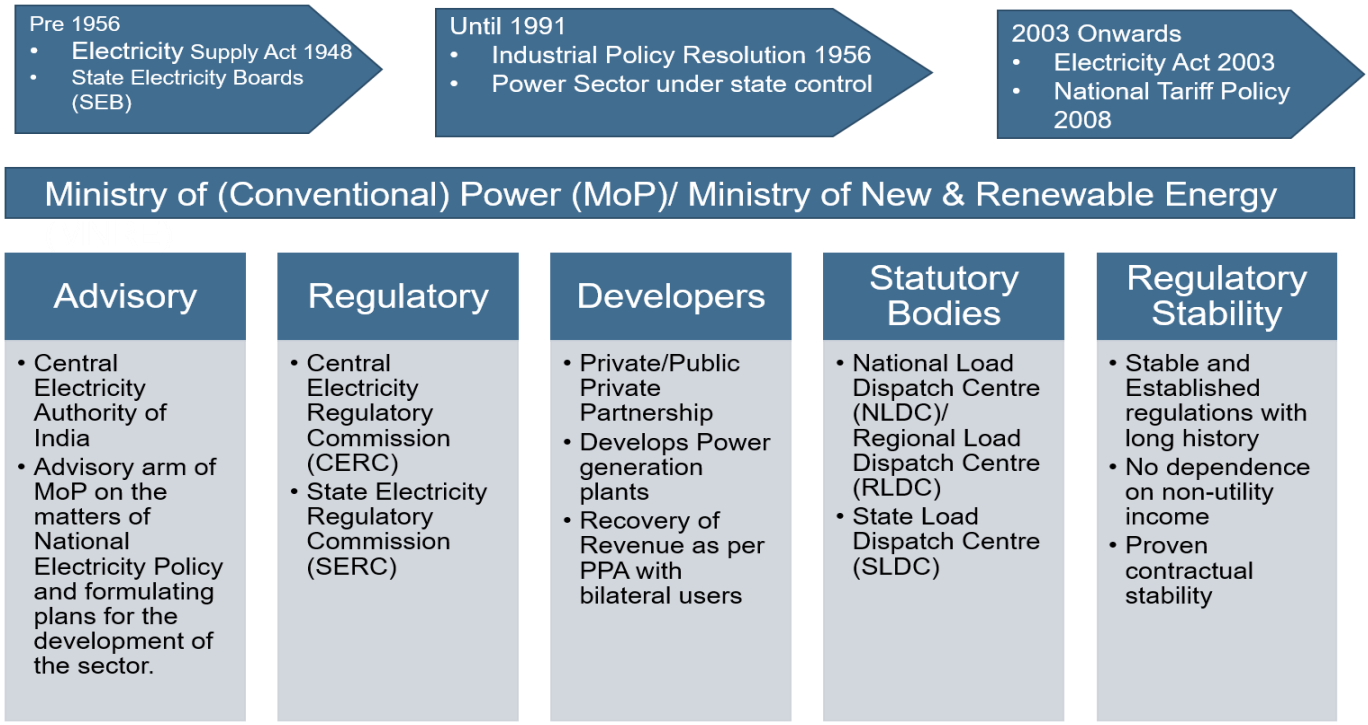
Overview

In India, the Electricity Act, 2003 governs the generation, transmission, distribution, exchange, and use of electricity. It also establishes a complex system of bodies to administer the Electricity Act's functions. The Electricity Act, among other things, delicensed all generation activities except hydropower.

The Electricity Act's principal goals are as follows:

- Promoting competition
- Protecting the interest of consumers
- Ensuring electricity supply to all areas along with a rationalization of tariffs
- Ensuring transparent policies and promotion of efficiency

The following diagram shows the regulatory structure of power sector in India:



Under the Electricity Act, the CEA is a statutory agency that advises the Government of India on policy, safety regulations, and technical standards. The Central Electricity Regulatory Commission (CERC) and the State Electricity Regulatory Commissions (SERCs) draft the regulations and the Government of India (in cooperation with the states and the CEA) develops policies (such as the Nation Tariff Policy and National Electricity Policy) as guidelines.

Table 4: Regulatory Capabilities of different bodies

	Centre		State/Private		
Policy	Ministry of Power		State Government		
Plan	CEA				
Regulations	CERC; MNRE		SERC		
System Operations	National Load Dispatch Centre, Regional Load Dispatch Centre		State Load Dispatch Centre		
Generation	Central Generation Stations, MNRE, Department of Atomic Energy		State Gencos	Captive and Co-Generation Plants, Independent Power Producers	Private Licensees in Ahmedabad, Kolkata, Mumbai, Surat, Delhi, Noida, etc.
Transmission	Central Transmission Utility (PGCIL)	Transmission Licensee	State Transmission Utility	Transmission Licensee	
Distribution	-		State Distribution Company		Private Discoms
Trading	Trading Licensee	Power Exchanges	Bilateral Markets		
Appeal	Appellate Tribunal (APTEL)				

Electricity generation, distribution, and transmission are regulated and overseen by regulatory bodies at the federal and state levels. They are self-contained entities with responsibilities outlined in the Electricity Act.

The CEA shall perform the following functions and duties:

- Advise the Government of India on matters relating to the national electricity policy, formulate short-term and long-term plans for the development of electrical infrastructure, coordinate the activities of the Central Transmission Utilities (CTU) and the State Transmission Utilities (STU) for the optimal utilization of resources to serve the interests of the national economy, and to provide reliable and affordable electricity for all consumers.
- Advise any state government, licensee, or generating company on such matters to enable them to operate and maintain the electrical infrastructure under their ownership or control in an improved manner and where necessary, in coordination with any other government, licensee, or generating company owning or having the control of another electricity system.
- Make available from time to time the public information related to the rules, regulations, reports, inquiries, and orders made under and by virtue of the Electricity Act and provide for the publication of reports and investigations.
- Advise the appropriate government and the appropriate commission on all technical matters relating to generation, transmission, and distribution of electricity.
- Establish the Central Research Committee which shall advise on matters relating to policy, services provided by licensees, protection of consumer interest, and electricity supply and standards of performance by utilities.

At the Central level, CERC performs the following functions:

- Regulates tariff of generating companies owned/controlled by the Government of India/State Government.
- Regulates tariff of generating companies other than those owned/controlled by the Government of India/ State Government, if such generating companies enter or otherwise have a composite scheme for the generation and sale of electricity in more than one state in India.
- Regulates inter-state energy transmission (including granting of license) including tariff of transmission utilities.
- Regulate the trading margin for the inter-state trading of electricity, if necessary.
- Discharge such other functions as may be assigned under the Electricity Act.

At the State level, SERCs perform similar functions to CERC:

- Determine tariff for generation, supply, transmission, and wheeling of electricity, wholesale, bulk, or retail sale within the state.
- Regulate the electricity purchase and procurement process of distribution licensees including the price at which electricity shall be procured from the generating companies or licensees or from other sources through agreements for the purchase of power for distribution and supply within the state.
- Facilitate intra-state transmission and wheeling of electricity.
- Issue licenses to persons seeking to act as transmission licensees, distribution licensees, and electricity traders with respect to their operations within the state.
- Establish a State Research Committee which shall advise on matters relating to policy, services provided by licensees, protection of consumer interest, and electricity supply and standards of performance by utilities.

In relation to the promotion of renewable energy, the Ministry of New and Renewable Energy (MNRE) is the relevant agency of the Government of India for the following matters:

- Solar Energy
- Wind Energy
- Bio-Gas Units
- Hydroelectric Power
- Tidal Energy
- Geothermal Energy

Solar Energy Corporation of India Limited (SECI), a government firm under MNRE's supervision, assists MNRE in implementing and facilitating schemes like as the Jawaharlal Nehru National Solar Mission (NSM), wind project schemes, and solar-wind hybrid project schemes.

Gujarat Electricity Regulatory Commission (GERC)

The Gujarat Electricity Regulatory Commission (GERC) is the state-level regulatory body established under the Electricity Regulatory Commissions Act, 1998, and continues under the Electricity Act, 2003. Its primary role is to regulate the power sector in Gujarat, covering generation, transmission, distribution, and trading of electricity, with a focus on ensuring efficient operations, fair tariffs, and consumer protection.

It performs similar function but within the jurisdiction of Gujarat:

- Determines tariffs for generation, transmission, wheeling, and retail sale of electricity in Gujarat. The commission ensures that tariffs are cost-reflective, safeguard consumer interests, and maintain the financial viability of utilities.
- Regulate the electricity purchase and procurement process of distribution licensees including the price at which electricity shall be procured from the generating companies or licensees or from other sources through agreements for the purchase of power for distribution and supply within the state.
- Issue licenses to persons seeking to act as transmission licensees, distribution licensees, and electricity traders with respect to their operations within Gujarat and monitors compliance with regulatory conditions.
- Facilitates intra-state transmission and wheeling of power and provides regulatory clarity on open access. Gujarat is among the leading states in open access operations for C&I consumers.
- Sets performance standards for utilities, enforces compliance, and ensures grievance redressal mechanisms are available for electricity consumers in the state.
- Sets Renewable Purchase Obligations (RPOs) for obligated entities and ensures compliance.
- Issues regulations and tariff frameworks for solar, wind, biomass, and hybrid projects.

• GERC has introduced supportive policies for rooftop solar and net metering, making Gujarat one of India's leaders in rooftop installations.

GERC functions as Gujarat's electricity regulator, balancing the interests of discoms, consumers, and investors, while actively enabling renewable energy adoption through clear policies on RPOs, open access, and rooftop solar.

Power Exchanges:

Electricity trading through Power Exchange (PX) has hitherto been introduced in many electricity markets. In India, there are two exchanges, the Indian Energy Exchange (IEX) and Power Exchange of India Ltd. (PXIL), functioning with guidance from CERC. The electrical market in India has a supply shortfall (in some locations) and is made up of a variety of generation methods. PX is a marketplace where utilities, power marketers, and other electricity providers post price and quantity bids for selling energy or services, and potential customers submit offers to buy energy or services.

Appellate Tribunals:

• The Central Government has established an Appellate Tribunal for Electricity (APTEL) for those dissatisfied with an order of the CERC or a state. The APTEL, like the Income-Tax Tribunal and the Central Administrative Tribunal, has the power to overturn or change that order.

• The APTEL comprises a chairperson who has been a Judge of the Supreme Court or Chief Justice of a High Court, one Judicial Member who has been or qualified to be a judge of the High Court, two technical members who are electricity sector experts and one technical member who is an expert from the petroleum and natural gas sectors.

• Since its operationalization, the APTEL has been called upon to resolve many complex and path-breaking issues, which has facilitated the development of the power sector as per the intent of the Electricity Act, 2003.

2.2 Review and Outlook of the Power Demand-Supply in India

The power sector in India has undergone significant transformation in recent years, driven by government initiatives aimed at enhancing efficiency, sustainability, and accessibility. With a mix of conventional and renewable energy sources, India has made considerable strides toward achieving its energy security goals. The push for renewable energy, particularly solar and wind, has positioned the country as a leader in global clean energy efforts. However, challenges remain, including outdated infrastructure, financial viability of state-owned utilities, and regional disparities in power access. The implementation of smart grid technologies and reforms in tariff structures are crucial for addressing these issues. Overall, while the power sector shows promise, continued investment and policy support are essential to ensure a reliable and sustainable energy future for all.

Renewable energy in India has emerged as a cornerstone of the country's energy strategy, driven by a commitment to sustainability and reducing carbon emissions. With ambitious targets set under the Paris Agreement, India aims to achieve 500 GW of renewable energy capacity by 2030. The country boasts a diverse mix of renewable sources, including solar, wind, biomass, and hydropower. Solar energy has seen exponential growth, with India becoming one of the largest solar markets globally. India's renewable energy sector is gaining strong traction, backed by progressive policies and sustained investment. Programs like the Solar Parks Scheme and the Wind-Solar Hybrid Policy have laid the groundwork for large-scale clean energy deployment. Although land acquisition bottlenecks and grid integration remain persistent hurdles, advancements in technology and a growing focus on energy infrastructure are helping to bridge the gaps. With its expanding renewable capacity, India is not only accelerating its domestic clean energy transition but also emerging as a key player in shaping the global low-carbon future.

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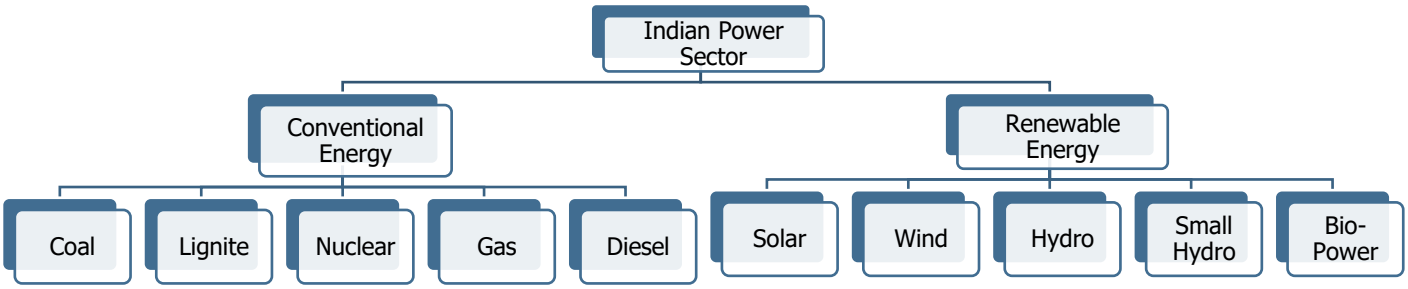
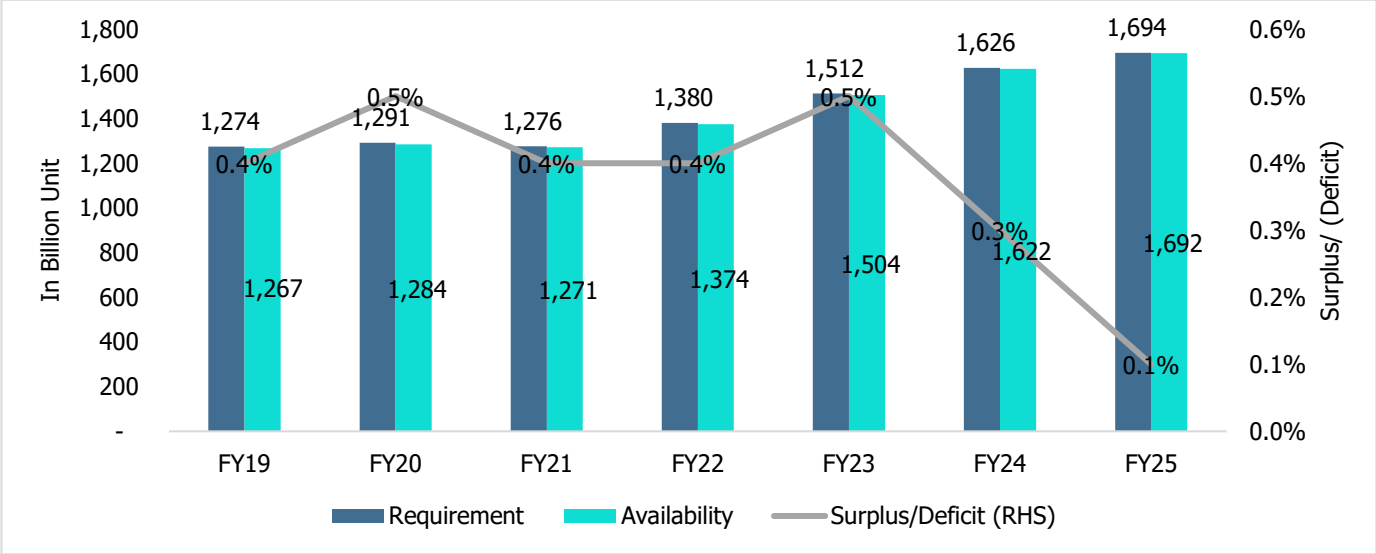


2.2.1 Power Demand, Supply, and Deficit in India

Power demand in the country has been on a rise in the past decade, with an exception during FY21 due to the Covid-19 pandemic. Peak energy demand grew at a CAGR of 5.4% from 148 GW in FY15 to 250 GW in FY25, while peak supply grew at a CAGR of 5.3% over the same period. There was a 4.2% y-o-y increase in the power requirement by the country in FY25. However, in FY25, due to high power demands, the peak demand not met was 2 GW and energy not supplied increased to 1,590 MU.

Chart 12: Power Position in India



Source: Power Ministry, Central EA, CareEdge Research

Covid-19 induced lockdown, and restrictions had led to lower demand and generation of electricity since the pandemic had curtailed commercial and business activity. As a result, the first half of FY21 witnessed a decline in power demand. However, with the gradual reopening of the economy despite localized lockdowns, the power demand has continued to gradually rise over the past 3 years. The electricity requirement has grown from 1,274 BU in FY19 to 1,694 BU in FY25. There has been a continuous deficit between electricity requirement and availability in the range of 0.1%- 0.5% between FY19 and FY25.

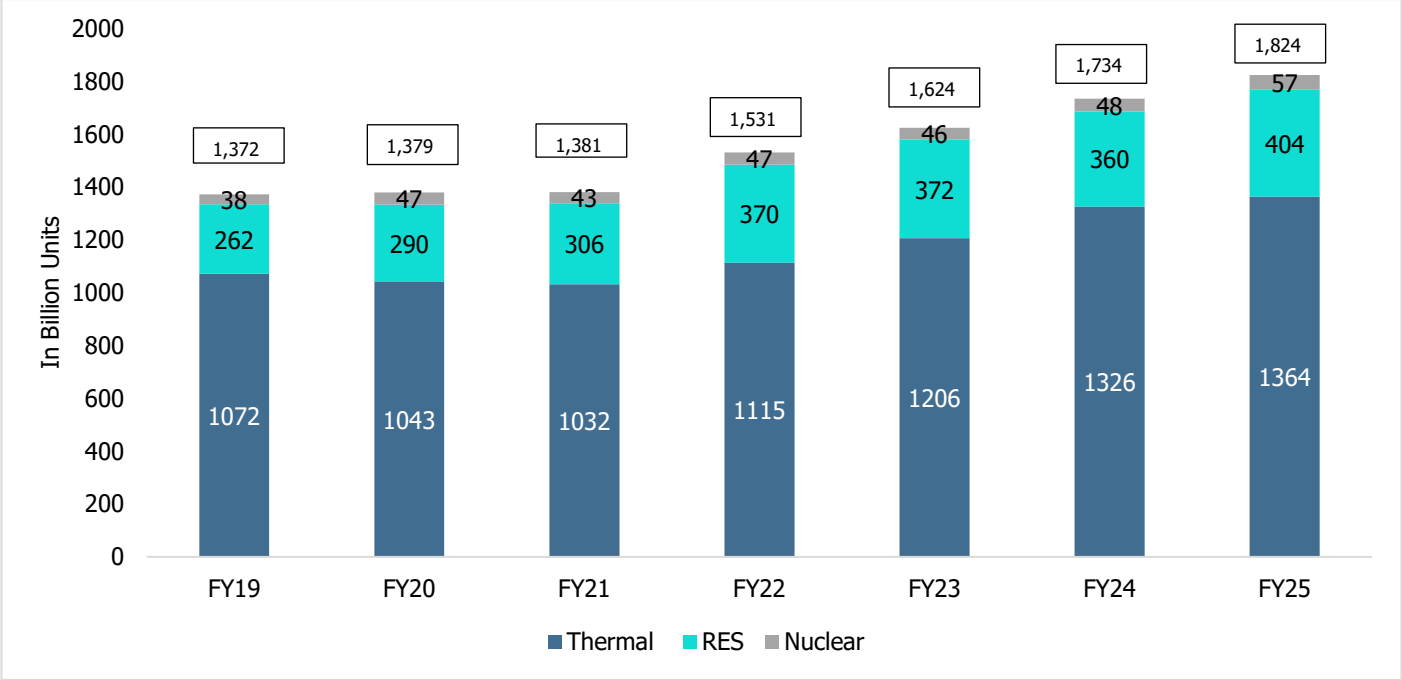
However, the peak demand not met was around 1.5 GW in FY19 and the average energy not supplied was around 7,070 MU. The peak demands not met, and energy not supplied has been on an increasing trend since and substantially decreased to 2.475 GW and 5,787 MU, respectively, in FY22. However, in FY24, due to high power demands, the peak demand not met was 3.34 GW and energy not supplied increased to 4,112 MU. Whereas the peak demand not met in

FY25 was relatively insignificant at 2 MW, while the energy not supplied increased to 1,590 MU. There was a 6.9 % y-o-y increase in the power requirement by the country in FY24. The power consumption and demand were highest in months of March and April due to higher temperatures during the summer season compared to last year.

2.2.2 Overview of the Indian Power Generation Industry

Indian power generation sector is one of the most diversified in the world. Power generation sources in India range from conventional sources such as coal, lignite, natural gas, oil, and nuclear to viable unconventional sources such as wind, solar, hydro, agricultural and household waste.

Chart 13: Power Generation over the years



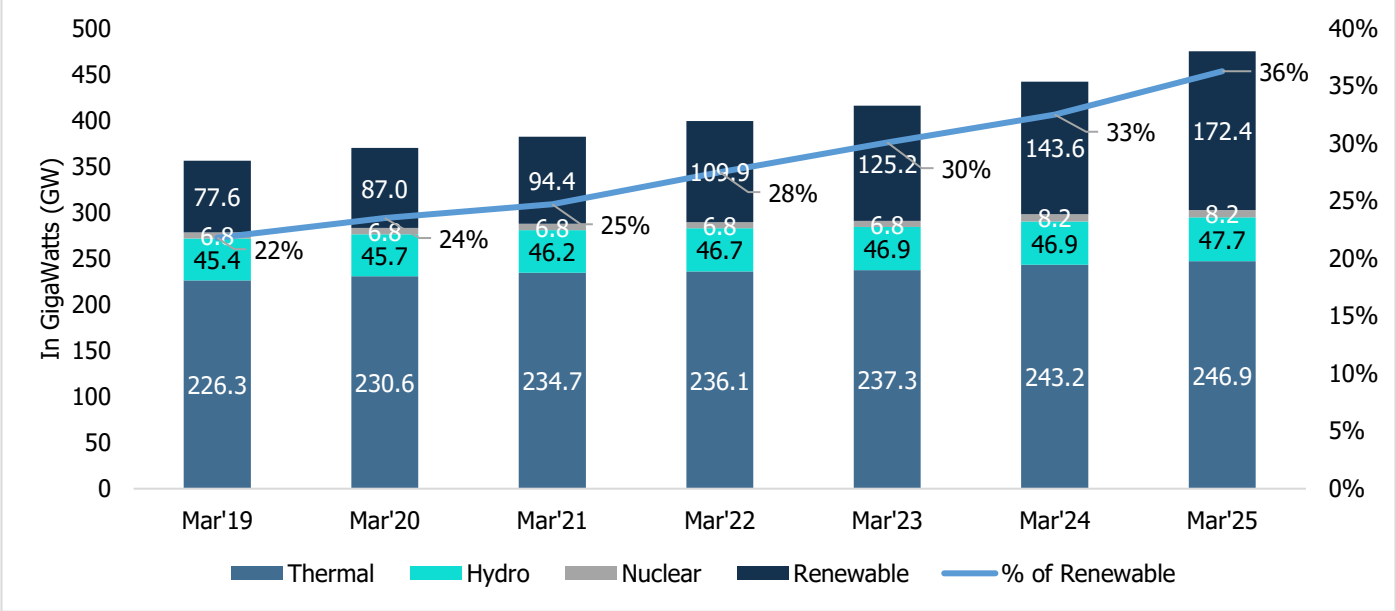
Source: Central Electricity Authority, CareEdge Research; RES refers to power generated from Hydro, Wind, Solar, Small hydro and Bioenergy projects;

Electricity generation in India increased from 1,372 BU in FY19 to 1,824 BU in FY25, implying a compounded annual growth rate (CAGR) of 4.9%. Electricity generation increased by about 5.2% y-o-y to 1,824 BU during April 2024 to March 2025. Thermal power forms the largest source of power in the country with about 75% of the electricity consumed being generated from thermal power plants. There are different types of thermal power plants, out of which coal based thermal power plants account for highest amount of electricity followed by gas and diesel. Renewable Energy Sources (RES) including solar, wind and hydro are quickly increasing their share, and their contribution has increased from 19.1% in FY19 to 22.2% in FY25.

Trend in Total Installed Capacity

The installed power capacity in India has increased from 356 GW in FY19 to 475 GW in FY25; it increased by 7.5% y-o-y as of March 2025; India is the world's third-largest producer and third-largest user of energy.

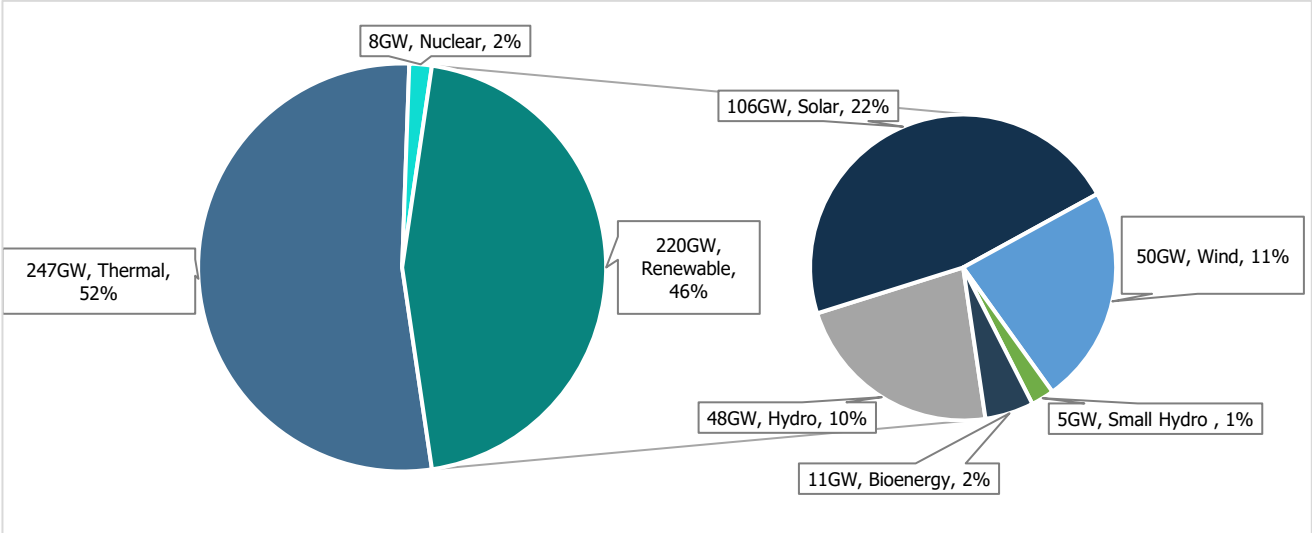
Chart 14: Installed Capacity Trend



Source: Central Electricity Authority, CareEdge Research

While conventional sources currently account for 54% of installed capacity, with the Government of India's ambitious projects and targets, RES installed capacity including hydro, which currently accounts for 46%, is expected to have nearly equal in contribution compared to conventional sources in the medium term. With consistent focus on renewable sector, the percentage share of installed capacity is expected to shift towards renewable energy.

Chart 15: Mode-wise total installed capacity – 475 GW (March 2025)

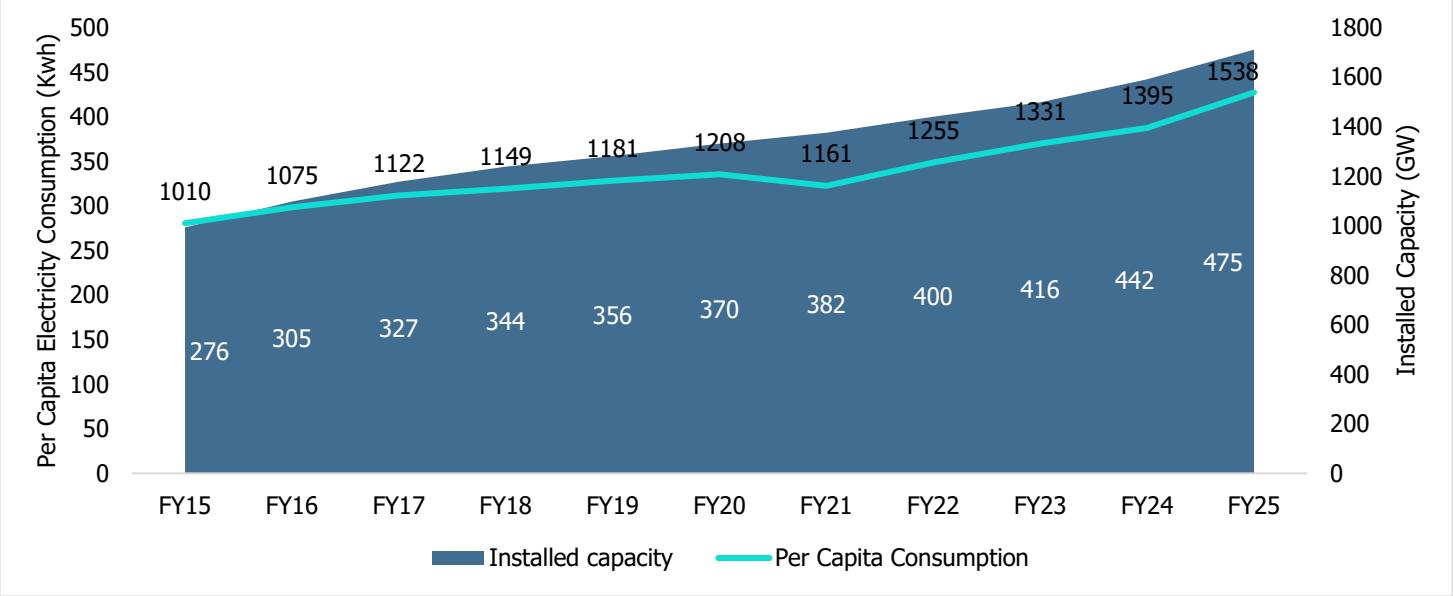


Source: Central Electricity Authority, CareEdge Research

Renewable accounts for 46% of the total power generation capacity of which solar accounts for the largest share of 22% followed by Wind at 11% and Hydro at 10%.

2.2.3 India's Per Capita Power Consumption

Chart 16: Growth of Electricity Sector in India - Installed Capacity and Per Capita Consumption*



Source: Central Electricity Authority, CareEdge Research
(*) Per Capita Consumption= Gross Electricity availability/ Mid-year Population

Developed countries such as Japan and the United States have the world's highest per capita electricity consumption. India's per capita consumption has remained low as compared to even the emerging countries like Brazil and Mexico, implying significant room for growth.

Table 5: Global Per Capita Consumption Comparison (MWh/Capita)

Year	World	India	Nigeria	Mexico	Thailand	Brazil	China	Japan	USA
1990	2.06	0.32	0.11	1.14	0.70	1.46	0.53	6.71	11.69
1995	2.14	0.46	0.11	1.38	1.25	1.63	0.79	7.53	12.64
2000	2.32	0.51	0.09	1.76	1.45	1.90	1.02	8.05	13.66
2005	2.58	0.61	0.13	1.98	1.91	2.02	1.81	8.30	13.68
2010	2.87	0.77	0.14	2.02	2.31	2.37	2.96	8.78	13.38
2015	3.06	1.01	0.15	2.23	2.58	2.56	4.05	8.01	12.86
2019	3.30	1.18	0.10	2.40	2.90	2.60	5.10	7.90	12.70
2022	3.43	1.08	0.14	2.35	2.87	2.72	6.11	7.81	12.99

Source: IEA, Central Electricity Authority (For India), CareEdge Research
Data for India is as per FY-Financial Year while for others it is CY-Current Year

India is among the top nations in the world which are leading the global renewable energy growth. On technology specific installed capacity, India ranks 4th in onshore wind, 3rd in Solar, 3rd in Bioenergy and 6th in Hydro as per International Renewable Energy Agency (IRENA) renewable capacity statistics 2025.

2.3 Transmission Line Network (220 kV & above)

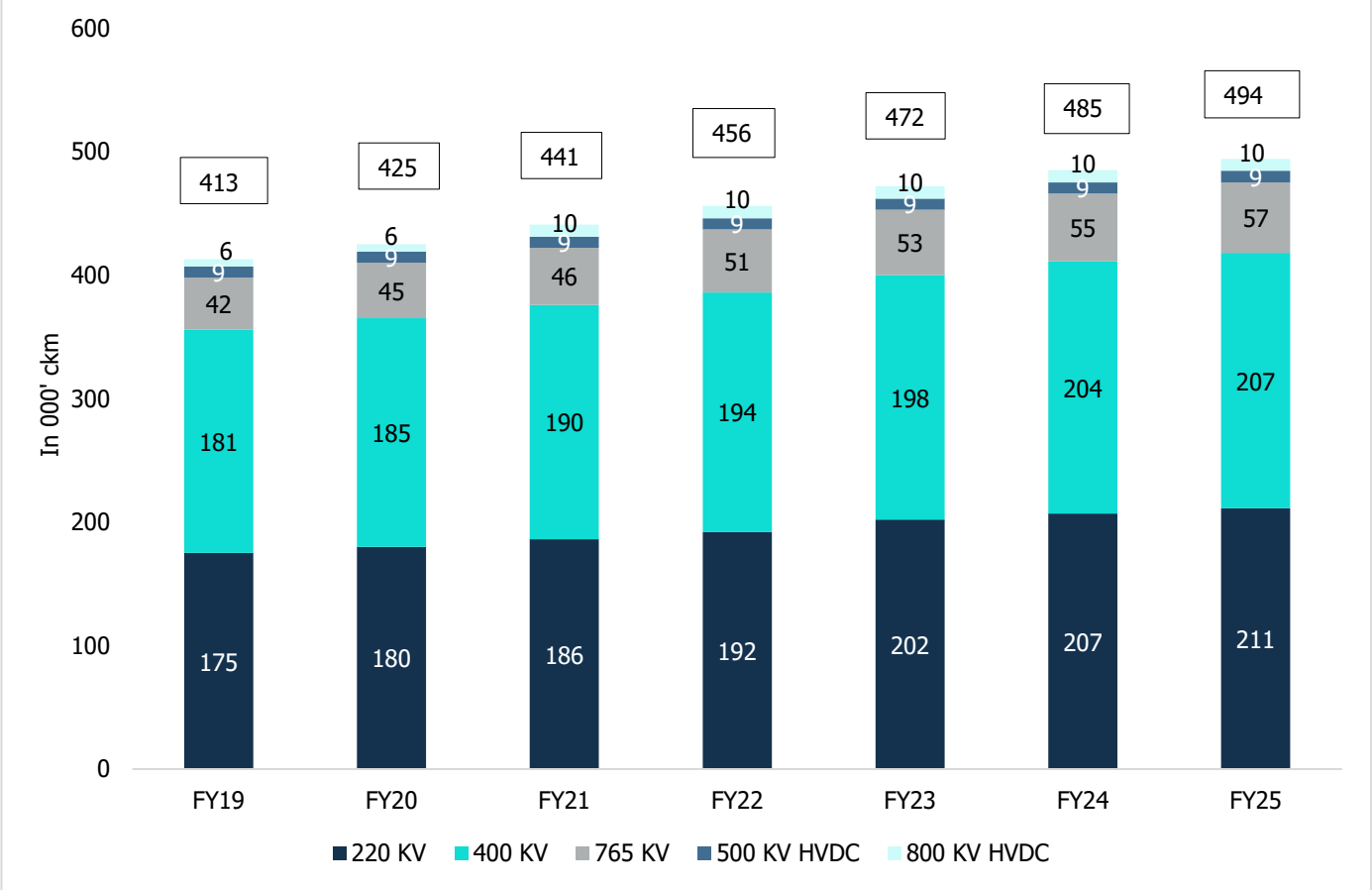
A transmission line is used for transmitting electrical power from a generating substation to several distribution units. Transmission planning has become even more essential to integrate and evacuate RE power with the current growth trajectory of RE in the last few years, coupled with the Government of India's target of integrating 500 GW non-fossil-based installed capacity by 2030.

India's power transmission system has seen robust growth driven by growing demand, the government's focus on providing electricity in rural areas, and the need for connecting the generation stations, including the integration of RE sources from the RE-rich states. Two central sector schemes-, the North Eastern Regional Power System Improvement Project (NERPSIP) and Comprehensive Scheme for Strengthening of Transmission & Distribution Systems in Arunachal Pradesh and Sikkim are playing a crucial role in reinforcing the transmission and distribution infrastructure in the North Eastern region.

Further, the government-owned Power Grid Corporation of India Ltd (PGCIL) is the industry leader that owns and operates most of the inter-state and inter-regional transmission lines in the country facilitating the transfer of power between different regions. While PGCIL and other state transmission utilities remain major players in the sector, the private sector participation has seen a healthy growth with the introduction of Tariff-based Competitive Bidding (TBCB) and a viability gap funding scheme for the inter-state projects.

Moreover, the transmission line network grew at a CAGR of approximately 3% to 4,94,374 CKm as of March 2025 from 4,13,407 CKm as of March 2019. During FY25, 8,830 CKm of transmission lines were added to the total network. Also, total transformation capacity addition during the May 2025 was 3,150 MVA. Whereas the transformation line capacity is at 13,54,103 MVA as of May 2025.

Chart 17: Transmission Line Network (220 kV & Above)



Source: Central Electricity Authority, CareEdge Research

There are many transmission projects under construction. These include various projects of transmission systems associated with renewable projects and conventional projects in Rajasthan, Karnataka, Maharashtra, etc. These projects are being executed mainly by PGCIL along with private players like Sterlite Power Transmission Limited, Adani Transmission Limited, ReNew Transmission Ventures Private Limited, etc.

Further, the substation line network grew at a CAGR of approximately 7.07% to 1.355 million MVA as of May 2025 from 0.899 million MVA as of March 2019. During FY25, the substation line network grew to 1.34 million MVA.

The Government of India has finalised the National Electricity Plan from 2023–2032 to strengthen Central and State transmission systems and meet a projected peak electricity demand of 458 GW by 2032. The estimated cost of the plan is Rs 9.15 lakh crore, it aims to expand the transmission network from 4.91 lakh CKm in 2024 to 6.48 lakh CKm by 2032 and increase transformation capacity from 1,290 GVA to 2,342 GVA during the same period.

This new plan includes nine High Voltage Direct Current (HVDC) lines of 33.25 GW, raising total HVDC capacity to 66.75 GW, and boosting inter-regional transfer capacity from 119 GW to 168 GW. It covers the network of 220 kV and above it will help in meeting the increasing electricity demand, facilitate RE integration and green hydrogen loads into the grid.

Additionally, 50.9 GW of Inter-State Transmission System (ISTS) projects worth Rs 60,676 crore have been approved to connect 280 GW of variable renewable energy by 2030 of this, 42 GW is completed, 85 GW is under construction, and 75 GW is under bidding.

In 2024, 10,273 ckm of transmission lines, 71,197 MVA of transformation capacity, and 2,200 MW of transfer capacity were added. To speed up project implementation, Right of Way (RoW) guidelines were revised in June 2024, increasing land compensation significantly up to 200% of market value for tower bases and 30% for corridors.

2.4 Distribution in Power sector

Distribution is the final stage in the power sector value chain. It connects the transmission utilities to the final consumers such as residential, commercial, agricultural, and industrial consumers. This segment is crucial for the power sector, as it generates revenue that is then passed on to the generation and transmission sectors. State-owned distribution companies (DISCOMs) primarily oversee this process.

To encourage competition among DISCOMs and improve operational efficiency, the government allowed private participation in power distribution through the Electricity Act of 2003. Although the majority of power distribution in India is handled by state-run DISCOMs, private distribution licensees serve around 10% of the population. In several urban centres such as Delhi, Mumbai, Kolkata, Surat, and Ahmedabad, private entities have been entrusted with distribution responsibilities and have delivered notable efficiency improvements. Additionally, distribution franchisees have contributed meaningfully to curbing losses and improving service quality in the regions under their purview.

The consumer base of DISCOMs is made up of five main segments: domestic, commercial, agricultural, industrial, and others. The industrial sector contributes the most revenue to DISCOMs, followed by the agricultural and domestic sectors.

2.4.1 Financial Health of the DISCOMs

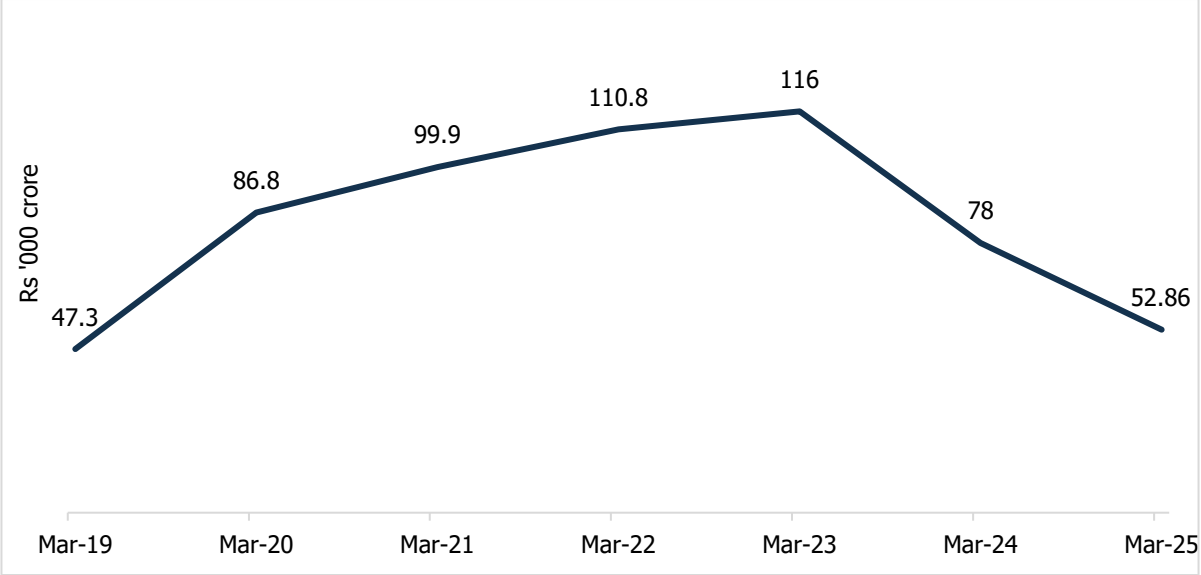
Outstanding Dues

Total Outstanding due that are owed by the distribution companies stood at Rs 52,860 crores as of Mar'25 as compared to Rs 78,000 crore as of Mar'24. The improvement in recovery of outstanding dues has been due to the implementation of Electricity (Late Payment Surcharge and Related Matters) Rules, 2022, which was notified in August 2022.

The rules were introduced to strengthen the regulatory provisions for recovery of outstanding dues of generating transmission and electricity trading licenses from distribution companies. The rules include late payment surcharge, prior intimation of payment schedule, priority-wise adjustment of payment, and EMI schedule structure. Further, under these rules, it has become difficult for DISCOMs to access power after the trigger date or in case of payment defaults unless the dues are settled.

The DISCOMs are now given 45 days by the power producers to pay bills towards electricity supplied after which the outstanding dues become overdue and the DISCOMs are penalized in most cases. Delays in payment by the DISCOMs adversely affect the cash flows of the generating companies, and hence, the generating companies need to make provisions for purchasing inputs like coal and keep adequate working capital. This impacts the entire value chain of the power sector. Schemes like Revamped Distribution Sector Scheme (RDSS) have been introduced to improve the operational efficiency and financial sustainability of DISCOMs.

Chart 18 : Outstanding payments by DISCOMs to conventional generation companies

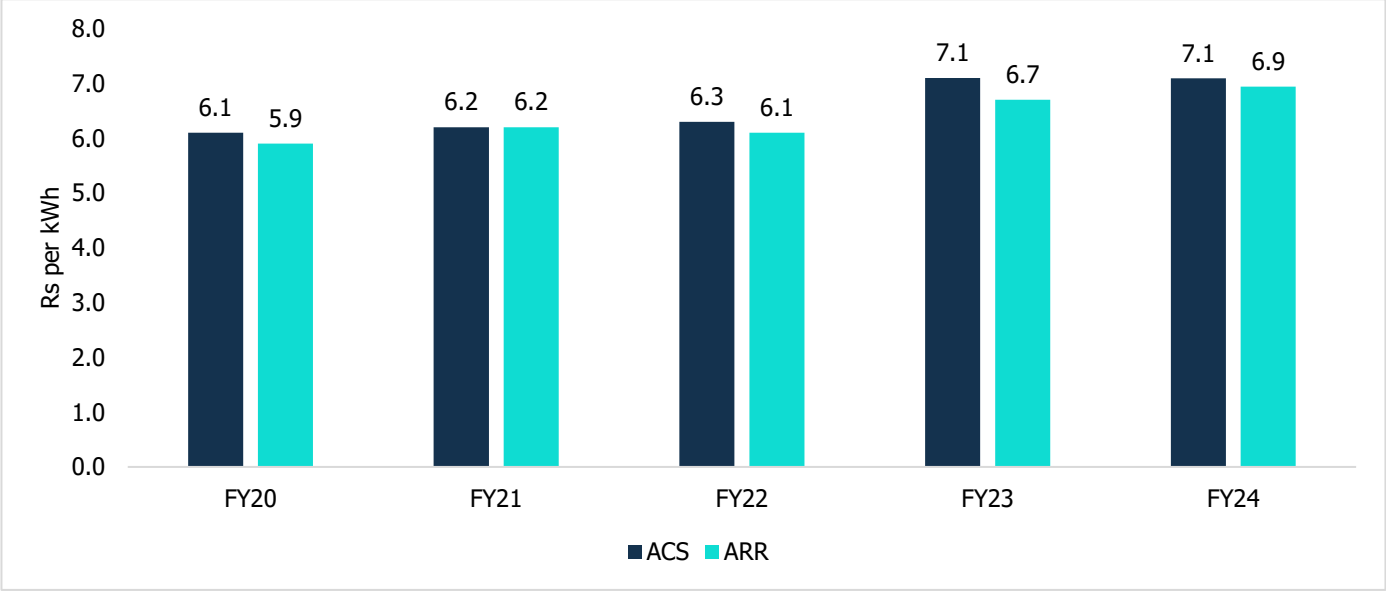


Source: PRAAPTI

Revenue Gap

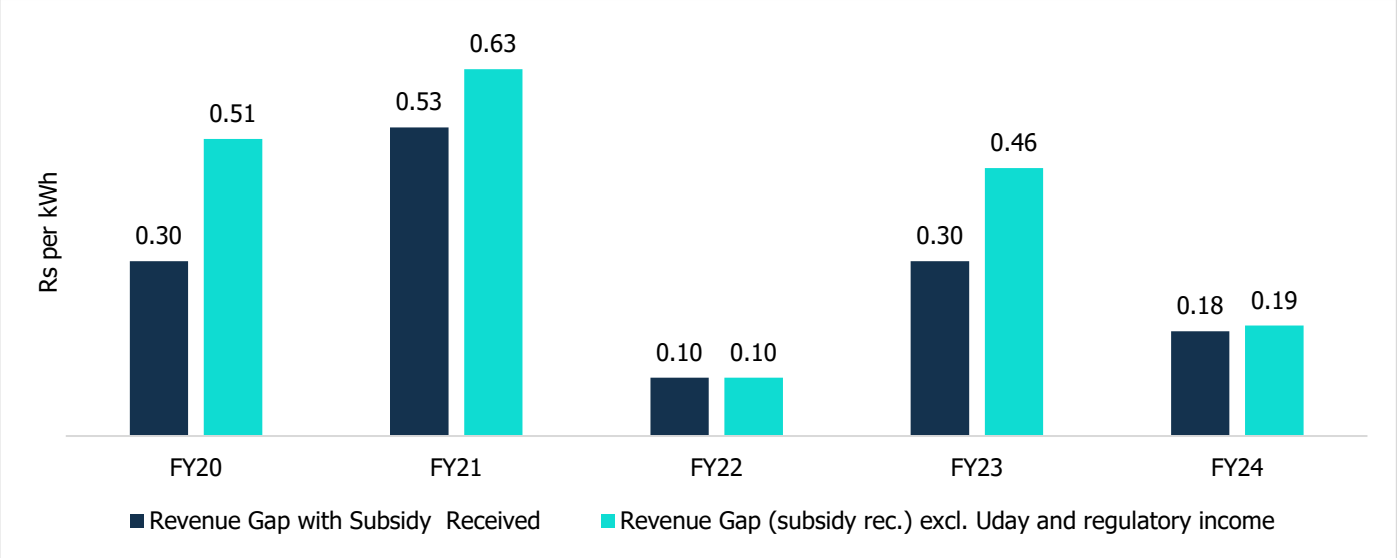
The average Cost of Supply (ACS) for distribution utilities rose from Rs 6.0 per kWh in FY19 to Rs 7.09 per kWh in FY24. Average Revenue Realized (ARR) with subsidy rose from Rs 5.48 per kWh in FY19 to Rs 6.94 per kWh in FY24. Besides operational inefficiency, the other major factor contributing to the ACS-ARR gap is the absence of adequate tariff revisions in some of the states.

Chart 19: Average Cost of Supply, Average Revenue



Source: PFC's report on performance of state power utilities 2023-24 Report

Chart 20: Revenue Gap



Source: PFC's report on performance of state power utilities 2023-24 Report

In 2015, the Government of India launched the UDAY scheme with the objective to turn around the operational and financial performance of the DISCOMs. As per the conditions of the scheme, the DISCOMs were supposed to bring down the AT&C losses to 15% and ACS-ARR gap to zero by the end of FY19.

Tariff Subsidy billed by distribution utilities increased from Rs 1,69,016 crore in 2022-23 to Rs 2,10,784 crore in 2023-24. As a percentage of total revenue, tariff subsidy billed by the utilities increased from 17.56% in 2022-23 to 20.21% in 2023-24.

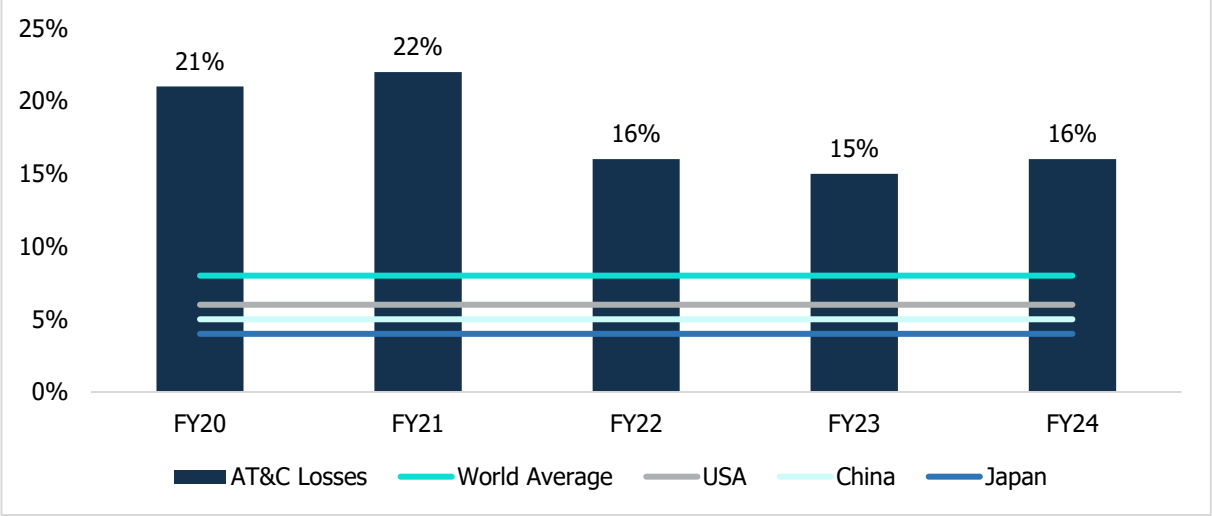
The Overall AT&C losses for distribution utilities deteriorated from 15.11% in 2022-23 to 16.12% in 2023-24. Billing Efficiency decreased from 86.98% in FY 2022-23 to 86.91% in FY 2023-24. Collection efficiency declined from 97.60% in 2022-23 to 96.51% in 2023-24. The ACS-ARR gap with subsidy received decreased from Rs 0.30 per kWh in FY20 to 0.18 per kWh in FY24.

AT&C Losses

Aggregate Technical & Commercial (AT&C) loss is the difference between units input into the system and the units for which the payment is collected. It can be divided into technical (transmission) and non-technical losses (commercial).

The AT&C losses of the DISCOMs have shown a fluctuating trend for the last five years, it has declined for the last three years, even though the losses have come down, they are significantly higher as compared to the world average of around 8%. The losses are mainly due to poorly maintained and overburdened distribution networks, inadequate metering, and electricity theft. Various measures including consistent improvement in the billing and collection activities have gradually helped minimise the AT&C losses. The AT&C losses reduced to 16% in FY24 for DISCOMs compared with the 21% in FY20.

Chart 21: National AT&C losses



Source: PFC's report on performance of state power utilities 2022-23 Report

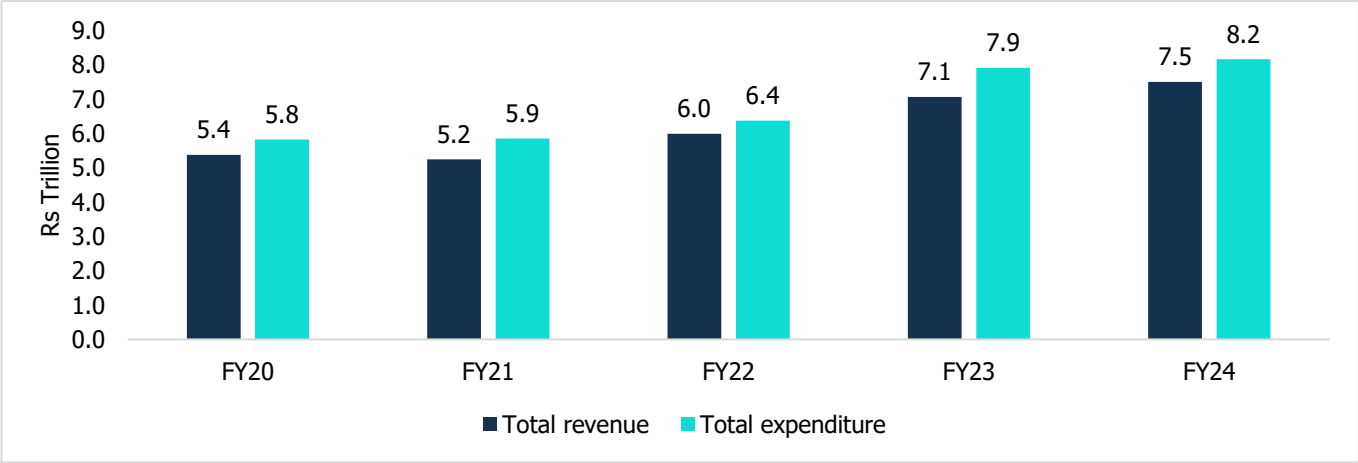
The AT&C losses and ACS-ARR gap has improved significantly due to the introduction of the Revamped Distribution Sector Scheme (RDSS). RDSS is a reforms-based and results-linked scheme with an outlay of Rs 3.03 Trillion towards power distribution till FY25-26. The aim of the scheme is to provide financial support for Prepaid Smart Metering & System Metering and the upgradation of the distribution infrastructure.

The Ministry of Power also issued regulations regarding mandatory energy accounting and auditing along with Later Payment Surcharge Rules which state that unless the distribution companies promptly pay for the power drawn from the Inter-State Transmission System (ISTS), their access to the power exchange will be cut off. These improvements were necessary to make the power sector more attractive to investors, since the demand for power has been growing, and further investments are required to meet the growing demand**.**

Total Revenue & Expenditure

Total expenditure of the DISCOMs increased by about 24% in FY23 whereas the revenues increased by 18% resulting in recovery of cost of 89% in FY23 as compared to 93% in FY19.

Chart 22: Total Revenue and Expenditure for Distribution Utilities



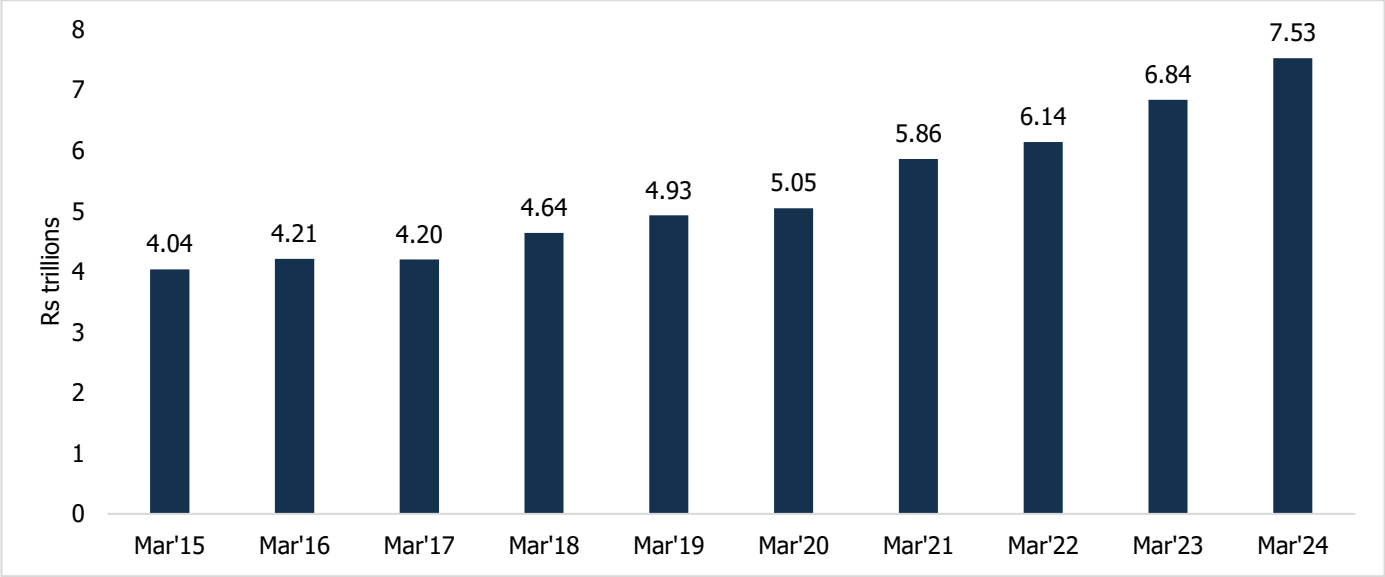
Source: PFC's report on performance of state power utilities 2023-24 Report

Total Borrowings

Total borrowings of DISCOMs increased from Rs 6.844 Trillion as on March 31, 2023 to Rs 7.5268 Trillion as on March 31, 2024. The year over year rate of increase in debt in FY24 is reduced to 10% from 16% in FY21. This trend has emerged due to improvement in bill collections; tariff increase and new norms which must be followed for DISCOMs to become eligible for loans sanction/disbursement by Power Finance Corporation (PFC) and REC Limited.

To support the sector, the Government of India came out with a liquidity relief scheme in 2019 with an outlay of Rs 90,000 crores (eventually increased to Rs 1.25 Trillions) for the state DISCOMs, in the form of loans against receivables, from PFC and REC. To be eligible for the relief, the DISCOMs must follow certain norms including timely availability of quarterly audited accounts, timely filing of tariff petitions and orders, clearance of any pending subsidies and bills due to DISCOMs, preparation of ACS-ARR gap and AT&C loss improvement plan, and zero defaults.

Chart 23: Total Borrowings for Distribution Utilities



Source: PFC's report on performance of state power utilities 2023-24 Report

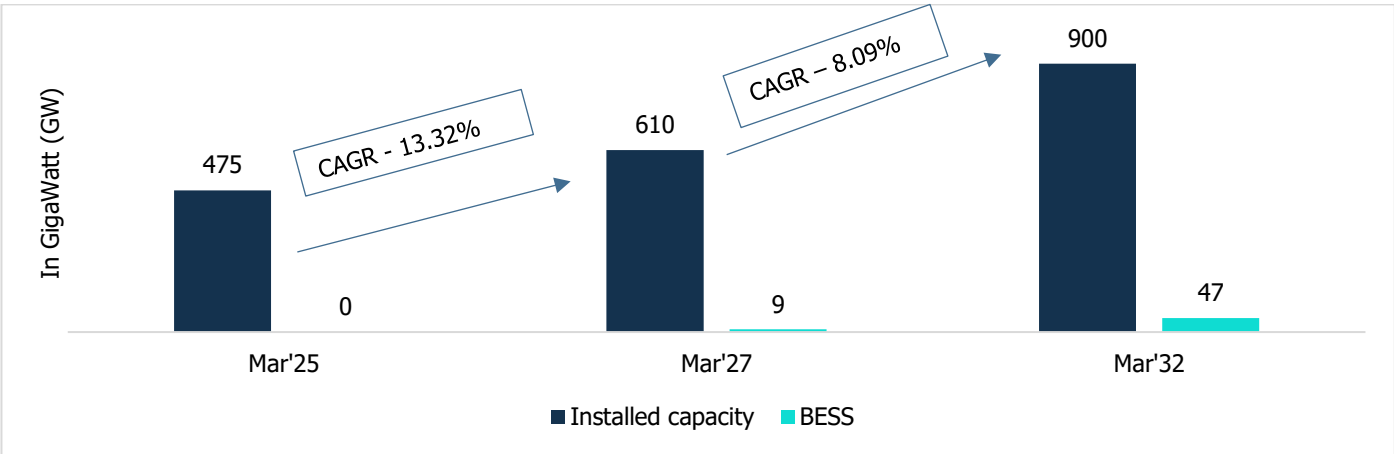
3 Outlook of the Power Sector

3.1 Outlook of Capacity Additions

The Indian power sector is witnessing a major transformation in terms of demand growth and energy mix. To ensure that everyone has access to reliable power and sufficient electricity, investments are being carried out to increase the installed capacity and clean energy transition. The government plans to establish a renewable capacity of 500 GW by 2030 and increase the share of non-fossil fuel-based installed capacity to around 50%.

As per National Electricity Plan Vol-2 released in FY24, the installed capacity is expected to grow from 475 GW in March 2025 to around 610 GW by March 2027, growing at a CAGR of around 11.36%. The Battery Energy Storage System (BESS) is expected to gain traction and reach 9 GW of installed capacity. Installed capacity is expected to reach 900 GW by March 2032, growing at a CAGR of 8.1% from March 2027, while the BESS capacity is expected to reach 47 GW.

Chart 24: Aggregate Installed Capacity Outlook



Source: National Electricity Plan (NEP), CareEdge Research

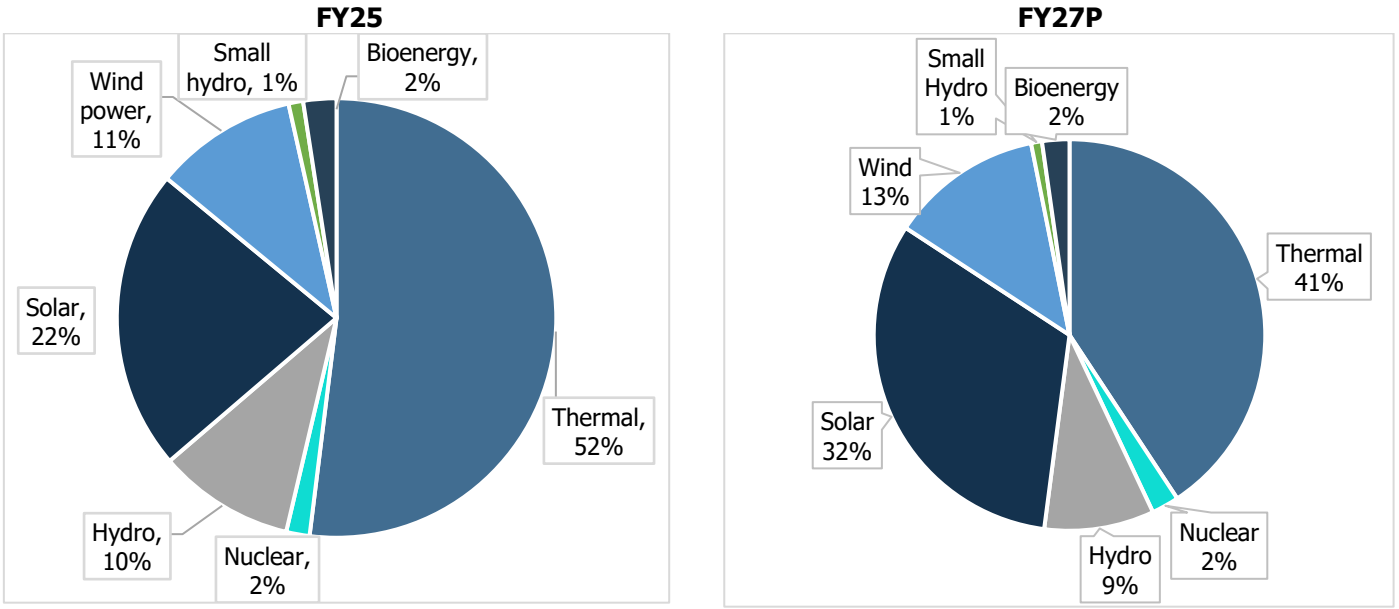
Table 6: Sector wise and fuel wise break up of Additional Capacity Requirement (MW)

	Under Construction (FY22 to FY27)	Additional Capacity Requirement (FY22 to FY27)	Total Capacity Addition (FY22 to FY27)	Under Construction (FY27 to FY32)	Additional Capacity Requirement (FY27 to FY32)	Total Capacity Addition (FY27 to FY32)
Renewable						
Hydro	10,462	0	10,462	1,032	8,700	9,732
PSP	2,700	0	2,700	80	19,160	19,240
Solar	92,580	38,990	131,570	0	17,900	17,900
Wind	25,000	7,537	32,537	0	49,000	49,000
Biomass	2,318	0	2,318	2,500	0	2,500
Small Hydro	352	0	352	250	0	250
Conventional						
Nuclear	6,300	0	6,300	2,400	4,200	6,600
Coal & Lignite	25,580	0	25,580	1,320	24,160	25,480
Total	165,292	46,527	211,819	7,582	284,220	291,802
BESS	0	8,680	8,680	0	38,564	38,564

Source: MNRE

In FY25, the conventional generation capacity accounted for 52% of the total installed capacity while renewable energy accounted for the balance 48%. By FY27, it is expected that the contribution of conventional generation will decline to 41%.

Chart 25:Break-up of the total installed capacity - FY25 vs FY27



Source: National Electricity Plan (NEP) March 2023, Central Electricity Authority, CareEdge Research

3.2 India's Renewable Potential and Global Rank in Terms of Installed Capacity

There has been a significant shift globally in the generation capacity mix due to the growing environmental concerns and climate change. India is an active participant and has taken initiatives toward sustainable development and cleaner environment, including significant additions of renewable energy generation capacity.

Further, India ranks 4th in the world, leading the global renewable energy growth. In technology-specific installed capacity, India ranks 4th in onshore wind, 3rd in Solar and Bioenergy, and 6th in Hydro as per the International Renewable Energy Agency (IRENA) renewable capacity statistics 2025.

Table 7: List of Top 10 Countries – Installed Capacity Statistics As of Dec 2024

Ranking	Technology Specific Ranking by Installed Capacity					Ranking - Total Renewable Installed Capacity
	Onshore Wind	Offshore Wind	Solar	Bioenergy	Hydro	
1	China	China	China	China	China	China
2	USA	UK	USA	Brazil	Brazil	USA
3	Germany	Germany	India	India	Canada	Brazil
4	India	UK	Germany	Germany	USA	India
5	Brazil	Denmark	Japan	UK	Russia	Germany
6	Spain	Belgium	Brazil	USA	India	Japan
7	France	France	Spain	Brazil	Norway	Canada
8	Canada	Vietnam	Italy	Finland	Turkey	Germany
9	Sweden	Japan	Australia	Indonesia	Vietnam	Russia
10	UK	Korea	Korea	Sweden	Japan	Spain

Source: IRENA Renewable Capacity Statistics 2025, CareEdge Research

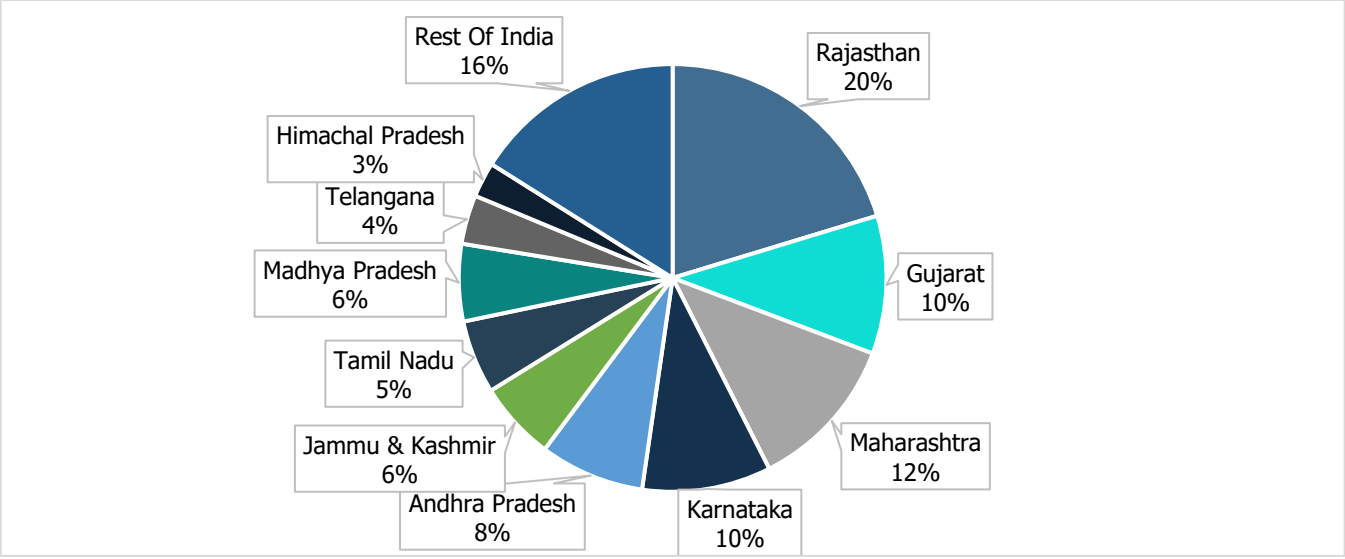
Table 8: India's Physical Progress cumulative up to FY25 (GW): (as of June 2025)

Sector	Cumulative up to FY25	Potential (GW)
Hydro Power	49.4	133.4
Wind Power	51.7	695
Solar Power	116.2	750
Small Hydro Power	5.1	21.1
Bioenergy- Biomass (Bagasse) Cogeneration	9.8	22
Bioenergy- Biomass (Non-Bagasse) (Cogeneration/ Captive Power)	0.9	
Waste to Power	0.3	3
Waste to Energy (Off-grid)	0.5	
Hybrid/ Round the clock/ Thermal + RE bundling	-	0
Total	**234.0**	**1,625**

Source: MNRE, Energy Statistics India 2024, CareEdge Research, PIB

The state-wise potential of renewable energy is as below. Rajasthan, Gujarat, Maharashtra, Karnataka, and Tamil Nadu are the top 5 renewable energy potential states.

Chart 26: State-wise estimated potential of renewable power in India (Total – 748 GWp)



*Excluding Hydro power

Source: Energy Statistics India 2025, CareEdge Research

India has a solar potential of 748 GW, if solar PV modules cover 3% of the waste land area. The top three states with highest solar potential are Rajasthan, Gujarat and Maharashtra accounting for 42% of total potential and top ten states account for around 75% of the total solar potential.

3.3 Power Peak Demand Forecast, Energy Requirement and Supply Potential

Power demand forecasting in India is a critical aspect of ensuring a reliable and efficient electricity supply, particularly as the country experiences rapid economic growth and Urbanisation. Rising industrialisation and population growth are expected to drive a substantial increase in electricity demand in the coming years. Agencies such as the Central Electricity Authority (CEA) are employing advanced modelling techniques to forecast future demand, taking into account demographic shifts, economic trends, and seasonal variations. The adoption of smart grid technologies and real-time data analytics is improving the precision of these projections. Nonetheless, challenges persist, including regional imbalances in power consumption and the urgent need for infrastructure modernisation. Accurate demand forecasting remains critical for optimising generation capacity, minimising outages, and ensuring the power sector is equipped to meet the nation's evolving energy requirements.

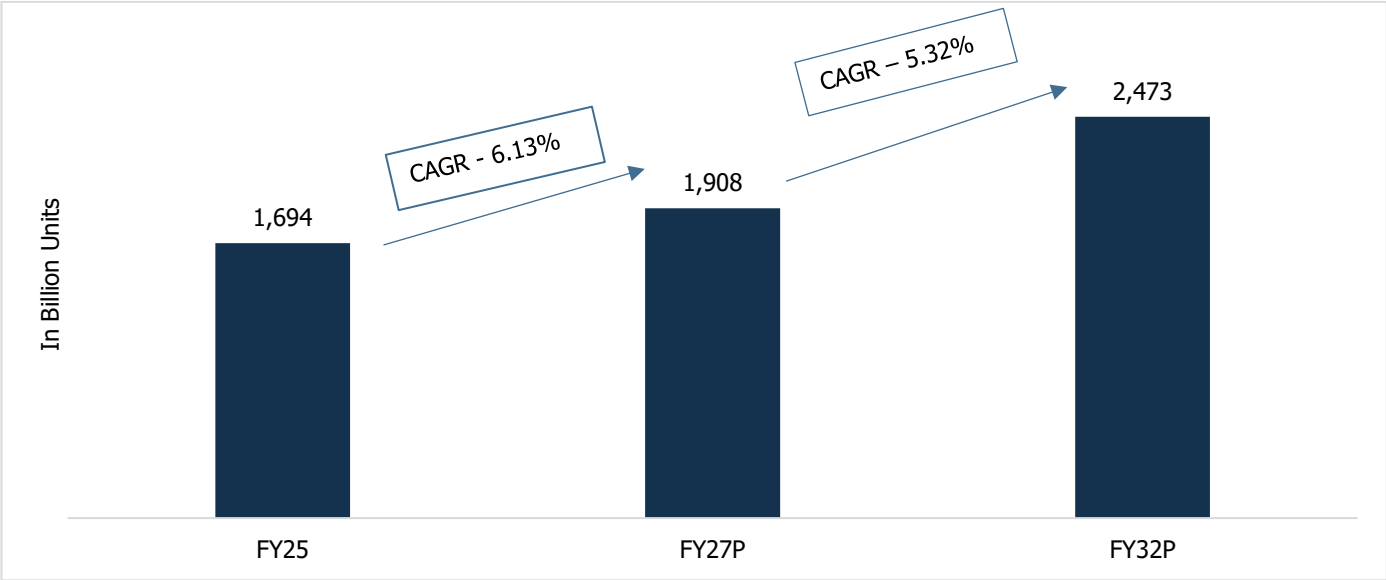
Table 9: All India Peak Demand and Energy Requirement

Region	Peak Demand (MW)		Energy Requirement (BU)	
	FY27	FY32	FY27	FY32
Northern	97,898.00	1,27,553.00	592.30	773.50
Western	89,457.00	1,14,766.00	596.80	763.20
Southern	80,864.00	1,07,259.00	460.90	596.60
Eastern	37,265.00	50,420.00	232.90	308.10
North-Eastern	4,855.00	6,519.00	24.90	32.40
All India	2,77,201.00	3,66,393.00	1,907.80	2,473.80

Source: Central Electricity Authority, CareEdge Research

Going forward, the Western and Northern regions are expected to continue to drive the energy requirement followed by the Southern region.

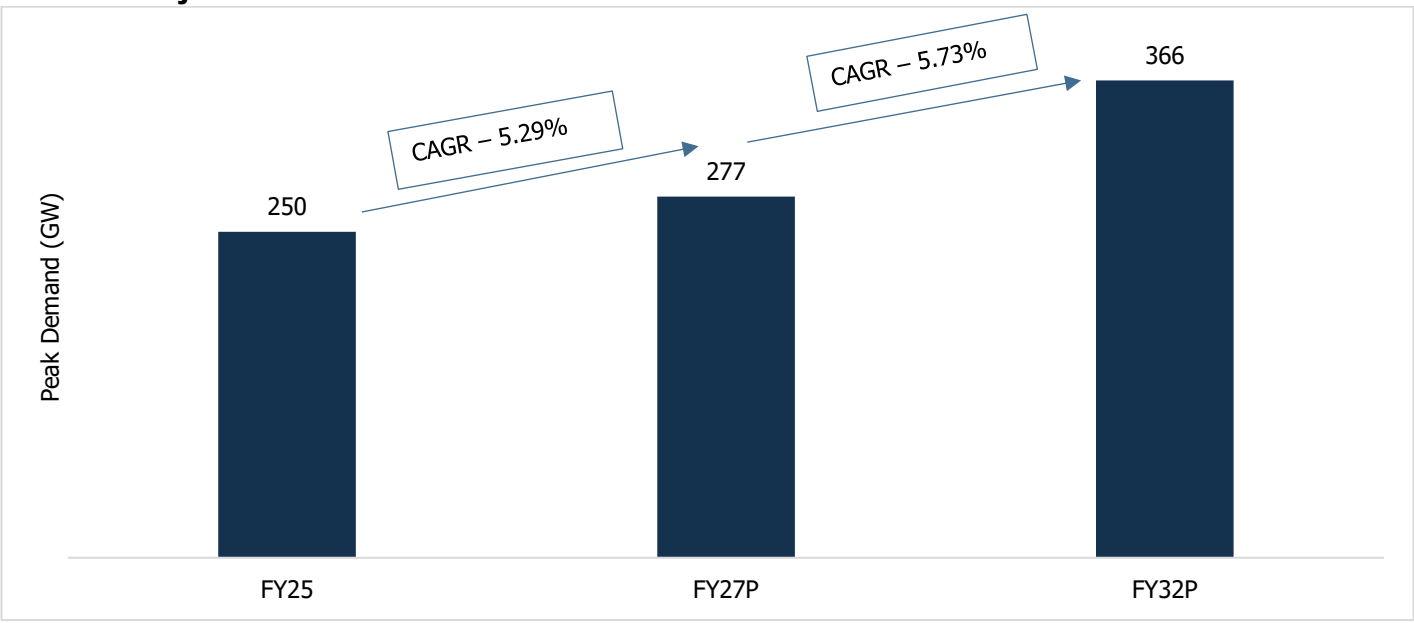
Chart 27: Projected All India Energy Requirement



Source: National Electricity Plan (NEP), CareEdge Research; Note: P is for Projections

According to the National Electricity Plan Vol 1, all India peak electricity demand is projected at 277 GW and energy requirement is projected at 1,908 BU for FY27. The power demand is further expected to rise with the growing population and increased economic activities. For FY32, the peak electricity demand is projected at 366 GW and energy requirement at 2,473 BU.

Chart 28: Projected All India Peak Demand

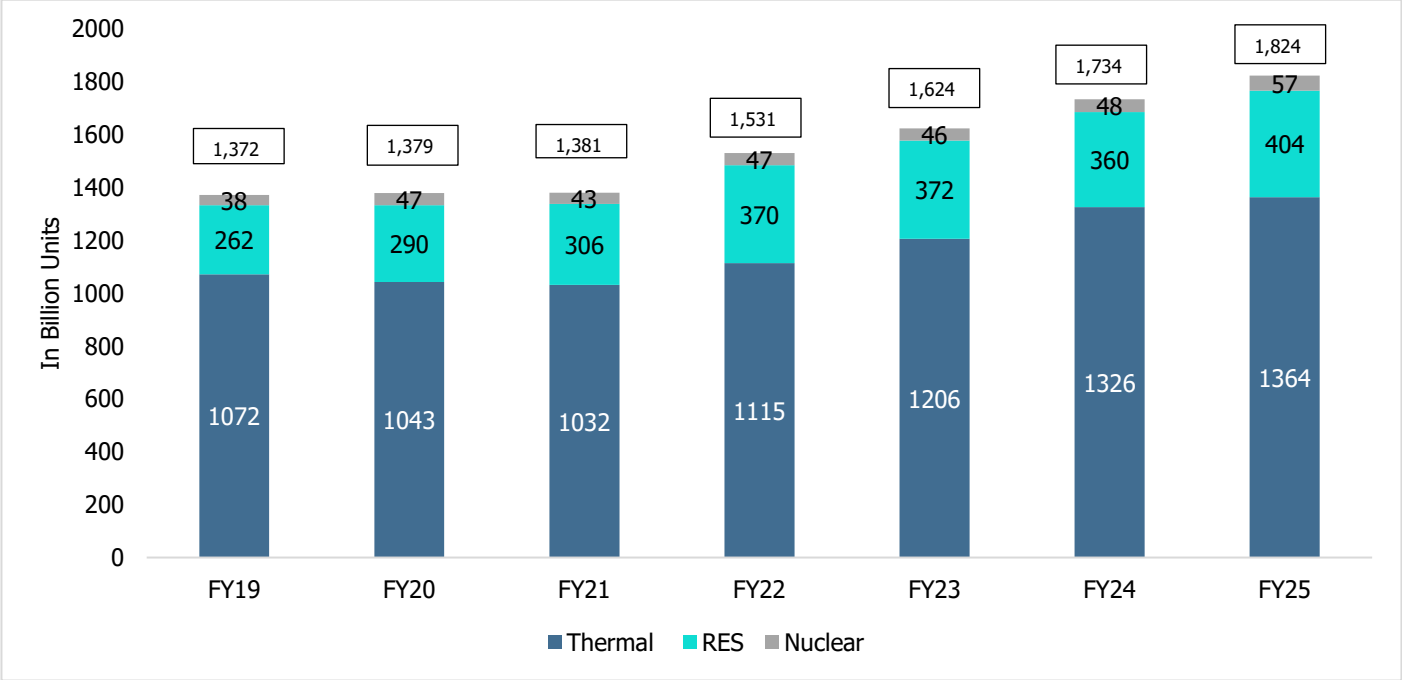


Source: National Electricity Plan (NEP) March 2025, CareEdge Research; Note: P is for Projected

The energy requirement is expected to grow at a CAGR of 6.13% and peak demand is expected to grow at CAGR of 5.29% between FY25-FY27. For FY27 to FY32, the CAGR is at 5.73% for energy requirement and 5.7% for peak demand.

3.4 Power Supply Mix of India

Chart 29: Power Generation over the years



Source: Central Electricity Authority, CareEdge Research; RES refers to power generated from Hydro, Wind, Solar, Small hydro and Bioenergy projects;

Electricity generation in India increased from 1,372 BU in FY19 to 1,824 BU in FY25, implying a compounded annual growth rate (CAGR) of 4.9%. Electricity generation increased by about 5.2% y-o-y during April 2024 to March 2025. Thermal power forms the largest source of power in the country with about 75% of the electricity consumed being generated from thermal power plants. There are different types of thermal power plants, out of which coal based thermal power plants account for highest amount of electricity followed by gas and diesel. Renewable Energy Sources (RES) including solar, wind and hydro are quickly increasing their share, and their contribution has increased from 19.1% in FY19 to 22.2% in FY25.

3.5 Long-Term Drivers and Constrains for Demand Growth

The growth drivers for the increasing power demand are mentioned below.

- **GDP and Energy Intensity**

India has latent power demand because of its low per capita power consumption, strong GDP outlook and growing population. India is likely to emerge as one of the world's fastest growing economy, as per IMF's April 25 outlook India is expected to grow by 6.2% in 2025 and 6.3% in 2026 respectively, which is expected to lead to an increase in the power demand of the country. The capacity addition surged in FY25, marking approximately ~13GW in Q1, and the trend is expected to continue. Also, the electricity generated from all sources increased over 3.6% in Q1 FY25 as compared to previous year same period.

- **Urbanisation**

Urbanisation leads to faster infrastructure development, job creation, development of the consumer, and services sectors, thereby major driver for the growing power demand. The urban consumption is increasing due to rising disposable income, favourable demographics and the trend is likely to continue.

- **Demand for Round-The-Clock power**

Recently, there has been a significant focus on blending two or more energy sources like wind-solar hybrid to achieve better synergies, higher plant load factor and better energy gains. The wind and solar energy have complementary generation patterns and hence provide smooth output. Round-The-Clock ensures quality clean power is made available round the clock, mixing renewable with conventional energy sources for stable power and utilization of existing coal-based plants.

- **Rural Electrification**

The Government of India has taken joint initiatives with the state governments for providing Power for All (PFA) to all households/homes, industrial, and commercial consumers including supply of power to agricultural consumers. PFA initiative along with rural electrification across various states aims to ensure 24X7 electricity access, enhance the satisfaction levels of the consumers, improve the quality of life of people and increase economic activities. This is one of the key drivers for the growing power demand.

Deen Dayal Upadhyaya Gram Jyoti Yojana (DDUGJY) was launched in December 2014 with the objective of electrification of all un-electrified villages as per Census 2011 by the Government of India. Similarly, Pradhan Mantri Sahak Bijli Har Ghar Yojana- SAUBHAGYA was launched in October 2017 for electrification of rural and urban poor households in the country. Schemes like Integrated Power Development Scheme (IPDS) with an outlay of Rs 326.12 billion including a budgetary support of Rs 253.54 billion from the Government of India have been approved.

- **Railway Electrification**

A lot of emphasis is given to railway electrification with the view to reduce the nation's dependence on the imported coal and petroleum-based energy and with a vision of providing eco-friendly, faster and energy-efficient mode of transportation.

Table 10: Trend of railway electrification in India (in route Kms)

Particulars	FY19	FY20	FY21	FY22	FY23	FY24	FY25
Electrified	35,488	39,866	45,881	52,247	58,812	63,456	68,701
Total	67,415	67,956	68,103	68,043	68,584	69,181	69,512
Railway Lines Electrified (% of Total)	52.60%	58.70%	67.40%	76.80%	85.80%	91.70%	98.80%

Source: Indian Railways

- **Electrification of Mobility Infra**

The global market for electric vehicles (EVs) is growing. As per the International Energy Agency (IEA), the global EV fleet will reach about 130 million by 2030, a sharp rise from just more than 5.1 million in 2018.

The growth of EV segment in India has also been on an increasing trend. The penetration of EVs has increased to 7.8% of the total vehicle sales in FY25.

Table 11: Sale of EV Units in India (in units)

EV Sales Units	FY19	FY20	FY21	FY22	FY23	FY24	FY25
Two-wheeler	25,393	24,839	44,782	2,52,568	7,28,069	9,48,518	11,49,422
Three-wheeler	1,18,944	1,40,683	90,073	1,82,604	4,04,427	6,32,806	6,99,063
Four-wheeler	1,632	2,727	5,132	18,567	91,506	91,506	1,07,645
Goods vehicle	517	50	400	2,203	8,494	8,494	8,844
Total EV sales units	**1,46,486**	**1,68,299**	**1,40,387**	**4,55,942**	**16,81,324**	**16,81,324**	**19,64,974**

Source: Council of Energy & Environment & Water (CEEW), SMEV, CareEdge Research

The Government of India has targeted 30% EV penetration by 2030. As EV adoption grows, there will be additional power demand for EVs and hence readiness of the electricity grid to EV charging demand is critical to achieve rapid and large-scale transition to EVs.

The charging demand by vehicle segment is depicted below in the table:

Table 12: Charging demand by vehicle segment (in units)

Vehicle segments	Total daily charging demand in kWh - 2025	Total daily charging demand in kWh – 2030
E – 2W	1,25,596	7,65,442
E-3W (passenger / cargo)	2,55,162	9,72,757
E-car (personal)	17,498	1,64,786
E-car (commercial)	55,931	4,91,838
Total	**4,54,187**	**23,94,823**

Source: Handbook of electric vehicle charging infrastructure implementation by NITI Aayog – Version 1

Constraints:

- **Grid Connectivity**

Power generation in India is dominated by coal-based generation. The use of other resources, such as renewable energy, is experiencing a staggering growth in installed capacity. Going forward, it is expected that the growth in renewable energy capacity additions will be healthy. Such expansion necessitate large-scale development within the transmission sector, primarily because utility-scale solar and wind power projects are typically situated in remote locations with limited supporting infrastructure. While the government has undertaken several initiatives to enhance transmission capacity in line with renewable energy additions, delays in commissioning transmission infrastructure for evacuating power from upcoming projects remain a significant risk for the sector.

- **Poor Health of DISCOMS**

The DISCOMs have faced several issues in the past including increasing debt levels, poor collection efficiency, high AT&C losses and high ACS-ARR gap. The government has taken multiple initiatives over the past few years to improve the sector. However, the delays in payment to the power producers pose a risk to their cash flow and overall financial stability.

- **Fuel Availability (Coal)**

Conventional thermal power generation depends on finite fuel sources such as coal, lignite, gas, and diesel, which are depleted through use. In contrast, renewable energy sources are naturally abundant and do not diminish over time. Between FY18 and FY20, India recorded an estimated 30 billion units (BU) of lost generation due to coal shortages. This shortfall was eliminated in FY21 and FY22 through increased coal imports, and since FY22, no generation loss has been reported due to coal supply constraints. However, dependence on imported fuel introduces risks related to price volatility

and supply disruptions. Such shortages can adversely impact power generation and compromise grid stability, making consistent fuel availability a critical issue for the sector. Although the government is actively working to boost domestic coal production and has prioritised fuel allocation for the power sector, imported coal remains essential to ensure optimal plant operation and meet the country's growing electricity demand.

3.6 Investments in the Power Generation, Transmission and Distribution Sector in India

Generation

As per the NEP, total power capacity is expected to increase to 900 GW by FY32 from 442 GW in FY24. The expected investments in the generation section between FY23-FY27 and FY27-FY32 are given in the following table.

Table 13: Expected investments in generation (Rs Crore)

	FY23-FY27	FY27-FY32
A. Conventional		
Thermal	2,18,430	1,85,855
Nuclear	1,20,280	43,051
Sub-total	**3,38,710**	**2,28,906**
B. Renewables		
Hydro	66,148	1,29,777
PSP	54,203	75,240
Wind	2,30,946	3,30,900
Offshore Wind	0	27,401
SHP	1,859	1,669
Biomass	24,704	23,105
Solar	6,80,970	7,96,771
BESS	56,647	2,92,637
Sub-total	**11,15,477**	**16,77,500**
Total	**14,54,188**	**19,06,406**

Source: National Electricity Plan (NEP) March 2023, CareEdge Research

Projected Investments in the Indian Electricity Transmission Sector

A total of Rs 42,998 cr. by the end of FY28 with highest investments in the Western Region of Rs19,298 cr.

Table 14: Transmission Line Investments (In Cr)

FY	WR	SR	NR	ER	NER	Total
FY24	7,365	6,659	10,770	285	417	25,495
FY25	11,320	3,391	1,077	594	77	16,459
FY26	614	-	-	-	430	1,044
FY27	-	-	-	-	-	-
FY28	-	-	-	-	-	-
Total	**19,298**	**10,050**	**11,847**	**879**	**925**	**42,998**

Source: ISTS Rolling Plan 2027-28, CareEdge Research

Distribution

A total of Rs 7.42 lakh crore is expected to be added under this section from FY22 to FY30.

Table 15: Projected Investments in The Indian Electricity Distribution Sector

Investment Required from 2022-27	Total Investment available with the Discom from various sources for period 2022-27 including RDSS	Investment Required from 2027-30	% of required investment already sanctioned upto 2027 under RDSS and other schemes
Rs 4.28	Rs 1.89	Rs 2.86	44%

Source: Distribution Perspective Plan 2030, Central Electricity Authority

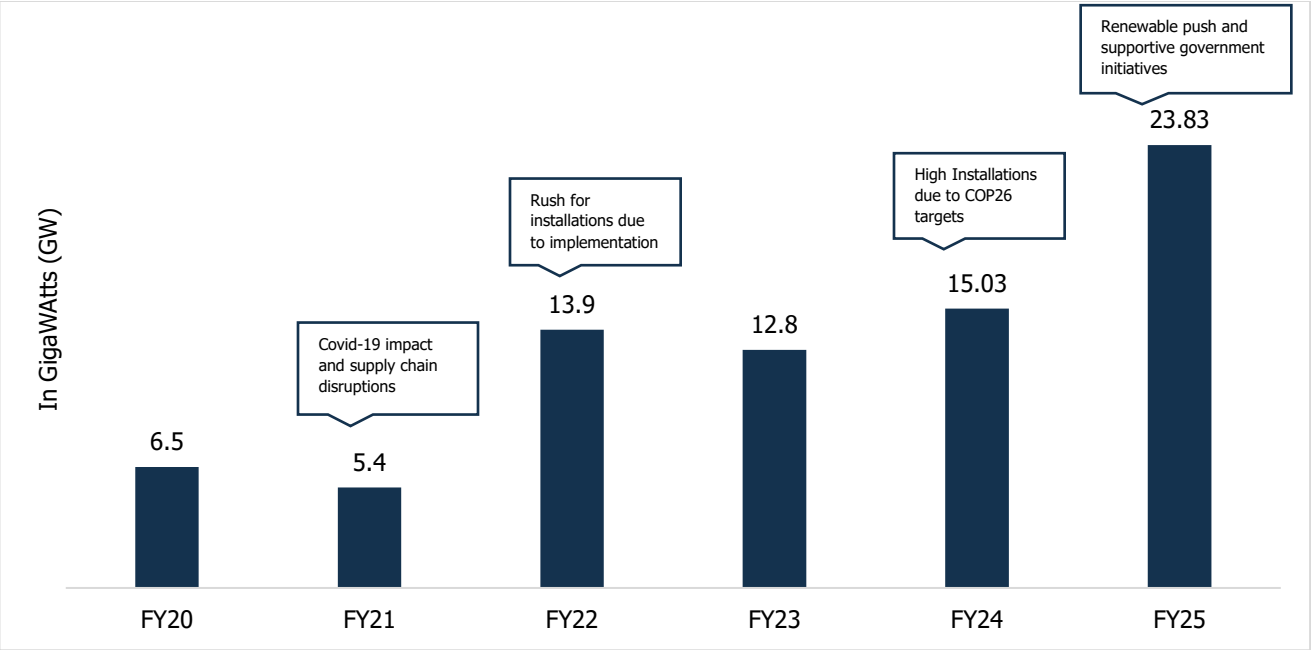
4 Indian Solar Power Sector

4.1 Evolution and Rise of Solar Power in India

India has significant solar energy potential. Approximately 5,000 trillion kWh of energy is incident over India's geographical area each year. Solar photovoltaic electricity can be successfully harvested, allowing for massive scalability in India. Many communities have benefitted from solar energy-based decentralized and distributed applications that satisfy their cooking, lighting, and other energy demands. Furthermore, over the years, India's solar energy sector has emerged as a key participant in grid-connected power generation capacity. It contributes to the government's objective of sustainable growth while evolving as a key anchor in meeting the nation's energy demands and ensuring energy security.

As of FY25, India's total solar installed capacity stood at 105.65 GW, accounting 22% of the installed power generation capacity and 49.7% total renewable energy capacity. This comprises 81.9 GW from ground-mounted solar plants, 17.0 GW from grid-connected solar rooftops, 2.8 GW from hybrid projects and 4.7 GW from off-grid solar systems.

Chart 30: Trend in Yearly Solar Capacity Installation



Source: Central Electricity Authority, CareEdge Research; Note: This includes onshore, offshore, rooftop and utility solar capacity installations

Over the previous years, the solar power industry has experienced strong growth. Over the FY20 to FY25, the segment registered CAGR of 29.67%, albeit from a low base, solar power additions in FY25 were higher, at 23.83 GW (vs. 15.03 GW in FY24).

Solar energy is an integral part of India's National Action Plan on Climate Change with the National Solar Mission (NSM) being one of the key solar-focused programs. The NSM is an initiative of the Indian government, with strong participation from states, to encourage environmentally sustainable growth while addressing India's energy security issues.

India has made a commitment to decrease the emissions intensity of its Gross Domestic Product (GDP) by 45% by 2030, compared to 2005 levels. Additionally, India aims to attain a non-fossil fuel-based installed power generation capacity of approximately 50% (500 GW) by 2030. These targets were proposed at the 26th session of the Conference

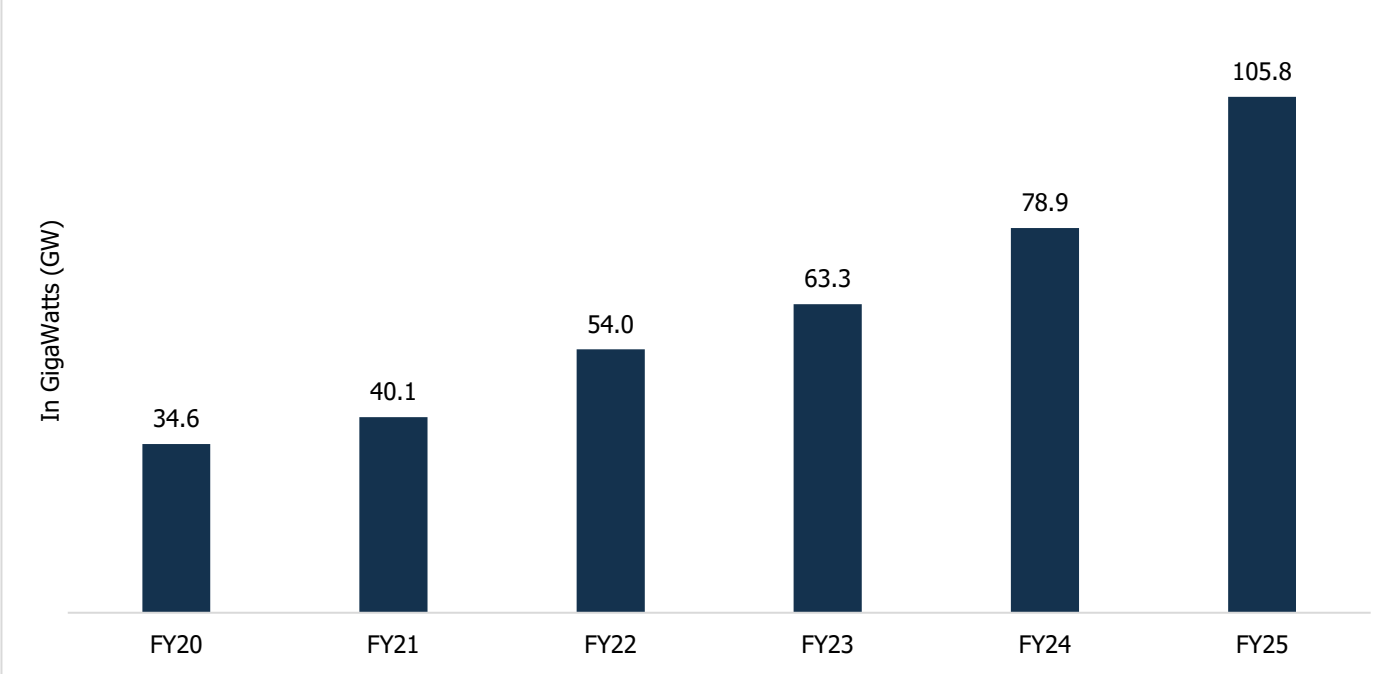
of the Parties (COP26) to the United Nations Framework Convention on Climate Change (UNFCCC), which took place in Glasgow, United Kingdom, in November 2021.

India has set an ambitious target of achieving net-zero emissions by 2070, reaffirming its long-term commitment to expanding renewable energy capacity. In pursuit of this goal, the government has introduced a range of supportive policies and programmes. Key initiatives include the Solar Park Scheme, the Pradhan Mantri Kisan Urja Suraksha evam Utthaan Mahabhiyan (PM-KUSUM), the Central Public Sector Undertaking (CPSU) scheme, and the Grid-Connected Solar Rooftop Programme. Additional measures such as support for domestic module manufacturing, Renewable Energy Certificates (RECs), Renewable Purchase Obligations (RPOs), 'must-run' status for renewables, and waivers on Inter-State Transmission System (ISTS) charges have further strengthened the policy framework to accelerate renewable energy deployment across the country.

4.2 Review of Overall Grid-Connected Solar Energy Capacity Additions

Grid-connected solar capacity refers to the solar power generation capacity which is connected to the utility grid. The grid-connected solar capacity has increased from 34,610 MW in FY20 to 1,05,814 MW as of FY25, representing 95.47% of the total installed solar power generation capacity.

Chart 31: Grid-Connected Solar Capacity



Source: MNRE, CareEdge Research; Note: This chart refers to cumulative capacity at the end of the respective financial years

Despite suffering from supply chain constraints and increasing shipping costs, the capacity installations have been high due to rapid technological improvements and a significant decline in module costs. Other drivers include increased competitiveness, faster completion of projects in pipeline during COVID-19 period, consistent focus of Government of India, greater demand from the commercial and industrial segments, etc. Rajasthan leads in grid-connected solar capacity with 29 GW, accounting for approximately 27% of the national total. It is followed by Gujarat with 19 GW and Tamil Nadu with 10 GW. Other key contributors include Karnataka, Maharashtra, Telangana, Andhra Pradesh, Madhya Pradesh, and Uttar Pradesh. Collectively, all remaining states contribute just 9% of the installed grid-connected solar capacity, amounting to around 7 GW.

Table 16: State Wise Capacity as of FY25

Sr. No.	STATES / UTs	Solar Power			
		Ground Mounted	Roof Top	Hybrid Solar	Total (excld. Off grid)
		(MW)	(MW)		(MW)
1	Andhra Pradesh	5,006.3	339.7	-	5,346.0
2	Arunachal Pradesh	1.3	6.7	-	8.0
3	Assam	126.0	95.3	-	221.3
4	Bihar	196.1	111.0	-	307.1
5	Chhattisgarh	900.4	107.4	-	1,007.8
6	Goa	2.0	54.9	-	56.9
7	Gujarat	13,556.1	5,534.6	829.6	19,920.3
8	Haryana	266.8	859.5	-	1,126.3
9	Himachal Pradesh	158.0	24.6	-	182.6
10	Jammu & Kashmir	2.5	42.2	-	44.7
11	Jharkhand	21.0	93.0	-	114.0
12	Karnataka	8,915.1	710.1	212.3	9,837.4
13	Kerala	323.2	1,375.5	-	1,698.7
14	Ladakh	-	1.8	-	1.8
15	Madhya Pradesh	4,590.8	572.5	-	5,163.3
16	Maharashtra	6,658.7	3,592.9	-	10,251.6
17	Manipur	0.6	7.1	-	7.7
18	Meghalaya	-	0.2	-	0.2
19	Mizoram	22.0	2.0	-	24.0
20	Nagaland	-	1.0	-	1.0
21	Odisha	574.5	84.9	-	659.4
22	Punjab	886.3	453.8	-	1,340.1
23	Rajasthan	25,169.5	1,591.8	1,980.0	28,741.3
24	Sikkim	0.5	5.1	-	5.6
25	Tamil Nadu	9,359.6	1,003.3	-	10,362.9
26	Telangana	4,360.5	472.9	-	4,833.4
27	Tripura	5.1	4.8	-	9.9
28	Uttar Pradesh	2,722.1	329.9	-	3,052.0
29	Uttarakhand	298.4	273.7	-	572.1
30	West Bengal	240.4	67.1	-	307.5
31	Andaman & Nicobar	25.1	5.3	-	30.4
32	Chandigarh	6.3	71.7	-	78.0
33	Dadar & Nagar Haveli/ Daman & Diu	14.3	83.6	-	97.9
34	Delhi	9.8	323.2	-	333.0
35	Lakshadweep	2.5	-	-	2.5
36	Pondicherry	1.0	66.3	-	67.3
37	Others	-	-	-	-
	Total (MW)	**84,422.6**	**18,369.5**	**3,021.8**	**1,05,813.9**

Source: MNRE, CareEdge Research

4.3 Review of Policies and States that Drove the Capacity Additions

As part of its Nationally Determined Contribution (NDC) under the COP26, the government has committed to reducing the emissions intensity of GDP by 45% below 2005 levels by 2030 and increasing the percentage of non-fossil fuels in total capacity to 50%.

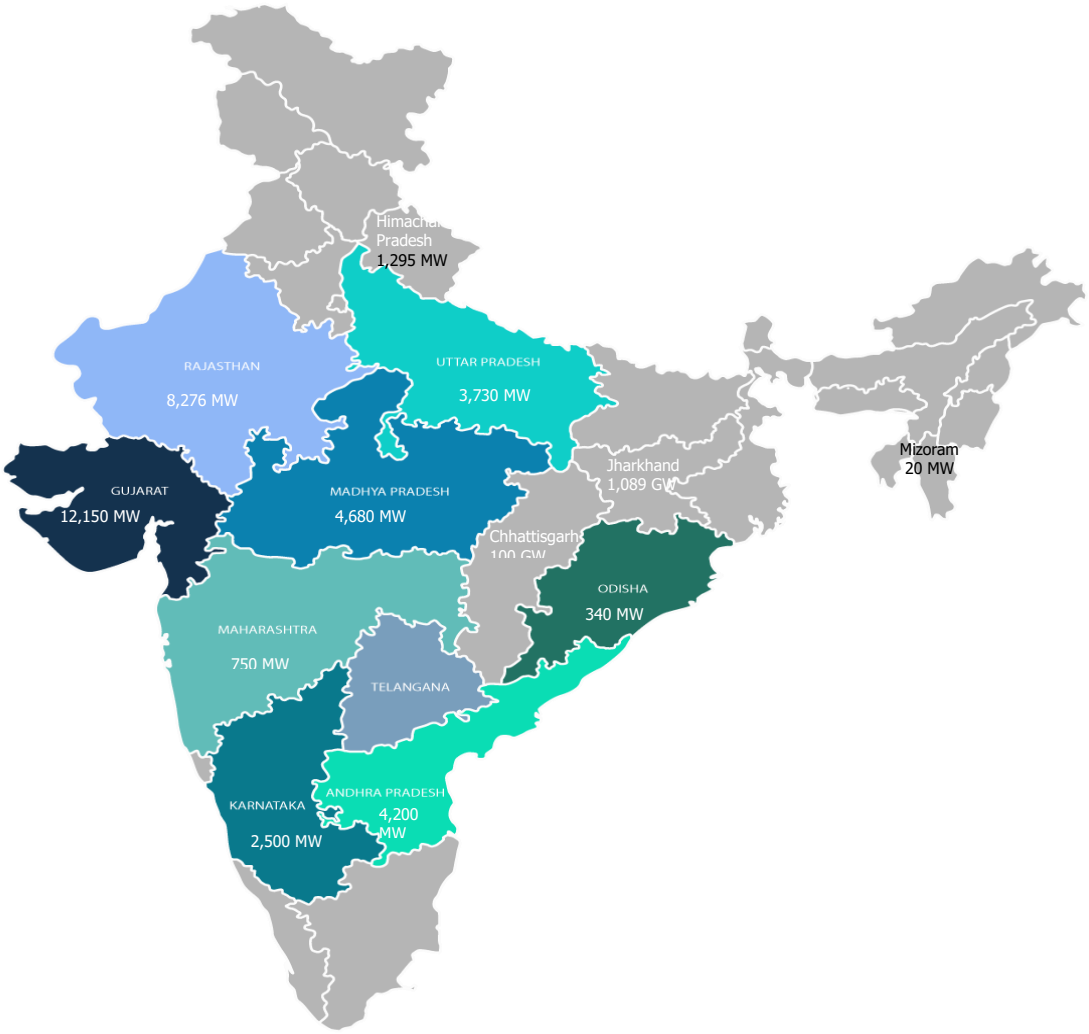
Further, India proposes to achieve 500 GW of installed capacity from non-fossil fuel sources by 2030, become energy-independent by 2047, and achieve net zero emissions by the year 2070. Hence, the government is focusing on renewable capacity additions through policy initiatives like Jawaharlal Nehru National Solar Mission (JNNSM), obligations of RPO, setting up of Solar Energy Corporation on India Ltd. (SECI), etc.

Government Support Schemes:

- **Solar Parks:**

The Government of India is implementing "Development of Solar Parks and Ultra Mega Power Projects" in the country. Under this scheme, 55 Solar Parks with aggregate capacity of 40 GW across 13 states have been sanctioned.

Chart 32: States with Solar Parks Facilities in India (Feb 2024)



As per FY25 annual report, 18 solar projects with total capacity of 10.8 GW have been fully developed and 6 solar parks of 4.8 GW are partially developed.

• Pradhan Mantri Kisan Urja Suraksha Evam Utthan Mahabhiyan (PM KUSUM):

The Government of India initiated the Pradhan Mantri Kisan Urja Suraksha evam Utthaan Mahabhiyan (KUSUM) Yojana in March 2019. Its objective is to increase farmers income while offering options for irrigation and reducing diesel dependency in the agricultural sector.

The primary goal of PM KUSUM is to ensure energy security for farmers in India, while fulfilling India's commitment to increase the proportion of installed electric power capacity from non-fossil-fuel sources to 40% by 2030, as part of its Intended Nationally Determined Contributions (INDCs). The scheme aims to increase solar capacity by 30,800 MW, with a total central financial support of Rs 344.22 Billion.

The scheme was approved by the Cabinet Committee on 19-02-2019, and consists of 3 components:

During 2024,

- Component A: 10,000 MW of Decentralized Ground Mounted Grid Connected Solar Power Plants.
- Component B: Installation of 20 lakh standalone solar powered agriculture pumps.
- Component C: Solarization of 15 lakh existing grid-connected agriculture pumps.

All components combined would support installation of additional solar capacity of 30.80 GW.

As of December 2024, 397 MW have been installed umber component A, 6.16 lakhs pumps have been installed under component B and 1.12 lakhs agricultural pumps have been solarized under component C.

As of January 2025, 418 MW of solar capacity has been installed out of the total sanctioned 10,000 MW. Additionally, 6,69,484 standalone pumps have been installed, while the number of pumps solarized under feeder-level solarization has reached 1,87,633, the state have tendered entire allocated capacity, and Letters of Award (LOAs) totalling over 20 GW have been issued, the gestation period of the same is 24 months from the date of issue, hence the installations are expected to be completed by March 2026.

• Roof Top Solar (RTS) Programme:

The Ministry of New and Renewable Energy (MNRE) launched the Rooftop Solar Programme Phase I in December 2015 in which incentives and subsidies were provided for residential, institutional and social sectors. The Phase-II was launched in February,2019 with the objective of achieving 40 GW of rooftop solar (RTS). The programme aims to install 4,000 MW of RTS capacity in the residential sector by providing Central Financial Assistance (CFA). According to MNRE, as of March 2024, the installed capacity under the programme in the residential sector stood at approximately 3,045 MW.

For general category states, the CFA is Rs 14,588/kW for the first 3 kW of RTS capacity and Rs 7,294/kW for RTS capacity beyond 3 kW and up to 10 kW. For special category states (including the North-eastern states, Sikkim, Uttarakhand, Himachal Pradesh, the UT of Jammu & Kashmir, Ladakh, Lakshadweep, and the Andaman & Nicobar Islands), the admissible CFA is Rs 17,662/kW for the first 3 kW of RTS capacity and Rs 8,831/kW for RTS capacity beyond 3 kW and up to 10 kW.

Resident Welfare Associations/Group Housing Societies (RWA/GHS) are also eligible for CFA for RTS installation in common facilities, up to a maximum of 500 kW capacity. The CFA for RWA/GHS is Rs 7,294/kW in general category states and Rs 8,831/kW in special category states.

• **Solar Cities:**
Under this scheme, at least one city in every Indian state is being developed as a solar city, where the entire electricity demand will be met through renewable sources—primarily solar. All households will have rooftop solar systems, along with solar streetlights and waste-to-energy plants. The program aims to empower urban local bodies to tackle energy challenges by offering a framework to create a master plan that assesses current energy use, forecasts future demand, and outlines action steps. Sanchi in Madhya Pradesh became the first city to be developed under this initiative.

• **International Solar Alliance:**
The International Solar Alliance (ISA) is a treaty-based inter-governmental organization working to create a global market system to tap the benefits of solar power and create clean energy applications. The aim of ISA is to pave the way for future solar generation, storage and technologies for the member countries by mobilizing over USD 1,000 billion by 2030. The achievement of ISA's objective will help the member countries fulfil the NDC commitments.

• **Greening of Islands:**
The government plans to convert the electricity systems in the islands of Andaman and Nicobar and Lakshadweep to green electricity, with RE sources meeting all energy demands. The Ministry grants a capital subsidy of 40% for projects under this plan.

• **Off-Grid Solar PV Applications Programme Phase III:**
The Off-grid and Decentralized Solar PV Application Program (Phase III), launched by MNRE on 7th August 2018, aims to provide solar-based solutions in areas with limited or no grid access. As one of the oldest programs, it supports applications like solar home lighting systems, streetlights, solar power plants, pumps, lanterns, and study lamps to improve energy access in remote and underserved regions.

The North-Eastern States' participation in Phase 3 of the Off-Grid Solar PV Applications Programme for Solar Street Lights, Solar Study Lamps, and Solar Power Packs was extended. The Scheme has sanctioned 0.174 million solar street lights, 1.35 million solar study lamps, and 4 MW solar power parks, all of which are now being implemented by state nodal agencies at various levels.

• **Green Energy Corridor:**
The Green Energy Corridor scheme was launched in 2015 for setting up of transmission and evacuation infrastructure to facilitate evacuation of electricity from renewable energy projects. The Intra state transmission system (ISTS) projects has been sanctioned to eight renewable energy states i.e. Tamil Nadu, Rajasthan, Karnataka, Andhra Pradesh, Maharashtra, Gujarat, Himachal Pradesh and Madhya Pradesh for evacuation of over 20,000 MW of renewable energy. As of December 2024, 9136 km of intra-state transmission lines have been constructed and 21413 MVA intra-state substations have been charged under Phase-I of Intra State Transmission System (ISTS) and grant of Rs 2,827.25 crore has been disbursed to the States.

• **Round-the-Clock-Power (RTC) for RE projects:**
The round-the-clock power mechanism is bundling of power has been bought by the government to overcome the issues of intermittency and low-capacity utilization of transmission infrastructure. Here the RE power is bundled with other sources and/or storage. Further, the Government is focusing towards promoting increased adoption of renewable energy and use of green hydrogen as envisaged in the National Green Hydrogen Mission, the Ministry of New and Renewable Energy is working on the modalities for promoting the use of green hydrogen in supporting round-the-clock electricity.

• **Competitive Bidding Guidelines for Solar Projects:**

The bidding guidelines have been issued for long-term procurement of power to promote competitive procurement from solar and to protect consumer interests. The guidelines for tariff-based competitive bidding process for procurement of power from grid connected solar PV power projects were issued vide resolution on 3rd August 2017.

• **Approved List of Models and Manufacturers (ALMM):**

The Ministry of New and Renewable Energy (MNRE) introduced a regulatory mechanism in 2019 to ensure that reliable, high-quality, tested and certified solar photovoltaic (PV) modules are used in solar projects. It was introduced to address concerns over poor-quality imports, promote domestic manufacturing under Make in India, and build a long-term reliable domestic market of solar assets. This list includes approved models and manufacturers that meet specified technical and quality standards like BIS certification, and the projects using modules from the ALMM are eligible for government schemes or incentives. This initiative has improved reliability, boosted domestic manufacturing, enhanced transparency for developers, and supports India's energy security and self-reliance goals.

• **PLI Scheme:**

The government introduced the Production Linked Incentive (PLI) Scheme to promote local manufacturing in the country. Of the 13 sectors for which PLI has been approved, 'High Efficiency Solar PV Modules' has also been included with MNRE as the designated ministry.

MNRE has appointed India Renewable Energy Development Agency Limited (IREDA) as the implementing agency for the PLI Scheme 'National Programme on High Efficiency Solar PV Modules' Tranche-1. The financial outlay for PLI for 'High Efficiency Solar PV Modules' Tranche-1 over a five-year period is Rs.45 billion. Under Tranche-1 of the PLI scheme, a total integrated capacity of 8,737 MW was allocated.

The government has further allocated a total capacity of 39,600 MW of domestic Solar PV module manufacturing across 11 companies as beneficiaries are under the PLI Scheme for High Efficiency Solar PV Modules (Tranche-II), with a total outlay of Rs 140 billion. Manufacturing capacity totalling 16,800 MW is expected to become operational by April 2025 and the balance of 15,400 MW capacity by April 2026.

The Tranche-II is expected to bring in an investment of Rs 930 billion. The PLI scheme is expected to add 48 GW of domestic Solar Module manufacturing capacity in the next 3 years As per MNRE's 2025 annual report, 48,337 MW fully/ partially integrated solar PV manufacturing capacities have already been awarded. Apart from this, the government is projected to focus on fostering a conducive environment to increase domestic production and improving the local supply chain.

• **CVB/BCD:**

Effective April 1, 2022, Basic Customs Duty (BCD) was introduced. In the 2025 budget, the Finance Minister reduced the BCD on imported solar PV cells from 25% to 20%, and on solar PV modules from 40% to 20%. This move aims to accelerate solar PV installations and support the achievement of renewable energy targets

• **National Infrastructure Pipeline:**

Under NIP, the Government of India has envisaged Vision 2025 targets like 24*7 clean and low-cost power available to all households, industry, commercial businesses, agriculture. The installed capacity is also targeted to increase to 619 GW from current 356 GW which consists of Thermal: 50%, Renewable: 39%, Hydro: 9%, Nuclear: 2%. The renewable energy share consumption is also set to increase to 19% from current 9%.

Table 17: Installed Capacity and Capex target for FY25

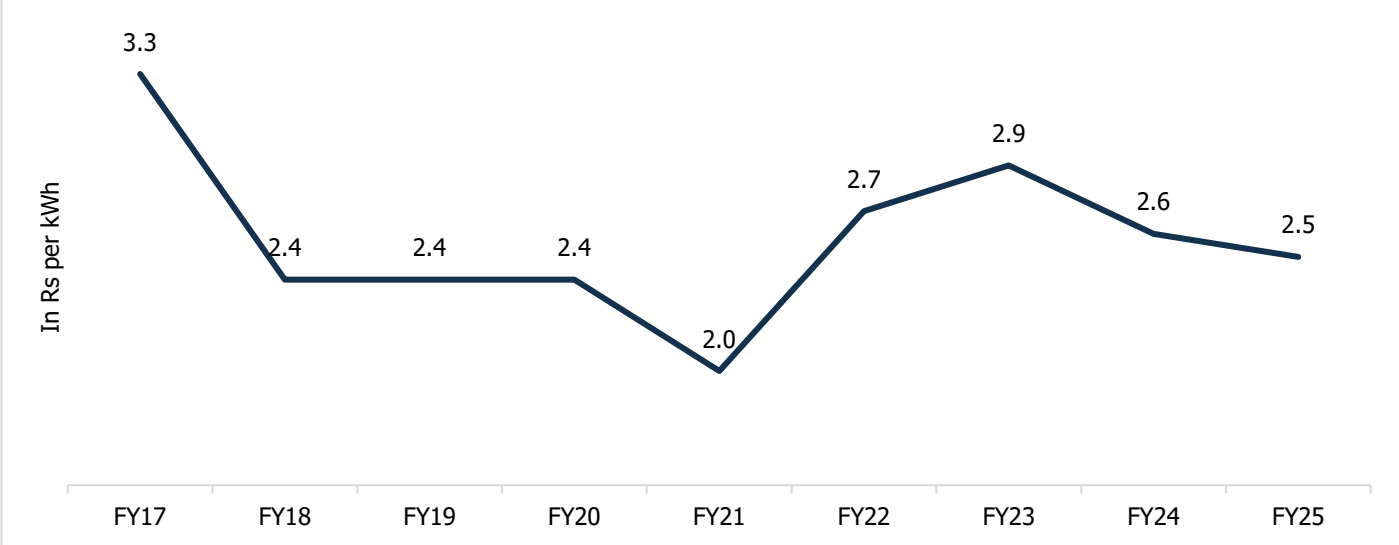
Category	Installed Capacity Target by Dec 25 (GW)	Installed Capacity Achieved by Mar 25 (GW)	Capex over (FY20-FY25) (Rs Cr.)
Solar Power	149.7	106	4,72,000
Wind Power	97	50	4,19,300
Small Hydro Power	7	5	23,500
Bio Power	12	11	14,700
Total	**266**	**172**	**9,29,500**

Source: NIP, CareEdge Research

4.4 Price Competitiveness of Solar Tariffs with Other Fuel Tariffs:

The solar tariffs in India are now competitive and have achieved grid parity due to technological improvements, economy of scale and reduction in solar cells/module prices. There has been a steep decrease in solar tariffs in India from Rs 3.3 kWh in FY17 to Rs 2.5 in FY25.

Chart 33: Trend in Solar tariff (Rs /kWh)



Source: MNRE Annual Report, CareEdge Research

Note: *Tariffs represent average of projects bid during the resp. periods.

The bid tariff rates during FY25 were around Rs 2.5 per unit. While in FY24, the bid tariff rates were around Rs 2.6 per unit, which is 3.85% lower, primarily due to falling global and domestic module prices, expansion in domestic manufacturing, and improved access to low-cost financing. Additionally, technological advancements like bifacial modules and large-scale auctions with credible off-takers enabled developers to bid more competitively.

4.5 Cost Comparison of Solar Energy with Other Sources of Electricity

Amongst the renewable energy sources, solar is the least expensive technology on per MW basis. This is followed by wind and hydro power projects. In comparison with the coal based thermal power plants, capital cost for most of the renewable power plants is lower.

Further, the construction timeline of solar capacities is significantly lower as compared to coal-based plants and other renewables, thereby resulting in relatively earlier project completion and commencement of cashflows as well as returns.

Table 18: Cost Comparison of Solar with other energy sources

Resource	Capex (Rs./MW)	O&M Fixed Cost	Construction Time (Years)
Solar	4.5 Cr	1% of Capex	0.5
Coal	8.34 Cr	Rs 19.54 lakh per MW	4
Hydro	6-20 Cr	2.5% of Capex	5 to 8
Wind (Onshore)	6-8 Cr	1% of Capex	1.5
Wind (Offshore)	13.7 Cr	1% of Capex	1.5
Biomass	9 Cr	2% of Capex	3

Note: All Capex figures are on actual basis at the cost level of 2021-22.
The capex of hydro is considered as per the project cost details furnished by the respective developers for state and private sector plants
Source: National Electricity Plan (NEP) March 2023, CareEdge Research

4.6 Importance of Payment Security Mechanism

One of the most significant risks for power producers is the counterparty risk associated with distribution companies' (DISCOMs) failure to make payments on time. Long-term tie-ups with distribution companies account for nearly 88% of power offtake from power producers in India.

Power producers and DISCOMs enter into power purchase agreements (PPAs) for the selling of electricity on essential contractual parameters such as tenure, rate, billing, and payment security. However, DISCOMs in India have been impacted by losses in the transmission and distribution systems, poor collection efficiencies, tariff controls, and other factors due to which they are unable to make payments to power producers on time.

Such payment delays have significant cash flow implications for generators, adversely affecting their financial stability and liquidity position. Moreover, the heightened risk of delayed receivables increases the cost of capital for power producers, as lenders factor in the potential risk while pricing loans. To mitigate these challenges, the government has introduced multiple layers of payment security within renewable energy PPAs. These include instruments such as letters of credit, default escrow mechanisms, payment security funds, tripartite agreements, and state government guarantees—designed to reduce both the perceived and actual risk for investors and improve financial predictability within the sector.

The following is a brief description of each:

- **Letter of Credit** - A letter of credit (LC) is a standard instrument given by banks (usually in exchange for a fee paid by DISCOMs) that guarantees payments to the recipient up to the letter's full value (typically 1.1 times the average monthly energy bill raised by SPD to DISCOM). If the DISCOM fails to make a payment, LC can be used.

• **Default Escrow Agreement** - Escrow is a legal arrangement in which a third party (usually a bank) holds a financial instrument or asset (in this example, DISCOM's cash flows) on behalf of two other parties. The power producer and DISCOM signed a default escrow agreement for an amount that typically matches the LC.

• **Payment Security Fund -** A payment security fund is a capital reserve that provides interest-free capital to its beneficiaries in the event of a DISCOM's payment default. This amount is generally equivalent to three months' worth of energy sale payments to the DISCOM

• **Tripartite Agreement -** In February 2017, the Solar Energy Corporation of India (SECI) was identified as a beneficiary of a tripartite arrangement between the Government of India, state governments, and the Reserve Bank of India. In accordance with this arrangement, in the event of default by state-owned DISCOMs, the central government (through the Reserve Bank of India) can withhold payment to state governments and divert them to central power sector utilities. SECI's strong credit profile, coupled with the tripartite agreement, enhances payment security against DISCOM defaults.

The solar sector overall has benefited from the higher share of central PPAs and the tripartite agreements for payment security.

• **State Government Guarantee**- As an alternative to a tripartite agreement, the state government may provide a financial guarantee when PPAs are negotiated directly between power producers and state DISCOMs.

5 Outlook for Solar Capacity Additions

5.1 Potential of Solar Power

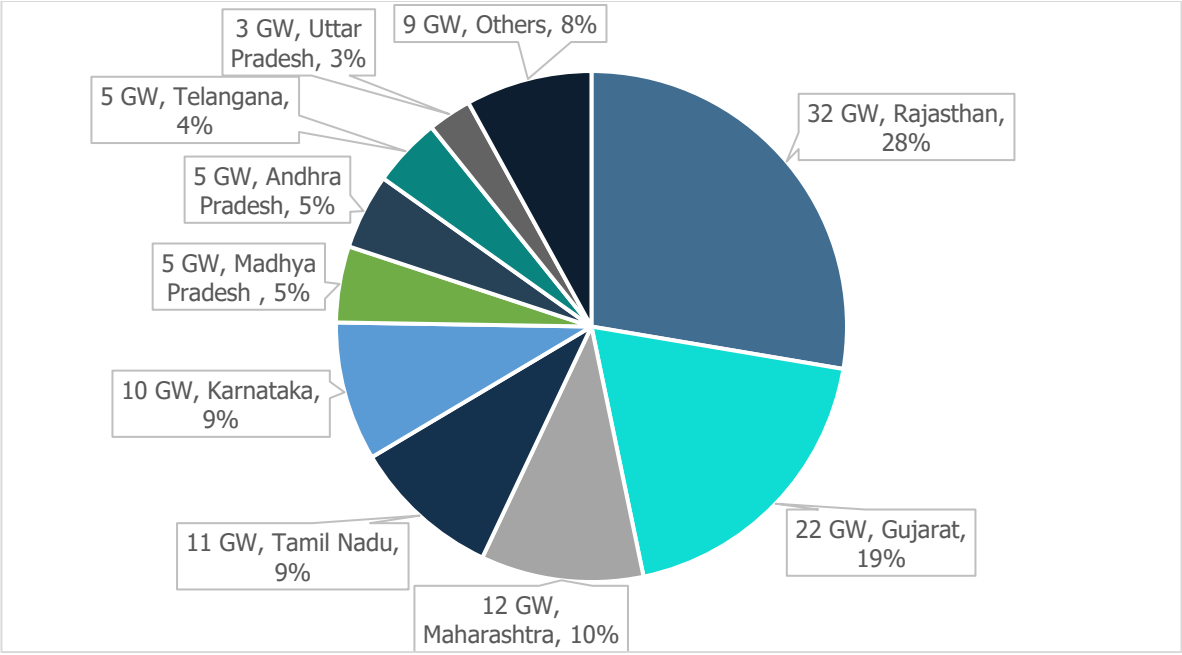
India has a solar potential of 749 GW with installed capacity of 116 GW as of June'25. The installed capacity is only around 15.49% of that of the potential indicating a significant untapped potential.

Chart 34: State-Wise Estimated Solar Power Potential (GW) February'24

Note: Solar Potential of Union Territories: 0.79 GW

Source: PIB, MNRE, NSEFI, CareEdge Research

Chart 35: State wise installed capacity of Solar as on July'25



Source: MNRE, CareEdge Research; Note: This is excluding Off-grid solar

Rajasthan, Gujarat, and Maharashtra together account for over 50% of the total installed capacity, holding the largest share among all states followed by Tamil Nadu and Karnataka at 9%.

Gujarat ranks second largest state in terms of solar power capacity installations. Gujarat has an estimated solar potential of 35,770 MW, placing it among the top ten states in India for solar resources. The state leads in rooftop solar installation under the PM Surya Ghar Muft Bijli scheme at 5.8 GW, part of this strong growth is a result of favourable policy and structural conditions. The state revised its solar power policy in 2021 for next five years, lowering security deposits requirement from earlier Rs. 25 lakhs/MW to Rs. 5 lakhs/ MW also removed the capacity ceiling from previous 500 kW or 1 MW providing freedom to consumer and investors to setup projects depending on their assessments and allows group ownership/self-consumption models. The availability of large tracts of land in districts like Kutch, Banaskantha, and Patan, along with streamlined approvals, good grid connectivity plans (including Green Energy Corridors), and strong incentives for the developers make the state particularly attractive for solar investment.

5.1.1 Assessment of Solar Power Parks as a Business Opportunity in India

Solar Parks are large parts of land developed with all the necessary infrastructure and clearances for setting up solar projects. Generally, the capacity of solar parks is 500 MW and above. However, due to a shortage of non-agricultural land, smaller parks that are up to 20 MW are also considered in states and union territories. Around 4 to 5 acres of land is required for setting up solar parks.

Schemes for Development of Solar Parks

In December 2014, the Government of India introduced the Scheme for the Development of Solar Parks and Ultra-Mega Solar Power Projects, initially aiming for a capacity of 20,000 MW. This target was later raised to 40,000 MW in March 2017, with the goal of establishing at least 50 solar parks. The scheme is set to continue until 31 March 2026. The Solar Energy Corporation of India (SECI) and the Indian Renewable Energy Development Agency (IREDA) are tasked with implementing the scheme and managing its funds on behalf of the government.

Under the schemes, central financial assistance (CFA) of up to Rs 25 lakhs per solar park is provided for preparation of detailed project report (DPR). Along with this, CFA of Rs 20 lakh per MW or 30% of the project cost, whichever is lower, is also provided on achieving the milestones prescribed in the scheme. The total grant approved under the scheme is Rs 8,100 crores.

Approved and Established Solar Parks

The government under its Development of Solar Parks and Ultra Mega Solar Power Projects scheme has targeted a cumulative installation of 40 GW of large-scale, grid-connected solar power plants by March 2026. Under this initiative, 53 solar parks with an aggregate capacity of 39,323 MW have been approved across 13 states.

As of PIB August 2025, 18 solar parks, with a capacity of 10,856 MW, are fully developed, with 10,756 MW of operational solar projects. Additionally, around 3,140 MW of solar capacity is operational within 8 parks. Together, approximately 13,896 MW of solar projects are already operational across 26 solar parks, while the remaining projects are under various stages of development.

Out of the total approved capacity, 21,289 MW has been awarded, which includes 11,416 MW that has already been commissioned and 9,873 MW currently under construction. In FY25, a total Central Financial Assistance of around Rs 163.6 Crore has been released to various Park Developers/CTU/STU under the scheme.

State-wise list of the solar parks sanctioned under the scheme along with details of installed capacity and location.

Table 19: List of Approved Solar Parks (February '25)

Sr. No.	State	Name of Park and Location	Capacity sanctioned MW	Projects installed MW
1	Andhra Pradesh	Ananthapuramu-I Solar Park, Ananthapuramu & Kadapa districts	1,400	1,400
2		Kurnool Solar Park, Kurnool district	1,000	1,000
3		Kadapa Solar Park, Kadapa district	1,000	387
4		Ananthapuramu-II Solar Park, Ananthapuramu district	500	400
5		Ramagiri Solar Park, Ananthapuramu district	300	-
6	Chhattisgarh	Rajnandgaon Solar Park, Rajnandgaon district	100	100
7	Gujarat	Radhnesada Solar Park, Banaskantha district	700	700
8		Dholera Solar Park, Ahmedabad district	1,000	300
9		NTPC RE Park, Kutch district	4,750	-
10		GSECL RE Park, Kutch district	3,325	-
11		GIPCL RE Park Ph-I, Kutch district	600	-
12		GIPCL RE Park Ph-II, Kutch district	1,200	-
13		GIPCL RE Park Ph-III, Kutch district	575	-
14	Himachal Pradesh	Pekhubela Solar Park, Una district	53	-
15	Jharkhand	SECI Floating Solar Park, Getalsud dam, Ranchi district	100	-
16		DVC Floating Solar Park Ph-II, Maithon dam, Dhanbad	234	-
17		DVC Floating Solar Park Ph-I, Tilaiya Dam (Jharkhand) & Panchet Dam (in Jharkhand & partly in West Bengal)	755	-
18	Karnataka	Pavagada Solar Park, Tumkur district	2,000	2,000
19		Bidar Solar Park, Bidar district	500	-
20	Kerala	Kasargod Solar Park, Kasaragod district	105	105

Sr. No.	State	Name of Park and Location	Capacity sanctioned MW	Projects installed MW
21		Floating Solar Park, Kollam district	50	-
22		Kasargod Solar Park Ph-II, Kasaragod district	100	-
23	Madhya Pradesh	Rewa Solar Park, Rewa district	750	750
24		Mandsaur Solar Park, Mandsaur district	250	250
25		Neemuch Solar Park, Neemuch district	500	330
26		Agar Solar Park, Agar district	550	550
27		Shajapur Solar Park, Shajapur district	450	155
28		Omkareswar Floating Solar Park, Khandwa	600	278
29		Barethi Solar Park, Chhatarpur district	630	-
30		Morena Solar Park, Morena district	600	-
31	Maharashtra	Sai Guru Solar Park, Dhule district	500	-
32		Dondaicha Solar Park, Dhule district	250	-
33		Patoda Solar Park, Beed district	250	-
34		Erai Floating Solar Park, Chandrapur district	105	-
35	Mizoram	Vankal Solar Park, Champai district	20	20
36	Odisha	Solar Park by NHPC, Ganjam district	40	-
37	Rajasthan	Bhadla-II Solar Park, Jodhpur district	680	680
38		Bhadla-III Solar Park, Jodhpur district	1,000	1,000
39		Bhadla-IV Solar Park, Jodhpur district	500	500
40		Phalodi-Pokaran Solar Park, Jodhpur & Jaisalmer district	750	450
41		Fatehgarh Phase-1B Solar Park, Jaisalmer district	421	421
42		Nokh Solar Park, Jaisalmer district	925	190
43		Pugal Solar Park Ph-I, Bikaner district	1,000	-
44		Pugal Solar Park Ph-II, Bikaner district	1,000	-
45		RVUN Solar Park, Bikaner district	2,000	-
46		Bodana Solar Park, Jaisalmer district	2,000	-
47	Uttar Pradesh	Solar Park in UP (Jalaun, Allahabad, Mirzapur & Kanpur Dehat districts)	365	365
48		Jalaun Solar Park, Jalaun district	1,200	-
49		Mirzapur Solar Park, Mirzapur district	100	-
50		Kalpi Solar Park, Jalaun district	65	65
51		Lalitpur Solar Park, Lalitpur district	600	-
52		Jhansi Solar Park, Jhansi district	600	-
53		Chitrakoot Solar Park, Chitrakoot district	800	-
54		Kanpur Dehat Park, Kanpur Dehat district	75	-
55		Kanpur Nagar Park, Kanpur Nagar district	35	-
Total			**39,958**	**12,396**

Source: PIB April'25, CareEdge Research

In FY25, the state-wise power generation in solar parks in (up to 28.02.2025) is given below

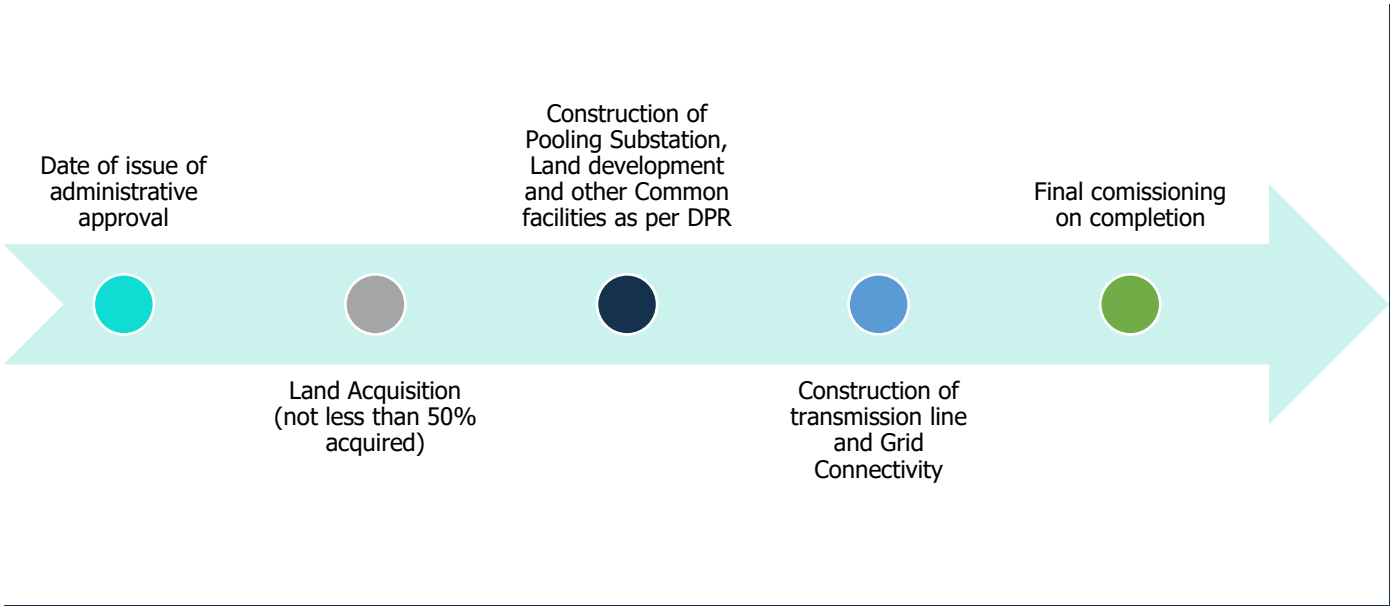
Table 20: State-wise power generation in solar parks

Sr. No	State	Power generation (in Million Units)
1	Andhra Pradesh	5,500.2
2	Chhattisgarh	194.3
3	Gujarat	1,898.9
4	Karnataka	3,940.9
5	Kerala	144.2
6	Madhya Pradesh	3,165.3
7	Mizoram	24.5
8	Rajasthan	6,718.4
9	Uttar Pradesh	712.6
Total		**22,299.2**

Source: PIB April'25, CareEdge Research

Model of Solar Park Operations

The solar parks are implemented through the following procedure-



Solar Parks are developed in collaboration with the state governments and their agencies, Central Public Sector Undertakings (CPSUs) and private entrepreneurs. The implementing agency is termed as Solar Power Park Developer (SPPD) and is selected in from any of the eight modes as per the scheme. The various modes for selection of SPPD and eligibility of CFA under the modes are given below:

Table 21: Different Modes under which solar power parks are developed

Mode	Brief Description	CFA Pattern
Mode-1	The State designated nodal agency or a State Government Public Sector Undertaking (PSU) or a Special Purpose Vehicle (SPV) of the State Government.	Rs 12 lakh/MW or 30% of the project cost, whichever is lower, to SPPD for development of internal infrastructure,

Mode	Brief Description	CFA Pattern
Mode-2	A Joint Venture Company of State designated nodal, agency and Solar Energy Corporation of India Ltd (SECI).	And Rs 8 lakh/MW or 30%of the project cost, whichever is lower, to the CTU/STU for creation of external transmission infrastructure
Mode-3	The State designates SECI as the nodal agency	
Mode-4	(i) Private entrepreneurs with/without equity participation from the State Government (ii) Selection of private entrepreneurs based on open transparent bidding process.	
Mode-5	Central Public Sector Undertakings (CPSUs) like SECI, NTPC etc.	
Mode-6	Private entrepreneurs without any Central Financial Assistance from MNRE	No CFA
Mode-7	SECI will act as the Solar Power Park Developer (SPPD) for Renewable Energy Parks	Rs 20 lakh/MW or 30% of the project cost, whichever is lower or external transmission infrastructure only
Mode-8	CPSU/ state PSU/ Government organisation/ their subsidiaries or the JV of above entities can act as SPPD.	Rs 20 lakh/MW or 30% of the project cost, whichever is lower, for internal infrastructure

Source: MNRE Annual Report 2022-23, CareEdge Research

The bidding usually takes place through reverse bidding auction process under the operation model. As per MNRE, the state in which the solar park is developed must buy at least 20% of the power produced in the park through its Discoms.

Outlook

India's Solar Parks and Ultra-Mega Solar Power Projects scheme is playing a pivotal role in accelerating large-scale solar deployment by easing critical bottlenecks such as land acquisition, regulatory clearances, and infrastructure access. Designed to offer plug-and-play facilities, the scheme reduces project execution timelines and enhances investor confidence. So far, nearly a quarter of the targeted capacity has been commissioned, with another 10% in the pipeline. With an ambitious goal of achieving 40,000 MW of installed solar capacity by FY26, the scheme is opening up significant growth avenues for developers, EPC contractors, and allied players in the solar ecosystem.

5.2 Outlook of Policies, States, and Key Factors to drive capacity additions

5.2.1 Key central and State-Level Incentives to Developers, DISCOMs and Domestic Module Manufacturers

The Government of India is committed to achieving its targets under COP26 and 50% share of non-fossil fuel based installed power generation capacity by 2030. Along with the increased tendering, the government has rolled out multiple initiatives to boost installation of solar power in the country like Pradhan Mantri Kisan Urja Suraksha evam Utthaan Mahabhiyan Yojana (PM-KUSUM), Rooftop Phase-II, waiver of ISTS charges, setting up ultra-mega RE parks, grid connected rooftop solar scheme, etc. These schemes have been discussed in detail in Sections 4.3 and 5.2 of the report.

There are two schemes under Solar Generation Based Incentives (GBI) - the Solar Demonstration GBI scheme and the Rooftop PV and Small Solar Power Generation Programme (the "RPSSGP") Scheme. The Solar Demonstration GBI Scheme was introduced in 2008 with the objective to develop and demonstrate the technical performance of grid interactive solar power generation and to achieve reduction in the cost of solar systems and the cost of solar generation in the country. The RPSSGP Scheme was introduced in 2010 with the objective to increase the capacity addition of Rooftop PV and small solar power plants with voltage levels up to 33kV.

To encourage domestic manufacturing of solar modules and to reduce import dependence, PLI scheme for Solar PV manufacturing, imposition of Basic Customs Duty of 25% on solar cells and 40% on solar modules was introduced.

Further, to address the challenge related to delays in payment by DISCOMs, the government has launched the RDSS Scheme for improving the financial sustainability and operational efficiency of the distribution sector. To ensure timely payment to the RE generators, the government has issued orders that power shall be dispatched against letter of credit (LC) or advance payment.

Considering the target to achieve 500 GW of non-fossil fuel based installed power capacity by FY30, the favourable policies and support from the government towards the renewable energy sector is expected to continue.

5.2.2 Availability of Finance and Evolution of Funding Mechanism

While loans from financial institutions (banks, non-banking financial companies, etc.) remain the main source of financing renewable energy projects in India, some new funding mechanisms have evolved as detailed below:

Instrument	Description
Green Bonds	Green Bonds Debt instruments designed to raise capital for projects that are environmentally sustainable and support climate initiatives. In January and February 2023, India issued green bonds worth Rs.80 billion, with proceeds allocated to renewable energy, energy efficiency, waste management, and more.
Masala Bonds	Rupee-denominated bonds that are issued outside of India. Corporations such as NTPC have launched green masala bonds specifically for renewable energy projects, although this market is still largely untapped.
Infrastructure InvITs	Infrastructure InvITs Investment vehicles focused on income-generating infrastructure, such as power plants. Developers have the option to bundle their projects into InvITs, allowing them to monetize their assets and secure funding for future developments.

5.2.3 Progress on T&D infrastructure

India has a target of 500 GW of non-fossil fuel capacity by 2030 and hence significant investments have commenced towards increasing and upgrading the transmission infrastructure. Transmission system has been planned for following RE capacity to be commission by 2030:

Table 22: Transmission System planned for Renewable Energy

Sr. No.	Category	Capacity (MW)	As on March'24
1.	RE capacity already commissioned (As on 31.12.2024)	1,65,943	2,20,096
2.	66.5 GW RE capacity to be integrated to Inter State Transmission System (ISTS) network (18.86111 GW already commissioned)	57,639	~40,000
3.	Additional RE capacity totalling to 236.58 GW to be integrated to ISTS network	2,36,580	Not available
4.	Margin already available in ISTS sub-station which can be used for integration of RE capacity	33,658	Not available
5.	Balance RE capacity to be integrated into an intra-state system under Green Energy Corridor-I Scheme	7,000	Not available
6.	RE capacity to be integrated to intra-state system under Green Energy Corridor -II Scheme	19,431	Not available
7.	Additional Hydro Capacity likely by 2030	16,673	Not available
	Total (RE)	**5,36,924**	

Source: Central Electricity Authority Report- Transmission System Integration of over 500GW RE Capacity by 2030, CareEdge Research

For integration of additional wind and solar capacity by 2030, the estimated length of transmission line and sub-station capacity planned is around 50,890 ckm and 4,33,575 MVA, respectively. The investment required for the green transmission is estimated to be around Rs 2,440 billion as per the Ministry of Power. Out of this, Rs 281 billion will be required for integration of offshore wind capacities while Rs 2,160 billion will be required for new solar and wind (onshore) plants.

Table 23: Tentative cost of additional transmission system

	RE Capacity (GW)	BESS (GW)	Requirement of Transmission system (GW)	Tentative cost of transmission system (Rs billion)	Average cost of Transmission system (Rs Million/MW)
On-shore RE Capacity (Solar & Wind)	268.68	51.5	217.18	2,161	9.95
Offshore RE capacity (Wind)	10	0	10	281	28.1
Total RE capacity	**278.68**	**51.5**	**227.18**	**2,442**	**10.75**

The tentative cost includes the cost of ISTS transmission schemes for (i) 66.5 GW RE capacity (excluding commissioned transmission schemes and associated RE capacity) (ii) 55.08 GW RE capacity and (iii) 181.5 GW RE capacity

Source: Central Electricity Authority Report- Transmission System Integration of over 500GW RE Capacity by 2030, CareEdge Research

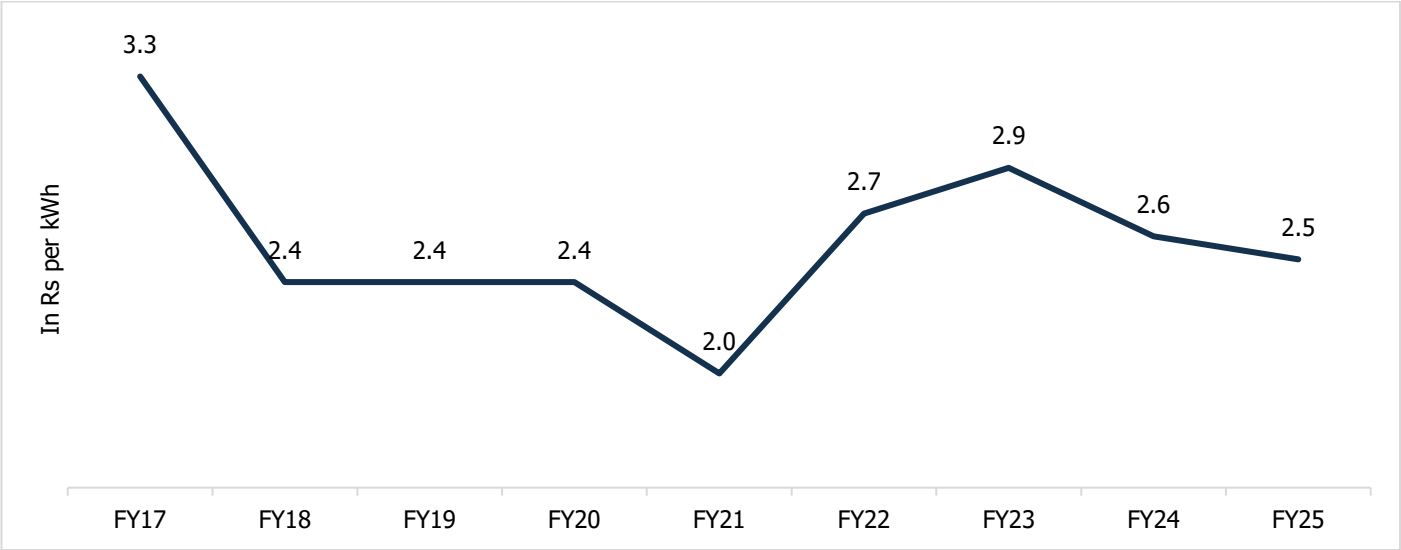
On the distribution front, there are various initiatives taken by government for providing 24X7 power supply to all households like the Integrated Power Development Scheme (IPDS) for development of urban distribution sector, Deen Dayal Upadhyaya Gram Jyoti Yojana (DDUGJY) for covering all aspects of rural power distribution, Pradhan Mantri Sahaj Bujli Har Ghar Yojana (Saubhagya) for universal household electrification covering every village and district, Ujwal

DISCOM Assurance Yojana (UDAY) for financial turnaround of the DISCOMs and Revamped Distribution Sector Scheme (RDSS) to improve operational efficiency and financial sustainability of DISCOMs.

5.2.4 Outlook on Levelized Tariff for Solar PV Projects in India

The solar tariffs in India are now competitive and have achieved grid parity due to technological improvements, economies of scale and reduction in solar cells/module prices. There has been a steep decrease in solar tariffs in India from Rs 3.3 kWh in FY17 to Rs 2.5 in FY25.

Chart 36: Trend in Solar tariff



Source: MNRE Annual Report, CareEdge Research

The bid tariff rates during FY25 were around Rs 2.5 per unit. While in FY24, the bid tariff rates were around Rs 2.6 per unit, which is 3.85% lower, primarily due to falling global and domestic module prices, expansion in domestic manufacturing, and improved access to low-cost financing. Additionally, technological advancements like bifacial modules and large-scale auctions with credible off-takers enabled developers to bid more competitively.

5.2.5 Potential long-term drivers and constraints of solar sector in India

Growth Drivers	•Declining prices of modules and other system components •Fiscal and regulatory incentives •Renewable Purchase Obligation •Infrastructure support from government •Traction in C&I segment •Green-Term Ahead Market •Low cost, construction and operation risk •Waiver of ISTS Charges •Fewer environmental concerns unlike thermal power •Advancement of module technology •Implementation of new technologies •PLI scheme for domestic module manufacturers
Constraints	•Counterparty risk in payment and signing of PPAs • High dependency on imports •Increase in capital costs due to material costs •Grid Integration •Unavailability round-the-clock

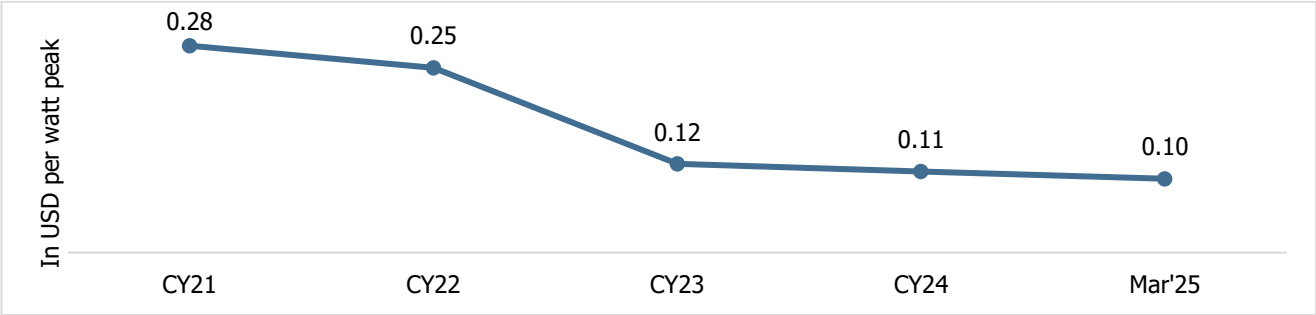
Growth Drivers:

• **Declining Prices of Modules and Other System Components**

Solar module costs have declined sharply over the past decade. Further, the balance of system cost has also decreased due to advancement of technology, better designs leading to low material consumption, product standardization, economies of scale etc. The decline in cost has led to lower funding requirements and enhanced overall project economics for solar power projects.

Module prices experienced an upward trend in second half of 2021 due to shortage of raw materials in China such as silicon and solar glass coupled with production cuts due to power crisis. However, prices declined in 2023 as raw material production increased and inventory levels in China rose.

Chart 37: Trend in Solar Module Prices



Source: CareEdge research

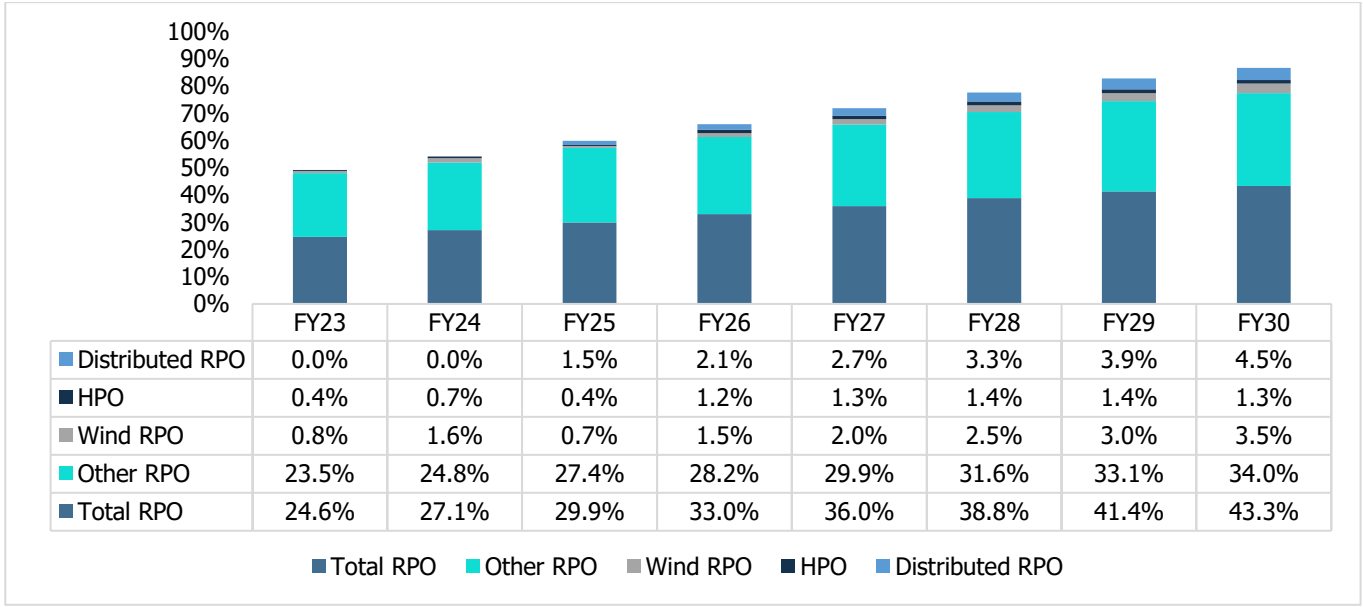
- **Fiscal and Regulatory Incentives**

India's present electricity generation is highly reliant on non-renewable natural resources like coal. Subsidy schemes and regulatory policies by the government are motivating power production companies to invest in the renewable energy sector. Several government initiatives, including the Pradhan Mantri Kisan Urja Suraksha evam Utthaan Mahabhiyan Yojana (PM-KUSUM), Rooftop Phase-II, Atmanirbhar Bharat - PLI scheme for Solar PV manufacturing, levying a Basic Customs Duty of 25% on solar cells and 40% on solar modules, 100% FDI, exemption from ISTS charges, ultra-mega renewable energy parks, and the grid-connected rooftop solar scheme, are intended to fuel growth in the sector. To ensure timely payment to the RE generators, the government has issued orders that power shall be dispatched against letter of credit (LC) or advance payment.

- **Renewable Purchase Obligation (RPO)**

The Ministry of Power has also provided RPO targets up to FY30, and obligated entities have to buy a certain percentage of their electricity from renewable sources. Alternatively, they can purchase Renewable Energy Certificates (REC) from the market. The target is to meet an RPO of 43.33% by FY30.

Chart 38: RPO Trajectory from FY23 to FY30



	FY23	FY24	FY25	FY26	FY27	FY28	FY29	FY30
Distributed RPO	0.0%	0.0%	1.5%	2.1%	2.7%	3.3%	3.9%	4.5%
HPO	0.4%	0.7%	0.4%	1.2%	1.3%	1.4%	1.4%	1.3%
Wind RPO	0.8%	1.6%	0.7%	1.5%	2.0%	2.5%	3.0%	3.5%
Other RPO	23.5%	24.8%	27.4%	28.2%	29.9%	31.6%	33.1%	34.0%
Total RPO	24.6%	27.1%	29.9%	33.0%	36.0%	38.8%	41.4%	43.3%

Source: Renewable Purchase Obligation and Energy Storage Obligation Trajectory Report dated 22nd July, 2023
Renewable Purchase Obligation and Energy Storage Obligation Trajectory Report dated 20th October, 2023, Ministry of Power, CareEdge Research

Note: Distributed RPO is not available for FY23 and FY24

- Wind RPO shall be met only through energy generated from wind power projects commissioned after 31st March 2024.
- Hydro purchase obligation (HPO) shall be met only by energy generated from hydro-power projects, Pumped Storage Plants (PSPs) and Small Hydro Projects commissioned after 31st March 2024.
- Distributed renewable energy target shall be met from capacities of less than 10 MW, including various solar installation configurations such as net metering, gross metering, virtual net metering etc.
- Other RPO targets shall be met by energy produced from any RE power projects not included above including all wind and hydropower projects commissioned before 1st April 2024.

• **Infrastructure Support from Government**

MNRE is implementing the scheme for the development of solar parks and ultra-mega solar power projects, under which, the infrastructure such as land, roads, transmission system (internal and external), pooling stations, etc., is developed with all statutory clearances/approvals. Thus, the solar project developers have plug-and-play benefits.

Further, under Mode 8 of the Solar Park Scheme, a facilitation charge of Rs 0.05/unit of power being generated from the projects in the parks is provided to the States to encourage the State Governments to provide necessary assistance to the Solar Power Park Developers (SPPDs) in identification and acquisition of land, to facilitate in obtaining all required statutory clearances, etc.

• **Traction in C&I segment**

The C&I segment is increasingly looking at procuring solar power for their operations either through rooftop solar projects or through open access. This preference is being driven by the following factors:

a) Commitment of corporates to decarbonizing their operations and supply chains, driven by environmental, social, and governance (ESG) considerations
b) Improvement in economic viability given the decline in project costs

Considering that the C&I segment consumes more than half of the power consumed in the country, the growing preference of this segment towards renewable energy will drive solar capacity additions.

• **Green-Term Ahead Market (GTAM)**

GTAM platform was launched in September 2020 to enable bulk electricity buyers (DISCOMs and corporates with more than 1MW contracted load) to procure renewable energy on a short-term basis from sellers (merchant RE producers, DISCOMs having excess RE beyond RPO etc.). This platform is targeted at encouraging RE-rich states to develop RE beyond their RPO. Further, it would also encourage more merchant power capacities.

• **Low Cost, Construction, and Operation Risk**

Amongst the renewable power sources, solar is the least expensive technology, as per MW basis. Further, the construction timeline of solar capacities is also lower compared to most other power generation technologies. Considering the shorter construction timelines, the construction risk for solar power is lower.

Table 24: Cost Parameters for Thermal and Renewable Power

Resource	Capex* (Rs Million MW)	O&M Fixed Cost (Rs MW)	Construction Time (Years)	Life (Years)
Coal	83.4	1.954 million	4	25
Renewable				
Hydro	60-200	2.5% of Capex	5-8	40
Solar	45- 41	1% of Capex	0.5	25
Wind (Onshore)	60^	1% of Capex	1.5	25
Wind (Offshore)	137	1% of Capex	1.5	25
Bioenergy	90	2% of Capex	3	20

Source: National Electricity Plan Vol-1 (March 2023), CareEdge Research

*Capex figures are considered on actual basis at cost level of 2021-22

^ Excludes soft cost, interest during construction, contingencies etc.

Further, operational risk associated with solar power projects like unpredictable solar radiation levels, technological challenges etc. remain. significant.

- **Waiver of ISTS Charges**

Ministry of Power has issued order for an extension to the inter-state transmission system (ISTS) charges waiver on solar and wind energy projects commissioned up to 30 June 2025. The apex body has requested for extension of the ISTS waiver based on the percentage of project completion however, the ministry is still in discussions regarding same.

Waiver of ISTS charges have been extended up to 30th June 2028; to boost hydro pumped storage plant and battery energy storage system, this 100% waiver is applicable to co-located BESS projects commissioned by June 2028.

As per the notification issued by Ministry of Power, a complete waiver of ISTS charges has been given for off-shore wind power projects commissioned on or before 31st December 2032 for a period of 25 years from the date of commissioning of the Project.

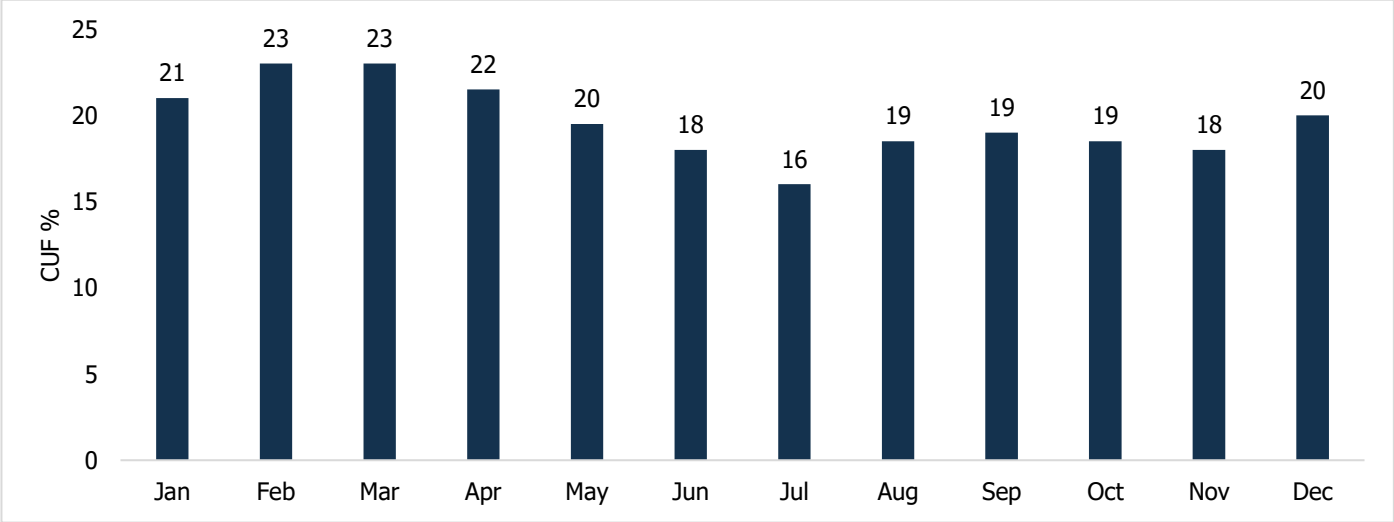
- **Fewer Environmental Concerns unlike Thermal Power**

There are no significant emissions during the generation of solar power. Therefore, there are fewer environmental concerns with solar power generation, unlike thermal power.

- **Advancement of Module Technology**

The performance of solar power plants is defined by the Capacity Utilization Factor (CUF), which is the ratio of the actual electricity output from the plant to the maximum possible output during the year. Improved module technology has led to more projects meeting PLF targets. Innovations like wind-solar hybrids, floating PVs, and storage systems are further boosting CUF and grid integration.

Chart 39: Typical month wise CUF variation of Solar



Source: National Electricity Plan Vol 1 (March 2023), CareEdge Research

- **Implementation of New Technologies**

India has been experimenting with new techniques to place solar power in agricultural lands, canals, and other bodies of water. These new and novel technologies, such as agrivoltaics, canal top PV, and floating PV, are still in their early stages of development and have higher installation prices, however, they present significant opportunities for future growth.

- **PLI scheme for Domestic Module Manufacturers**

In November 2020, the government approved the PLI scheme for High Efficiency Solar PV Modules (Tranche-I) with a proposed outlay of Rs 4,500 crore. The allocation under this scheme was fully utilized. Subsequently, the government approved Tranche – II of PLI scheme in September 2022 with an outlay of Rs 19,500 crore. Under this scheme, PLI will be disbursed for 5 years post commissioning of solar PV manufacturing plants on sales of high efficiency solar PV modules from the domestic market. The scheme envisages 65,000 MW per annum manufacturing capacity of fully and partially integrated solar PV modules at an investment of Rs 94,000 crore and import substitution of Rs 1.37 trillion.

The PLI scheme will lead to significant increase in the domestic module manufacturing capacity thereby reducing import dependence which will allow the solar power producers to have more control over their costs and also reduce risks related to supply chain and currency fluctuations.

Under the PLI Scheme for High Efficiency Solar PV Modules, Letters of Award have been granted to establish 48,337 MW of fully or partially integrated solar PV module manufacturing units. As on December'24, India's solar PV module manufacturing capacity stands at approximately 63 GW, as per the Approved List of Models & Manufacturers (ALMM).

Constraints:

- **Counterparty Risk in Payment and Signing of PPAs**

The weak financial health of DISCOMs remains the biggest challenge for the Indian power sector. As the ultimate customers for solar power producers, their financial situation continues to be dire in most cases, and hence, there have been consistent delays in payments.

The DISCOMs have faced several issues in the past including increasing debt levels, poor collection efficiency, high Aggregate Technical & Commercial (AT&C) losses, and a high ACS-ARR gap, the government has taken multiple initiatives over the past few years to improve the sector. While the AT&C Losses have been reduced from 27% in FY15 to 15.41% in 2023. However, the ACS-ARR gap increased from Rs0.15 per unit to Rs 0.45 per unit in last one year.

DISCOMs have begun clearing the overdue amounts to generation companies the government's imposition of a late payment surcharge. The government also expects that the DISCOMs will be able to clear all their outstanding dues by 2026. The total outstanding dues of States, which were at Rs 1,399.47 Billion as of July, 2022 has reduces to Rs 246.8 Billion as of January, 2024 after timely payment of 29 monthly instalment as mandated by the new rule.

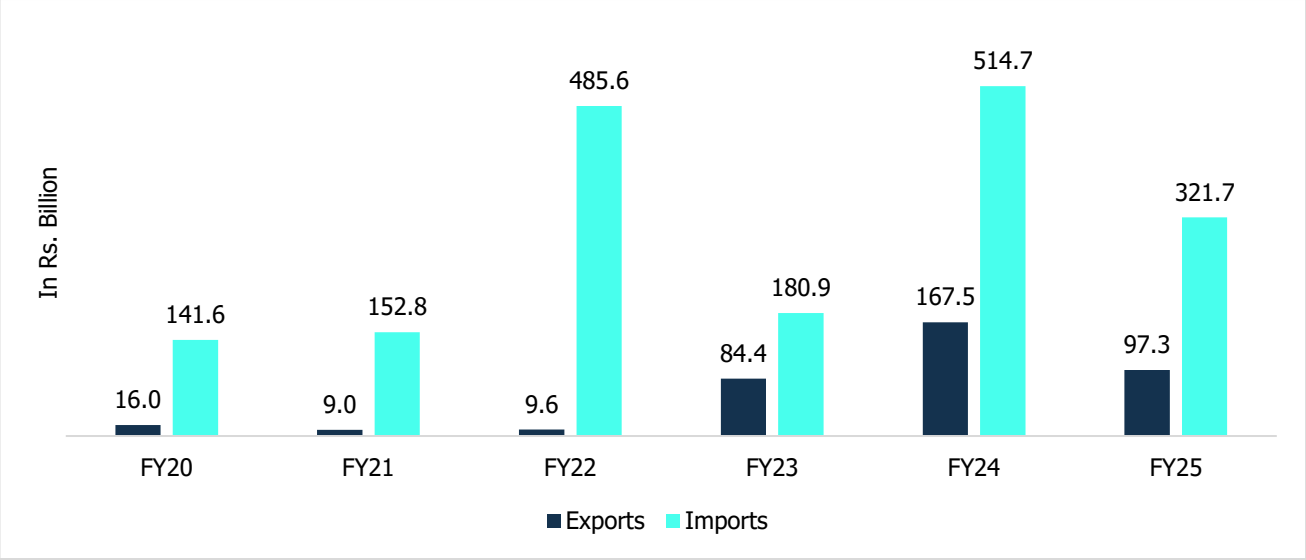
The Union Budget 2023-24 permitted the states to have a fiscal deficit of 3.5% of Gross State Domestic Product (GSDP) out of which 0.5% will be on account of power sector reforms. Such fiscal reforms will help the state undertake power distribution reforms, which will lead to the upgradation of the DISCOMs.

- **High Dependency on Imports**

Important components such as solar cells, modules, and inverters are largely imported by India's solar sector. The government has taken several efforts to boost indigenous industry, including raising import duties. The government has issued the scheme guidelines for implementation of the Production Linked Incentive Scheme on National Programme on High Efficiency Solar PV Modules.

Indian solar power producers are still dependent on imports of solar modules mainly from China which accounts for about 80% of the total imports, followed by Hong Kong and Malaysia, assessed based on to the value of imports.

Chart 40: Import and Export of Solar Cells and Modules



Source: Ministry of Commerce and Industry, CareEdge Research

- **Subdued domestic demand**:

The government's decision to delay the implementation of the Approved List of Models and Manufacturers (ALMM) to April 2024 led to reduced demand for domestic modules in India. This compelled manufacturers to seek opportunities in international solar markets.

- **Increase in Capital Costs Due to Material Costs**

The solar power generation is capital intensive as a lot of equipment used in solar power are imported. The high module prices coupled with other problems such as land issues are factors impacting the growth of the solar power industry.

Continued shortage of polysilicon, increased commodity prices and rupee depreciation have led to an increase in the module prices in Q4FY23. However, it is expected that in FY24 the downward trajectory in solar modules prices will return with increase in supply of polysilicon and reduction in input costs.

The ALMM mandate, introduced in 2021 to promote domestic solar manufacturing and reduce reliance on Chinese imports, disrupted project timelines due to limited local module availability. With demand outpacing supply, many developers deferred projects. To address this, the mandate was temporarily suspended for a year, enabling faster project execution and lowering costs. This pause supports capacity expansion while the government continues efforts to strengthen domestic manufacturing and the solar supply chain.

- **Grid Integration**

While the government has planned grid integration in line with renewable capacity additions, any delays in grid integration due to land acquisition, project execution delays, etc. For the additional solar capacity will impact the offtake of the projects.

- **Not Availability Round the Clock**

Solar energy is intermittent in nature and is available only for certain hours during the day. Intensity of solar energy is also seasonal. Therefore, the power generated from solar energy is not available round the clock due to the seasonal nature and variations.

5.3 Solar and Wind Park development in India

India is moving quickly toward a cleaner and more sustainable future, with its renewable energy sector growing at a fast pace. In 2025, the country made considerable progress in solar and wind energy, improved policies, and built better infrastructure. India aims to reach 500 GW of non-fossil fuel energy capacity by 2030. As of June 30, 2025, the country's total non-fossil fuel energy capacity stands at 242.78 GW.

In 2025, India added 23.83 GW of solar power and 4.15 GW of wind power. Solar power installations more than doubled, while wind power increased by 27% as compared to 2024. This growth was driven by government support, better policies, and more investment in local solar and wind manufacturing. Solar energy was the biggest contributor to renewable energy, making up 49.7% of the total renewable capacity. Rajasthan, Gujarat, and Tamil Nadu were the top states for solar installations, contributing 55% of total large-scale solar capacity.

The rooftop solar sector also grew 12% with 5.15 GW of new capacity additions as compared to previous year at 4.95 GW in 2024. This growth is attributed to the launch of the PM Surya Ghar: Muft Bijli Yojana in 2024, which helped install 7 lakh rooftop solar systems in just ten months. The off-grid solar sector also grew rapidly, with a total capacity of 5.04 GW as of June, 2025. This helped provide electricity to rural areas and improve energy access.

India's wind power sector added 4.15 GW of new capacity in 2025. Top states leading the way are Gujarat, Karnataka, and Tamil Nadu, contributing around 98% of the total wind power installations. These states continue to play a significant role in India's wind energy development.

5.4 IPP Business including Solar and FDRE projects

IPP in solar stand for an Independent Power Producer, that a private developer or operator builds, owns, finances, and operates solar energy generating assets and sells power through long-term PPAs that is distributes to utilities or commercial and industrial users. The different models in which an IPP functions is based on how the power generated is sold or distributed this could be direct power purchase, group captive solution or open access. Solar capacity has grown more than 35 times from 2.82 GW in 2014 to 105.65 GW in 2025, and this policy-driven expansion has also supported the growth of IPPs in the sector.

India's power mix is changing and renewable energy accounting for a 46% of the total capacity, this has given rise to challenges such as intermittency and grid stability. Models like Round-The-Clock (RTC) and Firm and Dispatchable Renewable Energy (FDRE) are being introduced to address these challenges. The aim is to provide RE power to meets demand throughout the day, improving grid stability. In this FDRE model, solar and wind generation is paired with energy storage systems to provide round-the-clock power to meet the power demand.

The FDRE tenders require manufacturers to design RE projects that are aligned with the power requirement of the buyer. The tender mandates the developers to meet at least 90% of the monthly demand, any shortfalls may attract penalties.

As per the guidelines as on February 2025, if the power generation company fails to attain their CUF (Capacity Utilization Factor) levels mentioned in the PPAs, for two years, the new minimum CUF obligation will be revised to the average CUF of past two years and the power generating company will have to pay a penalty equal to the tariff amount for either 24 months or the remaining period of the PPA whichever is less, in an event of default on penalties the PPA will be terminated.

5.5 Outlook of rooftop solar PV capacity additions in India

The rooftop solar PV capacity is expected to grow in India majorly due to growing awareness especially in the residential segment and C&I segment in India. Along with this, the Government of India is taking various initiatives to encourage the addition of capacity of rooftop solar PV.

The MNRE is implementing Phase II of the Rooftop Solar Programme where financial assistance of upto 40% is being provided for the installation of Grid Connected Rooftop Solar system in residential segment. This scheme was launched in March 2019 with a total outlay of Rs 11,814 crores. The scheme also has provisions for incentives to DISCOMs for the additional capacity, over and above the installed base capacity in the operational area of the DISCOMs.

Table 25: State/UT-wise Rooftop Solar capacity installed under PM-Surya Ghar Yojna (Solar Rooftop) and Total solar power installed capacity (May'25)

S.N.	State/UT	PM-Surya Ghar Yojna (Solar Rooftop)	Total Installed Capacity Solar Power
1	Andaman & Nicobar	5.30	30.62
2	Andhra Pradesh	339.70	5,434.38
3	Arunachal Pradesh	6.68	14.85
4	Assam	95.30	230.74
5	Bihar	111.00	328.34
6	Chandigarh	71.70	78.85
7	Chhattisgarh	107.40	1,398.50
8	DNH and DD	83.60	97.90
9	Goa	54.90	58.34
10	Gujarat	5,534.60	20,093.26
11	Haryana	859.50	2,107.82
12	Himachal Pradesh	24.63	217.22
13	J&K	42.20	74.49
14	Jharkhand	93.04	199.87
15	Karnataka	710.10	9,876.57
16	Kerala	1,375.50	1,723.64
17	Ladakh	1.80	7.80
18	Lakshadweep	0.00	4.97
19	Madhya Pradesh	572.50	5,265.37
20	Maharashtra	3,592.90	11,827.63
21	Manipur	7.11	13.79
22	Meghalaya	0.21	4.28
23	Mizoram	2.00	30.39
24	Nagaland	1.00	3.17
25	NCT of Delhi	323.20	334.50
26	Odisha	84.90	701.74
27	Puducherry	66.30	67.51
28	Punjab	453.80	1,421.43
29	Rajasthan	1,591.80	29,546.70
30	Sikkim	5.12	7.56
31	Tamil Nadu	1,003.30	10,433.27

32	Telangana	472.90	4,842.10
33	Tripura	4.80	21.24
34	Uttarakhand	273.71	593.07
35	Uttar Pradesh	329.90	3,376.74
36	West Bengal	67.13	320.62
	Total	**18,369.53**	**1,10,789.27**

Source: MNRE

The Financial outlay of the Phase-II Rooftop Solar (RTS) programme is Rs 118.14 Bn, which includes Rs 66 Bn of CFA and Rs 49.85 Bn of incentives to the Distribution Companies. The Programme has been extended till 31.03.2026 without change in the financial outlay initially approved for the Programme.

Technical issues and factors that are likely to hinder growth in rooftop solar capacity additions

Progress under the Rooftop solar program has historically been slow due to lack of information at grassroot level, low awareness among masses and lack of initiatives by DISCOMs. While the government is taking initiatives to address the challenges certain issues continue including regulatory issues such as inconsistent net metering and other policies across states, delay in net metering approvals by DISCOMs etc. continue to persist. Further, financing also continues to be a challenge for rooftop solar as it is perceived to be risky compared to other types of installations.

6 Overview of Indian Solar EPC Market

Solar EPC refers to the engineering, procurement and construction services provided for setting up solar power installations. Solar EPC companies offer comprehensive services tailored to the contract's requirements, which encompass system design, procurement of components like solar cells and modules, installation, and project commissioning. They may also choose to handle specific parts of the project. The Indian government's growing emphasis on renewable energy has greatly benefited this industry. However, the Solar EPC sector in India presents high entry barriers, as it demands a minimum level of technical expertise and experience to qualify for tenders, along with restrictions on joint ventures participating in bids.

The Solar EPC sector in India faces high entry barriers due to several factors. To bid for solar EPC tenders, companies must demonstrate significant technical expertise, including experience with large-scale projects (e.g., 50 MW or more). Joint ventures are often restricted to ensure bidders have the capability to independently handle projects. The industry also faces regulatory and policy challenges, including the need to obtain permits and navigate land acquisition processes, which can delay projects and increase costs. Additionally, staying updated with the latest technologies and managing operational challenges like supply chain disruptions further complicates participation, limiting competition to companies with substantial resources and experience.

Benefits of EPC in Solar Projects

Benefits	Description
Smooth management of Projects	When working on a turnkey basis, EPC companies handle every aspect of the project, eliminating the need for the project owner to coordinate with various parties.
Quality Assurance	EPC companies hire skilled engineers and technicians to carry out projects. They focus on delivering high-quality construction while reducing malfunctions, ultimately enhancing long-term performance.
Cost Efficiency	The EPC contractors have their own suppliers and procurement methods for easy procurement at competitive prices. With efficient designing of systems and cost-effective procurement, EPC companies can help achieve optimal construction costs for the project.
Timely Completion	Developing solar energy projects consists of several stages. EPC companies are hired to finish the project on schedule, and a skilled EPC company guarantees its prompt commissioning. Delays in completion usually result in penalties outlined in the EPC contract.

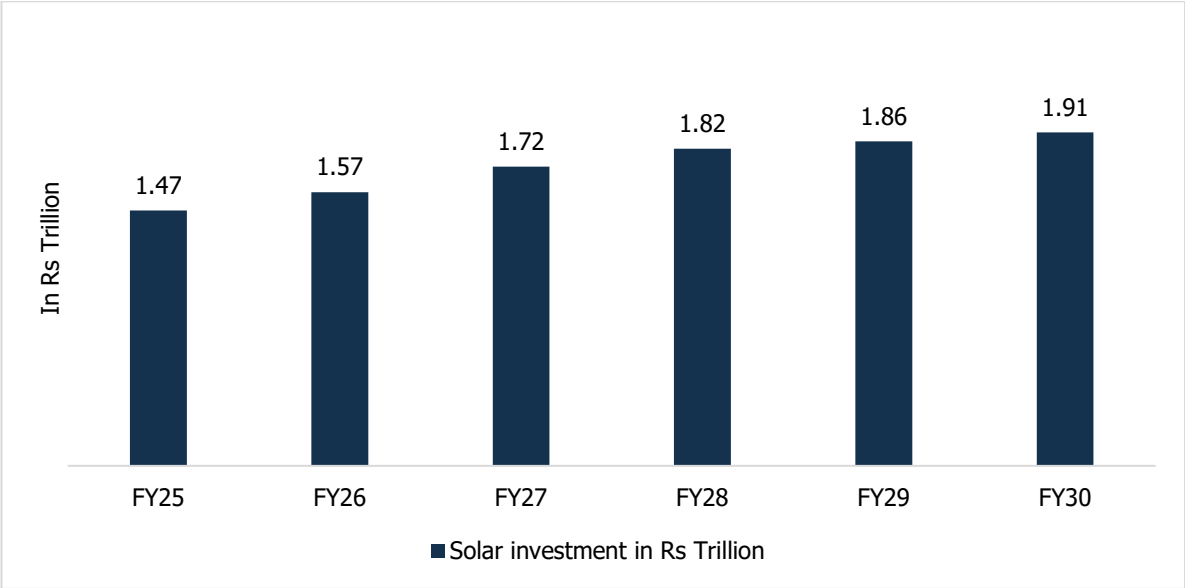
Type of solar installations

• **Utility Scale Solar:** Utility scale solar power stations are photovoltaic power station which are large enough to be able to generate greater than 1 MW of solar energy and transfer it in the transmission lines.
• **Ground mounted solar:** Ground mounted solar projects have photovoltaic modules installed on open land using mounting structures, these are installed in open fields, industrial areas, or barren land. This segment make up the largest share of India's solar installations, with approximately 81.0 GW of capacity as of Mar 2025, and are primarily used for large-scale grid-connected power generation.
• **Rooftop Solar:** A rooftop solar power system is a photovoltaic system which is mounted on the rooftop of a residential or commercial building or structure.
• **Distributed/Off-grid Solar:** Off-grid solar are independent grids where energy is stored in batteries rather than transferring it via grid lines or transmission lines.

6.1 Market size of Solar EPC

India's solar EPC market has been growing steadily due to strong government support, clear renewable targets, and falling costs of solar modules. The solar EPC costs typically account for 30-35% of the solar project capex. This implies an overall EPC opportunity worth Rs 1.72 trillion over FY27 and is expected to reach Rs 1.91 trillion in FY30.

Chart 41:Investments in Solar EPC Opportunity



Source: CareEdge Research

It has been observed that most private developers have their in-house EPC teams while the third-party solar EPC contractors are generally engaged by both public and private sector entities. Therefore, the opportunity for third party solar EPC contractors will depend on the overall share of public sector entities in the solar capacities added over FY24-27. Summary of solar capacity addition pipeline announced by key public sector entities is given in the following table.

Table 26: Solar Projects Pipeline of Public Sector Entities

Company	Projected Pipeline (GWp)	
	FY25P	FY26P
NTPC	8.7	10
NHPC	1.4	1.7
GSECL	1.3	1.8
SJVN	1.8	2.2
Coal India Ltd	1.4	1.2

Source: Company Reports, Sterling and Wilson Renewable Energy Investor Presentation

6.2 Assessment of Solar EPC contract

The framework of an EPC contract is such that it enables the owner to transfer the risk of design, procurement and construction entirely to the contractor. The contractor is then solely responsible for completing the project and handling it over to the owner in a turnkey project condition. The EPC phase of a project is called as the execution phase which is after the feasibility study and front-end engineering design study phase. But some EPC players also does feasibility studies to participate in tenders.

The key features of an EPC contract as follows:

- Single point ownership and responsibility
- Clearly defined deliverables and project specifications
- Fixed completion date
- Fixed completion price
- Procurement responsibilities
- Output Guarantees
- Liquidated damages to the client company for both delay and performance
- Security from the contractor or its parent company
- Caps on liability

Solar EPC contracts vary based on assignment of roles and responsibilities and penalty. Based on these differences, various project delivery mechanisms have been devised. The size and nature of the project also influences the choice of the project delivery mechanism.

EPC Project: Turnkey vs Balance of Plant

There are two types of modes for the EPC contract to be executed – the turnkey project structure and balance of plant structure.

Under the turnkey project structure, EPC company/contractor takes care of everything from design to execution of the work which includes EPC. The contractor delivers a ready to use facilities. The project must be completed within an agreed-upon budget and schedule. If these conditions are not met, the contractor may need to offer financial compensation. The turnkey solar project consists of the following process-

Survey of the site to check solar viability - The location of the project is surveyed to determine the future weather forecast and solar isolation.

Determination of solar power generation capacity and connection type - Solar PV installations can be made in grid-connection or off-grid connection types depending on the installation capacity and consumption pattern of the client.

The solar companies would determine the power generation capacity by considering the structure of the terrain and the amount of sunlight incident.

Engineering and design of solar PV system - While designing and engineering of the solar panels, angle, height, weather, roof structure, etc. are considered. The mounting structure for the solar array is constructed according to approved design and study.

Solar Power Plant Installation - After carefully considering all the project requirements, the panels are carefully installed.

Metering of Solar Power Plant- A turnkey solution provider considers factors such as electricity tariffs, power output and usage to prepare a net metering agreement that best suits your needs.

Solar Financing Solutions and Approvals- The turnkey solution providers might also have tie-ups with the financing organizations, private investors, etc., whenever required by the client.

Monitoring of Solar panel efficiency- The efficiency of solar PV modules is due to depreciation over a longer period. The solar turnkey solution providers monitor the efficiency of the panels and maintain the uniform efficiency of the panels by taking care of their sub-parts.

Operation and maintenance- After the installation of the solar panels, it requires occasional cleaning and is performed by the turnkey solution providers. They also manage the operations of the installed equipment and accessories.

Under the balance of plant (BoP) or the balance of system (BoS) structure, the entire project is divided into different parts. Generally, the modules, which form majority of the cost of the solar plant, are procured separately by the developer and the remaining segments including wiring, switches, mounting system, inverters, batteries etc. are procured under the EPC contract along with the project installation services

Third Party EPC Contracts - refers to an agreements where a solar project developer or investor outsources the complete responsibility of Engineering, Procurement, and Construction (EPC) to an external contractor instead of executing the project in-house. This model is widely adopted in utility-scale and increasingly in commercial & industrial (C&I) solar projects, where developers seek efficiency, speed, and technical expertise. This type of contracts provides flexibility in terms of risk mitigation, access to expertise, cost and time efficiency, quality assurance. The full lifecycle of project execution is managed by them, including site survey, design and engineering, procurement of modules, inverters, and balance-of-system components, installation, commissioning, and O&M support. As India accelerates toward its renewable energy targets, the demand for professional EPC services is rising. Many investors, IPPs (Independent Power Producers), and C&I customers prefer third-party EPC models to avoid the capital intensity of building in-house execution capabilities.

In house VS Third-Party EPC

Parameters	In-house EPC	Third-Party EPC
Execution Responsibility	Design, procurement, and construction is managed internally.	Third-Party EPC contractor takes full responsibility for the execution
Capital & Resources	Higher investment for equipment, vendor management, technical expertise,	Minimal internal resources needed, developer focuses on financing and asset ownership.
Risk Exposure	Higher exposure to delays, cost overruns, and technical challenges.	Risks are transferred to the EPC contractor under contract terms.
Expertise & Network	Limited to the developer's internal capabilities and experience.	Access to specialized expertise, established vendor networks, and optimized procurement.
Scalability	Challenging to scale up quickly across multiple projects.	Highly scalable as developers can implement multiple projects
Cost Structure	Can be cost-effective if the developer has experienced in-house teams.	Competitive pricing due to EPC economies of scale

6.3 Open Access and Captive Power Consumption

India's power sector relies on various Power Purchase Agreements (PPAs) to meet its energy needs. Long-term PPAs (25–30 years) dominate the market, ensuring stable revenue for producers and consistent supply for buyers, especially in thermal and renewable energy projects. Solar and wind PPAs play a key role in advancing India's clean energy goals, supported by government policies and competitive bidding. Short-term PPAs address temporary demands, while merchant PPAs allow producers to sell power in open markets. Captive and open access PPAs enable commercial and industrial (C&I) consumers to secure cost-effective power. Additional flexibility comes from government-sponsored PPAs for public projects and cross-border PPAs with neighbouring countries.

Open Access (OA) or Third-Party Consumption

Open Access allows large power consumers to directly procure power from independent power producers (IPPs) through the transmission and distribution network, bypassing discoms. In the solar energy segment, these agreements are structured under long-term power purchase agreements (PPAs), ranging from 10–25 years, with tariffs substantially lower than grid tariffs.

Various Open Access Models:

Model	Structure / Ownership	Key Benefits	Key Challenges
Third-Party Sale (Bilateral OA)	Consumer signs Power Purchase Agreement (PPA) with an Independent Power Producer (IPP). An IPP is a private entity that develops, owns, and operates power plants, and sells electricity to consumers or utilities under long-term agreements	Lower tariffs vs DISCOM, provides contractual flexibility, supports RE100/ESG targets.	High cross-subsidy & surcharges, regulatory uncertainty and banking restrictions.
Captive Model	Consumer sets up own plant; must hold ≥26% equity and consume ≥51% of power.	Tariff certainty, exemptions from surcharge , control over generation.	High capex, land approvals, financing hurdles and longer payback period.
Group Captive Model	Multiple consumers collectively own ≥26% equity and consume ≥51% power.	Suitable for C&I consumers with smaller loads, cost savings, flexible participation.	Legal complexity as equity is divided among a group and difficulty in compliance tracking.
Exchange-Based OA	Power purchased via exchanges (IEX, PXIL, HPX); short-term transactions.	High flexibility, transparent pricing, RE-only options via green products.	Price volatility, limited assured RE supply.
Green Open Access (GOA, 2022)	New framework for RE; available for >100 kW consumers with simplified approvals.	Lower costs, quicker approvals and strong alignment with sustainability goals.	Implementation challenges at state level, DISCOM resistance.

Captive Power Consumption

Captive power consumption in India refers to electricity generated by an entity or group of consumers primarily for their own use, rather than sourcing it from the grid. Under the Electricity Act, 2003 and Electricity Rules, 2005, a project qualifies as captive if the consumer(s) hold at least 26% equity in the plant and consume a minimum of 51% of the power generated. This model has become especially attractive for commercial and industrial (C&I) consumers seeking to reduce dependence on discoms, lower electricity costs, and secure long-term tariff stability. This model provides cost savings and greater energy control, however challenges such as high upfront investment, land acquisition, and regulatory compliance remain key considerations.

Open access and captive consumption models play an important role in India's renewable energy trajectory. The Ministry of Power's Green Open Access Rules (2022) have streamlined approvals, lowered the OA threshold to 100 kW, and capped surcharges. Captive projects remain attractive for larger industrial consumers seeking long-term price stability and exemption from regulatory uncertainties tied to OA charges.

6.4 Key Criteria for selection of EPC Contractor

Following key parameters are considered for selection of an EPC contractor for solar project development.

Criteria	Details
Credibility and Past Experience	The developer should assess the credibility and past track record of the solar EPC contractor, including its experience of working under various conditions – geographical, terrain-related, and time constraints. The number and scale of projects executed, the contractor's years of experience in the industry, relationships with vendors, land acquisition capabilities, operational regions, and past performance should all be evaluated.
Technical Team	The availability of an experienced team across various areas, technological partnerships, and the capability to deliver consistent results should be assessed.
Full-Service Solar Solution Provider	The EPC contractor must be able to deliver comprehensive solutions for the implementation of solar power plants. This encompasses all aspects, including site analysis, design, project management, procurement, installation, and commissioning.
Equipment Knowledge	An EPC company is expected to have in-depth knowledge of the equipment and its components. The sources of equipment, warranties, and deliverables should be clearly communicated to the client. Both the project and management teams should be experienced, with a deep understanding of the technical details of the products, utility setup, and engineering.
Licensing and Approvals	The EPC contractor should be well-versed in obtaining the necessary licenses and government approvals. The contractor should be responsible for arranging the licence to install the PV system.
Operation and Maintenance	Post-implementation support is essential for the long-term efficiency of the solar power plant. The client company should ensure the chosen EPC contractor offers comprehensive operation and maintenance services to support optimal plant performance. EPC contractors are primarily responsible for design and execution, their ability to provide robust operation and maintenance (O&M) services significantly impacts plant performance, generation output, and return on investment. O&M offerings include regular inspections, performance monitoring, preventive maintenance, module cleaning, and timely resolution of technical issues. Most O&M contracts are not typically for the plant's entire lifespan. These contracts usually cover a fixed tenure, typically ranging from 3 to 5 years post-commissioning, similar to a manufacturer's warranty. The duration can be negotiated and extended based on the terms outlined in the contract. The contract duration, scope of services, and performance guarantees can be negotiated upfront and extended periodically, depending on the client's requirements and the EPC contractor's capabilities. By ensuring strong O&M commitments, clients safeguard against performance degradation, minimize downtime, and secure long-term operational stability of their renewable energy assets.
Financial Health	The EPC contractor should be in satisfactory financial health, free from issues such as negative net worth or ongoing losses. Poor financial health can present challenges during project execution and may lead to delays.
Local Experience	A solar developer may also consider the EPC contractor's past experience in the project's geographical area or state, as familiarity with local regulations, approval processes, and vendors can provide a distinct advantage.

6.5 Key Covenants of an EPC Contract

The EPC contract is established between the client (the owner) and the EPC contractor for a specific project or scope that the contractor is obligated to deliver. EPC contracts feature several key elements and agreements:

Feature/Covenant	Description
Performance Specification	Defines the performance criteria the contractor must meet, ensuring clarity on the scope of work.
Single Point of Responsibility	The contractor is responsible for the entire scope of work, addressing any issues that arise.
Contract Price	Defines the payment terms, which could be fixed price or include variations and escalation clauses.
Completion Date	Guaranteed completion date, with penalties (liquidated damages) for delays unless time extensions are granted.
Performance Guarantees	The owner earns revenue by operating the solar facility, making it crucial for the facility to achieve the necessary standards of output, efficiency, and reliability. To protect the owner from potential risks, EPC contracts incorporate performance guarantees supported by performance liquidated damages (PLDs). These are penalties the contractor must pay if it does not meet the performance criteria outlined in the contract.
Caps on Liability	Limits the contractor's liability, typically as a percentage of the contract price.
Security	Performance security to protect the owner in case the contractor does not meet obligations, often in the form of a bank guarantee.
Retention	Withholds a percentage of payment until satisfactory project completion and performance, typically for 6–12 months.
Variations	Allows the owner to modify the scope of work, with adjustments to price and completion time as necessary.
Suspension	Gives the owner the right to suspend the works
Termination	Defines the termination rights of both parties.

6.6 In-house VS Outsourced EPC

In the Indian solar power landscape, both in-house and outsourced EPC (Engineering, Procurement, and Construction) models and the solar power developers consist of both public and private sector entities. The public sector entities include NTPC Renewable Energy, NHPC, SJVN, Gujarat State Electricity Corporation (GSECL), etc. while the private sector entities include Adani Group, Renew, Acme Solar, Ayana, Enfinity, Radiance, Serentica, Bluepine, IMC etc.

Most of the established private sector companies have mobilized in-house EPC teams which have the capability of executing large projects. This gives the companies a large control over project execution, timelines, cost efficiency, and quality assurance, however this comes at a high cost, maintaining an in-house power plant setup requires huge investments in terms of fixed overhead costs, requirement of skilled manpower and challenges of regulatory sanctions. There is limitations in terms of scalability.

The outsourced EPC is commonly used by public sector players such as NTPC, NHPC, and SJVN, as this offers flexibility in terms of plant management, the cost of maintenance, and outsourced setup provides access to specialized expertise and the ability to scale quickly by leveraging multiple EPC partners, the challenge in this model related to quality control, delays, and reliance on third-party performance, execution timelines. and dependency on a third-party.

Large power-consuming companies aiming to meet renewable targets prefer in-house EPC, while others opt for outsourced EPC due to its flexibility and lower costs.

6.7 Eligibility criteria for Tenders

The eligibility criteria for Solar EPC tenders can vary depending on the issuing authority, region, and specific project requirements. However, some common eligibility requirements are.

General Criteria

- The Bidder should be either a body incorporated in India under the Companies Act, 1956 or 2013 including any amendment thereto and engaged in the business of Solar Power.
- The EPC contractor should be able to provide end-to end solutions for a solar power plant implementation
- The Bidder (either individually or as a consortium or any of the participating members of the Consortium) shall not have been debarred by EMPLOYER/ Owner/ Ministry of MNRE or any other ministries and / or any other Government Department, Agencies or CPSUs from future bidding due to "poor performance" or "corrupt and fraudulent practices" or any other reason in the past.
- The Bidder should not be under any liquidation court receivership or similar proceedings on the due date of submission of bid.

Technical Criteria

- The bidder must have successfully installed and commissioned at least one grid-connected solar PV power project of a specified capacity. The project should have been commissioned prior to the Techno-Commercial Bid Opening date. The bidder is required to submit a list of such projects, indicating their grid-connected status, along with relevant supporting documentation, such as the commissioning certificate and work order/contract/agreement from the client or owner.

Financial Capacity

- The bidder must have an annual turnover of a specified amount per MW in any one of the last three financial years preceding the bid deadline, provided that the bidder has completed at least one full financial year of operation.OR
- The bidder must have a net worth equal to or greater than the value calculated at a specified rate per MW of the capacity offered in the bid.
- In case of more than one Price Bid submitted by the Bidder, the financial eligibility criteria must be fulfilled by such Bidder for the sum total of the capacities being offered by it in its Price Bid.

6.8 Key Aspects of DPTP (Developer Permit and Transfer Permit) model

The Developer Permit Transfer Permit (DPTP) model is commonly used in large-scale solar infrastructure projects, including Open Access Solar Projects, Solar Parks, Ground-mounted solar systems, and Green Energy Corridors. Under this model, the EPC company (developer), initiates the project by acquiring approvals for the project, land acquisition, environmental clearances, and transmission approvals and initiates the solar project this is referred to as the 'Developer Permit'. This developer then transfers the rights to use the installed solar capacity to another entity, an investor, Independent Power Producer (IPP), or energy user company or any other large conglomerate looking for a renewable energy source for their usage. This transfer happens through a Special Purpose Vehicle, which allows the other party to execute, own, or operate the project, this is referred to as 'Transfer Permit'. A The DPTP model is particularly relevant where the roles of development and execution are intentionally separated to optimize expertise, investment, and risk management.

Special Purpose Vehicle (SPV) is a distinct entity created for the purpose of executing this transaction. The initial developer creates the SPV and transfers all the rights to the counter party. An SPV enables efficient transfer of project rights, minimizes legal complexities, and enhances transparency in ownership and accountability.

Key features:

Risk isolation	The SPV is set up as a separate legal entity specific to a single project. This structure protects the parent company against any financial or legal risk associated with the project.
Project financing	The SPV has a distinct asset portfolio example Power Purchase Agreements (PPAs), permits regulatory approvals and revenue-generating contracts. The loans are secured against the project and cash flows are linked to the SPV, hence there is limited risk the parent's companies overall portfolio.
Ownership & Transfers	In an SPV model, the transfer of ownership is based on equity, this avoids complexities and transfer if made simple and easier.
Avoids regulatory challenges	All licenses, permits, agreements and contracts are held in the name of the SPV, this ensures accountability, rights and obligations, this streamlines compliance with regulatory authorities.

6.9 Key Drivers for Solar EPC Market

Solar EPC market is expected to be driven by the expected solar capacity additions in the country. Some of the factors driving solar capacity additions are as below:

- Fiscal and regulatory incentives
- RPO targets
- Falling prices of modules and other system components
- Advancement of technology
- PLI support for domestic module manufacturers

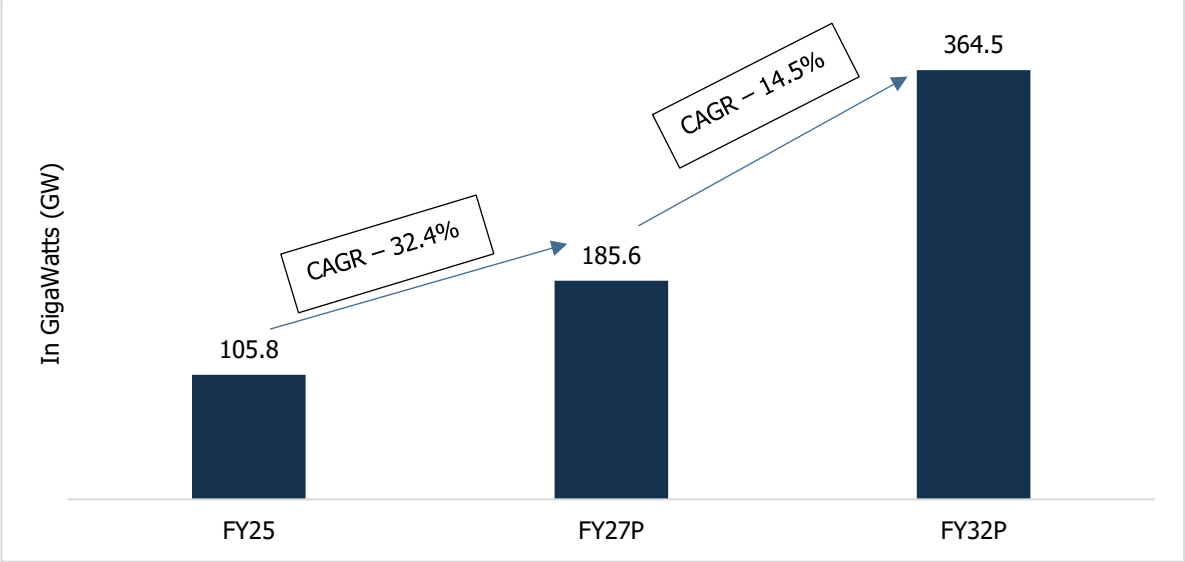
The above factors are discussed in detail in Section 5.2

6.10 Outlook for Solar EPC Market

There has been a substantial increase in the installed solar power capacity because of the government's push in a bid to achieve COP26 targets. The pace of bidding has also remained strong all along. MNRE has announced plans to invite bids for 50 GW of renewable energy capacity annually from FY24 to FY28 with an objective to achieve the targeted 500 GW installed capacity by 2030. Further, the domestic production of solar modules is also expected to increase driven by government initiatives such as the PLI scheme, which will lower the dependence on imports for critical components thereby addressing supply chain challenges and lowering the capital cost of solar power projects.

As per the National Electricity Plan Vol-2 (October 2024) 364 GW of installed solar power capacity is expected to be achieved by FY32.

Chart 42: Solar Power – Trend in Future Installed Capacity Additions

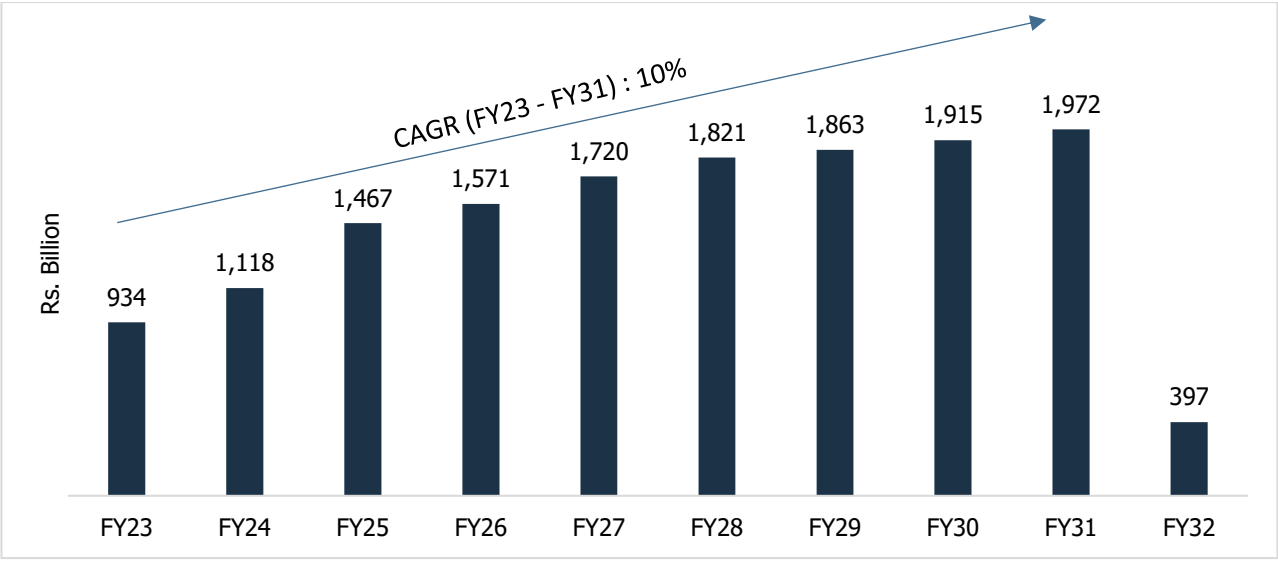


Source: National Electricity Plan Vol-2 (October 2024), CareEdge Research

To achieve the targeted capacity additions, an investment of Rs 5.9 trillion will be required between FY24-27. Earlier, the solar power developers used to award turnkey contracts to EPC players where-in the EPC players were responsible for end-to-end execution and delivery of the project. However, in the past few years, solar developers are preferring to procure solar modules separately under a larger contract for all their ongoing projects which enables them to negotiate better pricing. EPC contracts are being awarding excluding the module procurement.

A total investment of Rs 12,725 billion is projected for solar power from FY25-FY32. However, a significant decline in investment is anticipated in FY 2032, as the majority of the investments are expected to be completed by FY31. The expected investments in the generation sector for the periods FY23–FY27 and FY27–FY32 are outlined in the table below:

Chart 43: Total Investment in Solar power over FY23-FY32



Source: National Electricity Plan Vol-2 (March 2023), CareEdge Research

7 SWOT analysis for the Solar EPC sector

Strengths	Weakness
1. **Growing market potential** The government of India has set ambitious RE target of 500 GW by 2030, this has given rise to increase in demand for solar EPC. The all-India energy requirement is expected to increase by 6.13% by 2027 and given the RE push from the government backed initiatives and well-defined policy measures has made the solar EPC sector more attractive. 2. **Expertise in diverse topography** Indian solar EPC developers have built strong expertise in projects across a wide range of terrains, example deserts, coastal areas, higher altitude areas. Innovation such as floating solar installations, solar panel on canal tops and solutions for high-altitude or uneven landscapes, are being adopted, such adaptability positions India as a leader in implementing solar solutions in challenging environments. 3. **Technological advancement and Integration** There has been significant improvement in in solar technology such as high-efficiency panels, better inverters, and intelligent tracking systems have led to lower generation costs per megawatt. In addition, innovations such as wind-solar hybrid, floating PV Projects and storage technologies, are key drivers supporting the market these innovations are enhancing both the efficiency and economic viability of solar installations across project sizes **4. Infrastructure Support from Government** MNRE has implementing scheme for the development of solar parks and ultra-mega solar power projects, under which, the infrastructure such as land, roads, transmission system (internal and external), pooling stations, etc., is developed with all statutory clearances/approvals. Thus, the solar project developers have plug-and-play benefits. Further, under Mode 8 of the Solar Park Scheme, a facilitation charge of Rs 0.05/unit of power being generated from the projects in the parks is provided to the States to encourage the State Governments to provide necessary assistance to the Solar Power Park Developers (SPPDs) in identification and acquisition of land, to facilitate in obtaining all required statutory clearances, etc.	**1. Intermittency and Storage Challenges**: Renewable energy is intermittent in nature and is available only for certain hours during the day. India has on an average has 250 days of sunlight and the intensity of solar energy is also seasonal. Therefore, the power generated from renewable sources is not available round the clock due to the seasonal nature and variations. This limits the power generation capacity. **2. High Initial Capital Costs and regulatory requirements.** This is a highly capital-intensive industry, requires a substantial upfront investment. To generate about 1MW of energy, approximately 4 to 5 acres of land is needed. Requirements of state discoms approvals, licensing and land acquisition that make the whole process more time consuming. **3. Infrastructure and Grid Integration Constraints**: Large solar power plants are in remote areas with limited infrastructure to support generation and transmission. Inadequate transmission infrastructure in some regions causes delays in grid integration. The government has already implemented measures to develop the transmission capacity to support renewable capacity additions in India, however, delays in the addition of transmission infrastructure to evacuate power from the upcoming capacities is a key risk faced by the sector. **4. High Dependency on Imports -** Important components such as solar cells, modules, and inverters are largely imported by Indian players. Indian solar power producers are still dependent on imports of solar modules mainly from China, followed by Hong Kong and Malaysia, assessed based on the value of imports.

Opportunities	Threats
1. **Government Initiatives and Policy Support** The global push for renewable energy, especially solar power, aligns with government goals of reducing carbon footprints and enhancing sustainability. The Indian government has put forward ambitious renewable energy targets of achieving 500 GW by 2030 supported by strong policies such as M-KUSUM, PM Surya Ghar, and the Approved List of Models and Manufacturers (ALMM) providing a robust framework and financial incentives and subsidies like the Viability Gap Funding (VGF) for solar parks and hybrid systems. 2. **Climate Change Awareness:** The growing awareness of climate change and its impacts is significantly driving demand for renewable energy. As individuals, communities, and corporations become more conscious of their carbon footprints, there is a collective push towards sustainable practices. Public campaigns and educational initiatives have highlighted the importance of reducing greenhouse gas emissions, leading to increased support for renewable energy projects. Businesses are also recognizing the need to align their operations with environmental goals, fostering a culture of sustainability that prioritizes clean energy use. This heightened awareness not only influences consumer behaviour but also encourages investment in renewable technologies as a means of combating climate change. **3. Rising Energy Demand** As India continues to experience rapid urbanisation and economic growth, the demand for energy is soaring. The increasing population and expanding industries are straining the existing power infrastructure, making it imperative to find sustainable solutions. Renewable energy sources, such as solar and wind, offer a viable alternative to traditional fossil fuels, which are often subject to price volatility and supply constraints. This rising energy demand not only highlights the need for more power generation capacity but also underscores the importance of transitioning to cleaner energy sources that can support long-term growth without compromising environmental integrity.	1. **Regulatory and Policy Changes** Regulatory shifts, such as changes in renewable energy incentives, subsidies, or tax policies, could significantly affect the company's ability to secure contracts and maintain profitability. Additionally, any rollback in government support for solar energy or the introduction of new regulations could increase operating costs or reduce demand, threatening the company's growth prospects. 2. **Climate Change and Environmental Factors** Although solar power is a clean energy source, its efficiency can be impacted by external environmental factors such as inconsistent sunlight, unexpected weather conditions, or climate extremes. Any adverse weather events, such as droughts, floods, or storms, could affect the performance of solar power plants, reducing energy generation and impacting revenue streams. 3. **Technological Obsolescence** The rapid pace of technological change in the solar industry presents both opportunities and threats. If the company does not stay on the cutting edge of technological advancements, it risks falling behind competitors who can offer more efficient and cost-effective solutions. Continuous investment in R&D and technology adoption is essential to avoid being outpaced by technological breakthroughs in the market. 4. **Economic and Market Volatility** Economic downturns or shifts in energy demand patterns can negatively impact the renewable energy sector. For example, economic slowdowns can lead to reduced investment in new projects or the postponement of planned solar installations. Additionally, fluctuations in the global energy market, such as changes in fossil fuel prices or economic factors affecting the cost of materials, could disrupt business operations and financial stability.

8 Threats and Challenges

Threats	Details
Concentration in Indian Renewable Market	The company's operations are focused on India's renewable market, making it sensitive to domestic policy shifts and regulatory changes. Any reduction or removal of solar incentives could significantly impact revenue streams. Delays in land acquisition, grid connection approvals, or open access permissions may affect project timelines and financial outcomes.
Financial & Capital Risks	The company is exposed to the volatile module and equipment prices, may face margin pressure if costs rises, under fixed-price EPC contracts. Reliance on debt financing and private financing would strain their debt to service coverage ratio, or rising interest rates could disrupt project execution timelines.
Competitive market and Supply Chain Pressures	The intense competition from both domestic and global EPC players can drive down pricing, impacting profitability and limiting growth. And high dependency on imported solar cells and modules exposes them to exchange rate risk, import duties, and geopolitical trade shocks, which may disrupt supply continuity and cost planning.
Regulatory and Policy Changes	Government policies and incentives play a significant role in the financial viability of solar power systems. Tax credits, rebates, and feed-in tariffs (payments for excess solar power fed back into the grid) can significantly reduce the initial investment and operating costs of a solar system. Any withdrawal or reduction in these incentives could directly affect the cost competitiveness of the company's offerings, particularly in the residential and MSME segments. Moreover, potential changes in grid-related charges, net metering regulations, or open access frameworks could alter the financial attractiveness of solar projects, making customer acquisition more challenging and impacting project returns.
Challenges	**Details**
Upfront Cost and Installation	The high upfront costs of solar power systems, including panels, batteries, and inverters, can deter potential buyers. However, these costs can be mitigated through financing options and government incentives, such as tax credits and rebates. Installation can be complex and costly, especially when integrating various components. Professional installation is essential to ensure optimal performance and prevent damage.
Energy Storage and Consumption	Batteries may not store sufficient energy for cloudy days or nighttime, leading to dependence on grid power. Opting for a system with larger batteries or additional storage can address this issue. However, battery replacement remains an ongoing cost.
Maintenance and Climate Conditions	Solar systems require regular maintenance, including cleaning panels, checking batteries, and ensuring the inverter is functioning correctly. Environmental factors such as dirt, dust, snow, or extreme weather conditions can reduce panel efficiency by blocking sunlight or causing wear over time. Regular cleaning, proper panel placement, and periodic inspections are crucial to extending the system's lifespan, maintaining optimal performance, and minimising the impact of environmental conditions. Timely repairs to any system components, if required, also ensure the solar system operates at peak efficiency.
Technological Obsolescence	In both the solar power and EPC (Engineering, Procurement, and Construction) sectors, technological obsolescence poses a significant challenge. In the solar industry, rapid advancements in solar panel efficiency, energy storage solutions, and inverters can quickly make older systems less effective or outdated. Newer, more cost-efficient technologies can push older installations to the periphery, requiring upgrades or replacements to stay competitive and maximize energy output. Similarly, in the EPC sector, construction methods, materials, and machinery evolve quickly, leading to older methods becoming inefficient or incompatible with modern demands. To counter technological obsolescence, companies in both sectors must prioritize innovation, ongoing research, and the integration of newer technologies while ensuring adaptability in their designs and processes to extend the lifespan of their systems and maintain competitive edge.

9 Company Profiling

(Unless the context otherwise requires, in this section, references to "the Company" and "it" refers to Deon Energy Ltd or any entity under the control of Deon Energy Limited i.e., the AOP, on a consolidated basis.)

Deon Energy Limited is engaged in engineering, procurement, and construction (EPC) of solar projects, primarily in the state of Gujarat. The company undertakes both ground-mounted and rooftop installations, covering design, equipment procurement, construction, commissioning, and regulatory approvals. Around 90% of its revenue is generated from ground-mounted solar projects. In FY25, the company completed 78 such projects, with a cumulative installed capacity of 140 MW (DC) and 118 MW (AC).

The company also provides operations and maintenance (O&M) services for most of its EPC plants. In FY25, it entered into 44 O&M agreements, of 128 MW capacity. These services include equipment cleaning, repair, replacement of components, site security, and performance monitoring.

For plant monitoring, the company uses GSM data loggers and Supervisory Control and Data Acquisition (SCADA) systems, which combine software and hardware to monitor, control, and collect real-time data from power plants and solar projects. These systems connect sensors and field devices to a central platform, enabling operators to track performance, detect faults, and manage operations remotely.

As of now, the company has ongoing projects with a cumulative capacity of 575.89 MW, comprising 50.1% EPC projects and 49.9% O&M contracts. The company plans to enter in the Independent Power Producer (IPP) segment, a five-year Power Purchase Agreement (PPA) signed in January, 2025 with Koyo Granito LLP. It has also incorporated a wholly owned subsidiary, Deon Renewables Private Limited, along with several step-down subsidiaries, to support future growth and pursue opportunities in the renewable energy sector.

In FY25, top 10 clients contributed more than 50% of total revenue.

Top 10 Clients	**% of revenue share from operations**
Omax Cotspin Private Limited	9.5%
Fiotex Cotspin Private Limited	8.2%
Leaspin Textile LLP	6.3%
Sparten Granito Private Limited	5.0%
Agritex Enterprise LLP	4.8%
Antique Marbonite Private Limited	4.7%
Megacity Vitrified LLP	4.4%
Skajen Vitrifide Private Limited	4.3%
Patson Papers Private Limited	4.0%
Velloza Granito LLP	3.9%
Total	**55.1%**

Key Financial Performance	FY25	FY24	FY23
Total number of constructed solar power projects in the year	31	16	10
Constructed capacity in the year (MWDC)	87.73	19.53	16.34
Revenue earned from solar power projects in the year	2,953.31	658.81	382.06
Order Book of EPC Project (No of Projects)	28	27	14
Order Book of EPC Project (MWDC)	103.73	66.30	21.45
Order Book of EPC Project (Value)	2,943.99	2,215.78	783.67
Order Book of O&M Projects (No. of Projects)	30	23	10
Order Book of O&M Projects (MWDC)	84.52	62.57	14.94
Order Book of O&M Projects (Value)	17.01	28.18	7.10

10 Competitive Landscape

The competitive landscape in the solar EPC industry is dynamic and evolving. The market is witnessing strong competition based on factors such as product features, pricing, brand reputation, after-sales service, and technological advancements. While established brands hold significant market share, emerging players are challenging the status quo with innovative solutions and competitive pricing.

Operational Parameters

Parameters	KPI Green Energy Ltd	Zodiac Energy Ltd	Deon Energy Ltd
Order book (in MW)	2,950	-	315.50
Installed capacity (in MW)	950	22	140
Geographical presence	Gujarat	Gujarat, (Zambia) Africa	Gujarat
Offerings	Ground-mounted solar power plant	Rooftop Ground-mounted power plants Solar Tree	Ground-mounted Rooftop solar
O&M portfolio (in MW)	546	-	128
Area of focus	Independent Power Producer (IPP) Captive Power Producer (CPP)	Residential rooftop Commercial & Industrial rooftop	Commercial & Industrial segment

10.1 KPI Green Energy Limited

Founded in 2010, is headquartered in Surat, Gujarat, KPI Green Energy is a renewable energy company engaged in both power generation and third-party renewable energy sales within India. The company operates under two business models: as an Independent Power Producer (IPP), it develops, builds, owns, and operates renewable energy plants to supply clean energy for third-party consumers; and as a Captive Power Producer (CPP), it offers customized renewable energy solutions to industrial and commercial clients seeking to lower electricity costs and meet sustainability goals. As of FY25, the company has a cumulative installed capacity of 950 MW and a pipeline of 1.23 GW. They currently have 33 operational sites within India

Financial Parameters	FY23	FY24	FY25
Revenue From operations (in Rs millions)	6,437.86	10,239.00	17,354.54
EBITDA (in Rs millions)	2,084.89	3,368.43	5,637.70
EBITDA Margin (%)	32.38%	32.90%	32.49%
Profit/(loss) after tax for the year/ period (in Rs millions)	1,096.28	1,616.57	3,252.78
PAT Margin (%)	17.03%	15.79%	18.74%
Return on Equity (RoE) (%)	53.26%	29.56%	18.77%
Return on Capital Employed (%)	22.47%	18.18%	13.68%
Property, plant and equipment (in Rs million)	8,003.57	8,981.38	22,785.74
Net Fixed Asset Turnover Ratio (in times)	0.80	1.05	0.74
Debt to Equity Ratio (in times)	2.02	1.00	0.43
Debt Service Coverage Ratio (in times)	2.36	2.56	12.94
Current Ratio	1.20	1.49	2.76
Debtor Days	83	152	122
Creditor Days	217	284	168
Inventory Days	158	227	186
Working Cycle	24	96	140

Source: Company Annual Reports, CareEdge Research

10.2 Zodiac energy

Zodiac Genset Private Limited was founded in 1992 and later changed to Zodiac Energy Ltd. in 2007. They are headquartered in Ahmedabad, Gujarat. The company provides end-to-end services, including design, supply, installation, testing, commissioning of EPC projects, along with operation & maintenance (O&M) of solar energy projects. It caters to diverse segments through turnkey solutions for residential and commercial rooftop systems, ground-mounted installations, floating solar projects, and solar trees. In addition to its EPC services, the company also functions as an Independent Power Producer (IPP), developing solar assets and supplying electricity directly to distribution utilities and corporate consumers.

Financial Parameters	FY23	FY24	FY25
Revenue From operations (in Rs millions)	1,376.59	2,200.61	4,077.77
EBITDA (in Rs millions)	75.00	189.62	370.37
EBITDA Margin (%)	5.45%	8.62%	9.08%
Profit/(loss) after tax for the year/ period (in Rs millions)	31.89	109.72	199.70
PAT Margin (%)	2.32%	4.99%	4.90%
Return on Equity (RoE) (%)	9.25%	26.24%	27.71%
Return on Capital Employed (%)	9.32%	22.34%	14.11%
Property, plant and equipment (in Rs million)	23.95	23.42	756.70
Net Fixed Asset Turnover Ratio (in times)	50.09	52.75	4.44
Debt to Equity Ratio (in times)	1.25	0.80	1.63
Debt Service Coverage Ratio (in times)	1.97	4.18	3.40
Current Ratio	1.64	1.98	1.96
Debtor Days	110	130	51
Creditor Days	14	29	11
Inventory Days	52	28	56
Working Cycle	148	129	96

Source: Company Annual Reports, CareEdge Research

10.3 Deon Energy Ltd

Deon Energy Ltd was founded in 2020 as a partnership firm under the name M/s Deon Energy in Gujarat, and later converted into a private limited company in 2024. The company offers renewable energy solutions, with a focus on engineering, procurement, and construction (EPC) of solar energy projects on a turnkey basis. It primarily serves to the commercial and industrial (C&I) segment in Gujarat. Its operations includes both ground-mounted and rooftop solar EPC projects. Their total installed capacity is approximately 140 MW across Gujarat.

In addition to EPC services, they also provides operations and maintenance (O&M) services for most of the solar power plants it has built. The services include cleaning, repairs, maintenance, replacement of equipment of solar panels, inverters, and cables, as well as security of the power plants. The scope of O&M varies depending on agreements with clients.

Financial Parameters	FY23	FY24	FY25
Revenue From operations (in Rs millions)	418.36	684.26	2,988.02
EBITDA (in Rs millions)	5.70	48.05	354.13
EBITDA Margin (%)	1.36%	7.02%	11.85%
Profit/(loss) after tax for the year/ period (in Rs millions)	2.22	29.93	261.58
PAT Margin (%)	0.53%	4.37%	8.75%
Return on Equity (RoE) (%)	20.65%	142.06%	181.96%
Return on Capital Employed (%)	27.05%	117.28%	118.72%
Property, plant and equipment (in Rs million)	5.79	13.32	20.12
Net Fixed Asset Turnover Ratio (in times)	72.31	51.37	146.76
Debt to Equity Ratio (in times)	0.35	0.23	0.15
Debt Service Coverage Ratio (in times)	4.22	38.43	2,210.67
Current Ratio	1.06	1.06	1.80
Debtor Days	9	23	6
Creditor Days	10	16	4
Inventory Days	34	77	41
Working Cycle	33	84	43

Source: Company Annual Reports, CareEdge Research

Parameter	Formula
Net Sales / Revenue	Revenue from Operations
COGS	Cost of material consumed + Purchase Stock in Trade - Changes in inventories of finished goods, stock-in-trade and work-in-progress
Gross Profit	Revenue from Operations - COGS
Gross Profit Margin	Gross Profit / Revenue from operations
EBITDA	PBT + Interest Cost + Depreciation & Amortization - Other income - Profit from associates
EBITDA Margin	EBITDA/ Revenue from operations
EBIT	EBITDA - Depreciation & Amortization
EBIT Margin	EBIT/ Revenue from operations
PAT Margin	Profit after Tax/ Revenue from operations
Debt	Long term Borrowings + Short term Borrowings
Cash	Cash + Bank
Fixed Assets	Gross Fixed Assets
Debt to Equity	Debt/ Total Equity
Return on Equity (ROE)	PAT/ Average Total Equity
Return on Capital Employed (ROCE)	EBIT/ Total Capital Employed Total Capital Employed Total Capital Employed = (Total equity + Total borrowings + Deferred Tax Liabilities - Intangible Assets)
Current Ratio	Current Assets/ Current Liabilities
Debtor Days	(Debtors/ Revenue from operations)*365
Creditor Days	(Creditors/ Total Expenses)*365
Inventory Days	(Inventory/Cost of Goods Sold)*365
Working Cycle	Debtor Days + Inventory Days - Creditor Days
Debt Service Coverage Ratio (DSCR)	(Profit after tax + interest expenses + Depreciation and amortisation expenses+(Profit)/Loss on sale of fixed assets) / (Total interest and principal repayments.)
Net Fixed Asset Turnover Ratio	Revenue from operation/ Fixed Assets (Net)

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