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Industry Report

Solar Engineering, Procurement and Construction ("EPC") Services Industry

2026

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24th September 2026

Prepared by
Marqis Analytics

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List of Abbreviations

Abbreviation	Full Form	Abbreviation	Full Form
AI	Artificial Intelligence	ALMM	Approved List of Models and Manufacturers
AMRUT	Atal Mission for Rejuvenation and Urban Transformation	API	American Petroleum Institute
ASTM	American Society for Testing and Materials	BESS	Battery Energy Storage System
BIS	Bureau of Indian Standards	BSE	BSE Limited
CAGR	Compound Annual Growth Rate	CAPEX	Capital Expenditure
C&I	Commercial and Industrial	CEA	Central Electricity Authority
CGD	City Gas Distribution	CMIE	Centre for Monitoring Indian Economy
CNG	Compressed Natural Gas	COO	Chief Operating Officer
COVID-19	Coronavirus Disease 2019	CPI	Consumer Price Index
CSP	Concentrated Solar Power	CY	Calendar Year
DCS	Distributed Control System	DFC	Dedicated Freight Corridor
DFT	Dry Film Thickness	DRI	Direct Reduced Iron
EAF	Electric Arc Furnace	EBITDA	Earnings Before Interest, Tax, Depreciation and Amortisation
EMS	Environmental Management System	EN	European Norm
EPC	Engineering, Procurement and Construction	EPC + O&M	Engineering, Procurement and Construction plus Operations and Maintenance
ERP	Enterprise Resource Planning	ERW	Electric Resistance Welded
ESG	Environmental, Social and Governance	EV	Electric Vehicle
FE	Foreign Exchange	FY	Financial Year
GAIL	GAIL (India) Limited	GDP	Gross Domestic Product
GI	Galvanised Iron	GJ	Gigajoule
GNDI	Gross National Disposable Income	GNM	Group Net Metering
GoI	Government of India	GST	Goods and Services Tax
GVA	Gross Value Added	GW	Gigawatt
HRC	Hot Rolled Coil	HSAW	Helical Submerged Arc Welded
HSLA	High Strength Low Alloy	IBEF	India Brand Equity Foundation
IEC	International Electrotechnical Commission	IEA	International Energy Agency
IEA PVPS	International Energy Agency Photovoltaic Power Systems Programme	IIP	Index of Industrial Production
IMF	International Monetary Fund	INR	Indian Rupee
IPP	Independent Power Producer	IRC	Indian Roads Congress
IS	Indian Standard	ISI	Indian Standards Institution

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ISO	International Organization for Standardization	JJM	Jal Jeevan Mission
kW	Kilowatt	kWh	Kilowatt-hour
LCOE	Levelized Cost of Electricity	LFPR	Labour Force Participation Rate
MNRE	Ministry of New and Renewable Energy	MoP	Ministry of Power
MoSPI	Ministry of Statistics and Programme Implementation	MS	Mild Steel
MT	Million Tonnes	MTPA	Million Tonnes Per Annum
MW	Megawatt	NHAI	National Highways Authority of India
NIP	National Infrastructure Pipeline	NMDC	National Mineral Development Corporation
OEM	Original Equipment Manufacturer	O&M	Operations and Maintenance
OHSAS	Occupational Health and Safety Assessment Series	OPEX	Operating Expenditure
PAT	Profit After Tax	PE	Provisional Estimate
PESTLE	Political, Economic, Social, Technological, Legal and Environmental	PFCE	Private Final Consumption Expenditure
PIB	Press Information Bureau	PLFS	Periodic Labour Force Survey
PLI	Production Linked Incentive	PM	Prime Minister
PM-KUSUM	Pradhan Mantri Kisan Urja Suraksha evam Utthaan Mahabhiyan	PMAY	Pradhan Mantri Awas Yojana
PMI	Purchasing Managers' Index	PNGRB	Petroleum and Natural Gas Regulatory Board
PPA	Power Purchase Agreement	PPP	Purchasing Power Parity
PV	Photovoltaic	PVPS	Photovoltaic Power Systems
R&D	Research and Development	RBI	Reserve Bank of India
RESCO	Renewable Energy Service Company	RINL	Rashtriya Ispat Nigam Limited
ROCE	Return on Capital Employed	RONW	Return on Net Worth
SAIL	Steel Authority of India Limited	SAW	Submerged Arc Welded
SCADA	Supervisory Control and Data Acquisition	SEBI	Securities and Exchange Board of India
SERC	State Electricity Regulatory Commission	SGS	Société Générale de Surveillance
SME	Small and Medium Enterprise	SWOT	Strengths, Weaknesses, Opportunities and Threats
T&D	Transmission and Distribution	TMCP	Thermo-Mechanically Controlled Process
TReDS	Trade Receivables Discounting System	UAE	United Arab Emirates
USA	United States of America	USD	United States Dollar
UT	Union Territory	VNM	Virtual Net Metering
WEO	World Economic Outlook	—	—

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1. Global Macroeconomic Scenario

1.1 Global GDP Growth Scenario

As per the IMF's World Economic Outlook (WEO) Update published in July 2026, global growth is projected to slow to 3.0% in CY 2026, down from an average of 3.5% in CY 2024–25, before recovering to 3.4% in CY 2027. This is broadly unchanged on a cumulative basis compared with the April 2026 WEO, though it conceals sharp divergence across countries. The moderation reflects the negative supply shock from the conflict in the Middle East and associated disruptions to energy flows through the Strait of Hormuz, which is being partly offset by an accelerating global technology cycle driven by artificial intelligence (AI)-related investment and adoption. Economies well integrated into the AI/technology value chain—including Taiwan, Korea, Thailand and Malaysia—have significantly outperformed expectations, while energy-importing economies with limited exposure to the technology upturn, including many low-income countries, continue to face a more pronounced drag.

Global headline inflation is projected to rise from 4.1% in CY 2025 to 4.7% in CY 2026, before easing to 3.9% in CY 2027, marking a stalling of the disinflation trend that had been in place since early 2024. The upward revision (0.3 percentage point higher than the April 2026 WEO for 2026) reflects higher energy and food prices, with crude oil prices projected to rise by approximately 32% and natural gas prices by about 22% in 2026 relative to 2025. World trade volume growth is projected to slow sharply from 5.0% in 2025 to 3.5% in 2026, before recovering to 4.3% in 2027, reflecting tariff-related drag and the gradual adjustment of global trade and production linkages.

In China, growth is projected to slow to 4.6% in CY 2026 (down from 5.0% in CY 2025) and further to 4.1% in CY 2027, as elevated global oil prices, structural headwinds and continued property sector weakness weigh on activity, notwithstanding stronger-than-expected exports and high-tech manufacturing. In the Euro Area, growth is projected to slow to 0.9% in CY 2026 before improving to 1.2% in CY 2027, reflecting the drag from higher energy prices, a sizable negative carryover from the first quarter, and weak consumer confidence; Germany's growth is projected at 0.7% in CY 2026, improving to 1.0% in CY 2027, supported by net exports and fiscal measures.

Meanwhile, India is expected to remain among the fastest-growing major economies despite an increasingly uncertain global environment. According to the IMF, India's real GDP growth is projected at 6.4% in FY2026–27 and 6.7% in FY2027–28, supported by resilient private consumption, robust services activity and domestic demand. On a calendar-year basis, the IMF projects India's economy to expand by 7.0% in 2026 and 6.4% in 2027. Consumer price inflation is expected to remain broadly contained, supporting macroeconomic stability even as global inflationary pressures persist.

Overall, while global growth in CY 2025 remained resilient, the outlook for CY 2026 reflects a genuine crosscurrent—a war-driven supply shock pulling growth down, countered by an

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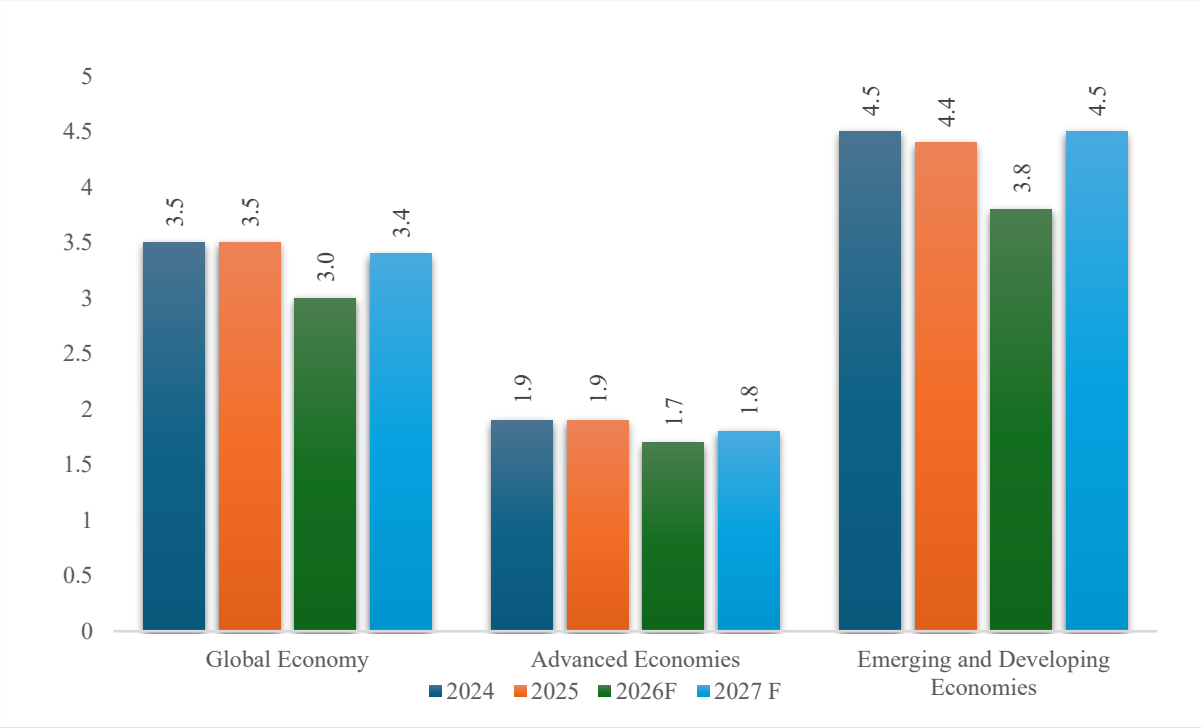
AI/technology-led investment boom pushing growth up in select economies. Risks to the outlook remain tilted to the downside, with renewed Middle East conflict, trade fragmentation, and a potential correction in AI-driven valuations as the key threats, while a swifter energy-market normalisation and stronger technology investment present the main upside. India's relative macroeconomic stability, resilient domestic demand, and continued investment momentum position it favourably amid these global crosscurrents.

1.2 Historical GDP Growth Trends



Note: *Advanced Economies and Emerging & Developing Economies are as per the classification of the World Economic Outlook (WEO). This classification is not based on strict criteria, economic or otherwise, and it has evolved over time. It comprises of 40 countries under the Advanced Economies including the G7 (the United States, Japan, Germany, France, Italy, the United Kingdom, and Canada) and selected countries from the Euro Zone (Germany, Italy, France etc.). The group of emerging market and developing economies (156) includes all those that are not classified as Advanced Economies (India, China, Brazil, Malaysia etc.).*
F – Forecast, Source – IMF World Economic Outlook July 2026

In CY 2024, global growth remained resilient at 3.5%, supported by easing inflation and improved supply chain conditions. Advanced economies expanded by 1.9%, while emerging and developing economies recorded stronger growth of 4.5%, reflecting continued resilience across developing markets.

In CY 2025, global GDP growth remained stable at 3.5%, despite ongoing geopolitical tensions and structural challenges. Advanced economies-maintained growth at 1.9%, while emerging and developing economies continued to outperform with growth of 4.5%.

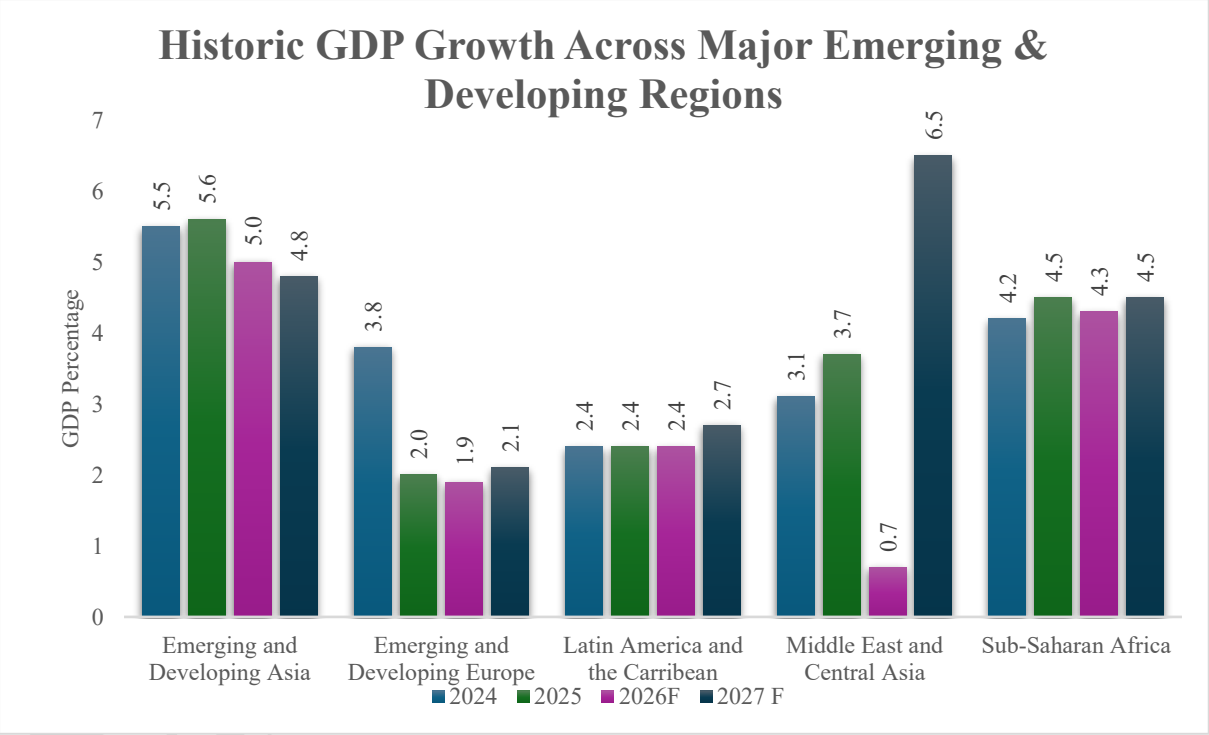
Global growth is projected to moderate to 3.0% in CY 2026, reflecting the impact of higher energy prices, geopolitical tensions, and trade-related headwinds. Advanced economies are

expected to grow at 1.7%, while emerging and developing economies are projected to expand by 3.8%.

Growth is expected to recover to 3.4% in CY 2027, supported by improving global trade conditions and continued investment momentum. Advanced economies are forecast to grow at 1.8%, while emerging and developing economies are projected to expand by 4.5%, highlighting their continued resilience relative to advanced economies.

1.3 GDP Growth Across Major Regions

GDP growth across major global regions—including Europe, Latin America & the Caribbean, Middle East & Central Asia, and Sub-Saharan Africa—continues to display varied trajectories. While some regions are stabilizing post-pandemic, others remain challenged by structural and cyclical issues. The global outlook presents a mixed scenario, with emerging economies continuing to outperform advanced economies.



Source-IMF World Economic Outlook July 2026 update.

In Emerging and Developing Asia, growth stood at 5.5% in CY 2024 and increased to 5.6% in CY 2025. Growth is projected to moderate to 5.0% in CY 2026 and further to 4.8% in CY 2027. The moderation reflects weaker external demand, trade-related uncertainty, and spillovers from slower growth in China, partly offset by resilience in domestic demand across major economies, with India continuing to act as a key growth driver.

Emerging and Developing Europe recorded growth of 3.8% in CY 2024, moderating to 2.0% in CY 2025 and 1.9% in CY 2026, before improving to 2.1% in CY 2027. The region continues to face structural manufacturing weakness, geopolitical spillovers and subdued external demand, although gradual stabilization in trade and domestic demand is expected to support recovery.

For Latin America and the Caribbean, growth stood at 2.4% in CY 2024 and remained unchanged at 2.4% in CY 2025 and CY 2026, before improving to 2.7% in CY 2027. The modest outlook reflects weak productivity trends, fiscal constraints, and subdued external demand, partially supported by improving macroeconomic stability and policy credibility.

In the Middle East and Central Asia, growth stood at 3.1% in CY 2024 and improved to 3.7% in CY 2025, before declining sharply to 0.7% in CY 2026 and rebounding to 6.5% in CY 2027. This volatility reflects geopolitical disruptions, particularly conflicts affecting energy markets, alongside fluctuations in commodity prices and regional uncertainty.

Sub-Saharan Africa recorded growth of 4.2% in CY 2024, improving to 4.5% in CY 2025. Growth is projected to moderate slightly to 4.3% in CY 2026 before improving to 4.5% in CY 2027. Growth is supported by improving domestic demand and supply conditions, although structural constraints, high debt levels and commodity price volatility continue to pose risks.

Overall, while regional growth trajectories remain uneven, emerging and developing economies are expected to continue outperforming advanced economies, supported by relatively stronger domestic demand and favourable demographics. However, disparities persist due to structural challenges, geopolitical tensions, and commodity market volatility.

1.4 Global Economic Outlook

At the current juncture in CY 2026, the global economy continues to exhibit mixed performance, with divergence in outcomes across regions driven by differences in growth dynamics, inflation trends, geopolitical exposure, and policy responses. While the global economy had shown resilience through technology-led investment, accommodative financial conditions, and reduced tariff pressures, the broader outlook has weakened due to the outbreak of conflict in the Middle East, disruptions in energy markets, and elevated geopolitical risks. Structural headwinds, including tighter financial conditions, geoeconomic fragmentation, and subdued productivity growth, continue to keep global growth below historical averages.

The United States continues to demonstrate relative resilience among advanced economies, though growth is moderating as the economy absorbs the lagged effects of prior policy tightening and softer labour market conditions. Across advanced economies, growth is projected at 1.7% in CY 2026, constrained by weak industrial activity, lower productivity growth, and cautious business investment. In Europe, growth conditions remain subdued, with persistent manufacturing weakness, energy-related uncertainties, and weak external demand weighing on activity, although gradual monetary easing and fiscal support may provide some stabilization.

In China, growth prospects remain constrained by continued property sector stress, weak domestic demand, and changing trade dynamics, although export-oriented sectors and technology-linked investment continue to provide support. In contrast, India remains among the strongest-performing major economies, with GDP growth projected at 7.0% (calendar year basis) in CY 2026, supported by resilient domestic demand, sustained infrastructure

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investment, digitalisation, and structural reforms. Broader Emerging and Developing Asia continues to outperform other regions, although growth is moderating amid weaker global trade momentum.

In Latin America and the Caribbean, growth remains modest amid fiscal constraints, weak productivity trends, and subdued external demand, although improving macroeconomic management in some economies provides support. Sub-Saharan Africa is expected to see gradual strengthening supported by improving supply conditions and domestic demand recovery, while the Middle East and Central Asia face a more volatile outlook due to direct spillovers from conflict-related disruptions and uncertainty in commodity markets. The impact of energy supply risks, including disruptions related to the Strait of Hormuz, has increased downside risks for commodity-importing economies and vulnerable emerging markets.

Globally, inflation dynamics have become more challenging. Global headline inflation is projected to rise to 4.7% in CY 2026 from 4.1% in CY 2025, reflecting the inflationary effects of higher energy prices, supply-side disruptions, and second-round pressures. Central banks are therefore expected to remain vigilant, with policy responses remaining cautious and data dependent. While monetary easing had been expected to support demand, renewed inflation risks may delay or moderate the pace of policy normalization in several economies.

Looking ahead, the medium-term outlook remains one of slower but stable growth, with global GDP projected at 3.4% in CY 2027, following a moderation to 3.0% in CY 2026, below the long-term historical average. Advanced economies are expected to remain on a structurally lower growth path, while emerging and developing economies continue to provide the primary engine of global growth. Future prospects will depend significantly on the evolution of geopolitical tensions, the normalization of energy markets, progress in restoring trade stability, and the extent to which productivity gains from technological innovation, including artificial intelligence, translate into broader economic growth. The IMF also highlights that structural reforms, multilateral coordination, and strengthened macroeconomic resilience will be critical to sustaining growth momentum over the medium term.

Overall, while the global economy remains resilient, the outlook has become more fragile amid elevated downside risks. Growth in CY 2026 and beyond is expected to remain below historical averages, shaped by geopolitical uncertainty, tighter financial conditions, and structural constraints, although emerging economies—particularly India and broader Asia—continue to provide relative support to global growth.

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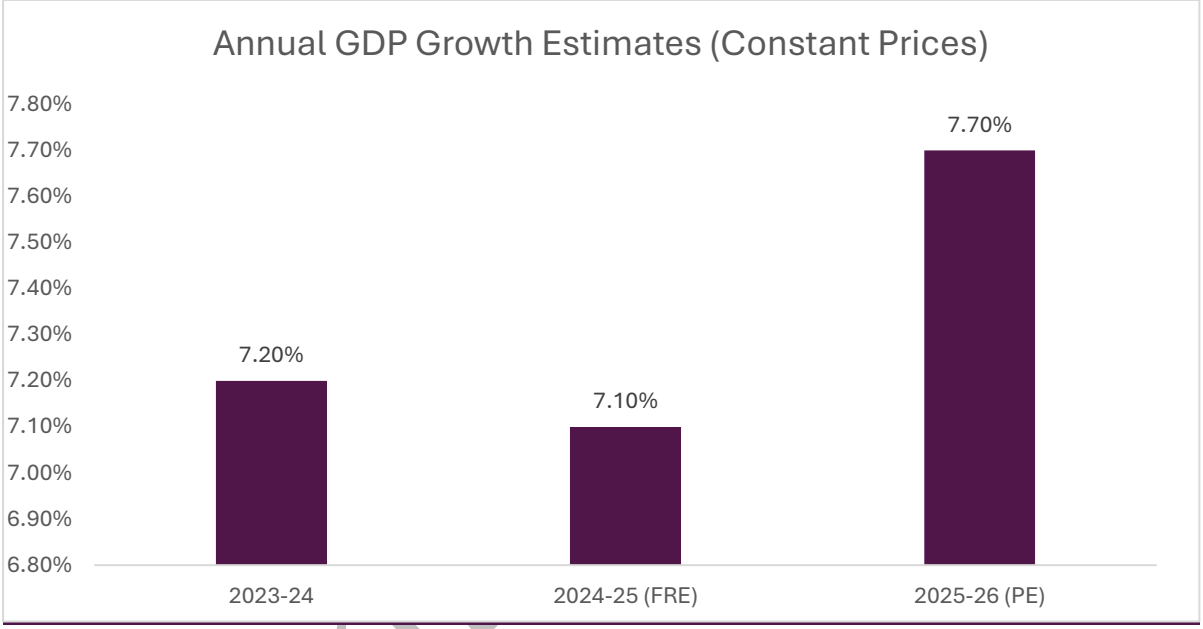
2. *India's Macroeconomic Scenario*

2.1 Gross Domestic Product (GDP)

According to the latest Provisional Estimates by MOSPI, GOI (05 June 26), Real GDP has been estimated to grow by 7.7% in FY 2025-26. Nominal GDP has witnessed a growth of 8.9%. Real GDP or GDP at Constant Prices is estimated to attain a level of INR 323.12 lakh crore in the FY 2025-26, against the First Revised Estimate (FRE) of GDP for the year 2024-25 of INR 299.89 lakh crore.



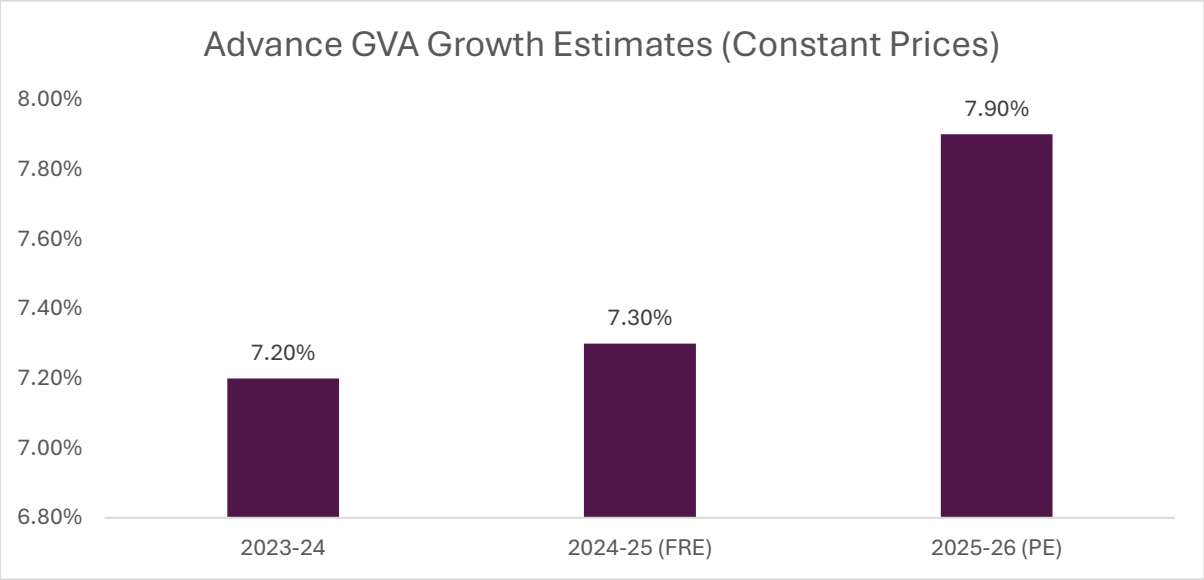
Note: FRE - First Revised Estimates; PE – Provisional Estimate
Source: New Series of Gross Domestic Product (GDP) Estimates with Base Year 2022-23 by MOSPI, PIB Press Release dated 05 June 2026).

According to the International Monetary Fund (IMF) World Economic Outlook Database (April 2026), India is estimated to be the sixth-largest economy in the world in 2026, with a Gross Domestic Product (GDP) of approximately USD 4.15 trillion at current prices. India's ranking reflects the latest national accounts data, including the revised GDP series released by the Government of India, which changed the base year from FY 2011-12 to FY 2022-23. India's position in the global ranking is influenced by the revised GDP estimates and the depreciation of the Indian Rupee against the U.S. Dollar.

The economies ranked ahead of India are the United States (USD 32.38 trillion), China (USD 20.85 trillion), Germany (USD 5.45 trillion), Japan (USD 4.38 trillion), and the United Kingdom (USD 4.26 trillion).

2.2 Gross Value Added (GVA)

According to the Provisional Estimate of GDP for 2025-26 by MOSPI, Govt. of India (GoI), Real GVA is estimated at INR 294.91 lakh crore in the year 2025-26, against INR 273.36 lakh crore in FY 2024-25, registering a growth rate of 7.9% as compared to 7.3% growth rate in 2024-25. Nominal GVA is estimated to attain a level of INR 314.87 lakh crore during FY 2025-26, against INR 288.54 lakh crore in 2024-25, showing a growth rate of 9.1%.



Note: FRE - First Revised Estimates; PE – Provisional Estimate
Source: New Series of Gross Domestic Product (GDP) Estimates with Base Year 2022-23 by MOSPI, PIB Press Release dated 05 June,2026)

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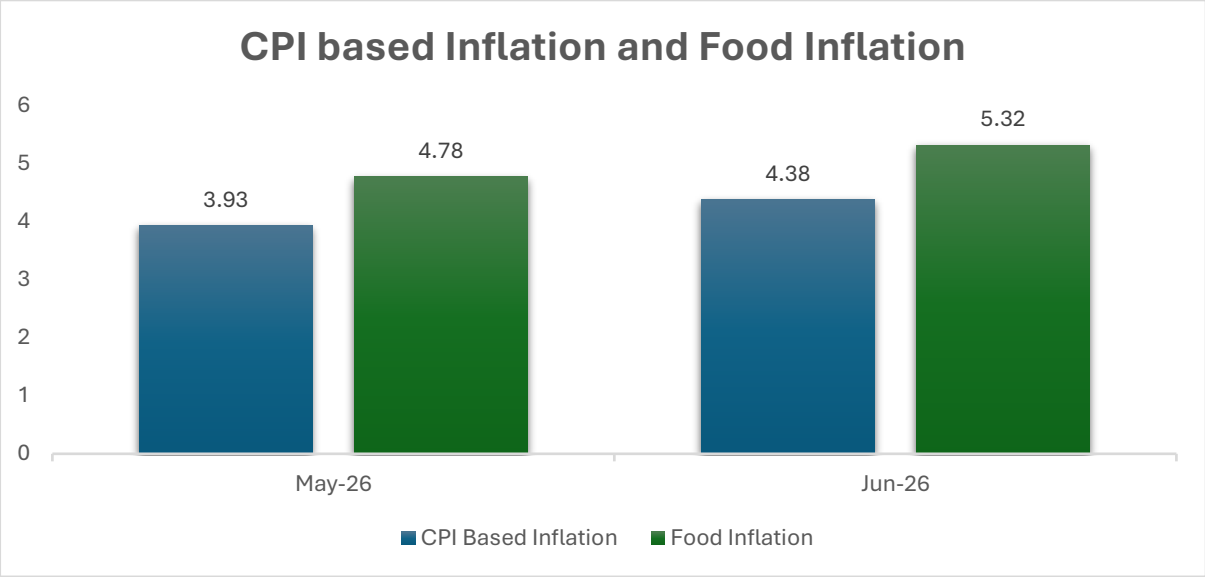
2.3 Consumer Price Index (CPI)

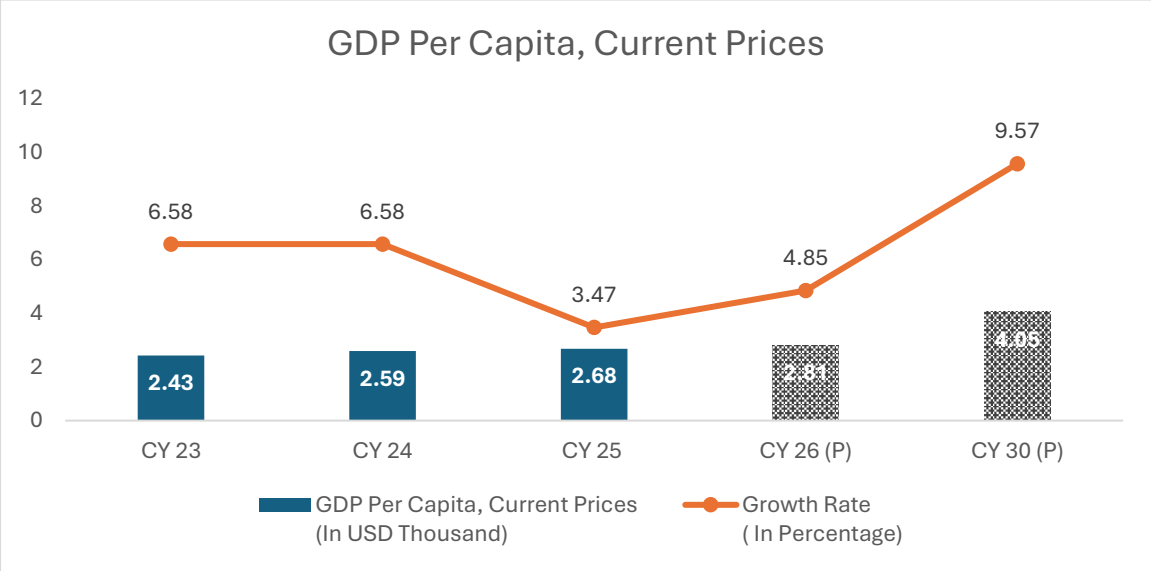
Year-on-year inflation rate based on All India Consumer Price Index (CPI) with base year 2024 for the month of June 2026 over June, 2025 is 4.38%(Provisional). Corresponding inflation rates for rural and urban are 4.74% and 3.92%, respectively.



Source: MOSPI, GOI, 13 July 2026

2.4 India Per Capita GDP Forecast

Per capita GDP growth for India is estimated at 9.57 % CAGR between FY 2026-FY 2030. Increased individual incomes are expected to create additional discretionary spending, which may be beneficial for the sector.



Note: E = Estimated, P = Projected

Source: IMF Data Mapper, World Economic Outlook April 2026, India, GDP Per Capita

2.5 Private Final Consumption Expenditure (PFCE)

Private Final Consumption Expenditure (PFCE) represents the total spending by resident households on final consumption of goods and services, serving as a key indicator of consumer demand and overall economic well-being. It reflects the extent of household consumption and plays a crucial role in driving GDP growth. PFCE, at constant prices, accounted for 55.7% of GDP in FY2026 (same as FY2025). This marks a gradual moderation from 56.4% in FY2024 and 57.1% in FY2023, indicating a relative shift in the composition of economic growth. The decline is primarily attributable to higher changes in stocks (inventory build-up), which increased the share of investment components in GDP, even as household consumption continues to remain a key driver of the economy.

Source: - MOSPI, Press Note on New Series of GDP Estimates with Base Year 2022-23, Provisional Estimates of Annual Gross Domestic Product For 2025-26 released on June 05th, 2026.

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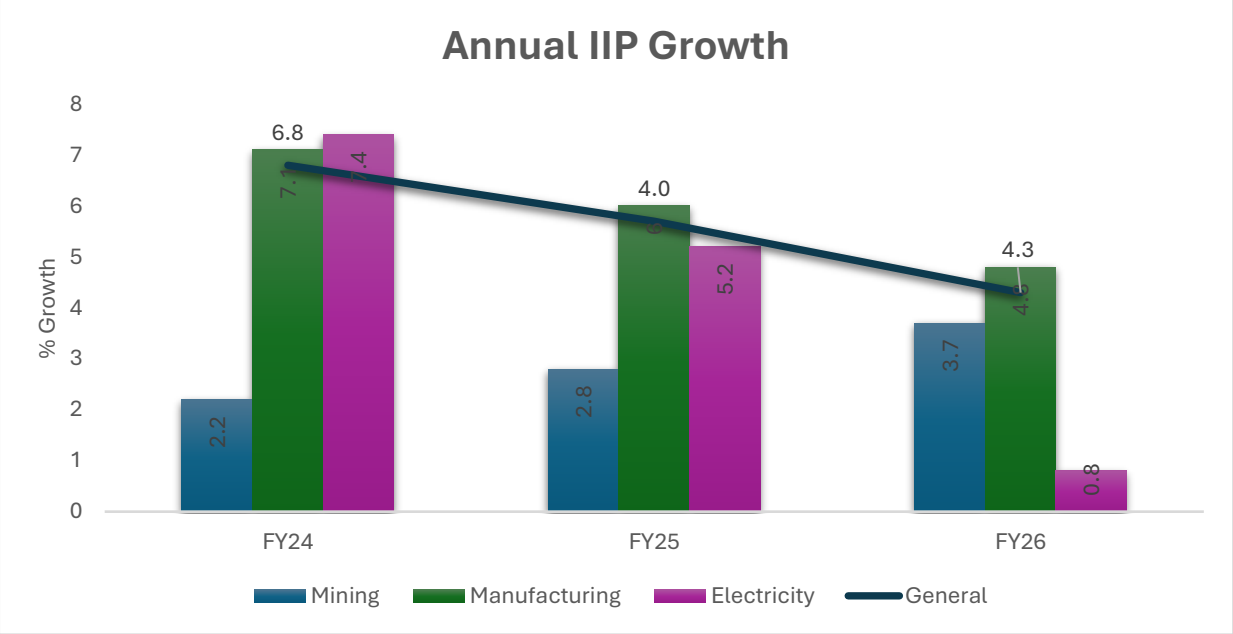
2.6 IIP Growth – Index of Industrial Production

As per the Index of Industrial Production (IIP), industrial output grew by 7.3% in June 2026, indicating an improvement in industrial activity compared with the 5.7% growth recorded during FY 2025. IIP growth had moderated from 6.8% in FY 2024 to 5.7% in FY 2025, reflecting a moderation in industrial momentum during the year. The subsequent acceleration in June 2026 indicates a strengthening in industrial activity, supported by improved output across key industrial segments.

Among key components:

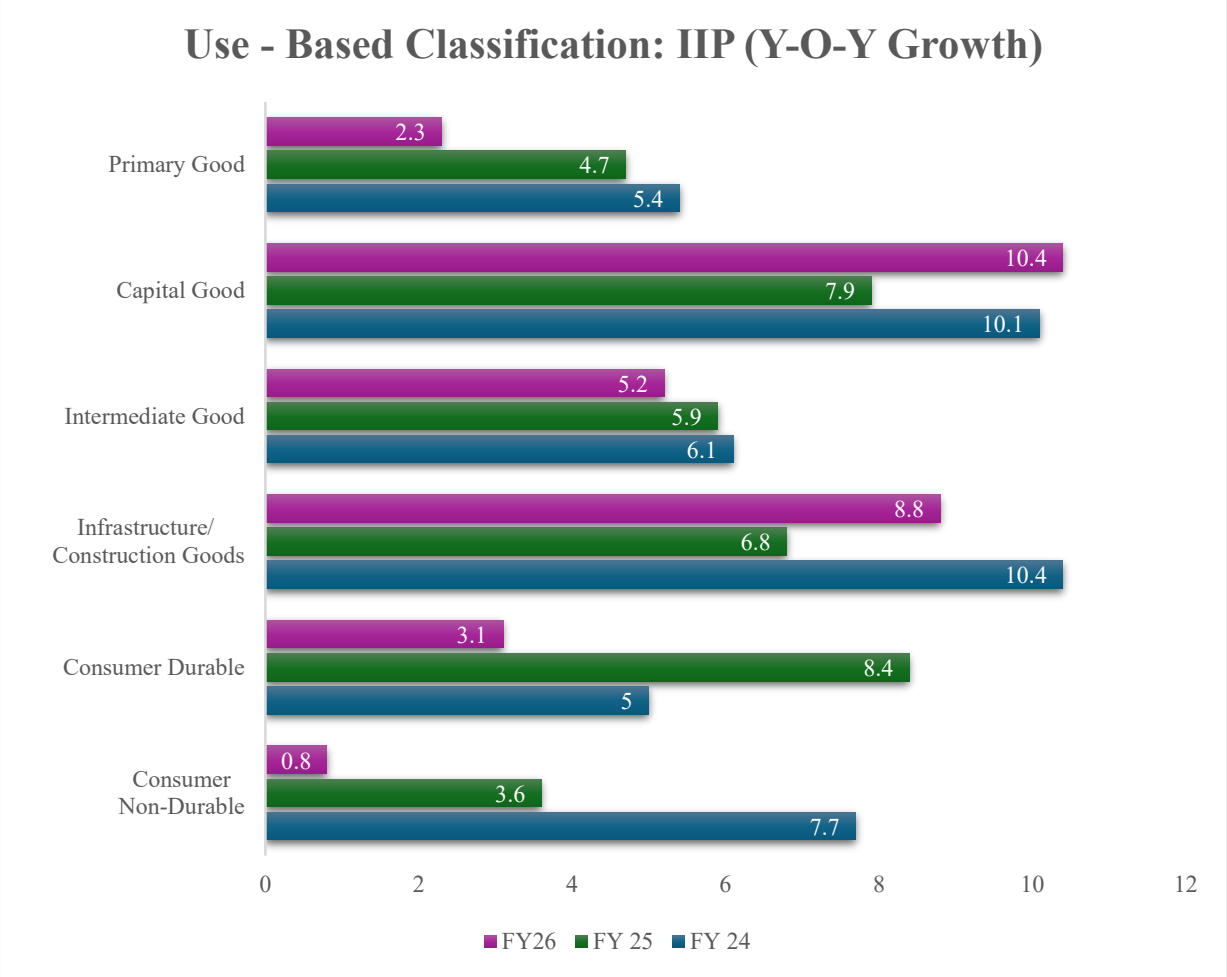
- Manufacturing, which carries a 77.6% weight in the IIP, recorded 4.8% growth in FY 2026, compared with 6.0% growth in FY 2025, following 7.1% in FY 2024, indicating a moderation in manufacturing activity during FY 2026.
- Mining recorded 3.7% growth in FY 2026, compared with 2.8% growth in FY 2025 and 2.2% in FY 2024, indicating an improvement in mining activity during FY 2026.
- Electricity registered 0.8% growth in FY 2026, compared with 5.2% in FY 2025 and 7.4% in FY 2024, reflecting a significant moderation in electricity output during FY 2026.
- Overall IIP growth stood at 4.3% in FY 2026, compared with 5.7% in FY 2025 and 6.8% in FY 2024, indicating a broad moderation in industrial activity during FY 2026.

This slowdown indicates tightening domestic demand and spillover effects from a weaker global industrial cycle.



Source: Ministry of Statistics & Programme Implementation (MOSPI); Base Year 2022-23

Use-Based Classification Trends:



Source: Ministry of Statistics & Programme Implementation (MOSPI); Base Year 2022-23.

According to the use-based classification:

- Capital Goods growth improved to 10.4% in FY 2026 from 7.9% in FY 2025, following 10.1% in FY 2024, indicating a recovery in investment-oriented industrial activity.
- Primary Goods growth moderated further to 2.3% in FY 2026 from 4.7% in FY 2025, following 5.4% in FY 2024, reflecting a continued deceleration in the segment.
- Intermediate Goods growth moderated to 5.2% in FY 2026 from 5.9% in FY 2025, after recording 6.1% in FY 2024, indicating a slight easing in industrial input demand.
- Infrastructure/Construction Goods recorded the strongest growth among the major use-based categories at 8.8% in FY 2026, improving from 6.8% in FY 2025, following 10.4% in FY 2024, reflecting sustained momentum in infrastructure and construction-related activities.
- Consumer Durables growth moderated to 3.1% in FY 2026 from 8.4% in FY 2025, after recording 5.0% in FY 2024, indicating softer demand for durable consumer goods.

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- Consumer non-durables registered 0.8% growth in FY 2026, compared with 3.6% growth in FY 2025 and 7.7% in FY 2024, reflecting a significant moderation in demand for non-durable consumer goods.

The use-based classification indicates a broad-based improvement in industrial activity in FY 2026, led by Infrastructure/Construction Goods, Capital Goods and Intermediate Goods. Consumer Durables continued to grow, albeit at a slower pace, while Primary Goods recorded a sustained moderation and Consumer Non-Durables remained subdued.

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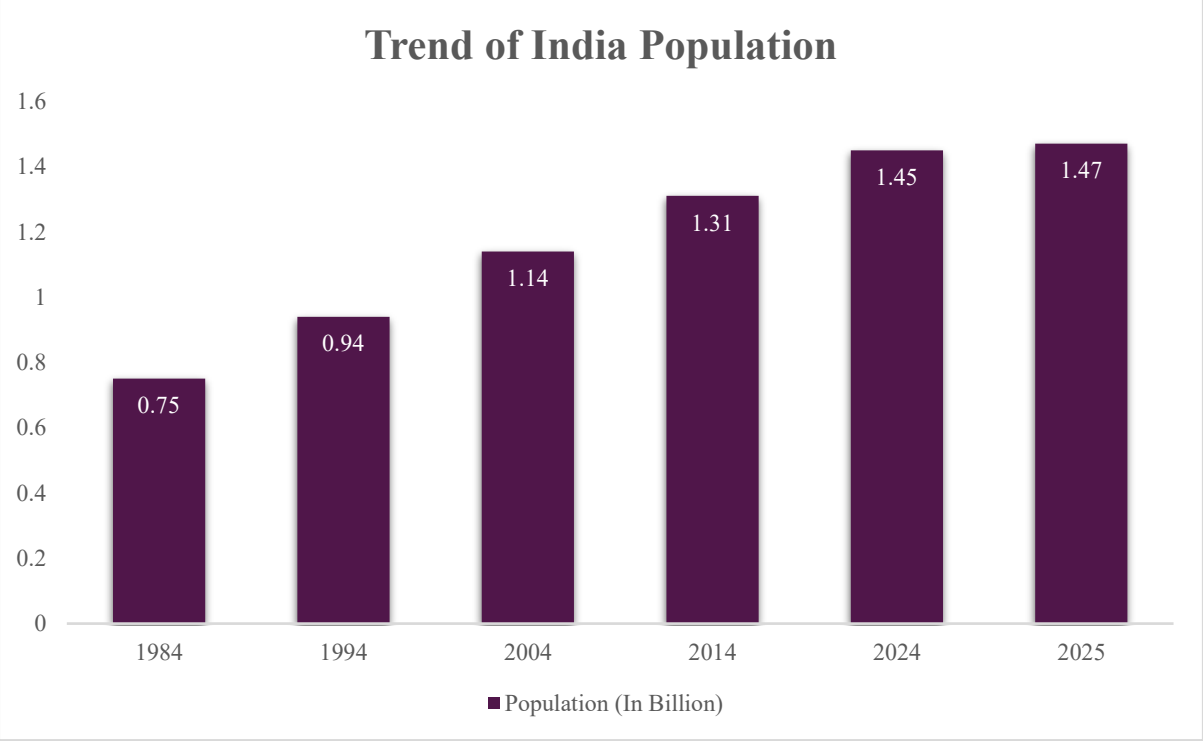
2.7 Overview on Key Demographic Parameters

2.7.1 Population growth

India's economic trajectory and consumption dynamics are closely tied to its demographic shifts. India's population expanded from approximately 0.75 billion in 1984 to 1.45 billion in 2024 and is further reached around 1.47 billion in 2025, consolidating its position as the world's most populous nation. This sustained growth underlines the emergence of a vast labour force and consumer base, which is essential for driving long-term economic growth, supporting rising consumption demand and strengthening the country's overall economic potential.



Source: World Bank Database. Population Data 2025 - Worldometer, Marqis Analytics

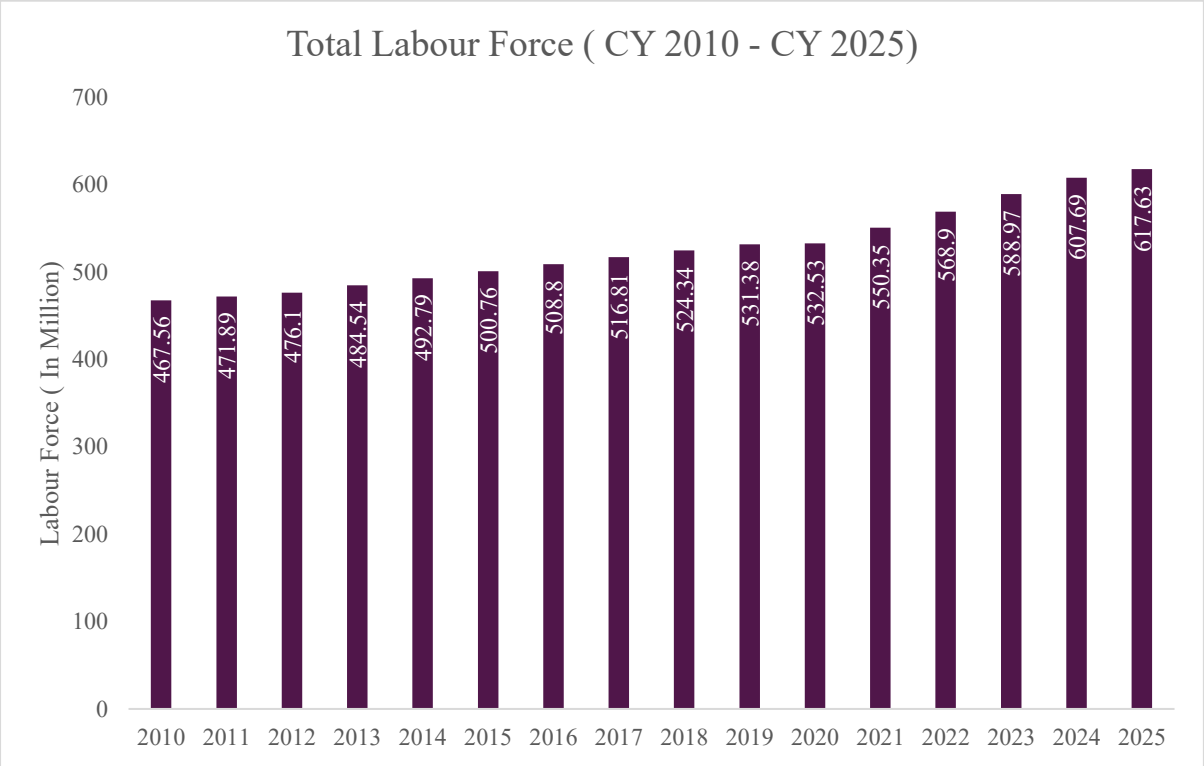
2.7.2 Labour Force in India

India's labour force has experienced steady growth over the past decade. In 2010, the total labour force was approximately 467.56 million. By 2025, this number had increased to 617.63 million.

This upward trend underscores the expanding working-age population, improving labour force participation and gradual recovery in employment post the pandemic period. The sharp increase observed after 2020 highlights the rebound in economic activity and rising workforce engagement across sectors. However, it also emphasizes the need for sustained job creation to effectively absorb the growing labour pool.

The labour force participation rate (LFPR) has also witnessed variations over time due to changing socio-economic conditions, including urbanization, education levels and sectoral employment shifts.

These trends highlight the importance of implementing policies that not only generate employment opportunities but also improve job quality, productivity and inclusivity across key sectors of the economy.



Source: World Bank Database

2.7.3 Labour Laws in India

Labour is a subject under the Concurrent List of the Indian Constitution, enabling both the Central and State Governments to frame relevant legislation. In a major reform initiative, the Government of India has consolidated 29 existing central labour laws into four comprehensive Labour Codes to simplify compliance, reduce multiplicity of definitions, and promote transparency. These include:

- The Code on Wages, 2019
- The Industrial Relations Code, 2020
- The Code on Social Security, 2020
- The Occupational Safety, Health and Working Conditions Code, 2020

As of 31st December 2024, the Central Government and most States/Union Territories had pre-published draft rules under all four Labour Codes. Regional consultations were held to align state-level rules with the central framework. Once fully implemented, these Codes are expected to harmonize the needs of workers and industry, facilitate ease of doing business, and support employment generation.

Additionally, the Ministry of Labour & Employment is revamping the Shram Suvidha Portal to improve regulatory compliance and has launched the e-Shram Portal to register workers from the unorganised sector. Over 30 crore registrations have been completed, and the portal has been integrated with 12 key social welfare schemes, enabling targeted delivery of benefits.

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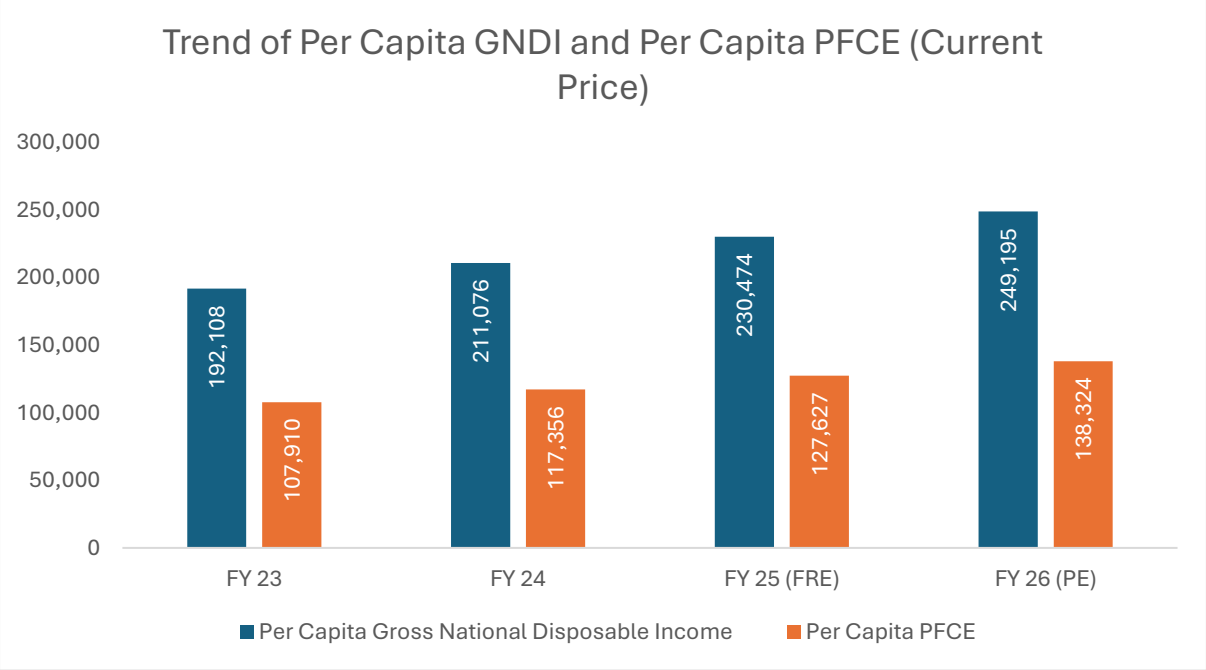
2.7.4 Disposable Income and Consumer Spending

Gross National Disposable Income (GNDI) represents the total income available to a nation's residents for consumption and saving after accounting for income transfers with the rest of the world. Per Capita GNDI has exhibited a steady upward trend over the recent years, increasing from approximately INR1,92,108 in FY23 to INR 2,11,076 in FY24 and further to INR 2,49,195 in FY26 (PE). It reflects the continued growth in income available to households and businesses, supporting consumption and savings activities within the economy.

The rise in disposable income has been accompanied by higher consumer spending, as reflected in the growth of Private Final Consumption Expenditure (PFCE), which measures the total value of goods and services consumed by households. Per Capita PFCE increased from approximately INR 1,07,910 in FY23 to INR 1,38,324 in FY26 (PE). The growth of approximately 8.0% in FY26 over FY25 indicates sustained consumer demand and continued expansion in household consumption expenditure, supported by rising income levels and economic activity.



Note: Data mentioned is in INR, FRE – First Revised Estimates, PE – Provisional Estimates.
Source: PIB, New Series of Gross Domestic Product (GDP) release date on 5th June 2026. Estimates with Base Year 2022-23

2.8 Union Budget FY26-27 Highlights

The Union Budget FY 2026–27, presented by Finance Minister Nirmala Sitharaman, introduces a comprehensive set of measures aimed at stimulating economic growth, enhancing infrastructure and fostering inclusive development. With a focus on sectors such as agriculture, MSMEs, infrastructure, innovation and exports, the budget seeks to create a conducive environment for sustained economic expansion.

- **Capital Expenditure and Infrastructure Development**
  In FY2026-27, the Union Budget has increased the public capex towards to INR 12.2 lakh crore from the previous INR 11.21 lakh crore (3.1% of GDP) which was earmarked in FY 2025–26. To strengthen the confidence of private developers regarding risks during infrastructure development and construction phase, the budget proposed to set up an Infrastructure Risk Guarantee Fund to provide prudently calibrated partial credit guarantees to lenders.
- **Support for MSMEs**
  Recognizing the pivotal role of Micro, Small and Medium Enterprises (MSMEs) in India's economic landscape, the budget introduced a three-pronged approach to support the sector. The budget introduced a dedicated INR 10,000 crore SME Growth Fund as well as proposed to top up the Self-Reliant India Fund set up in 2021, with INR 2,000 crore to continue support to micro enterprises and maintain their access to risk capital. With TReDS, more than INR 7 lakh crore has been made available to MSMEs. To leverage its full potential, the budget further proposed four measures: (i) mandate TReDS as the transaction settlement platform for all purchases from MSMEs by CPSEs, serving as a benchmark for other corporates; (ii) introduce a credit guarantee support mechanism through CGTMSE for invoice discounting on TReDS platform; (iii) link GeM with TReDS for sharing information with financiers about government purchases from MSMEs, encouraging cheaper and quicker financing; (iv) introduce TReDS receivables as asset-backed securities, helping develop a secondary market, enhancing liquidity and settlement of transactions. Moreover, Government will facilitate Professional Institutions such as ICAI, ICSI, ICMAI to design short-term, modular courses and practical tools to develop a cadre of 'Corporate Mitras', especially in Tier-II and Tier-III towns, which will help MSMEs meet compliance requirements at affordable costs.
- **Establishment of dedicated Rare Earth Corridors**
  A Scheme for Rare Earth Permanent Magnets was launched in November 2025. In line with that, the budget proposed to support the mineral-rich States of Odisha, Kerala andhra Pradesh and Tamil Nadu to establish dedicated Rare Earth Corridors to promote mining, processing, research and manufacturing.

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- **Agriculture Related Schemes**
  To diversify farm outputs, increase productivity, enhance farmers' incomes and create new employment opportunities, the budget announced support schemes related to high value crops such as coconut, sandalwood, cocoa and cashew in coastal areas. Agar trees in Northeast and nuts such as, almonds, walnuts and pine nuts in hilly regions will also be supported. India is the world's largest producer of coconuts.
  About 30 million people, including nearly 10 million farmers, depend on coconuts for their livelihood. To further enhance competitiveness in coconut production, the Budget proposed a Coconut Promotion Scheme to increase production and enhance productivity through various interventions including replacing old and non-productive trees with new saplings/plants/varieties in major coconut growing States. A dedicated programme is proposed for Indian cashew and cocoa to make India self-reliant in raw cashew and cocoa production and processing, enhance export competitiveness and transform Indian Cashew and Indian Cocoa into premium global brands by 2030.
  Further, the Central Government will partner with State Governments to promote focused cultivation and post-harvest processing to restore the glory of the Indian Sandalwood ecosystem. To rejuvenate old, low-yielding orchards and expand high-density cultivation of walnuts, almonds and pine nuts, the budget announced to support a dedicated programme to enhance farmer incomes and in bringing value addition by engaging youth.

The Union Budget FY 2026–27 presents a balanced approach to economic growth by addressing immediate consumption needs and laying the foundation for long-term sustainability. Through targeted investments in infrastructure, support for MSMEs and sector-specific initiatives, the budget aims to foster an inclusive and resilient economy. These measures are expected to create new opportunities for financial institutions, as the growing demand for investment products will provide avenues for expansion and innovation in the financial services sector.

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2.9 Concluding Remarks about Macroeconomic Scenario

The major headwinds to global economic growth remain significant, including escalating geopolitical tensions, volatility in global energy and commodity markets, persistent inflationary pressures, tighter financial conditions, geoeconomic fragmentation, rising public debt, climate-related disruptions, and uncertainty surrounding the pace and impact of technological transformation. In particular, the ongoing Middle East conflict and associated risks to energy supply chains have heightened downside risks to the global outlook, while weaker trade momentum and structural productivity challenges continue to weigh on medium-term growth prospects.

Despite these challenges, India's economy remains relatively well-positioned compared to other major emerging markets. According to the IMF's April 2026 WEO, India's GDP growth is projected at 6.5% in CY 2026, maintaining its position as one of the fastest-growing major economies globally and significantly above the global growth projection of 3.1%. Key positive factors supporting India's growth include resilient domestic demand, sustained public infrastructure spending, a strengthening investment cycle, expanding digital infrastructure, and continued progress in structural reforms. Inflation, as measured by the Consumer Price Index (CPI), remained contained at 3.4% in March 2026 under the revised base year, supporting household purchasing power, although rising global oil prices and supply disruptions may pose upside risks.

India's strategic position as a manufacturing and investment destination continues to strengthen, supported by government initiatives, supply chain diversification trends, a skilled labour force, and a dynamic innovation ecosystem. Public investment is expected to remain a critical growth driver, with the Union Budget FY 2026–27 increasing capital expenditure to INR 12.21 lakh crore from INR 11.21 lakh crore in the previous year, reinforcing the government's investment-led growth strategy. In addition, the proposed Infrastructure Risk Guarantee Fund is aimed at improving private sector participation in infrastructure by mitigating project-related risks, which is expected to crowd in private investment, enhance infrastructure capacity, and support long-term productivity growth.

Private sector investment intentions are also expected to strengthen alongside public capex, while rising disposable incomes, improving rural demand, and continued policy support are likely to reinforce consumption momentum. Strengthening supply chains, expanding infrastructure capacity, and sustaining inflation stability will be critical in supporting resilience against external shocks. These factors are expected to support India's medium-term growth momentum and strengthen its ability to navigate global uncertainties.

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3. Industry Definition and Scope – Solar EPC Services

The Indian Solar Engineering, Procurement and Construction ("EPC") Services Industry forms part of the broader renewable energy and power infrastructure ecosystem and provides engineering and execution capabilities for solar projects across utility-scale, commercial and industrial ("C&I"), residential and institutional applications. Solar EPC encompasses design and engineering, procurement, construction, installation, testing and commissioning, together with project development and, in several cases, operations and maintenance ("O&M") services. The industry links solar technology and equipment providers, project developers, asset owners and end-users in converting solar-power opportunities into operational generation assets.

The industry comprises pure-play solar EPC contractors, renewable energy companies with EPC capabilities, equipment manufacturers offering integrated solutions and specialised O&M providers. Services cover rooftop, ground-mounted utility-scale, open-access, group captive and other grid-connected applications, as well as emerging floating solar and solar-plus-storage configurations. Certain State regulatory frameworks also provide for Group Net Metering ("GNM") and Virtual Net Metering ("VNM") arrangements for eligible renewable-energy systems. Under GNM, electricity generated by a renewable-energy system may, subject to applicable regulations, be adjusted against consumption at multiple electricity service connections of the same eligible consumer or entity within the relevant distribution-licence area. Under VNM, electricity generated by an eligible renewable-energy system may, subject to applicable regulations, be allocated or credited among multiple participating consumers or electricity service connections within the relevant distribution-licence area. The eligibility criteria, ownership requirements, metering arrangements, billing mechanisms and other conditions applicable to GNM and VNM vary across States and are governed by the relevant State Electricity Regulatory Commission and distribution licensee. EPC scopes include site assessment, system design and engineering, procurement of modules, inverters, mounting structures and other balance-of-system components, civil and electrical works, grid interconnection, testing and commissioning, followed, where contracted, by O&M and performance monitoring.

Within the solar value chain, EPC providers undertake site evaluation, system sizing and design, engineering, equipment procurement, civil and electrical construction, installation, grid connectivity, testing and commissioning. The industry serves C&I enterprises, residential consumers, government and public-sector entities, utilities, independent power producers ("IPPs"), renewable energy developers and other institutional customers. Project scale and configuration vary with customer requirements, available land or rooftop area, electricity consumption, grid connectivity and applicable regulations.

The industry has evolved from relatively fragmented installation activity towards organised EPC and integrated solar solution providers capable of executing larger, technically complex

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and geographically distributed projects. Digital monitoring, remote supervision, automated data acquisition, inverter- and string-level performance monitoring and data-based maintenance are enhancing operational visibility, while improvements in module and inverter technologies and increasing deployment of battery energy storage and hybrid configurations are expanding available technical solutions.

Solar EPC projects span industrial and commercial rooftops, urban and rural locations, agricultural land, solar parks and other ground-mounted sites. Execution requires consideration of site conditions, solar resource availability, system design, equipment specifications, civil and electrical infrastructure, grid connectivity, technical standards and regulatory requirements. Compliance with applicable equipment requirements, including the Approved List of Models and Manufacturers ("ALMM"), where applicable, and quality control over modules, inverters, structures and other balance-of-system components are relevant to project execution and system performance.

The industry also operates under capital expenditure ("CAPEX"), operating expenditure ("OPEX")/Renewable Energy Service Company ("RESCO"), open-access and group captive models, depending on project structure and customer requirements. These models provide alternative mechanisms for solar adoption and management of project investment, electricity procurement and operating requirements, while increasing rooftop, distributed and open-access deployment expands opportunities beyond conventional utility-scale projects.

India's cumulative installed solar capacity reached 162.15 GW as of June 30, 2026, comprising approximately 121.25 GW of ground-mounted, 30.11 GW of grid-connected rooftop, 4.36 GW of the solar component of hybrid projects and 6.43 GW of off-grid solar capacity. The expansion of the installed base has increased requirements for project engineering, construction, commissioning, monitoring and lifecycle maintenance services. [MNRE, Physical Achievements – June 2026]

Government programmes including the Grid Connected Rooftop Solar Programme, PM Surya Ghar: Muft Bijli Yojana and PM-KUSUM support rooftop, residential and decentralised solar deployment, respectively. These initiatives, together with utility-scale renewable-energy procurement and state-level solar programmes, contribute to project opportunities for EPC service providers. [MNRE]

As the solar base expands, EPC providers are increasingly extending their role beyond construction and commissioning to O&M, remote monitoring, performance optimisation, troubleshooting and other lifecycle services. Participants are differentiated by project execution and engineering capabilities, procurement and project management, geographic reach, technology integration, quality assurance and post-commissioning support, reflecting the industry's transition towards integrated solar project execution and lifecycle services.

The Indian Solar EPC Services Industry represents an important execution layer within the country's renewable-energy and power infrastructure ecosystem. Continued solar-capacity additions, increasing rooftop, distributed and C&I adoption, growth in open-access applications and policy support are expected to sustain opportunities across the solar project

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lifecycle. At the same time, participants are required to manage equipment procurement, project timelines, working capital, grid connectivity, regulatory compliance, technical quality and post-commissioning performance, creating opportunities for organised players with established execution capabilities, technical expertise, geographic reach and integrated O&M and monitoring services.

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4. Market Segmentation

The Indian Solar EPC Services Industry exhibits a diversified structure based on project type and application, customer segment, commercial model, technology configuration, service offering, project scale, geography and participant profile. These dimensions reflect differences in project requirements, execution complexity, customer needs, financing structures and technical capabilities, and provide a framework for assessing demand and competitive positioning across the solar project lifecycle.

Category	Sub-Category	Description / Insights
By Project Type and Application	**Utility-Scale Ground-Mounted Solar**	Large grid-connected solar projects and solar parks developed by utilities, independent power producers ("IPPs"), renewable-energy developers and government agencies. EPC scope generally includes site development, civil works, mounting structures, module and inverter installation, electrical infrastructure, substations, evacuation facilities, grid connectivity and commissioning.
	Commercial & Industrial ("C&I") Solar	Solar projects serving factories, warehouses, commercial establishments and other industrial or commercial consumers. Projects may be rooftop, ground-mounted or structured through open-access or group captive arrangements and generally require customised system design and project execution.
	Rooftop Solar	Solar systems installed on residential, commercial, industrial and institutional rooftops. The segment requires site assessment, structural evaluation, system design, electrical integration and coordination with distribution utilities. Government programmes, including the Grid Connected Rooftop Solar Programme and PM Surya Ghar: Muft Bijli Yojana, support rooftop deployment. [MNRE]

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	Open Access / Group Captive Solar	Off-site solar projects supplying electricity to eligible C&I consumers through applicable open-access arrangements. Group captive projects involve consumer participation in project ownership and electricity consumption in accordance with applicable regulations. EPC providers may undertake plant development and execution, evacuation infrastructure and, where contracted, O&M.
	Group Net Metering ("GNM") / Virtual Net Metering ("VNM")	Regulatory and metering arrangements available under applicable State frameworks for eligible renewable-energy systems. Under GNM, electricity generated by an eligible renewable-energy system may, subject to applicable regulations, be adjusted against consumption at multiple electricity service connections of the same eligible consumer or entity within the relevant distribution-licence area. Under VNM, electricity generated by an eligible renewable-energy system may, subject to applicable regulations, be allocated or credited among multiple participating consumers or electricity service connections within the relevant distribution-licence area. Eligibility, ownership requirements, capacity limits, metering, billing and other conditions vary across States and are governed by the relevant State Electricity Regulatory Commission and distribution licensee.
	Government & Institutional Solar	Projects for government departments, public-sector entities, railways, defence, municipalities, educational institutions, hospitals and other public or institutional premises. Projects may be awarded through tenders and executed under EPC, EPC+O&M or RESCO structures.
	Agricultural / Rural Solar	Includes decentralised solar generation, solar agricultural pumps and solarisation of agricultural feeders and related applications. Government programmes such as PM-KUSUM support deployment in this segment. [MNRE]

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	Emerging Applications	Includes floating solar, agri-solar, solar-plus-storage and renewable hybrid projects. These applications may require additional technical capabilities relating to floating structures, storage integration, grid management, land utilisation and system integration.
By Customer / End-Use Segment	**Industrial**	Manufacturing plants, process industries, factories and other energy-intensive users seeking on-site or off-site renewable power.
	Commercial & Institutional	Offices, warehouses, retail establishments, hotels, hospitals, educational institutions and other commercial or institutional premises.
	Residential	Individual households and residential premises, primarily served through rooftop solar installations.
	Government & Public Sector	Government departments, PSUs, municipalities, railways and other public-sector or government-controlled entities.
	Utilities, IPPs & Renewable Developers	Utilities, independent power producers and renewable-energy developers requiring EPC contractors for grid-connected and utility-scale projects.
By Commercial / Ownership Model	**CAPEX Model**	The customer or project owner funds and owns the solar asset, while the EPC contractor undertakes design, procurement, construction and commissioning. O&M may subsequently be contracted separately.
	RESCO / Third-Party Ownership Model	A third-party developer or renewable-energy service company finances, owns and/or operates the solar asset and supplies electricity to the customer under a contractual arrangement, generally reducing the customer's upfront capital requirement.
	Open Access PPA	Electricity is generated at an off-site renewable-energy project and supplied to an eligible consumer through the applicable transmission and distribution network under an agreed contractual structure.

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	Group Captive	Renewable-energy projects involving consumer participation in project ownership and consumption, subject to applicable regulatory requirements. These structures may be used by C&I consumers for renewable-power procurement.
	IPP / Developer-led Projects	Renewable-energy developers or IPPs develop and own projects and sell generated electricity to utilities, government agencies or other eligible purchasers. EPC contractors execute the project for the developer rather than earning revenue from electricity generation.
By Technology / System Configuration	**Crystalline Silicon PV**	Includes mono-crystalline and other crystalline-silicon photovoltaic technologies, which are widely used in solar installations. EPC companies integrate modules with inverters, mounting structures and other balance-of-system components.
	Fixed-Tilt Systems	Fixed mounting structures are widely used across rooftop and ground-mounted projects due to their relatively straightforward design, installation and maintenance requirements.
	Tracking Systems	Single-axis or other tracking systems may be deployed in selected utility-scale projects to increase energy yield, generally involving additional structural, control and O&M requirements.
	Solar-plus-Storage	Integrates photovoltaic generation with battery energy storage systems ("BESS") to support energy management, dispatchability and other grid or customer requirements.
	Hybrid Renewable Systems	Combines solar with wind, storage or other renewable technologies to optimise generation profiles, land utilisation and system integration.
By EPC / Service Offering	**Engineering & Design**	Includes feasibility assessment, site evaluation, system sizing, plant layout, electrical and civil design and other pre-construction engineering activities.

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	Procurement & Supply	Covers procurement and supply of modules, inverters, mounting structures, cables, transformers and other balance-of-system components.
	Construction & Installation	Includes civil works, structural installation, module and equipment installation, electrical works and associated project-execution activities.
	Testing & Commissioning	Includes electrical testing, system integration, grid synchronisation, performance verification and commissioning of the completed solar project.
	Operations & Maintenance ("O&M")	Includes preventive and corrective maintenance, plant monitoring, troubleshooting, performance management and other post-commissioning services.
	Digital Monitoring & Performance Management	Includes remote monitoring, data acquisition, inverter/string-level monitoring, performance analytics and technology-enabled maintenance and asset-management services.
By Project Scale	**Small / Distributed Projects**	Residential, small commercial, institutional and other distributed installations, generally involving multiple sites and relatively smaller individual project capacities.
	Mid-sized Projects	C&I, institutional, distributed and open-access projects requiring greater engineering, procurement and project-management capabilities.
	Large / Utility-scale Projects	Large ground-mounted and grid-connected projects requiring substantial civil, electrical, evacuation and grid-interconnection infrastructure and integrated project execution.
By Geography	**North India**	Includes Rajasthan, Haryana, Punjab, Uttar Pradesh, Delhi and surrounding markets, with applications across utility-scale, C&I, rooftop and institutional solar.
	West & Central India	Includes Gujarat, Maharashtra, Madhya Pradesh and adjoining markets, with solar

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		projects across industrial, utility-scale, C&I, rooftop and open-access applications.
	South India	Includes Karnataka, Tamil Nadu, Andhra Pradesh, Telangana and Kerala, with utility-scale, C&I, rooftop and institutional solar applications.
	East & North-East India	Includes West Bengal, Odisha, Jharkhand, Bihar and the North-Eastern states, with rooftop, institutional, rural and distributed solar applications.
	International Markets	Certain organised EPC participants undertake projects outside India in selected international markets, subject to applicable local regulatory and technical requirements.
By Participant Type	**Large Integrated EPC / Renewable Energy Companies**	Companies with engineering, procurement, construction and project-management capabilities, often supported by project-development, power-generation, equipment supply or O&M businesses. Indicative participants include Tata Power, L&T, Sterling and Wilson Renewable Energy, Mahindra Susten, Jakson Green, Waaree and other integrated renewable-energy companies.
	C&I and Rooftop Specialists	Participants focused on distributed, C&I, rooftop, open-access and RESCO projects, often differentiated by multi-site execution, customer relationships, financing solutions and O&M capabilities.
	Mid-sized / Regional EPC Companies	Organised EPC contractors generally focused on selected States, customer segments or project sizes, competing through regional execution capabilities, customer relationships and project flexibility.
	Small / Local Installers	Fragmented participants serving residential, small commercial and distributed projects, often competing on local presence, price and installation turnaround.

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	O&M / Asset Management Providers	Dedicated or EPC-affiliated service providers undertaking plant monitoring, preventive and corrective maintenance, troubleshooting, performance management and lifecycle asset-management services.

Source: *MNRE, Ministry of Power ("MoP"), Central Electricity Authority ("CEA"), applicable State Electricity Regulatory Commissions, distribution licensees, company disclosures and publicly available industry information, as applicable. The above segmentation is based on project type, customer segment, commercial model, technology configuration, service offering, project scale, geography and participant profile. The categories may overlap, as individual solar projects may fall within more than one category depending on their configuration, customer, ownership structure and applicable regulatory framework. GNM and VNM are State-level regulatory and metering arrangements and their applicability, eligibility, ownership requirements, capacity limits, metering and billing mechanisms may vary across jurisdictions.*

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Segment Interpretation

The Indian Solar EPC Services Industry is diversified across project application, customer segment, commercial model, technology configuration, service offering, project scale and geography, with each segment differing in execution complexity, capital requirements, technical specifications and lifecycle-service needs.

Utility-scale and ground-mounted projects require integrated EPC capabilities covering site development, civil and electrical works, module and inverter installation, substations, evacuation infrastructure and grid connectivity. C&I and rooftop solar involve more customised system design based on site conditions, electricity consumption, available roof area and customer requirements, creating opportunities for multi-site EPC, monitoring and O&M services. Open-access and group captive projects extend EPC requirements to off-site generation, evacuation infrastructure and coordination among developers, consumers and other stakeholders.

Government, institutional, agricultural and rural applications provide additional demand through tender-based and decentralised solar projects, including rooftop, ground-mounted and solarisation applications. Commercial structures such as CAPEX, OPEX/RESCO, open access and group captive provide alternative mechanisms for financing, ownership and procurement of solar power and influence the contractual role of EPC providers.

From a technology perspective, the industry is evolving from conventional photovoltaic installations towards higher-efficiency modules, tracking systems, digital monitoring, hybrid configurations and solar-plus-storage solutions, increasing the importance of engineering, system integration and technology-management capabilities. At the same time, the expanding installed solar base is supporting demand for O&M, remote monitoring, preventive and corrective maintenance, troubleshooting and performance optimisation, extending EPC participation beyond initial construction and commissioning.

The competitive landscape comprises large integrated renewable-energy and EPC companies, C&I and rooftop specialists, regional and mid-sized EPC contractors, local installers and specialised O&M providers. Competition varies by project scale, customer segment, geography, technical capability and ability to provide integrated services.

The industry is progressing from an installation-oriented activity towards integrated solar project execution and lifecycle-service provision. Organised participants with established engineering, procurement and project-management capabilities, technology integration, geographic reach and O&M expertise are positioned to address opportunities across the expanding solar project lifecycle.

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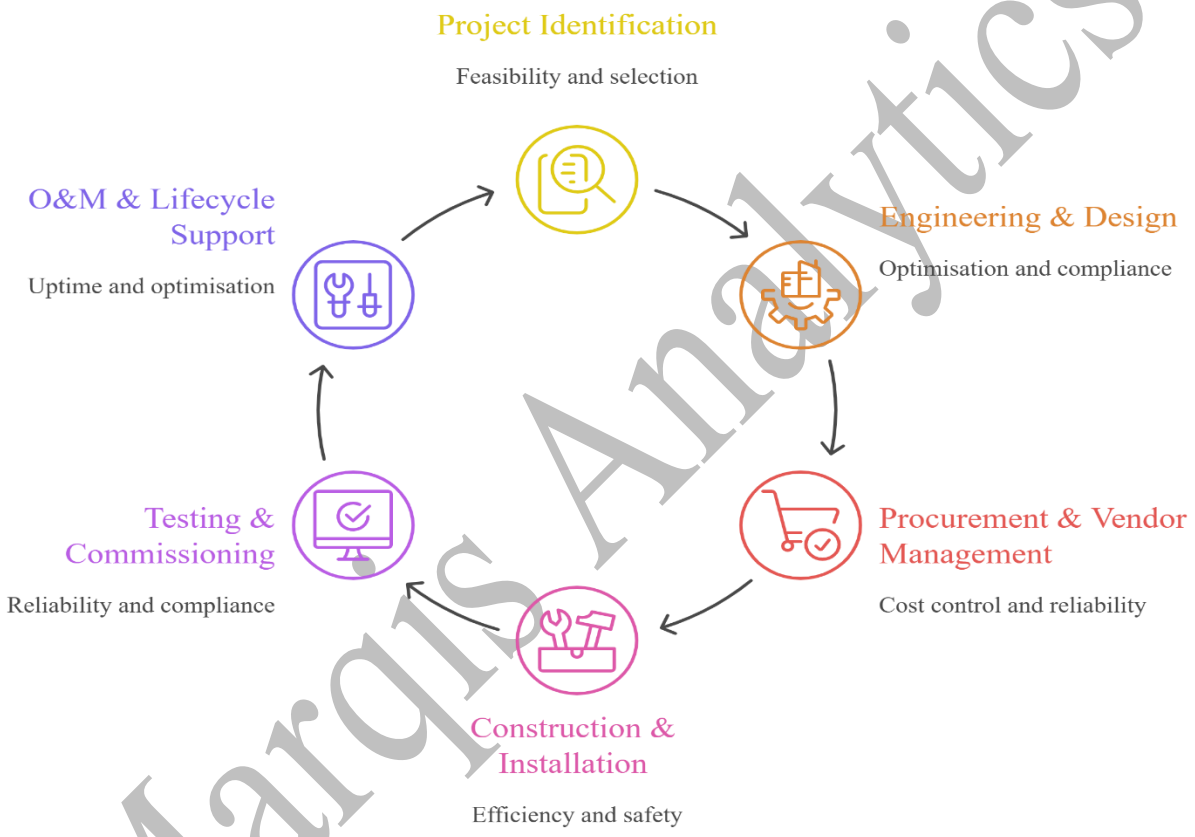
Value Chain Analysis:

The Indian Solar EPC Services Industry operates through an integrated value chain extending from project identification and feasibility assessment to engineering, procurement, construction, commissioning and lifecycle O&M. Value creation across the chain depends on technical design, equipment sourcing, project execution, regulatory coordination, quality management and post-commissioning performance. The value chain varies by project type, including utility-scale, C&I, rooftop, institutional and open-access projects, and may extend into project development and asset management for integrated participants.



1. Project Identification, Feasibility & Bid Preparation

The value chain begins with project identification, business development and feasibility assessment through competitive tenders, pre-qualification processes, direct customer engagement, developer-led pipelines, channel partners and referrals. Participants evaluate site conditions, solar resource, land or rooftop availability, electricity requirements, grid connectivity, project scope, technical specifications, commercial terms and applicable regulatory requirements.

Bid preparation generally includes preliminary system design, energy-yield assessment, scope analysis, cost estimation, resource planning, execution scheduling and risk assessment. For utility-scale and government projects, participants may additionally evaluate land and evacuation status, grid-connectivity requirements, equipment eligibility and payment-security

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arrangements. For C&I and rooftop projects, assessment may include structural suitability, shading, existing electrical infrastructure and customer consumption patterns. Effective project selection and bidding influence contract structure, execution obligations, project economics and profitability.

2. Engineering, System Design & Project Planning

Following project selection or award, engineering and system design constitute the principal technical value-adding stage. Activities include site surveys, solar-resource assessment, system sizing, plant layout, module and inverter selection, mounting-structure design, civil and structural engineering, electrical design, protection systems, monitoring architecture and grid-interconnection planning.

For rooftop and C&I projects, engineering may additionally involve structural and load-bearing assessment, shading analysis, integration with existing electrical systems and coordination for applicable utility approvals. Utility-scale projects require detailed optimisation of plant layout, string and inverter configuration, substations, evacuation systems and associated electrical infrastructure. High-quality engineering improves constructability, reduces rework, optimises equipment utilisation and supports project cost, timeline and generation-performance objectives.

3. Procurement, Vendor Management & Supply Chain

Procurement involves sourcing modules, inverters, mounting structures, cables, transformers, switchgear, monitoring equipment and other balance-of-system components, together with civil and electrical materials and specialised services. Activities include vendor evaluation and qualification, OEM coordination, technical specification, commercial negotiation, purchase-order management, logistics and quality verification.

Procurement strategies are influenced by project specifications, equipment availability, delivery schedules, applicable standards and requirements such as the Approved List of Models and Manufacturers ("ALMM"), where applicable. Projects may involve domestic and, where permitted, imported equipment depending on technical and commercial requirements. Effective vendor and supply-chain management is critical to maintaining material availability, controlling procurement costs, avoiding execution delays and supporting project margins.

4. Construction, Installation & Project Execution

Construction and installation represent the core delivery stage of the EPC value chain. Activities include site preparation, civil works, foundations, mounting-structure installation, module installation, inverter and electrical-equipment installation, cabling, earthing, protection systems, substations, monitoring systems and associated evacuation infrastructure.

Execution requirements vary significantly by project type. Utility-scale projects require large-site management and coordination across multiple civil, structural and electrical work packages, while rooftop and C&I projects require integration with existing facilities and minimisation of disruption to customer operations. Execution performance depends on project

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management, contractor coordination, workforce productivity, safety management, quality control and adherence to approved engineering specifications.

5. Testing, Grid Integration, Commissioning & Handover

Following installation, the project undergoes testing, system integration and commissioning to establish operational readiness and compliance with applicable technical and contractual requirements. Activities may include electrical testing, equipment and protection-system checks, inverter synchronisation, monitoring-system integration, performance verification and grid-connectivity coordination.

For grid-connected projects, commissioning may require coordination with relevant utilities, inspection authorities and other stakeholders for applicable approvals and connectivity requirements. Formal handover generally includes as-built drawings, operating and maintenance manuals, warranties, test records, compliance documentation and client acceptance records. Successful commissioning marks the transition from project execution to commercial operation and subsequent lifecycle management.

6. O&M, Performance Optimisation & Lifecycle Support

The value chain extends beyond commissioning through operations and maintenance ("O&M"), remote monitoring, troubleshooting and performance management. Services may include preventive and corrective maintenance, inspections, module cleaning, inverter and electrical-system servicing, fault identification, spare-parts support, performance analysis and system optimisation.

Digital monitoring, SCADA and data-based performance-management systems enable remote supervision and identification of operational issues. O&M arrangements may include defined availability or performance obligations depending on contractual terms. As the installed solar asset base expands, lifecycle services provide EPC participants with opportunities for recurring revenue, customer retention, repeat projects and longer-term asset relationships.

For integrated renewable-energy companies, the value chain may additionally extend into project development, land and regulatory processes, financing, power-sale arrangements and long-term asset ownership or management. For EPC-focused participants, collaboration with developers and asset owners enables participation in these adjacent stages through EPC, O&M or other project-level arrangements. Feedback from asset owners and end-users on system performance, maintenance requirements and operational conditions can further inform future system design, technology selection and lifecycle upgrades.

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5. Global and Indian Industry Outlook

Global Renewable Power Sector

The global power stack is rapidly transitioning from thermal baseload to variable renewables. Utility-scale solar and wind lead new deployments, while grid-scale batteries and flexible gas turbines increasingly balance intermittency.

- **Economics:** Solar's Levelized Cost of Electricity (LCOE) continues to fall due to advances in module efficiency, balance-of-system scale, digital O&M, and lower financing costs in mature markets.
- **Bottlenecks:** Expansion is still constrained by grid congestion, interconnection delays, land-use constraints, and trade measures (tariffs, AD/CVD).
- **Investor insight:** Solar has shifted from a "growth satellite" to a core capacity-addition asset class. Storage attachment rates are rising, expanding value creation across global portfolios.

Global Renewable Power Installed Capacity by Region (CY20–CY25)

Global renewable energy installed capacity (including solar, wind, hydropower, bioenergy, and geothermal energy) increased from 2,810.89 GW in CY 2020 to 5,149.28 GW in CY 2025, registering a CAGR of 12.87%. The growth was primarily driven by large-scale renewable energy deployment across Asia, Europe, and India, supported by decarbonization targets, energy security initiatives, and continued investment in clean energy infrastructure.

In GW	CY 2020	CY 2021	CY 2022	CY 2023	CY 2024	CY 2025	CAGR '20 '25	Share of global %
World	2,810.89	3,077.12	3,379.38	3,872.82	4,457.34	5149.28	12.87%	100.00%
Asia excl. India	1166.8	1308.94	1467.54	1785.85	2171.87	2640.1	17.74%	51.27%
India	134.77	147.41	163.29	175.87	205.39	250.51	13.20%	4.86%
Europe	606.69	649.38	706.76	782.74	857.56	934.33	9.02%	18.14%
N America	422.33	460.82	490.07	525.99	571.63	613.69	7.76%	11.92%
Africa	51.44	53.57	58.77	65.47	71.09	82.37	9.87%	1.60%
Middle East excl. Saudi	23.21	25.46	30.14	35.02	37.17	44.11	13.70%	0.86%
Saudi Arabia	0.41	0.44	0.84	2.84	6.6	12.33	97.53%	0.24%
Others	270.06	283.25	297.84	320.33	324.04	309.00	2.73%	6.00%

Source: International Renewable Energy Agency (IRENA), Renewable Capacity Statistics 2026.

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Asia (excluding India) remained the largest renewable energy market globally, with installed capacity increasing from 1,166.80 GW in CY 2020 to 2,640.10 GW in CY 2025, representing a CAGR of 17.74% and accounting for 51.27% of global installed renewable energy capacity in CY 2025. The region's growth was largely supported by substantial renewable energy additions across China and other Asian economies.

India's renewable energy installed capacity increased from 134.77 GW in CY 2020 to 250.51 GW in CY 2025, registering a CAGR of 13.20%. India accounted for 4.86% of global renewable energy capacity in CY 2025, reflecting continued expansion in solar, wind, and other renewable energy installations.

Europe remained the second-largest regional market, with renewable energy capacity rising from 606.69 GW in CY 2020 to 934.33 GW in CY 2025, growing at a CAGR of 9.02% and contributing 18.14% of global capacity. North America recorded installed capacity of 613.69 GW in CY 2025, compared with 422.33 GW in CY 2020, reflecting a CAGR of 7.76% and a global share of 11.92%.

Among emerging regions, Africa's renewable energy capacity increased from 51.44 GW in CY 2020 to 82.37 GW in CY 2025, while the Middle East (excluding Saudi Arabia) expanded from 23.21 GW to 44.11 GW during the same period, registering CAGRs of 9.87% and 13.70%, respectively. Saudi Arabia recorded the fastest growth, with installed renewable energy capacity increasing from 0.41 GW in CY 2020 to 12.33 GW in CY 2025, representing a CAGR of 97.53%, albeit from a relatively small base.

The continued expansion of renewable energy capacity across major regions reflects increasing policy support, declining technology costs, growing energy demand, and global decarbonization efforts. As renewable energy penetration increases, grid integration, transmission infrastructure development, energy storage deployment, and asset performance optimization are expected to remain key priorities across renewable energy markets.

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Global Solar Energy

The global solar energy sector has witnessed significant growth over the past five years, supported by declining technology costs, favorable policy measures, increasing investments in renewable energy infrastructure, and rising demand for clean power. Solar energy has emerged as a key contributor to global renewable energy capacity additions and the broader energy transition. Global installed solar energy capacity increased from 721.13 GW in CY 2020 to 2,391.60 GW in CY 2025, registering a CAGR of 27.10%. Growth was primarily driven by the rapid deployment of solar photovoltaic ("PV") systems across utility-scale, commercial, industrial, and residential applications.

In GW	CY 2020	CY 2021	CY 2022	CY 2023	CY 2024	CY 2025	CAGR '19'25
World Solar Energy	721.13	866.04	1058.03	1422.02	1880.39	2391.6	27.10%
Solar PV On-Grid	714.72	859.67	1051.47	1415.16	1872.81	2383.2	27.23%
Solar PV Off grid	4.09	4.75	5.61	6.57	8.79	10.34	20.38%
Others	6.4	6.36	6.56	6.86	7.58	8.42	5.64%

Note: Others include concentrated solar power, solar power heating and cooling, Agro voltaic, Building integrated solar, solar fuels, Other hybrid solar cells
Source: IRENA 2026, Marqis Analytics

On-grid solar PV remained the dominant segment, accounting for approximately 99.6% of total installed solar capacity in CY 2025. Installed on-grid PV capacity increased from 714.72 GW in CY 2020 to 2,383.20 GW in CY 2025, reflecting a CAGR of 27.23%, supported by utility-scale projects and grid-connected distributed solar installations.

Off-grid solar PV capacity increased from 4.09 GW in CY 2020 to 10.34 GW in CY 2025, registering a CAGR of 20.38%. Although representing a small share of global solar capacity, off-grid systems continue to support electrification in remote and underserved regions. Other solar technologies, including concentrated solar power (CSP), solar heating and cooling systems, agrivoltaics, building-integrated solar technologies, solar fuels, and hybrid solar applications, increased from 6.40 GW to 8.42 GW during the same period, registering a CAGR of 5.64%.

The continued expansion of solar capacity underscores the growing role of solar energy in the global power mix and is expected to support further investments in grid infrastructure, energy storage, and solar asset management solutions.

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Global Solar Power Installed Capacity by Region (CY19–CY24) – On Grid

Solar power has been the primary driver of renewable energy capacity additions globally, supported by declining technology costs, supportive policy frameworks, energy transition initiatives, and growing investments in clean energy infrastructure. Global installed solar power capacity increased from 721.13 GW in CY 2020 to 2,391.58 GW in CY 2025, registering a CAGR of 27.10%.

Asia remained the largest solar market globally, with installed capacity increasing from 411.55 GW in CY 2020 to 1,528.22 GW in CY 2025, reflecting a CAGR of 30.00% and accounting for 63.90% of global solar capacity in CY 2025. Excluding India, Asia accounted for 1,393.06 GW of installed capacity, representing 58.25% of global capacity, driven primarily by large-scale solar deployment across China and other Asian economies.

In Gigawatts	CY2020	CY2021	CY2022	CY2023	CY2024	CY2025	CAGR '20-'25	Share of global %
World	721.13	866.04	1058.03	1422.02	1880.39	2391.58	27.10%	100.00 %
Asia ex.India	372.19	438.49	536.57	768.52	1059.76	1393.06	30.21%	58.25%
India	39.36	49.63	63.13	72.71	98.13	135.16	27.98%	5.65%
Europe	159.07	187.73	222.38	281.09	344.11	405.42	20.58%	16.95%
North America	84.25	106.07	125.02	154.67	193.91	228.97	22.13%	9.57%
Africa	8.39	9.49	12.02	15.56	18.38	22.19	21.48%	0.93%
Middle East excl. Saudi	7.31	9.45	13.42	17.47	19.06	25.91	28.81%	1.08%
Saudi Arabia	0.36	0.39	0.39	2.39	6.15	11.88	101.35 %	0.50%
Others	50.20	64.79	85.09	109.61	140.89	168.98	27.48%	7.07%

Source: IRENA 2026, For India the figures are estimated.

India's installed solar capacity increased from 39.36 GW in CY 2020 to 135.16 GW in CY 2025, registering a CAGR of 27.98% and accounting for 5.65% of global installed solar capacity. The growth was supported by utility-scale solar projects, expanding rooftop installations, and government-led renewable energy initiatives.

Europe remained the second-largest regional solar market, with installed capacity increasing from 159.07 GW in CY 2020 to 405.42 GW in CY 2025, registering a CAGR of 20.58% and accounting for 16.95% of global capacity. North America recorded installed solar capacity of

228.97 GW in CY 2025, compared with 84.25 GW in CY 2020, reflecting a CAGR of 22.13% and a global share of 9.57%.

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Among emerging markets, the Middle East recorded the fastest regional growth, with installed solar capacity increasing from 7.67 GW in CY 2020 to 37.79 GW in CY 2025, representing a CAGR of 37.58%. Within the region, Saudi Arabia expanded from 0.36 GW to 11.88 GW during the same period, registering a CAGR of 101.35%, albeit from a relatively low base. Africa's installed solar capacity increased from 8.39 GW in CY 2020 to 22.19 GW in CY 2025, reflecting a CAGR of 21.48%.

The continued expansion of solar capacity across major regions underscores the increasing role of solar energy in global power generation. While Asia and Europe continue to account for the majority of installed capacity, emerging markets in the Middle East and Africa are witnessing accelerated deployment, supported by energy diversification strategies, improving project economics, and growing renewable energy investments.

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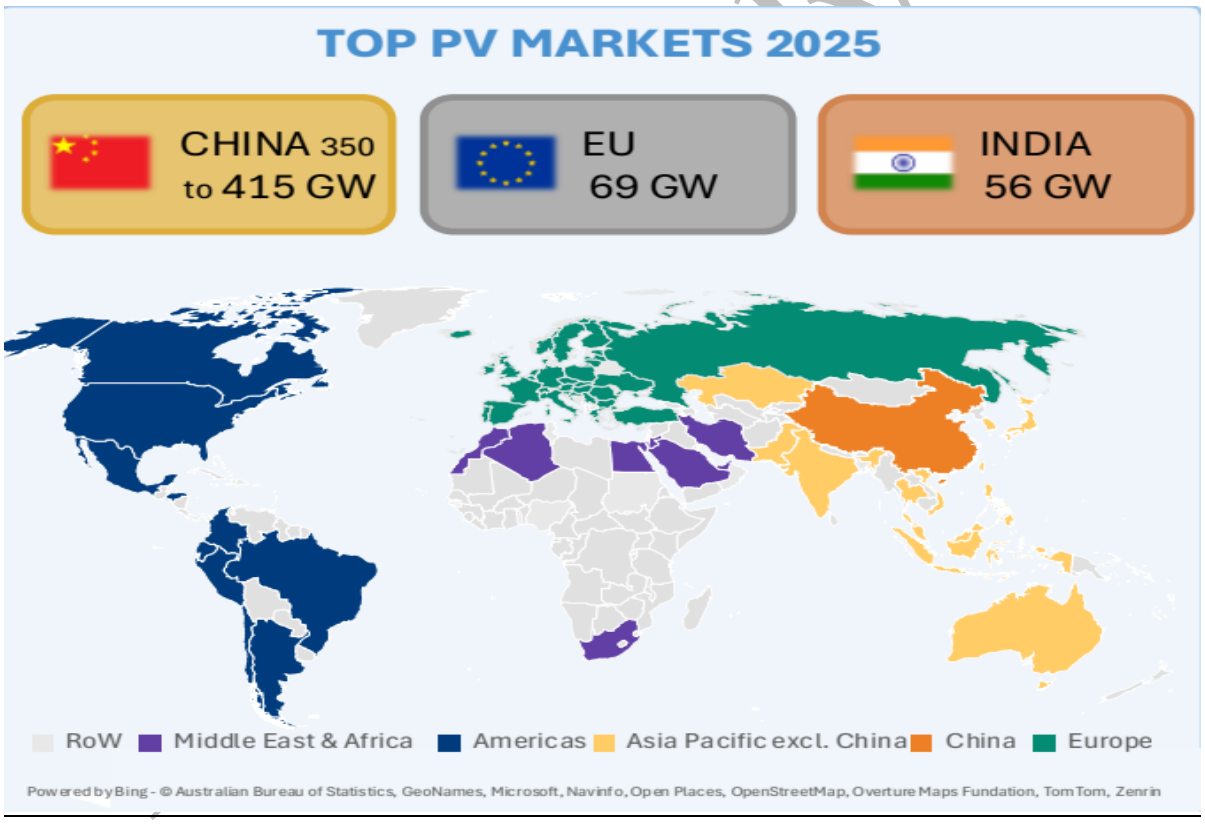
Global Solar PV Markets:

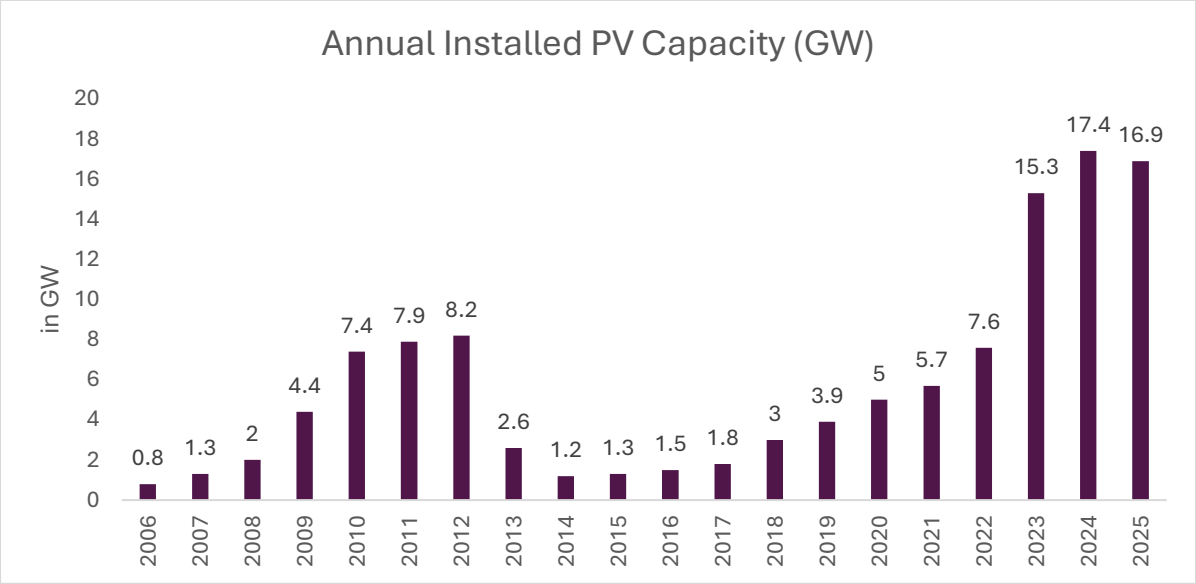
The global solar photovoltaic (PV) market continued its rapid expansion in 2025, with annual installations reaching an estimated 698 GW, driven by accelerating investments in renewable energy, declining module costs, and supportive energy transition policies worldwide. Market growth remained heavily concentrated among a few leading regions, with China retaining its position as the largest solar PV market globally, accounting for approximately 415 GW of annual installations. The European Union ranked second with 69 GW of new capacity additions, supported by ongoing decarbonization initiatives and energy security objectives, while India emerged as the third-largest market with 55.9 GW of installations, reflecting strong growth in both utility-scale and distributed solar deployment. Together, these markets continue to play a pivotal role in shaping global solar demand, capacity expansion, and investment trends, underpinning the industry's transition toward becoming a central pillar of the global electricity system.



Source: Snapshot-of-Global-PV-Markets-2026, IEA PVPS, Marqis Analytics

Annual solar photovoltaic (PV) installations exhibited a mixed growth trajectory between 2006 and 2025. The market expanded rapidly from 0.8 GW in 2006 to 8.2 GW in 2012, driven by supportive policy frameworks and early adoption of solar technologies. Installations subsequently declined to 2.6 GW in 2013 and reached a low of 1.2 GW in 2014, reflecting policy adjustments and market consolidation. From 2015 onwards, the market gradually recovered, with annual additions increasing from 1.3 GW in 2015 to 7.6 GW in 2022. Growth accelerated significantly thereafter, with installations more than doubling to 15.3 GW in 2023

and reaching a record 17.4 GW in 2024, supported by declining module prices, expanding utility-scale projects, and growing renewable energy demand. Although annual additions moderated slightly to 16.9 GW in 2025, installation levels remained substantially higher than historical averages, indicating the continued strength and maturity of the solar PV market.



Source: IEA PVPS, Marqis Analytics

The global cumulative solar PV capacity remains highly concentrated in Asia, led by China, which accounted for 49% of worldwide installed PV capacity in 2025, reflecting its dominant role in solar deployment and renewable energy investments. Excluding China, the broader Asia-Pacific region represented a further 16% of global cumulative capacity, supported by significant contributions from markets such as India, Japan, Australia and South Korea. Europe also accounted for 16% of global installed capacity, underpinned by long-established solar markets and continued investments in energy transition initiatives. The Americas represented 13% of global cumulative PV capacity, driven primarily by the United States and Brazil, while the Rest of the World contributed 4%.

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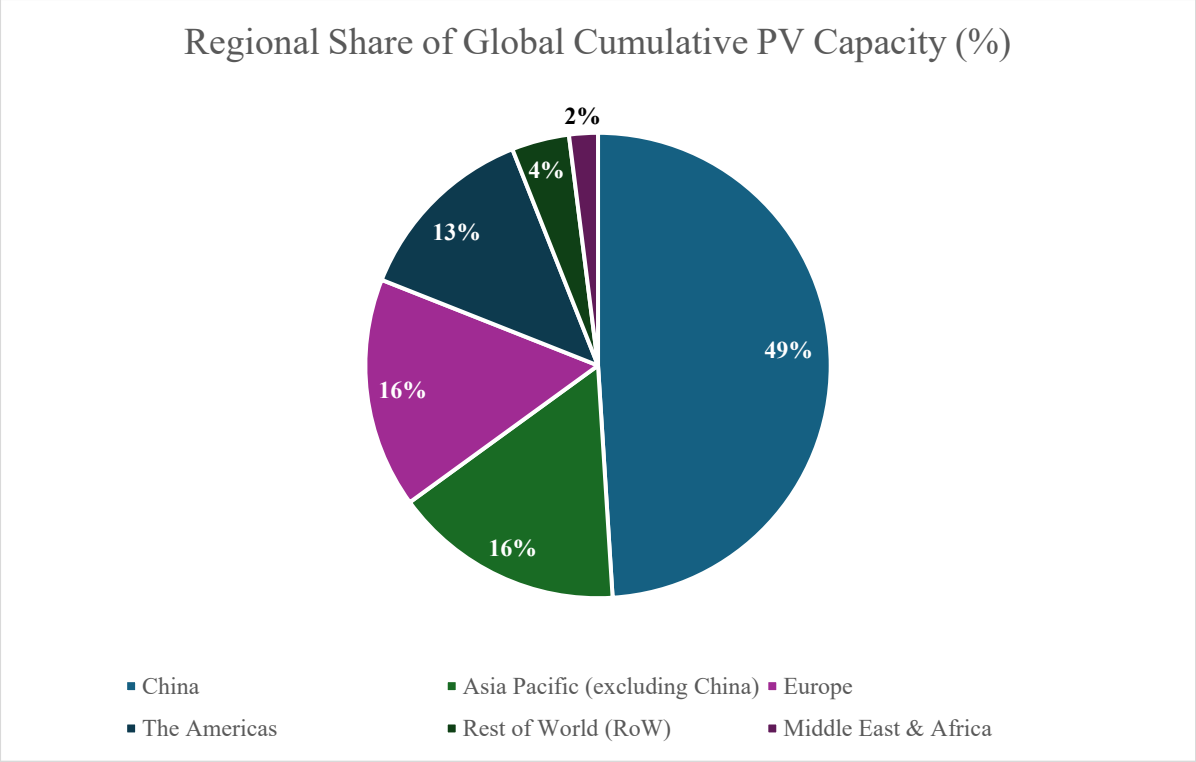

Source: IEA PVPS 2026, Marqis Analytics

The Middle East and Africa accounted for 2% of global installed capacity, indicating a relatively early stage of solar market development despite increasing project pipelines and substantial long-term growth potential. Overall, the regional distribution highlights China's continued dominance in the global solar industry, while also demonstrating the growing contribution of other major markets toward the expansion of worldwide solar generation capacity.

Evolution Of Cumulative PV Installations in Major Markets:

Global cumulative solar photovoltaic (PV) capacity has expanded significantly over the past decade, increasing from 41 GW in 2010 to approximately 2,974 GW in 2025, reflecting the accelerating adoption of solar energy worldwide. Growth was initially led by established markets such as Europe, Japan and the United States; however, the market landscape has progressively shifted towards Asia, particularly China, which reached approximately 1,464 GW of cumulative installed capacity in 2025 and accounted for nearly half of global installed PV capacity. The European Union remained the second-largest cumulative market with 406 GW, followed by the United States with 268 GW and India with 180 GW.

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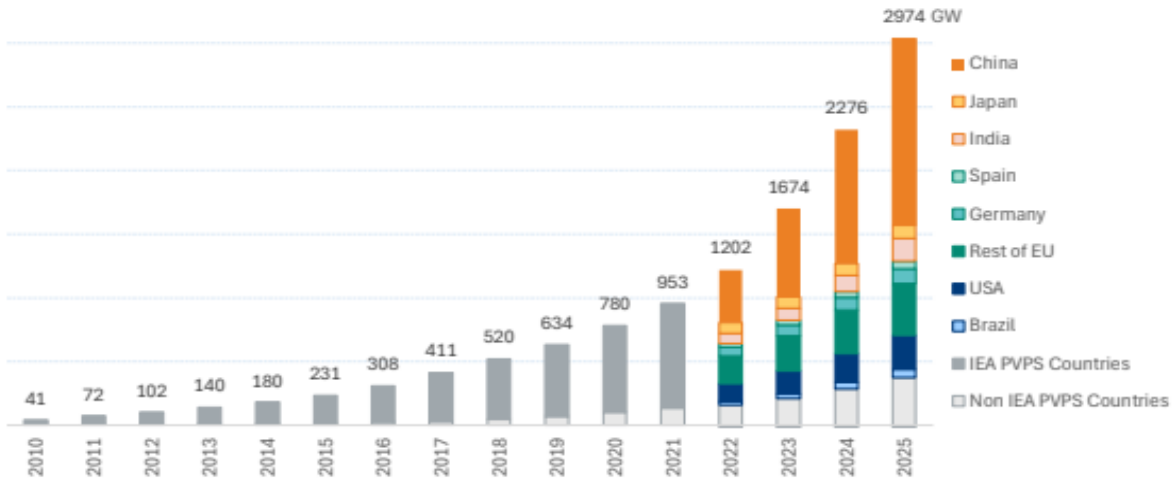
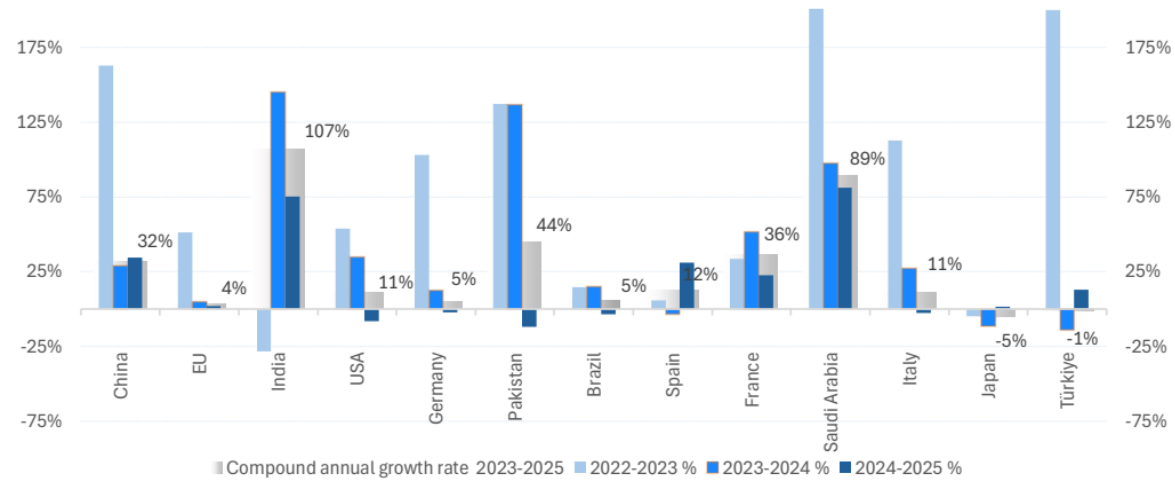


Source: Snapshot-of-Global-PV-Markets-2026, IEA PVPS

Other major markets, including Germany, Japan, Brazil and Spain, also continued to expand their installed base, contributing to the diversification of global solar deployment. The rapid increase in cumulative capacity highlights the transition of solar PV from a niche renewable technology to a mainstream source of electricity generation, supported by declining technology costs, supportive policy frameworks and growing investments in clean energy infrastructure.

EVOLUTION OF NEW ANNUAL CAPACITY IN SOME MAJOR MARKETS - COMPOUND ANNUAL GROWTH RATE 2023 - 2025:

The evolution of new annual solar PV capacity across major markets between 2023 and 2025 highlights significant differences in growth trajectories, reflecting varying levels of market maturity, policy support, grid readiness and investment activity.



Source: IEA PVPS 2026, Marqis Analytics

Emerging and rapidly expanding markets recorded the strongest compound annual growth rates (CAGR) over the period, led by India (107%), Saudi Arabia (89%) and Türkiye (36%), supported by large-scale utility projects, growing electricity demand and government-led renewable energy initiatives. China, the world's largest solar market, continued to expand at a robust CAGR of 32%, reinforcing its dominant position in global solar deployment. In contrast, more mature markets such as the European Union (4%), the United States (11%), Germany (5%), France (12%) and Italy (11%) experienced relatively moderate growth as higher levels

of solar penetration shifted market challenges towards grid integration, permitting and transmission constraints. Meanwhile, Brazil (-5%) and Japan (-1%) recorded marginal declines in annual installations, while Pakistan experienced exceptional growth during the period despite year-to-year volatility. The data indicates that global solar capacity expansion is increasingly being driven by high-growth emerging markets, while established markets continue to grow at a comparatively measured pace due to infrastructure and market maturity considerations.

Top Solar PV Markets by Annual and Cumulative Capacity in 2025

The ranking of major solar PV markets in 2025 highlights both the scale of annual deployments and the concentration of cumulative installed capacity in a limited number of countries. China remained the dominant global market, accounting for an estimated 415.0 GW of annual installations and approximately 1,463.5 GW of cumulative installed capacity, far exceeding all other markets. The European Union ranked second in annual installations with 65.7 GW and second in cumulative capacity with 406.0 GW, reflecting its long-established solar sector. India emerged as the third-largest market for annual installations, adding 55.9 GW during the year, while also becoming the fourth-largest market globally in cumulative capacity with 180.5 GW.

For Annual Installed Capacity				For Cumulative Capacity			
1		China	415.0 GW*	1		China	1463.5 GW*
(2)		European Union	65.7 GW	(2)		European Union	406.0 GW
2		India	55.9 GW	2		USA	268.2 GW
3		USA	43.2 GW	3		India	180.5 GW
4		Germany	16.9 GW	4		Germany	117.3 GW
5		Pakistan	15.8 GW*	5		Japan	102.7 GW
6		Brazil	13.8 GW	6		Brazil	66.0 GW
7		Spain	11.3 GW	7		Spain	59.0 GW
8		France	7.4 GW	5		Pakistan	52.2 GW
9		Saudi Arabia	6.8 GW	8		Australia	44.3 GW
10		Italy	6.5 GW	9		Italy	43.5 GW

Note:*The European Union grouped 27 European countries in 2024, out of which Germany, Spain, Italy, France also appear in the Top Ten, either for the annual installed capacity or the cumulative installed capacity. The European Commission is a member of IEA-PVPS through its Joint Research Centre (EC-JRC). IEA-PVPS preliminary assessment is higher than official China reporting. Source: IEA PVPS*

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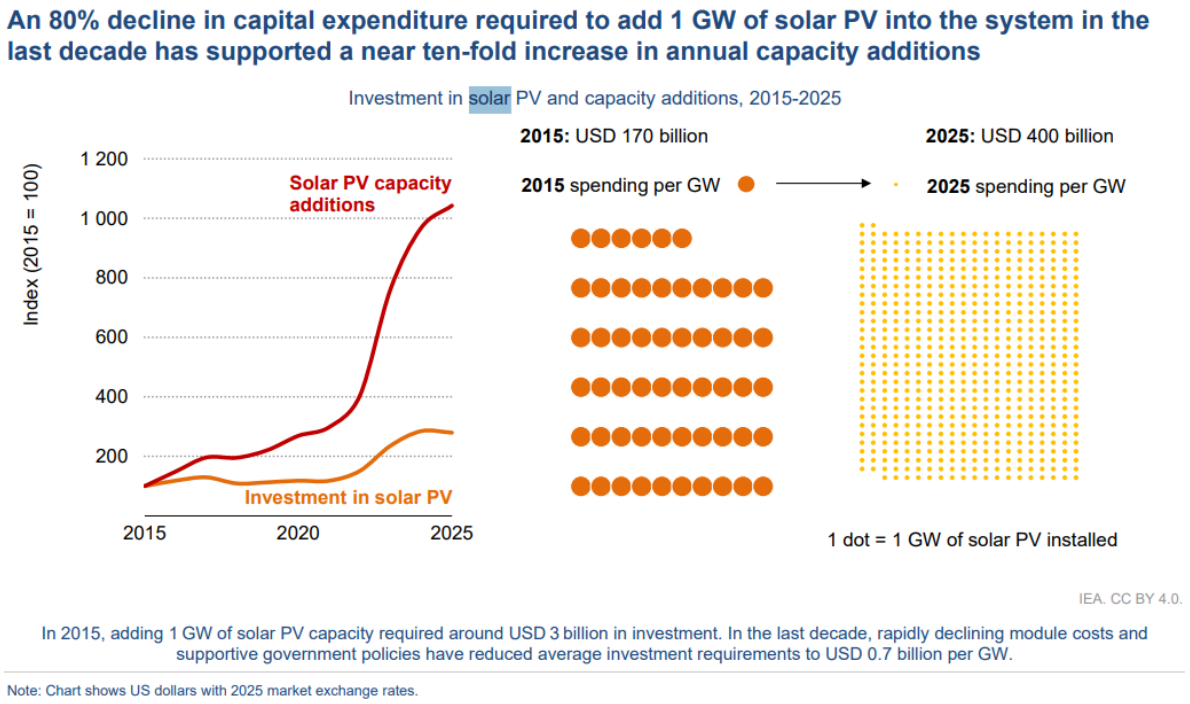
The United States ranked fourth in annual additions at 43.2 GW and third in cumulative installed capacity at 268.2 GW. Among other key markets, Germany, Japan, Brazil, Spain, Pakistan, Australia and Italy continued to strengthen their installed base, reflecting sustained investments in solar energy infrastructure. The rankings demonstrate the growing geographical diversification of solar deployment while underscoring the continued leadership of China, the European Union, the United States and India in shaping global solar PV capacity expansion and long-term market development.

Global Annual Investment in Solar PV (CY21–CY25)

The solar photovoltaic (PV) industry has become significantly more cost-efficient over the last decade, enabling much faster deployment of new solar power capacity worldwide. In 2015, approximately USD 170 billion was invested in solar PV globally, and adding 1 GW of solar capacity required around USD 3 billion of investment, resulting in about 57 GW of new capacity additions during the year.

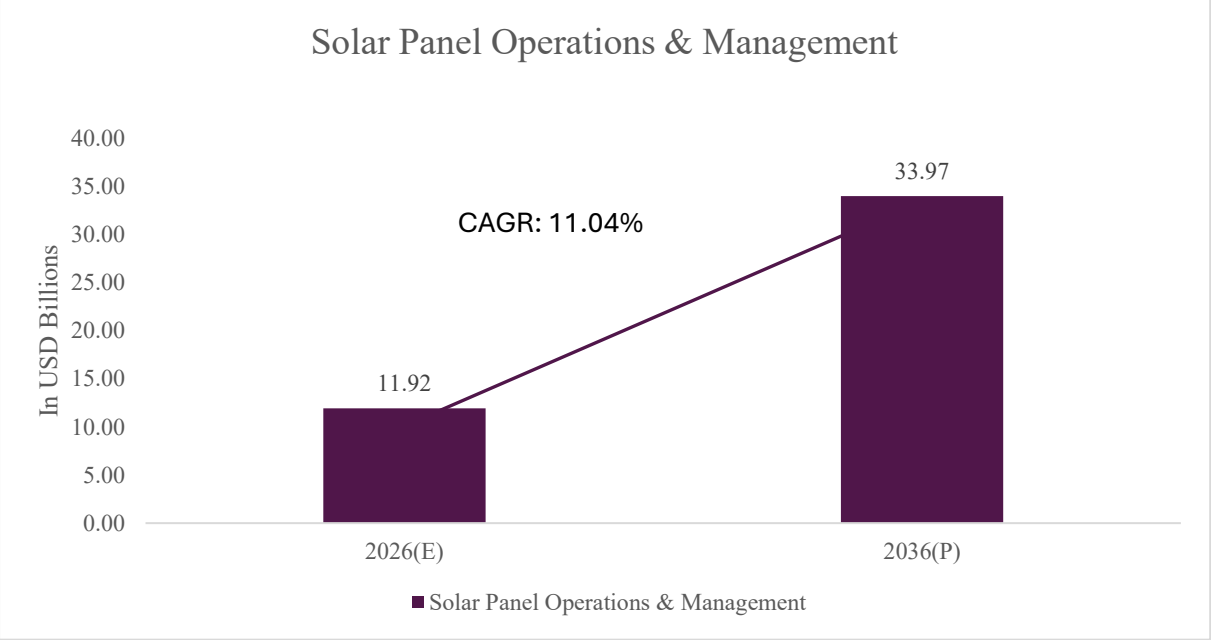


Source:IEA, Marqis Analytics

By 2025, global solar PV investment is projected to increase to approximately USD 400 billion; however, the average investment required to add 1 GW of capacity is expected to decline sharply to around USD 0.7 billion. As a result, annual solar PV capacity additions are projected to rise to approximately 571 GW, representing more than a ten-fold increase compared with 2015. While total investment in solar PV is expected to increase by about 135% during the period, annual capacity additions are projected to grow by over 900%, highlighting substantial improvements in capital efficiency. The decline of nearly 80% in investment required per GW has been supported by rapidly falling solar module costs, technological advancements, economies of scale, and supportive government policies, making solar energy one of the most cost-effective sources of new power generation globally.

Global Solar PV Operations and Management Industry

The global solar PV operations and maintenance (O&M) market is becoming increasingly important as the installed base of solar assets expands worldwide. The market is estimated at USD 11.92 billion in 2026 and is projected to reach USD 33.97 billion by 2036, registering a CAGR of 11.04% during the period. This growth reflects the rising need for asset monitoring, preventive and corrective maintenance, performance optimization, and lifecycle management services across utility-scale, commercial, and distributed solar installations.



Source: Marqis Analytics, E-estimated, P-Projected.

The increasing demand for O&M services is closely linked to the rapid growth in global solar PV capacity. As solar installations continue to expand, operators and asset owners are focusing on maximizing energy generation, improving system reliability, reducing downtime, and optimizing long-term returns on investment. Growing emphasis on operational efficiency, digital monitoring solutions, predictive maintenance, and compliance with evolving regulatory and sustainability requirements is expected to further support the expansion of the solar PV O&M market.

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Key forces shaping the Solar PV Operations and Management include:

- **Scale of Installed Assets** – As GW-scale additions persist annually, O&M demand is becoming annuity-like, with revenue models tied to long-term performance contracts.
- **Digitalization and Predictive Analytics** – AI-driven monitoring, robot inspection, and digital twin technologies are shifting O&M from reactive to predictive, reducing downtime and optimizing asset health.
- **EPC-to-O&M Transition** – Engineering, Procurement, and Construction (EPC) firms increasingly bundle O&M services, securing long-term annuity streams post-deployment.
- **Asset Ownership Shifts** – Institutional investors and YieldCos. prioritize professional O&M providers to protect returns, driving consolidation and outsourcing.

- **Regional Momentum** – Markets such as India, the Middle East, and Latin America exhibit heightened demand, where harsh climatic conditions necessitate high-frequency O&M interventions.

Benefits of Solar PV Operations and Management (O&M)

Robust Operations and Management (O&M) is no longer a peripheral service in solar PV deployment but a core enabler of asset longevity, yield optimization, and financial viability. As global capacity scales into multi-terawatt territory, disciplined O&M practices provide tangible benefits across technical, financial, and sustainability dimensions:

- **Performance Optimization:** Regular monitoring, predictive diagnostics, and preventive interventions reduce downtime, ensuring higher capacity utilization and generation yield.
- **Cost Efficiency**: Advanced O&M lowers lifecycle costs by mitigating equipment failures, optimizing spare part logistics, and extending asset lifespan — directly impacting the Levelized Cost of Energy (LCOE).
- **Investor Assurance**: Structured O&M contracts (availability guarantees, performance-linked payments) provide predictable cashflows, bolstering project bankability and attracting institutional capital.
- **Regulatory Compliance**: Standardized O&M frameworks ensure adherence to evolving grid codes, safety standards, and ESG-linked reporting obligations.
- **Technological Advantage:** Integration of robotics, waterless cleaning and AI-driven monitoring allows leaner operations in challenging terrains and resource-constrained geographies.
- Sustainability Impact: Efficient O&M reduces resource wastage (water, chemicals, manpower) while sustaining higher renewable generation, reinforcing the environmental credibility of solar portfolios.

In effect, Solar O&M functions as both a technical safeguard and a financial hedge, securing returns for asset owners while supporting the global energy transition.

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Key Projects in Solar Operations and Management

The global solar O&M landscape is best understood through flagship projects that illustrate scale, innovation, and geographic adaptation. These projects serve as benchmarks for investors and policymakers, showcasing how predictive analytics, robotics, and digital integration are reshaping lifecycle management.

1. China – Ultra-Large Utility Parks

Gonghe Photovoltaic Project, Qinghai (3.18 GW): One of the world's largest contiguous PV plants, Gonghe deploys AI-driven diagnostics, autonomous cleaning systems, and centralized spare-part ecosystems to ensure operational resilience.

https://fisnova.com/wp-content/uploads/2026/05/Three-Gorges-Renewables-100-MW-Tower-CSP-in-Golmud.

https://heliosesp.com/wp-content/uploads/2023/05/Gonghe-50-MW-concentrated-solar-power.png

Inner Mongolia Bases (>1 GW each): Multiple ultra-large projects integrate advanced SCADA systems and digital twin platforms, optimizing O&M across dispersed assets in challenging terrain.

2. India – Bhadla & Rewa Ultra Mega Solar Parks

Rewa Ultra Mega Solar Park (750 MW): India's first ultra-mega park, supported by the World Bank Clean Technology Fund, features robotic cleaning, modular inverter upkeep, and SCADA-based yield optimization. Known for pioneering reverse bidding, it has set benchmarks in tariff reduction and O&M standardization.

Bhadla Solar Park (2.25 GW): The world's largest solar park adopts robotic cleaning systems, advanced grid management for desert variability, and integrated digital O&M platforms. Coordination between state and private developers ensures high availability ratios.

3. Middle East – Mohammed bin Rashid Al Maktoum Solar Park, Dubai

Targeting 5 GW by 2030, the project combines autonomous robotic cleaning, drone-based thermal imaging, and advanced control platforms. Integration of 15-hour storage capacity enables dispatchable solar output. The park is a global benchmark for desert solar efficiency and automated O&M execution.

4. United States – Large-Scale O&M Frameworks

Topaz Solar Farm (550 MW, California): Operated under a 25-year O&M contract with First Solar, emphasizing predictive maintenance, digital twin modeling, and availability guarantees.

Mount Signal Solar Farm (794 MW, California): Leverages fleet-wide condition monitoring, life-cycle predictive analytics, and advanced diagnostics to reduce downtime and extend asset life.

Solar Star (579 MW, California): Employs remote diagnostics and digital O&M systems to maintain consistent yield across a multi-block farm structure.

5. Europe – Distributed O&M Portfolios

Countries like Spain and Germany have pioneered aggregated O&M frameworks where multiple mid-sized portfolios (10–50 MW) are managed on unified digital platforms. This approach enables cost-per-MW reduction, fleet-wide health monitoring, and improved remote diagnostics across fragmented assets.

https://upload.wikimedia.org/wikimedia/commons

6. Africa – Benban Solar Park, Egypt (1.8 GW)

Africa's largest solar facility employs centralized O&M with digital task management systems and automation pilots, showcasing how standardized O&M contracts can de-risk large multi-developer projects in emerging markets.

https://egyptoil-gas.com/wp-content/uploads/2016/05/desert-solar.jpg

India's Solar Market

India has emerged as the world's third-largest solar power producer, supported by rapid capacity expansion, policy support, and increasing domestic manufacturing capabilities. The country's installed solar power capacity increased from 2.82 GW in March 2014 to 150.26 GW as of March 31, 2026, representing an addition of 147.44 GW and a growth of over 53 times during the period. Simultaneously, domestic solar module manufacturing capacity expanded from 2.3 GW in 2014 to approximately 172 GW as of March 31, 2026.As of July 2025, India's cumulative solar power capacity stood at 154.24 GW, comprising:

Ground-mounted solar plants

Grid-connected rooftop solar systems

Hybrid projects

Off-grid installations

- **117.36 GW** – Ground-mounted solar plants
- **26.75 GW** – Grid-connected rooftop solar systems
- **3.06 GW** – Hybrid projects
- **6.17 GW** – Off-grid installations

India crossed the milestone of 150 GW of cumulative installed solar capacity on March 31, 2026. The installed base comprised 110.43 GW of utility-scale solar projects, 25.73 GW of rooftop solar installations, and 14.10 GW of KUSUM and other off-grid projects. Earlier, as of July 2025, cumulative installed solar capacity stood at 154.24 GW, including 117.36 GW of ground-mounted solar plants, 26.75 GW of grid-connected rooftop systems, 3.06 GW of hybrid projects, and 6.17 GW of off-grid installations.

The sector recorded its highest-ever annual solar capacity addition during FY 2025-26, with 44.61 GW of new installations against a target of 34 GW. This represented a substantial increase over the previous record of 23.83 GW added in FY 2024-25. The industry also achieved its highest-ever monthly solar capacity addition of 6.66 GW during the year.

Distributed solar installations witnessed significant growth, with a record addition of 16.31 GW during FY 2025-26, comprising 8.71 GW of rooftop solar capacity and 7.67 GW under the KUSUM scheme. Distributed solar accounted for approximately 36% of the total solar capacity added during the year. Cumulative rooftop solar installations have benefited more than 4.2 million households across the country, supported by the PM Surya Ghar initiative, which

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reached 3.43 million households, including approximately 2.27 million households added during FY 2025-26.

India's solar development remains concentrated in resource-rich states such as Rajasthan, Gujarat, Karnataka, Tamil Nadu, Andhra Pradesh, Maharashtra, Madhya Pradesh, Chhattisgarh, and Odisha, which offer favorable solar irradiation levels and large-scale project opportunities. Additionally, Palli village in Jammu & Kashmir has emerged as India's first carbon-neutral panchayat, operating entirely on solar energy, demonstrating the growing role of solar power in supporting sustainable rural development.

State-Level Breakdown of Solar Deployment

S. No.	STATES / UTs	Ground Mounted Solar	RTS (including PM-Surya Ghar Yojana)	Hybrid Solar	Comp. Off-grid Solar / KUSUM Comp.B	Solar Power Total	Total RE Capacity
1	**Andhra Pradesh**	6567.52	1105.60	600.56	88.82	8362.50	16916.71
2	**Arunachal Pradesh**	1.27	6.68	9.17	17.12	140.61	
3	**Assam**	220.96	621.30	12.64	854.90	8.00	
4	**Bihar**	302.16	248.80	21.28	572.24	112.50	
5	**Chhattisgarh**	1417.96	332.40	390.98	2141.34	272.09	
6	**Goa**	8.52	87.90	1.49	97.91	1.94	
7	**Gujarat**	24946.63	8146.70	1586.03	200.53	34879.88	53834.78
8	**Haryana**	267.76	1417.40	1214.20	2899.36	151.40	
9	**Himachal Pradesh**	284.00	66.70	34.58	385.29	9.20	
10	**Jammu & Kashmir**	2.49	147.90	38.75	189.14	5.00	
11	**Jharkhand**	21.00	96.70	227.74	345.44	19.10	
12	**Karnataka**	10485.39	938.20	359.25	231.65	12014.48	27873.80
13	**Kerala**	342.27	2259.50	25.07	2626.84	71.52	
14	**Ladakh**	6.00	11.40	1.35	18.75	45.79	
15	**Madhya Pradesh**	5335.56	1058.80	197.77	6592.12	3686.45	
16	**Maharashtra**	12171.30	5977.70	2249.93	20398.93	6447.91	
17	**Manipur**	0.60	10.60	6.39	17.59	5.45	
18	**Meghalaya**	0.21	4.07	4.28	13.80	13.80	

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19	**Mizoram**	22.00	5.90	7.12	35.02	45.47	
20	**Nagaland**	1.60	2.58	4.18	35.07	75.00	
21	**Odisha**	725.96	436.20	84.67	1246.83	50.40	
22	**Punjab**	886.77	663.40	117.02	1667.19	299.50	
23	**Rajasthan**	38897.03	2315.60	2283.30	874.44	44370.37	50718.39
24	**Sikkim**	0.52	5.12	1.92	7.56	55.11	
25	**Tamil Nadu**	12641.87	1635.80	75.91	14353.58	12318.02	
26	**Telangana**	4360.49	795.90	8.75	5165.14	128.10	
27	**Tripura**	7.78	16.90	23.64	48.32	16.01	
28	**Uttar Pradesh**	3181.00	2975.80	380.63	6537.43	1985.50	
29	**Uttarakhand**	541.05	381.60	32.68	955.33	72.72	
30	**West Bengal**	281.23	69.13	13.14	363.50	300.00	
31	**Andaman & Nicobar Islands**	25.05	7.50	0.27	32.82	5.25	
32	**Chandigarh**	6.34	71.70	0.81	78.85	78.85	
33	**Dadra & Nagar Haveli and Daman & Diu**	14.30	129.10	143.40	3.75	3.75	
34	**Delhi**	9.84	454.30	1.46	465.60	84.00	
35	**Lakshadweep**	2.45	4.30	2.52	9.27	9.27	
36	**Puducherry**	1.03	91.30	0.18	92.51	92.51	
37	**Others**	45.01	45.01	4.30	49.31		
Total (MW)		**123986.10**	**32595.64**	**4829.14**	**6629.17**	**168040.05**	**295554.37**

Source: Ministry of New & Renewable Energy — *State-wise (Location based) installed capacity of Renewable Power as on 31.08.2026*.

Unit: MW (Megawatt)

Domestic Manufacturing Growth

India's solar manufacturing ecosystem has witnessed unprecedented expansion in the last two years, positioning the country as a self-reliant and globally competitive player across the solar value chain.

1. Solar Module Manufacturing

- This rapid expansion has been enabled by large-scale investments, government-led tendering, and Production Linked Incentive (PLI) schemes.

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- The higher domestic module capacity reduces dependence on imported products, especially from China, and strengthens India's export competitiveness.

2. Solar PV Cell Manufacturing

- This scaling up addresses one of the critical gaps in India's solar supply chain, were domestic PV cell production earlier lagged module assembly.
- Increased cell production ensures greater backward integration and lowers import reliance, particularly for projects supported under government-linked programs.

3. Ingot-Wafer Manufacturing

- A major milestone was achieved with the commissioning of India's first ingot-wafer manufacturing facility.
- Ingot-wafer production is a critical upstream process that provides the base material for solar cells. Until now, India depended almost entirely on imports for this stage of the value chain.
- Establishing this facility marks the beginning of India's transition towards a fully integrated solar manufacturing ecosystem, reducing vulnerabilities to global supply chain disruptions.

Policies such as Basic Customs Duty (BCD) on imported modules/cells and mandatory domestic sourcing under government schemes have supported this expansion.

India has emerged as a global leader in advancing solar energy cooperation through multilateral platforms. The International Solar Alliance (ISA), co-founded by India and France in 2015, now brings together over 100 member countries with the objective of mobilising USD 1 trillion in solar investments by 2030, reducing technology costs, and promoting affordable solar deployment, particularly in Least Developed Countries (LDCs) and Small Island Developing States (SIDS). Complementing this, the One Sun, One World, One Grid (OSOWOG) initiative, launched by India in 2018, envisions the creation of a transnational solar grid to enable cross-border electricity trade under the principle that "the sun never sets." By linking solar-rich regions across South Asia, Africa, and Europe, OSOWOG aims to ensure reliable, sustainable, and cost-effective energy access, reinforcing India's leadership in shaping the global clean energy transition.

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Operations and Maintenance (O&M) – Indian Solar EPC Services Industry

Operations and Maintenance ("O&M") represents the post-commissioning stage of the solar project lifecycle and encompasses activities required to maintain the safe, reliable and efficient operation of solar assets over their operating life. O&M services generally include preventive and corrective maintenance, module cleaning, electrical and inverter maintenance, plant monitoring, performance optimisation, troubleshooting, spare-parts management, site management and applicable compliance activities. Under the Central Electricity Regulatory Commission ("CERC") Renewable Energy Tariff Regulations, 2024, O&M expenses include expenditure on manpower, repairs, spares, consumables, insurance and overheads.

India's cumulative installed solar capacity reached 162.15 GW as of June 30, 2026, comprising 121.25 GW of ground-mounted solar, 30.11 GW of grid-connected rooftop solar, 4.36 GW of the solar component of hybrid projects and 6.43 GW of off-grid solar capacity. The expanding operational asset base supports an increasing requirement for post-commissioning O&M and lifecycle services. [MNRE, Physical Achievements – June 2026]

O&M Cost Dynamics and Benchmarks

O&M expenditure varies materially depending on project size, location, technology configuration, site conditions, soiling conditions, accessibility, equipment mix and contractual scope. Industry estimates indicate that annual O&M costs for utility-scale solar projects may range from approximately ₹1–2 lakh per MW per year for limited-scope arrangements to approximately ₹4–8 lakh per MW per year for broader O&M contracts, depending on the services included. Comprehensive arrangements covering preventive and corrective maintenance, module cleaning, inverter servicing, monitoring, performance reporting and defined support services generally involve higher costs than limited-scope arrangements.

For C&I and rooftop solar projects, O&M costs similarly vary according to system size, site accessibility, cleaning requirements, equipment configuration and service scope. Smaller installations may be serviced through annual maintenance contracts ("AMCs") or periodic service arrangements, while larger C&I systems may be covered under structured O&M contracts with defined response times, monitoring and performance obligations.

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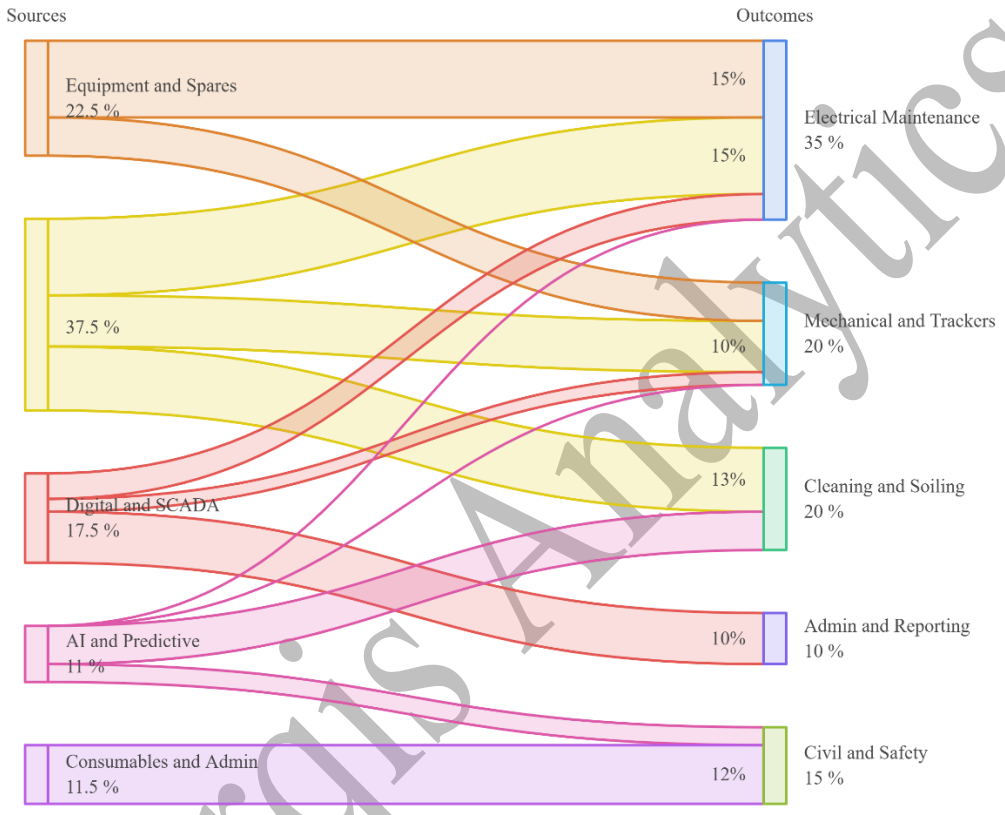
Accordingly, reported O&M cost benchmarks should be treated as indicative industry ranges rather than standardised industry tariffs. Actual contracted costs may differ substantially depending on the technical and commercial requirements of individual projects.

O&M Expenditure Allocation

Manpower and site management represent the largest portion of O&M costs, followed by electrical maintenance and mechanical systems.



Note: *The above cost ranges are indicative industry benchmarks and may vary depending on project size, location, plant configuration, equipment mix, site conditions, service scope, cleaning frequency and contractual terms.*

For regulatory tariff determination, CERC provides a separate framework. The CERC Renewable Energy Tariff Regulations, 2024 specify that, for solar PV, floating solar and solar thermal projects, O&M expenses are determined on a project-specific basis considering prevailing market trends. The Regulations further provide that normative O&M expenses, where applicable under the Regulations, are escalated at 5.25% per annum for the tariff period. Accordingly, CERC's regulatory treatment should be viewed as a tariff-determination benchmark and not as a universal representation of actual O&M expenditure incurred by every solar project or O&M service provider.

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Key O&M Activities

Solar O&M encompasses preventive, corrective and performance-management activities, including:

- **Module cleaning and soiling management:** Removal of dust, dirt, bird droppings and other deposits that may reduce energy generation. Cleaning frequency depends on soiling conditions, geography, water availability and site requirements and may involve manual, semi-automated or robotic solutions.
- **Inverter and electrical-system maintenance:** Inspection and servicing of string and central inverters, transformers, switchgear, protection systems, cables, earthing and associated electrical infrastructure, including electrical testing and component replacement.
- **Preventive, corrective and breakdown maintenance:** Scheduled inspections and servicing, fault rectification and repair or replacement of defective or failed components, including modules, inverters, cables, fuses and protection devices.
- **Monitoring and performance management:** Use of SCADA, data loggers and remote-monitoring platforms to track generation, equipment status, alarms and plant performance. Data analytics, thermal imaging, drone-based inspections and AI-enabled diagnostics are increasingly being adopted for fault detection and performance optimisation.
- **Site management and vegetation control:** Vegetation management, security, fencing, access roads, drainage, housekeeping and other site-level activities required for safe and continuous operation.
- **Warranty, spare-parts and compliance management:** Coordination with OEMs for warranty claims, replacement parts and technical support, together with applicable safety, inspection, reporting and grid-related compliance requirements.

O&M Contract Structures

O&M services are generally structured through comprehensive O&M contracts, non-comprehensive O&M arrangements and AMCs, depending on project size and customer requirements.

Contract Structure	Typical Scope
Comprehensive O&M	Preventive and corrective maintenance, module cleaning, monitoring, routine equipment servicing and defined spare-parts support; may include performance and availability obligations.
Non-comprehensive O&M	Preventive maintenance and monitoring, with major repairs, component replacement and certain consumables charged separately.

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AMC / Rooftop O&M	Periodic inspection, cleaning, inverter and electrical checks and performance reporting, with additional corrective services provided as required.

Utility-scale and large C&I contracts may incorporate availability commitments, performance requirements, response-time obligations and penalty or incentive mechanisms linked to agreed performance parameters. Contract tenure and pricing structures vary according to project structure, customer requirements and scope of services and may be negotiated on a fixed ₹ per MW per year basis, with escalation provisions or other contractual mechanisms.

Regulatory Framework and O&M Economics

O&M forms part of the tariff framework applicable to renewable-energy projects under CERC's Renewable Energy Tariff Regulations, 2024. The Regulations identify O&M expenses as a component of renewable-energy tariff and define O&M expenses to include manpower, repairs, spares, consumables, insurance and overheads. For solar PV, floating solar and solar thermal projects, CERC specifies that O&M expenses are determined on a project-specific basis considering prevailing market trends.

The Regulations also provide for a 5.25% annual escalation of normative O&M expenses for the tariff period. This escalation mechanism applies within the regulatory tariff-determination framework and should not be interpreted as an escalation assumption applicable to all commercial O&M contracts.

Market Development

The O&M segment is developing alongside India's expanding installed solar asset base. As solar projects transition from construction to operation, demand for preventive maintenance, corrective interventions, monitoring, component replacement and performance optimisation increases. The market comprises integrated EPC and renewable-energy companies, OEM-led service providers and independent O&M specialists, with smaller and regional EPC participants also developing post-commissioning service capabilities.

The growth in operational solar capacity provides a structural basis for recurring O&M requirements. The requirement for services is further influenced by plant age, equipment condition, soiling levels, geographic location, contractual performance requirements and the increasing use of digital monitoring and predictive maintenance technologies.

Strategic Importance of O&M for EPC Participants

For EPC participants, O&M represents an important extension of the project lifecycle beyond construction and commissioning and provides opportunities for:

- **Recurring revenue and greater revenue visibility:** Long-term O&M arrangements can provide recurring service income alongside project-based EPC revenues.
- **Customer retention and repeat business:** Continued post-commissioning engagement can strengthen customer relationships and create opportunities for upgrades, capacity augmentation, storage integration and other lifecycle services.

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- **Performance optimisation:** Continuous monitoring and operational data can support generation optimisation, fault identification and equipment-performance assessment.
- **Lifecycle asset management:** O&M capabilities enable EPC participants to participate across a larger portion of the solar project's operating lifecycle rather than limiting their role to construction and commissioning.

The Indian solar O&M segment is therefore evolving from a maintenance-oriented activity towards an integrated lifecycle service function encompassing monitoring, preventive and corrective maintenance, performance optimisation and technical support. The continued expansion of utility-scale, C&I, rooftop, open-access and hybrid solar installations is expected to support ongoing requirements for post-commissioning services. Organised EPC participants with technical manpower, established execution capabilities, regional service networks and technology-enabled monitoring systems can participate across this recurring segment of the solar project lifecycle.

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Battery Energy Storage System (BESS) Industry

Evolving Market Landscape

The Battery Energy Storage System (BESS) industry comprises electrochemical storage systems that store electrical energy for subsequent discharge. BESS is deployed across utility-scale power systems, commercial and industrial facilities, residential applications, renewable energy projects and decentralised power systems. Its principal applications include energy shifting, renewable energy integration, peak management, grid balancing, ancillary services and backup power.

The global battery-storage market has expanded with the increasing deployment of variable renewable energy and the requirement for additional flexibility in electricity systems. According to the International Energy Agency (IEA), global battery-storage capacity additions reached approximately 108 GW in 2025, representing an increase of around 40% over 2024. Approximately 80% of new battery-storage capacity additions in 2025 were utility-scale, with the balance comprising behind-the-meter installations for commercial and residential consumers.

Lithium-ion technology continues to account for the predominant share of battery-storage deployments. Within lithium-ion technologies, Lithium Iron Phosphate (LFP) has gained significant adoption in stationary storage applications. The IEA estimates that LFP batteries accounted for approximately 90% of battery-storage deployments in 2025, reflecting their suitability for applications requiring frequent cycling and comparatively lower costs.

The application profile of BESS is also evolving. Energy shifting has become an increasingly important application as renewable generation and peak-load requirements increase. The IEA estimates that energy shifting accounted for more than 90% of new battery-storage projects in 2025, compared with approximately 40% in 2015. The average duration of utility-scale battery projects commissioned in 2025 increased to approximately three hours, compared with around two hours in 2023, while an increasing share of projects provides four hours or more of storage duration.

The BESS value chain extends across battery cells, modules and packs, battery management systems, power conversion systems, thermal management, system integration, energy-management software, project development, EPC, operation and maintenance and end-of-life recycling. The relative importance of these components varies according to project configuration, storage duration, chemistry and end-use application.

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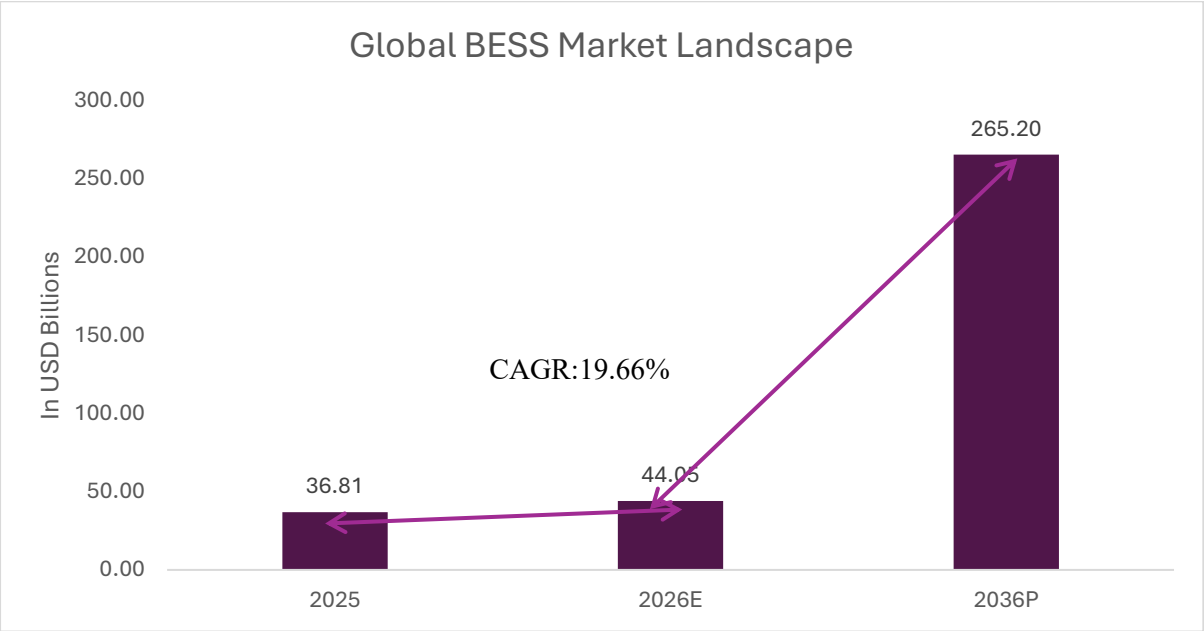
Global Market Size and Growth

The global BESS market is estimated at USD 36.81 billion in 2025, increasing to USD 44.05 billion in 2026E and projected to reach USD 265.20 billion by 2036P, representing an implied CAGR of 19.66% during 2026E–2036P.



Source: *Marqis Analytics, E-estimated, P-Projected.*

The projected growth in the global BESS market is supported by increasing renewable-energy penetration, the requirement for electricity-system flexibility, growth in energy-shifting applications, continued technology development and increasing deployment of utility-scale and distributed storage systems. The market is also being influenced by the declining cost of battery technologies and increasing adoption of longer-duration storage applications. The IEA has reported that battery costs declined by more than 90% between 2010 and 2025, although project economics continue to vary by technology, geography and application.

Key Global Market Drivers

1. Renewable Energy Integration and Power-System Flexibility

The increasing share of variable renewable energy from solar and wind generation creates a requirement for flexible resources capable of balancing variations in electricity generation and demand. Battery storage can respond rapidly to changes in system conditions and can be used for energy shifting, balancing, ancillary services and congestion management. The IEA identifies battery storage as an increasingly important flexibility resource as electricity systems accommodate higher levels of renewable generation.

2. Increasing Requirement for Energy Shifting

The growing contribution of solar and wind generation increases the requirement to store electricity during periods of generation availability and supply it during periods of higher demand. Battery storage therefore enables electricity to be shifted across time and can support the utilisation of renewable generation beyond the period of generation.

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The increasing share of energy-shifting applications in global battery-storage additions indicates a broader use of BESS beyond short-duration ancillary services.

3. Technology Development and Cost Reduction

Advances in battery chemistry, manufacturing scale, system integration, battery-management systems, power-conversion systems and thermal management have supported the wider deployment of battery storage. The increasing adoption of LFP chemistry in stationary applications reflects the importance of cost, cycle life and operating characteristics in storage-system selection.

4. Grid Modernisation and Distributed Energy Management

Battery storage can provide flexibility at different points of an electricity network, including generation sites, transmission-constrained locations, distribution networks and consumer premises. Depending on system design and applicable market mechanisms, BESS may support peak management, ancillary services, renewable-energy integration and utilisation of existing network infrastructure.

5. Increasing Duration of Storage Applications

The transition towards energy shifting and renewable-energy integration is increasing the requirement for storage systems with longer discharge durations. The IEA reported that the average duration of utility-scale battery projects commissioned in 2025 increased to approximately three hours, with a growing proportion of projects offering four hours or more of storage.

Key Technology and Application Segments

Technology / Segment	Key Characteristics	Principal Applications
Utility-Scale BESS	Grid-connected battery systems deployed as standalone assets or alongside renewable-generation projects	Energy shifting, renewable integration, capacity support, ancillary services and grid balancing
Commercial & Industrial BESS	Behind-the-meter systems designed around the electricity-demand profile of commercial and industrial consumers	Peak-demand management, energy-cost optimisation, backup power and renewable self-consumption
Residential BESS	Smaller battery systems generally integrated with rooftop solar or household energy-management systems	Solar self-consumption, backup power and household energy management

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Renewable-Integrated BESS	Battery systems co-located with solar or wind generation	Renewable-energy shifting, firming and improved utilisation of renewable generation
Standalone BESS	Independently connected storage assets capable of charging from the grid and discharging based on system requirements	Energy shifting, balancing, ancillary services and capacity support
Emerging Storage Technologies	Includes sodium-ion, flow batteries and other electrochemical or long-duration technologies	Applications requiring alternative cost, duration, safety or resource characteristics

The market is further segmented by battery chemistry, storage duration, system configuration, application, ownership structure and revenue model. Within utility-scale systems, storage duration is becoming an increasingly relevant parameter as energy-shifting requirements increase.

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Indian BESS Industry

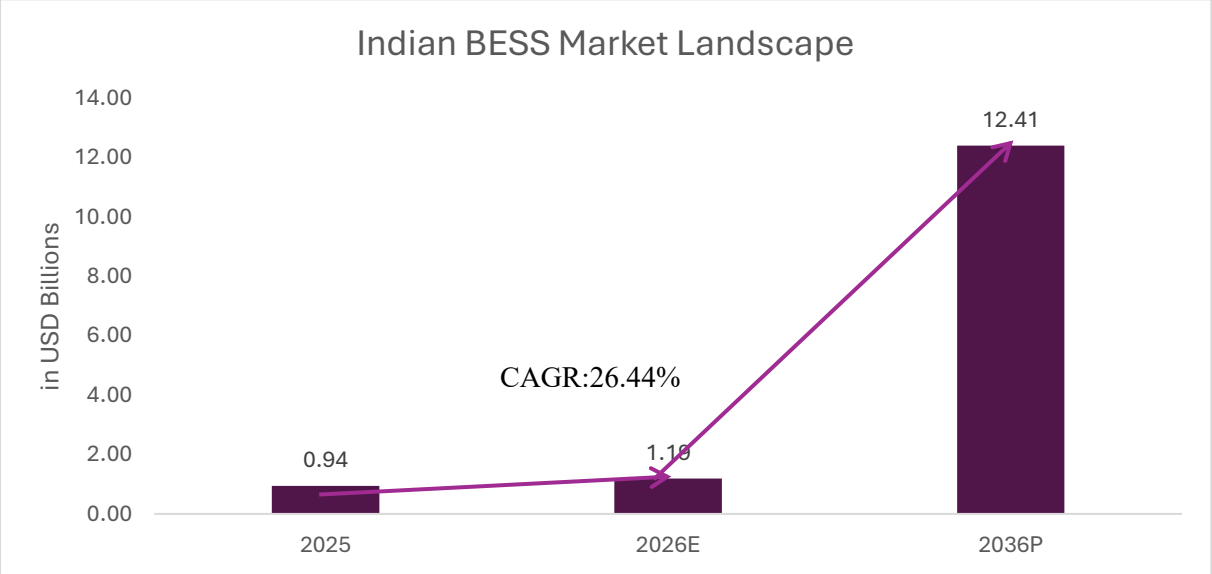
Evolving Market Landscape

India's BESS market is developing alongside the expansion of renewable-energy capacity and the increasing requirement for electricity-system flexibility. The Central Electricity Authority (CEA), through the National Electricity Plan, has identified progressively higher energy-storage requirements for 2026-27, 2031-32 and 2047, with BESS forming an increasing component of the projected requirement.

The development of the Indian BESS market is supported by the Energy Storage Obligation framework, provisions for standalone energy-storage systems, renewable-energy integration requirements, procurement frameworks and financial support mechanisms for selected battery-storage projects. The Ministry of Power has also introduced Viability Gap Funding (VGF) mechanisms to facilitate the development of BESS capacity.

Indian Market Size and Growth

The Indian BESS market is estimated at USD 0.94 billion in 2025, increasing to USD 1.19 billion in 2026E and projected to reach USD 12.41 billion by 2036P, representing an implied CAGR of 26.44% during 2026E–2036P.



Source: *Marqis Analytics, E-estimated, P-Projected.*

The projected expansion of the Indian BESS market reflects the country's increasing requirement for storage alongside renewable-energy deployment, development of energy-storage procurement mechanisms, increasing grid-flexibility requirements and policy support for storage deployment.

The above market-value estimates represent the estimated economic size of the BESS market and should be distinguished from the physical energy-storage requirements projected by the CEA in GWh.

Indian Energy-Storage Requirement

As per the National Electricity Plan, the CEA projects total energy-storage requirements of 82.37 GWh in 2026-27, increasing to 411.40 GWh in 2031-32 and 2,380 GWh by 2047. The BESS component is projected at 34.72 GWh, 236.22 GWh and 1,840 GWh, respectively.

Period	Total Energy Storage Requirement	BESS Component	PSP Component
2026-27	82.37 GWh	34.72 GWh	47.65 GWh
2031-32	411.40 GWh	236.22 GWh	175.18 GWh
2047	2,380 GWh	1,840 GWh	540 GWh

Source: *Central Electricity Authority, National Electricity Plan 2023, as reported by the Ministry of New and Renewable Energy and Ministry of Power.*

The CEA projections indicate an increasing requirement for both pumped-storage projects and BESS, with BESS accounting for a larger share of the projected storage requirement over the longer term.

Key Indian Market Drivers

1. Expansion of Renewable-Energy Capacity

The continued expansion of solar and wind generation increases the requirement for flexible resources capable of balancing variable generation and shifting electricity availability across different periods. The Ministry of New and Renewable Energy identifies energy storage as an important resource for reducing renewable-generation variability, supporting grid stability, enabling energy and peak shifting and facilitating greater renewable-energy integration.

2. Rising BESS Requirement

The CEA's projected increase in BESS requirements from 34.72 GWh in 2026-27 to 236.22 GWh in 2031-32 and 1,840 GWh by 2047 provides a long-term planning basis for the development of battery-storage capacity in India.

3. Energy Storage Obligation

India has established an Energy Storage Obligation (ESO) trajectory to facilitate the availability of storage capacity alongside renewable-energy deployment. The ESO increases from 1% in FY2023-24 to 4% by FY2029-30, with annual increments of 0.5 percentage points. The obligation is considered fulfilled only when at least 85% of the total energy stored is procured from renewable-energy sources on an annual basis.

4. Government Support for BESS Deployment

The Government of India has introduced financial-support mechanisms to facilitate BESS deployment. In June 2025, the Ministry of Power approved VGF support for 30 GWh of BESS capacity at ₹18 lakh per MWh, amounting to total financial support of ₹5,400 crore through

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the Power System Development Fund (PSDF). Of the 30 GWh, 25 GWh was allocated to 15 States and 5 GWh to NTPC.

In addition, the Ministry of Power's Annual Report 2025-26 states that the Government is supporting the development of 43.85 GWh of BESS capacity through VGF, comprising 13.85 GWh under the earlier VGF scheme and 30 GWh under the June 2025 PSDF-supported scheme.

5. Increasing Requirement for Grid Flexibility

As electricity demand, renewable generation and distributed energy resources increase, storage can provide flexible capacity for energy shifting, balancing and other grid-support functions. The Ministry of Power's National Framework for Promoting Energy Storage Systems recognises the role of storage in integrating renewable energy and meeting system-level storage requirements.

Regulatory and Policy Framework

India's BESS sector operates within the broader electricity regulatory framework, supplemented by specific policies and programmes for energy storage.

Key Policy and Regulatory Measures

- **Energy Storage Obligation (ESO):** The ESO trajectory increases from 1% in FY2023-24 to 4% by FY2029-30, with annual increments of 0.5 percentage points and a requirement that at least 85% of the total energy stored be procured from renewable-energy sources.
- **National Framework for Promoting Energy Storage Systems:** The framework provides a policy basis for development and integration of ESS within the electricity system and recognises storage requirements identified under the CEA's National Electricity Plan.
- **Standalone Energy Storage:** The national ESS framework provides for standalone energy-storage systems and their participation within the electricity system, subject to applicable regulations and connectivity requirements.
- **Viability Gap Funding:** Government support has been extended to BESS projects through VGF schemes, including the PSDF-supported 30 GWh programme approved in June 2025.
- **Inter-State Transmission Charges:** The Government has established provisions relating to waiver of Inter-State Transmission System (ISTS) charges for eligible energy-storage projects, subject to applicable conditions and prevailing regulations. The Ministry of New and Renewable Energy lists the relevant ESS charge-waiver framework among the sector's current policy measures.

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- **Battery Waste Management:** Battery-storage projects and battery manufacturers are also subject to the applicable battery-waste management framework, including provisions relating to collection, recycling and extended producer responsibility.
- **Domestic Technology Development:** Government technical and policy programmes include initiatives relating to advanced chemistry cells, sodium-ion batteries, grid-scale storage technologies and battery reuse and recycling. MNRE's ESS technical-report repository includes studies by NITI Aayog, CEA and other institutions covering these areas.

International standards such as IEC 62619, IEC 62933, UL 9540/9540A and NFPA 855 may also be relevant depending on equipment specifications, project jurisdiction, customer requirements and applicable certification arrangements. These standards should be treated as international technical and safety standards and not as blanket Indian statutory requirements.

Industry Challenges

1. Capital Intensity and Project Economics

BESS projects require substantial upfront investment, while project economics depend on utilisation, storage duration, financing costs, battery replacement requirements, degradation and the applicable procurement or revenue structure.

2. Revenue-Model and Market-Design Development

The economic viability of storage depends on the ability to utilise and monetise multiple services, including energy shifting, capacity support and ancillary services. The development of suitable market and procurement mechanisms therefore remains an important factor affecting project economics.

3. Supply-Chain Dependence

Battery manufacturing involves multiple stages, including cell production, active materials, battery components and system integration. Geographic concentration across parts of the global battery supply chain can expose manufacturers and developers to commodity-price, logistics, trade and supply-availability risks.

4. Grid Connectivity and Project Execution

Large BESS projects require suitable land, grid connectivity, permitting, equipment procurement and commissioning. Delays in grid connectivity, approvals or equipment delivery may affect project implementation timelines.

5. Battery Degradation and Performance

Battery systems experience degradation over their operating life. System design therefore requires consideration of cycle life, operating conditions, thermal management, performance guarantees, augmentation requirements and replacement provisions.

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6. Safety and Compliance Requirements

Battery storage systems require appropriate battery-management systems, thermal management, monitoring, protection and fire-safety measures. Compliance with applicable technical, electrical and safety requirements is relevant to project development, operation and insurance.

7. End-of-Life Management and Recycling

The increasing deployment of batteries will require appropriate collection, reuse, recycling and material-recovery mechanisms. The development of end-of-life management capabilities is therefore an important component of the battery-storage value chain.

Emerging Opportunities

1. Utility-Scale Renewable-Integrated BESS

The increasing requirement for renewable-energy integration and energy shifting creates opportunities for standalone and renewable-integrated BESS projects. The CEA's projected increase in BESS requirements provides a long-term planning basis for additional storage capacity in India.

2. Commercial and Industrial Storage

C&I consumers can use BESS for peak management, renewable-energy utilisation, backup power and electricity-cost optimisation, subject to applicable tariffs, operating profiles and project economics.

3. Domestic Battery Manufacturing and System Integration

Development of domestic cell, battery-pack and system-integration capabilities can expand the Indian BESS value chain and support greater domestic participation across battery manufacturing and system integration. Government technical programmes also cover advanced chemistry cells, sodium-ion batteries and other storage technologies.

4. Long-Duration and Alternative Chemistries

Sodium-ion, flow batteries and other emerging storage technologies may address applications where storage duration, material availability, safety characteristics, operating conditions or cost structures differ from conventional lithium-ion systems. MNRE's technical-report repository includes dedicated assessments of sodium-ion batteries and advanced grid-scale storage technologies.

5. Energy-Management and Digital Systems

Battery-management systems, energy-management systems, forecasting, dispatch optimisation and aggregation platforms can support the efficient operation of distributed and utility-scale storage assets and enable the utilisation of storage across multiple applications.

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6. Recycling and Circularity

The expansion of battery deployment creates opportunities in battery diagnostics, second-life applications, recycling and recovery of valuable materials. Development of circularity across the battery value chain can support resource recovery and end-of-life management.

Industry Outlook

The global BESS industry is expanding as battery storage assumes a larger role in electricity-system flexibility and renewable-energy integration. Global battery-storage additions reached approximately 108 GW in 2025, with utility-scale systems accounting for approximately 80% of new capacity additions. LFP accounted for approximately 90% of deployments, while energy shifting represented more than 90% of new projects by primary application. These developments indicate increasing deployment of battery storage for energy shifting and renewable-energy integration alongside traditional grid-support applications.

In India, the development of BESS is supported by the projected increase in energy-storage requirements, the Energy Storage Obligation framework, government-supported procurement and VGF programmes and the broader requirement for flexibility associated with increasing renewable-energy deployment. The CEA's planning projections indicate BESS requirements increasing from 34.72 GWh in 2026-27 to 236.22 GWh in 2031-32 and 1,840 GWh by 2047.

The development of the BESS industry will depend on the evolution of storage economics, availability and cost of financing, battery technology, supply-chain conditions, grid connectivity, procurement and market mechanisms, safety and technical standards and the ability of projects to utilise storage across multiple applications.

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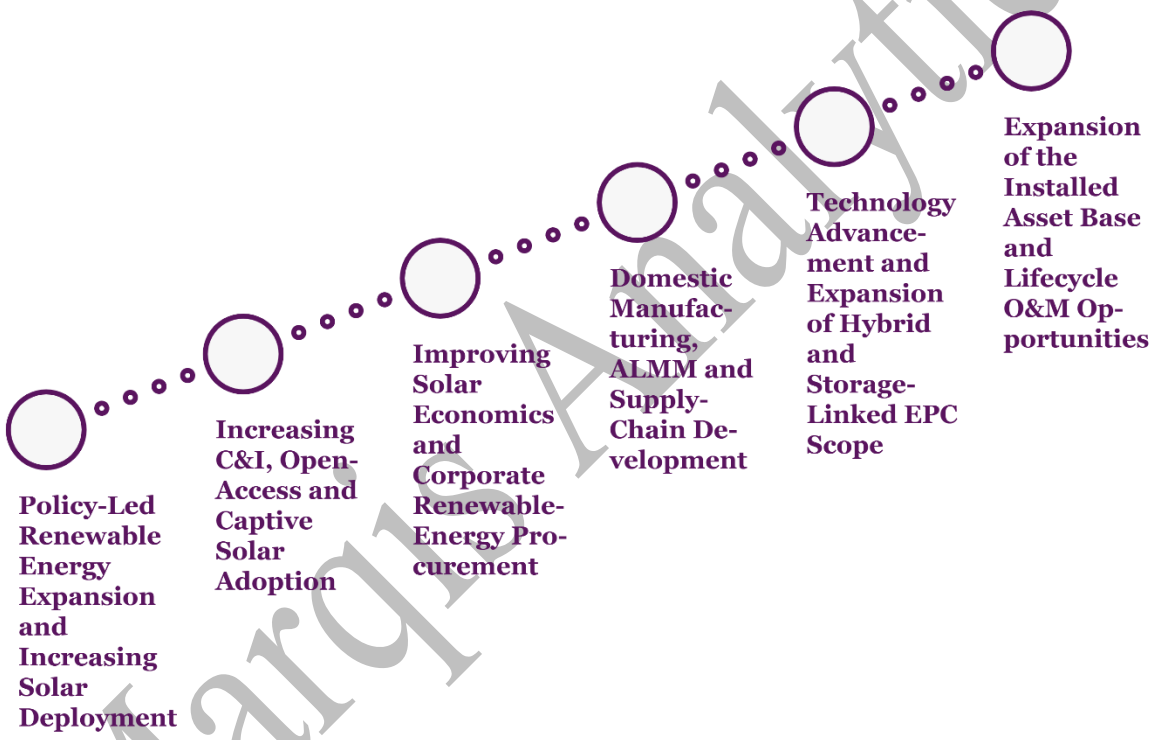
6. Market Dynamics

6.1 Key Growth Drivers

The Indian Solar EPC Services Industry is supported by a combination of policy-led capacity expansion, increasing commercial adoption, improving project economics, domestic supply-chain development, technological advancement and the growing requirement for lifecycle services. These factors are expanding the addressable market for EPC participants across utility-scale, C&I, rooftop, open-access, captive, hybrid and storage-linked projects.



Source: *Ministry of New and Renewable Energy ("MNRE"), Ministry of Power ("MoP"), Central Electricity Regulatory Commission ("CERC") and other applicable Government of India sources.*

1. Policy-Led Renewable Energy Expansion and Increasing Solar Deployment

India's long-term renewable-energy policy framework provides sustained visibility for solar capacity additions and, consequently, for associated EPC services. India has set a target of 500 GW of non-fossil fuel-based installed capacity by 2030, alongside its commitment to increase the share of non-fossil sources in cumulative installed power capacity. The existing policy framework is supported by Renewable Purchase Obligation ("RPO") trajectories, central and state renewable-energy programmes, competitive bidding and government-supported solar deployment schemes. The RPO trajectory notified by the Ministry of Power provides for a progressive increase in the overall RPO requirement through FY2030, supporting demand for renewable power procurement.

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The scale of the underlying market provides a substantial demand base for EPC services. India's cumulative installed solar capacity reached 162.15 GW as of June 30, 2026, comprising 121.25 GW of ground-mounted solar, 30.11 GW of grid-connected rooftop solar, 4.36 GW of the solar component of hybrid projects and 6.43 GW of off-grid solar.

Government programmes also broaden the application base beyond utility-scale projects. For example, PM-KUSUM provides for decentralised grid-connected solar plants and solarisation of agricultural pumps, while PM Surya Ghar supports residential rooftop deployment.

Industry impact: The combination of long-term capacity objectives, procurement obligations and government programmes provides a continuing project pipeline for EPC contractors across multiple solar applications.

2. Increasing C&I, Open-Access and Captive Solar Adoption

The C&I segment is an important growth avenue for solar EPC services as commercial and industrial consumers seek greater control over electricity costs, renewable-energy procurement and emissions. Solar projects for C&I consumers can be deployed through rooftop, captive, group-captive and open-access structures, thereby expanding the addressable market beyond conventional utility-scale projects.

Open-access and captive structures enable eligible consumers to procure renewable electricity from projects located away from their consumption facilities, subject to applicable central and state regulatory provisions, including charges, banking arrangements and other conditions. Group-captive structures further enable consumer participation in project ownership, subject to the applicable statutory requirements.

The increasing adoption of these structures creates demand for multi-site EPC execution, electrical integration, evacuation infrastructure, metering, grid connectivity and long-term O&M services. It also allows EPC participants to serve industrial clusters, manufacturing facilities, data centres, commercial establishments and other electricity-intensive consumers.

Industry impact: Growth in distributed and offsite procurement models diversifies EPC order opportunities and increases demand for customised engineering, project execution and lifecycle support.

3. Improving Solar Economics and Corporate Renewable-Energy Procurement

The economic attractiveness of solar power remains a key driver of EPC demand. Solar projects can provide consumers with greater long-term visibility over electricity costs, particularly where grid electricity costs are relatively high and renewable-energy procurement can be structured through captive, group-captive, rooftop or open-access arrangements.

For C&I consumers, the adoption decision is increasingly influenced by a combination of electricity-cost optimisation, energy-cost predictability and renewable-energy procurement requirements. Corporate decarbonisation objectives and Scope 2 emissions reduction initiatives can further support renewable-energy procurement, particularly among companies with defined sustainability targets or requirements from customers, investors and lenders.This demand is not limited to direct asset ownership. Consumers may also access renewable power through third-party ownership, power purchase agreements and other procurement structures, creating EPC opportunities across both on-site and off-site projects.

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Industry impact: The combination of economic savings and renewable-energy procurement requirements supports continued investment by C&I consumers and creates a broader customer base for EPC providers.

4. Domestic Manufacturing, ALMM and Supply-Chain Development

The development of India's domestic solar manufacturing ecosystem is increasingly influencing EPC procurement and project execution. The Approved List of Models and Manufacturers ("ALMM") framework requires eligible projects covered by the applicable provisions to use modules and, where applicable, cells from approved manufacturers and models. MNRE maintains separate ALMM lists for solar PV modules and solar PV cells and continues to update these lists. The ALMM framework increases the importance of supplier qualification, procurement planning, traceability and compliance management for EPC contractors. The regulatory framework has also evolved to include ALMM List-II for solar PV cells, with MNRE issuing successive revisions during 2026.

Domestic manufacturing policies, including production-linked incentives for high-efficiency solar PV modules, further support development of domestic manufacturing capacity and the broader solar supply chain.

For EPC participants, a deeper domestic supply base can improve procurement visibility and reduce exposure to international supply-chain disruptions, although changes in eligible manufacturers, specifications, lead times and regulatory requirements may require continuous supplier and inventory management.

Industry impact: Increasing domestic-content and approved-supplier requirements favour EPC participants with established procurement networks, technical qualification capabilities and regulatory-compliance systems.

5. Technology Advancement and Expansion of Hybrid and Storage-Linked EPC Scope

Technological advancement across modules, inverters, mounting systems, monitoring platforms and energy-storage systems is increasing the technical scope of solar EPC projects. Improvements in module efficiency can support higher generation from a given project footprint, while advanced inverter and monitoring systems enable greater control over plant performance. The industry is also moving towards hybrid renewable-energy configurations and storage-linked projects, including solar-plus-storage and solar-wind-storage combinations. Such projects require EPC capabilities extending beyond conventional PV installation to include battery energy storage systems ("BESS"), power-conversion systems, energy-management systems, grid integration and associated control infrastructure.

Digitalisation is similarly expanding the scope of EPC and lifecycle services through SCADA, remote monitoring, data analytics, drone-based inspection, thermal imaging and predictive fault identification. These technologies support improved plant monitoring and can create additional opportunities for EPC participants with integrated O&M capabilities.

Industry impact: Increasing project complexity raises the value of engineering, integration and digital capabilities and creates opportunities for EPC participants to expand beyond conventional balance-of-system execution.

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6. Expansion of the Installed Asset Base and Lifecycle O&M Opportunities

The rapid expansion of India's installed solar base is creating a growing requirement for post-commissioning services. With 162.15 GW of solar capacity operational as of June 30, 2026, the addressable base for preventive maintenance, corrective maintenance, monitoring, module cleaning, inverter servicing, component replacement and performance optimisation continues to increase. O&M provides EPC participants with an opportunity to extend their involvement beyond project construction and commissioning into the operating life of solar assets. Long-term O&M arrangements can provide recurring service revenues, while continuous plant monitoring generates operational information that can support performance optimisation, troubleshooting and future system upgrades. The increasing deployment of technically complex projects, including hybrid and storage-linked systems, further expands the requirement for specialised lifecycle support.

Industry impact: The expansion of the installed asset base increases the recurring addressable market for O&M and lifecycle services and provides EPC participants with an opportunity to diversify revenue beyond project-based EPC contracts.

The installed solar base provides a substantial existing asset base, while continued policy support and diversification of project structures create opportunities across utility-scale, rooftop, C&I, open-access, captive, hybrid and storage-linked applications.

For organised EPC participants, the principal opportunity lies not only in increasing project volumes but also in moving towards higher-value engineering, integrated procurement and execution, storage and hybrid integration, digital monitoring and recurring O&M services. This favours participants with technical capabilities, established supplier relationships, project-execution experience and the ability to manage evolving regulatory and compliance requirements.

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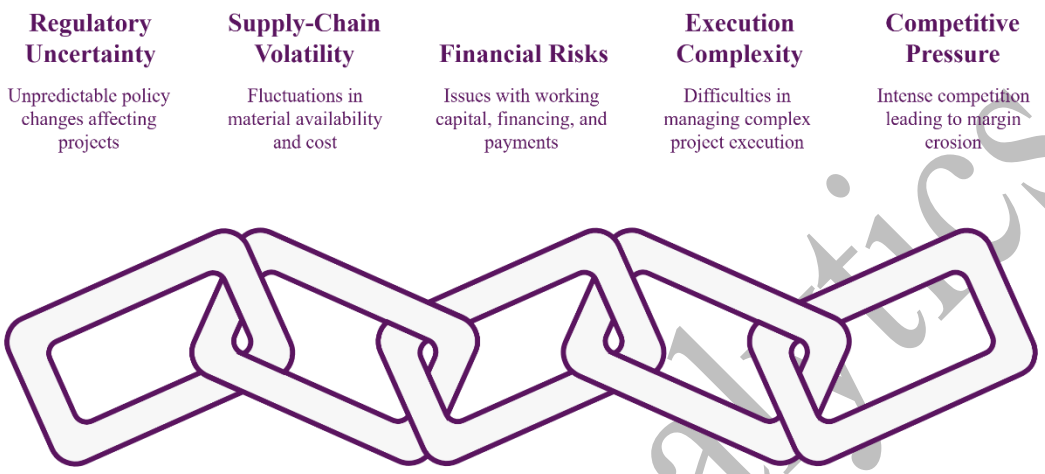
6.2 Threats and Challenges

The Indian Solar EPC Services Industry, while supported by strong structural growth drivers, remains exposed to regulatory, land and grid-related constraints, supply-chain volatility, financing and working-capital pressures, execution complexities and intense competitive conditions. These factors can affect project timelines, procurement costs, liquidity, margins and revenue visibility across utility-scale, C&I, rooftop, open-access, captive, hybrid and storage-linked projects.



Source: *Ministry of New and Renewable Energy ("MNRE"), Ministry of Power ("MoP"), Central Electricity Regulatory Commission ("CERC") and other applicable Government of India sources, supplemented by industry-level assessments where specifically indicated.*

1. Regulatory, Land and Grid-Connectivity Constraints

Solar EPC projects remain exposed to changes in central and state-level regulations, approval requirements and project-development conditions. Changes in the Approved List of Models and Manufacturers ("ALMM") framework, domestic-content requirements, customs duties and other trade measures can affect procurement strategies, equipment availability and project economics. At the state level, changes in net-metering provisions, open-access charges, banking arrangements, cross-subsidy surcharge ("CSS") and additional surcharge ("AS") may affect the viability and timing of C&I, captive and open-access projects.

Utility-scale projects are additionally exposed to land availability, title and conversion requirements, environmental and local approvals and community-related considerations. Grid evacuation and transmission infrastructure can also constrain project execution, particularly where renewable generation capacity is concentrated in resource-rich locations and transmission capacity requires augmentation to evacuate power to load centres. Delays in transmission-system development, connectivity approvals, substations, pooling infrastructure or associated evacuation facilities may postpone project commissioning and commercial operation. Constraints in available transmission capacity may also affect the scheduling or evacuation of generated power and, where applicable, contribute to curtailment and associated project-level revenue and performance risks. Even where land is secured, delays in transmission infrastructure, grid connectivity approvals and evacuation facilities can postpone commissioning and commercial operation. Curtailment or inadequate evacuation capacity may further affect generation and project economics.

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Industry impact: Regulatory changes and project-development bottlenecks can increase execution timelines, procurement complexity and compliance costs, requiring EPC participants to maintain regulatory capabilities, flexible project planning and appropriate contractual protections.

2. Supply-Chain Volatility and Technology-Related Risks

Solar EPC execution is dependent on the timely availability and pricing of modules, cells, inverters, mounting structures, electrical equipment and other balance-of-system components. Module and cell price volatility, ALMM/DCR requirements, availability of approved models, import-related measures, shipping disruptions and logistics constraints can increase procurement costs or delay project execution, particularly for projects contracted on fixed-price terms.

The rapid evolution of high-efficiency modules, trackers, hybrid systems, battery energy storage systems ("BESS"), advanced inverters and digital monitoring platforms is also increasing technical and procurement complexity. EPC participants need to continuously update engineering capabilities, supplier relationships and technology expertise. Equipment failures, spare-parts availability and performance issues may additionally affect plant availability and contractual performance obligations.

Industry impact: Supply-chain disruptions and rapid technology changes can increase procurement and execution risks, while favouring EPC participants with diversified vendor networks, forward procurement capabilities, technical expertise and appropriate contractual mechanisms for managing cost and specification changes.

3. Working-Capital, Financing and Payment Constraints

Solar EPC execution requires contractors to incur expenditure on equipment procurement, mobilisation, construction and subcontracting before receiving corresponding milestone payments. This creates working-capital requirements and dependence on bank guarantees, credit facilities and timely customer collections. Delayed receivables, particularly in projects involving financially weaker offtakers or DISCOM-linked structures, can create cash-flow mismatches and constrain the ability of EPC participants to undertake additional projects.

Project development and execution are also sensitive to interest rates, availability of project finance, lender risk appetite and financial-closure timelines. Higher financing costs can affect project feasibility, while delays in financial closure may postpone project commencement, re-bidding or project conversion. Smaller EPC participants may be more exposed to these constraints due to comparatively limited access to low-cost funding.

Industry impact: High working-capital requirements, payment delays and financing constraints can increase liquidity pressure and restrict order-book execution, favouring EPC participants with stronger balance sheets, disciplined receivables management and access to diversified sources of funding.

4. Execution Complexity, Competition and Margin Pressure

Solar EPC projects require coordination across engineering, procurement, civil works, structural installation, electrical systems, grid interconnection, commissioning and, increasingly, storage and digital systems. Weather conditions, site accessibility, availability of skilled engineers and technicians, subcontractor performance and health, safety and environment ("HSE") requirements can affect project schedules and execution costs. Performance guarantees, commissioning obligations and delay-related contractual provisions may further expose EPC contractors to liquidated damages and margin erosion.

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The industry also faces intense competition and aggressive bidding, particularly in utility-scale and standardised C&I projects. Competitive tendering can limit pricing power and place pressure on EPC margins. The rooftop and small C&I segments remain relatively fragmented, while dependence on a limited number of large projects can create order-book concentration risk.

Industry impact: Execution complexity and competitive intensity can constrain margins and increase project-level risk, favouring participants with strong project-management systems, skilled manpower, execution track records, diversified customer portfolios and differentiated engineering, integration and O&M capabilities.

The Indian Solar EPC Services Industry therefore combines significant long-term growth potential with material execution and commercial risks. The principal challenges relate to evolving regulatory requirements, land and grid constraints, supply-chain and technology risks, working-capital and financing pressures, and competitive margin intensity. For organised EPC participants, the ability to manage procurement and regulatory compliance, execute projects within contracted timelines, maintain financial discipline and provide integrated engineering, digital monitoring and lifecycle O&M services will remain important to sustaining competitiveness and profitability.

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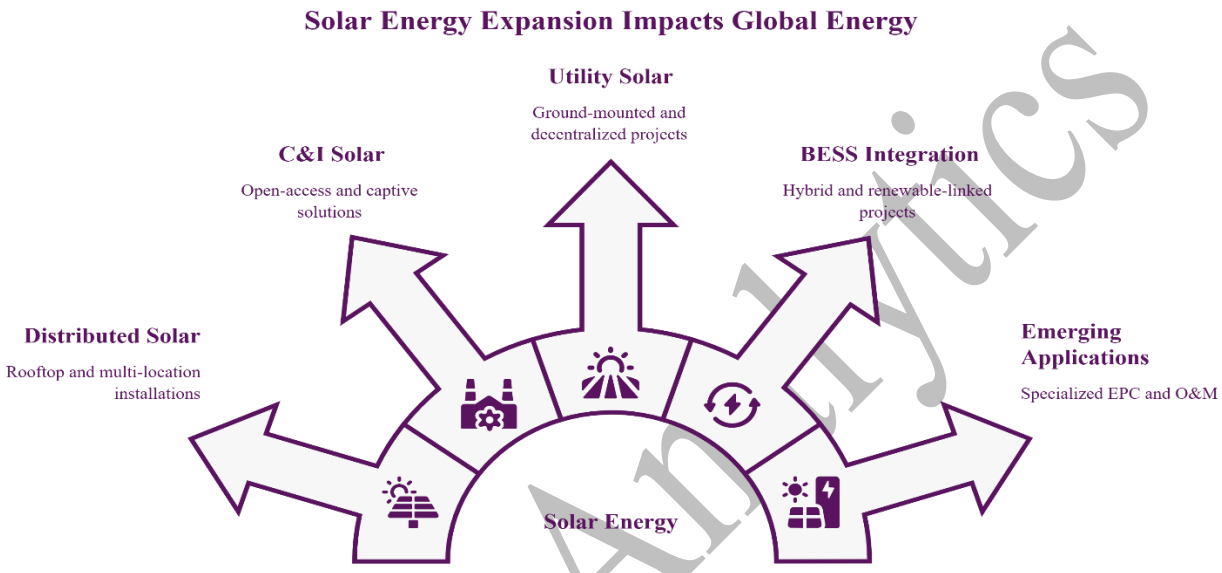
6.3 Market Opportunities

The Indian Solar EPC Services Industry presents multiple addressable market opportunities across rooftop, C&I, utility-scale, decentralised, open-access, captive, storage-linked and lifecycle service applications. These opportunities arise from the expansion of the installed solar base, diversification of project and electricity-procurement structures, development of energy-storage and hybrid systems and increasing requirements for project integration and lifecycle services. The scale and timing of individual opportunities remain subject to project economics, financing availability, land and grid connectivity, regulatory approvals, customer procurement decisions and competitive bidding.



Source: *Ministry of New and Renewable Energy ("MNRE"), Ministry of Power ("MoP"), Central Electricity Authority ("CEA"), Press Information Bureau ("PIB") and applicable State regulatory authorities.*

1. Rooftop, Distributed and Multi-Location Solar

Rooftop and distributed solar represent an addressable market beyond conventional ground-mounted projects. MNRE estimates India's overall solar potential at approximately 748 GW, indicating substantial scope for further solar deployment.

The residential rooftop market is being supported by the PM Surya Ghar: Muft Bijli Yojana, which has an outlay of ₹75,021 crore and targets rooftop solar installations in one crore households by FY2026-27. The scheme also provides for RESCO and utility-led aggregation models in addition to the residential consumer-led model.

C&I consumers, institutions and other eligible consumers can deploy rooftop and distributed solar subject to applicable State regulations and distribution-licensee requirements. Group Net Metering ("GNM") and Virtual Net Metering ("VNM"), where provided under applicable State frameworks, can further support eligible multi-location or participating-consumer configurations.

Market opportunity: The expansion of rooftop and distributed solar creates opportunities for EPC participants in site assessment, engineering, procurement, installation, metering, grid interconnection, commissioning and related services across multiple customer locations.

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2. Open-Access, Captive and Group-Captive Solar for C&I Consumers

The Green Energy Open Access Rules, 2022 provide a framework for eligible consumers to procure renewable energy through green open access. Green energy open access is available to consumers with contracted demand or sanctioned load of 100 kW or more, either through a single connection or through multiple connections aggregating 100 kW or more in the same electricity division of a distribution licensee, subject to the prescribed regulatory framework. For captive consumers, the applicable rules do not prescribe a load limitation.

Open-access, captive and group-captive arrangements provide C&I consumers with additional structures for procuring renewable electricity. Their implementation involves requirements relating to project location, connectivity, transmission and wheeling, metering, banking, applicable charges and State-level regulations.

Market opportunity: These arrangements create opportunities for EPC participants to execute off-site ground-mounted solar projects for C&I consumers and require capabilities in generation systems, evacuation infrastructure, grid connectivity, electrical systems and project coordination.

3. Utility-Scale, Ground-Mounted and Decentralised Solar Projects

Ground-mounted solar remains a major component of India's solar market. MNRE data indicates that India's cumulative installed solar capacity reached 164.59 GW as of July 31, 2026, including 122.57 GW of ground-mounted solar, 30.74 GW of grid-connected rooftop solar, 4.77 GW of the solar component of hybrid projects and 6.51 GW of off-grid solar. Separately, as of November 30, 2025, approximately 69.12 GW of solar capacity was under implementation and 35.46 GW was tendered, in addition to 132.85 GW already installed.

Decentralised applications provide an additional project segment. Under PM-KUSUM, the Government has provided for 34,800 MW of solar capacity, including decentralised ground- or stilt-mounted grid-connected renewable-energy plants, standalone solar agricultural pumps and solarisation of grid-connected agricultural pumps.

Government, public-sector and institutional assets can also provide opportunities for rooftop and ground-mounted solar deployment, subject to applicable procurement and project-specific requirements.

Market opportunity: The continuing development of utility-scale and decentralised projects provides opportunities across engineering, procurement, construction, electrical infrastructure, evacuation, grid integration and commissioning, including projects involving geographically dispersed sites.

4. BESS, Hybrid and Renewable-Energy-Linked Projects

The integration of renewable generation with energy storage represents an emerging area for EPC services. The Government has supported BESS deployment through Viability Gap Funding ("VGF") schemes, including 13.22 GWh under the initial scheme with a budgetary allocation of ₹3,760 crore and a subsequent scheme for 30 GWh with financial support of ₹5,400 crore from the Power System Development Fund.

Renewable-energy procurement frameworks also provide for hybrid and firm and dispatchable renewable-energy configurations. Such projects can require integration of solar generation with battery storage, power-conversion systems, energy-management systems, protection and control systems and grid infrastructure.

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The National Green Hydrogen Mission, with an initial outlay of ₹19,744 crore, targets at least 5 million metric tonnes of green hydrogen production per annum by 2030. The Mission envisages substantial additional renewable-energy capacity to support green hydrogen production, creating a potential adjacent market for renewable-energy infrastructure.

Market opportunity: BESS, hybrid renewable-energy and green-hydrogen-linked projects can expand the technical scope of EPC services into renewable-energy integration, storage, electrical systems, grid infrastructure and associated project execution.

5. Emerging Solar Applications and Specialised EPC

Solar deployment is expanding beyond conventional rooftop and ground-mounted configurations. MNRE has undertaken assessment and mapping of floating solar potential, while other specialised solar applications are also being evaluated and developed.

Floating solar projects require project-specific engineering relating to floating platforms, anchoring, electrical cabling and water-body conditions. Other emerging configurations, including agrivoltaic applications, may similarly require specialised structural, electrical and operational solutions.

Market opportunity: Emerging applications can create specialised EPC requirements and opportunities for participants with capabilities in project-specific engineering, structural design, electrical integration, installation and commissioning. These segments remain at an earlier stage of development than conventional ground-mounted and rooftop solar.

6. Lifecycle O&M and International EPC Opportunities

India's expanding installed solar base creates an established market for post-commissioning services. Solar assets require varying levels of preventive and corrective maintenance, plant monitoring, equipment servicing, component replacement and performance management depending on project configuration and contractual arrangements.

The use of digital monitoring, data acquisition and remote plant-management systems can support O&M and performance-monitoring services. The requirement for such services may increase as the installed asset base expands and projects incorporate more sophisticated electrical, hybrid and storage systems.

International markets also provide opportunities for Indian EPC participants with relevant technical, project-management and cross-border execution capabilities. Such opportunities are subject to host-country regulations, tender requirements, financing arrangements, local-content requirements, logistics, currency exposure and other country-specific risks.

Market opportunity: Lifecycle O&M provides an additional service market alongside new-project EPC, while international EPC opportunities can provide geographic diversification for Indian participants with the requisite execution and regulatory capabilities.

Indian Solar EPC Services Industry offers opportunities across rooftop and distributed solar, C&I open-access and captive projects, utility-scale and decentralised generation, BESS and hybrid systems, emerging solar applications and lifecycle O&M services. The market also provides opportunities for international project execution by EPC participants with appropriate technical and cross-border capabilities.

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The opportunity for individual EPC participants will depend on their project-execution capabilities, customer relationships, geographic coverage, procurement network, financial resources, technical expertise and ability to comply with evolving central and State-level regulatory requirements. Accordingly, the expansion of the underlying solar market provides a broad addressable opportunity, but does not necessarily translate into proportionate revenue growth for individual EPC participants.

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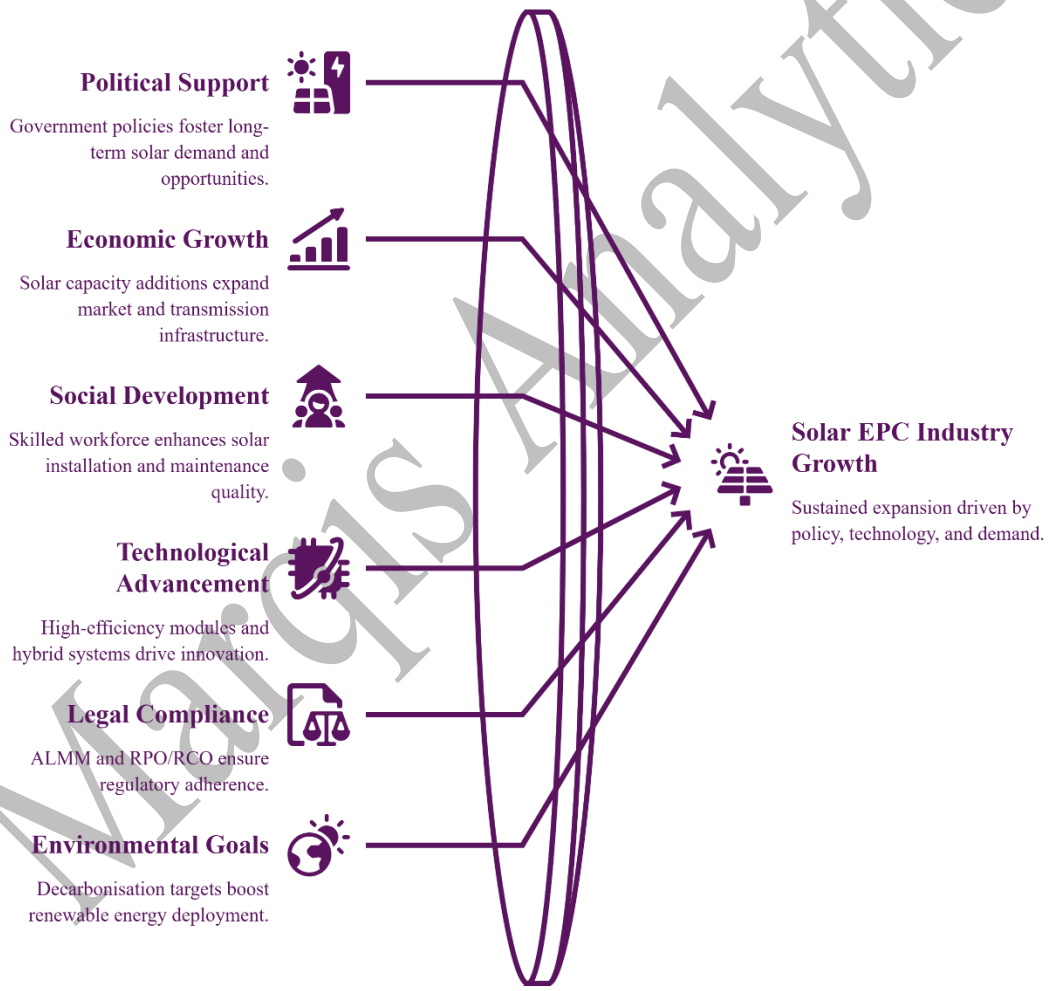
7. PESTLE Analysis of the Industry

A PESTLE analysis evaluates the Political, Economic, Social, Technological, Legal and Environmental factors shaping the external operating environment of the Indian Solar EPC Services Industry. The sector is influenced by long-term renewable-energy targets, government procurement and support programmes, transmission infrastructure development, domestic manufacturing policies, technological advancement and India's climate commitments. These factors collectively influence project pipelines, procurement structures, execution requirements and the evolution of EPC services across utility-scale, rooftop, C&I, hybrid and storage-linked applications.



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Factor	Description	Impact on Solar EPC Services Industry
Political	• India is targeting 500 GW of non-fossil fuel-based installed electricity capacity by 2030 and Net Zero emissions by 2070. [PIB / Government of India] • Government support includes PM-KUSUM, PM Surya Ghar Muft Bijli Yojana, Solar Parks, Green Energy Corridor and the National Programme on High Efficiency Solar PV Modules, together with distributed solar mechanisms such as Group Net Metering ("GNM") and Virtual Net Metering ("VNM") in applicable States. [MNRE / PIB] • Renewable Energy Implementing Agencies have a government-notified bidding trajectory for renewable-energy procurement, while standard bidding guidelines cover solar, wind, hybrid and firm and dispatchable renewable-energy projects. [MoP / MNRE / SECI]	• Provides a long-term policy-backed demand environment for solar EPC services. • Government programmes broaden EPC opportunities across utility-scale, rooftop, decentralised and agricultural applications. • Competitive bidding and renewable procurement programmes provide visibility to project pipelines, while changes in scheme design and bidding conditions require EPC participants to maintain regulatory and tendering capabilities.
Economic	• India has recorded sustained growth in solar capacity additions, with solar accounting for a significant proportion of recent renewable-energy capacity additions. [MNRE / PIB] • The Government is simultaneously expanding transmission infrastructure to support renewable-energy deployment; the National Electricity Plan envisages approximately 1,91,474 circuit km of transmission lines and 1,274 GVA of transformation capacity during 2022-23 to 2031-32. [MoP / CEA] • Battery Energy Storage System ("BESS") deployment is also being supported through Viability Gap Funding ("VGF") schemes, including support for 13.22 GWh under the first scheme and a further 30 GWh scheme with ₹5,400 crore of financial support approved in 2025.. [MoP / PIB]	• Continued capacity addition expands the addressable market for EPC execution, electrical infrastructure and lifecycle services. • Transmission investment supports grid evacuation and enables development of large renewable-energy projects. • Increasing storage deployment can expand EPC scope towards BESS integration, power-conversion systems and associated grid infrastructure. • EPC participants remain exposed to project financing, procurement costs, payment cycles and competitive bidding conditions.
Social	• MNRE has established renewable-energy skill-development programmes including Suryamitra, Varunmitra, Vayumitra and Jal-Urjamitra for installation, commissioning,	• Development of trained technicians supports the scalability of solar EPC installation,

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	operation and maintenance of renewable-energy systems. [MNRE] • The Suryamitra programme was initiated to develop a skilled workforce for the solar sector and had trained 51,529 Suryamitras as of September 2022. [MNRE] • Training programmes are implemented across India with emphasis on areas having significant solar potential and installed projects. [MNRE]	commissioning and O&M activities. • Availability of trained manpower can improve execution quality, safety and maintenance capabilities as the installed asset base expands. • Continued skill development remains important as project complexity increases and operations extend into hybrid, storage and digitally monitored installations.
Technological	• The PLI scheme for High Efficiency Solar PV Modules is designed to promote high-efficiency module manufacturing, integrated manufacturing facilities, local sourcing and technological self-sufficiency. [MNRE / PIB] • PLI Tranche-I has an outlay of ₹4,500 crore, with Letters of Award ("LoAs") covering 8,737 MW of fully integrated manufacturing capacity, while Tranche-II has an outlay of ₹19,500 crore, with LoAs covering 39,600 MW of fully or partially integrated manufacturing capacity. [MNRE] [MNRE] • Government procurement frameworks and grid planning increasingly incorporate storage, hybrid renewable projects and grid-modernisation requirements. [MoP / MNRE]	• Increasing availability of high-efficiency modules and domestic manufacturing capabilities can support improved project design and procurement flexibility. • Greater adoption of hybrid and storage-linked configurations expands the technical scope of EPC contractors beyond conventional PV installation. • EPC participants increasingly require capabilities in system integration, electrical engineering, monitoring, storage and grid interconnection. • Faster technology evolution increases the need for continuous technical capability development and supplier qualification.
Legal	• The Approved List of Models and Manufacturers ("ALMM") framework requires applicable government, government-assisted, public sector and specified open-access and net-metering projects to use eligible models and manufacturers included in the relevant ALMM framework. [MNRE] • The first ALMM List-II for solar PV cells was issued in July 2025 and has been subsequently revised, with the latest available revision issued in July 2026. [MNRE] • The Ministry of Power has notified Renewable Purchase Obligation ("RPO")	• ALMM requirements increase the importance of supplier eligibility, procurement planning, documentation and compliance management for EPC contractors. • Periodic revisions to approved manufacturers and models require EPC participants to continuously monitor regulatory requirements and supplier status. • RPO/RCO requirements support renewable-energy procurement demand, while evolving electricity-sector regulations require EPC participants to

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	and Renewable Consumption Obligation ("RCO") trajectories through 2029-30, with applicable provisions for non-compliance with the RCO. [MoP / PIB] • State-level regulatory frameworks may provide for Group Net Metering ("GNM") and Virtual Net Metering ("VNM") arrangements, subject to applicable eligibility, capacity, metering, billing and distribution-licensee requirements. [Relevant SERC / MNRE] • GNM and VNM arrangements may require EPC participants to account for applicable metering, electricity-settlement, documentation and distribution-licensee requirements for eligible distributed solar configurations.	maintain regulatory-compliance capabilities.
Environmental	• India's climate strategy includes 500 GW of non-fossil capacity by 2030, a 45% reduction in emissions intensity of GDP from 2005 levels by 2030, reduction of projected carbon emissions by 1 billion tonnes by 2030 and Net Zero emissions by 2070. [PIB / Government of India] • Government policy identifies renewable-energy expansion, energy storage and grid modernisation as important components of India's energy transition. [MoP / MNRE] • Continued expansion of solar capacity increases the importance of efficient project design, land and resource management and lifecycle management of renewable-energy assets.	• Strengthens the structural role of solar energy within India's long-term decarbonisation pathway and supports sustained demand for solar EPC services. • Environmental objectives encourage deployment of renewable generation, storage and associated grid infrastructure. • Increasing scale of solar deployment is likely to place greater emphasis on resource efficiency, responsible project development and lifecycle management, including end-of-life considerations for solar equipment.

Source: *Ministry of New and Renewable Energy ("MNRE"), Ministry of Power ("MoP"), Central Electricity Authority ("CEA"), and Press Information Bureau ("PIB"), Government of India.*

The PESTLE environment remains structurally supportive for the Indian Solar EPC Services Industry, particularly through long-term non-fossil capacity targets, government-led renewable-energy programmes, transmission investment and the development of domestic solar manufacturing. At the same time, the operating environment is becoming more technically demanding and regulatory-intensive, with ALMM compliance, storage integration, evolving procurement frameworks and grid-integration requirements increasing the capabilities required from EPC participants. Accordingly, the industry is likely to favour organised EPC companies with strong project execution, procurement, regulatory compliance, technical integration, working-capital management and lifecycle O&M capabilities.

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8. Government Initiatives Regulatory Framework and Policy Support

The Indian Solar EPC Services Industry operates within a policy environment focused on renewable-energy capacity expansion, distributed solar deployment, domestic manufacturing, grid integration, energy storage and long-term decarbonisation. Government initiatives administered primarily by the Ministry of New and Renewable Energy ("MNRE") and the Ministry of Power ("MoP"), together with electricity-sector regulations and procurement frameworks, influence project pipelines, equipment sourcing, grid connectivity, technical standards and execution requirements across utility-scale, C&I, rooftop, decentralised, hybrid and storage-linked solar projects

Key Government Initiatives and Policy Support

Policy / Initiative	Policy Details	Industry Impact
National Infrastructure Pipeline ("NIP")	The National Infrastructure Pipeline envisaged infrastructure investment of approximately ₹111 lakh crore during FY2020–FY2025, covering sectors including energy, roads, railways and urban infrastructure. [PIB / Department of Economic Affairs]	Provides a broad infrastructure investment framework supporting renewable-energy, power and associated infrastructure development. Creates opportunities for solar EPC contractors across utility projects, public assets and institutional infrastructure.
PM GatiShakti National Master Plan	Launched in October 2021 as a whole-of-government platform for integrated planning and coordinated execution of infrastructure projects. The framework integrates infrastructure and logistics-related data to improve project planning and coordination. [PIB / PM GatiShakti]	Supports coordination between renewable-energy projects, transmission infrastructure, logistics and industrial development. Improved project sequencing can assist EPC participants in managing land, logistics, utility interfaces and evacuation-related dependencies.
National Programme on High Efficiency Solar PV Modules under PLI	The Production Linked Incentive ("PLI") programme for high-efficiency solar PV modules has an approved outlay of ₹24,000 crore across Tranche-I and Tranche-II. Tranche-I has an outlay of ₹4,500 crore with Letters of Award ("LoAs") for 8,737 MW of fully integrated manufacturing capacity, while Tranche-II has an outlay of ₹19,500 crore with LoAs for 39,600 MW of fully or partially integrated capacity. [MNRE / PIB]	Supports development of domestic solar PV manufacturing and greater integration of the domestic supply chain. Increasing domestic manufacturing capacity can improve procurement options and supply visibility for EPC participants, while also increasing the importance of supplier qualification and compliance with applicable ALMM requirements.
PM-KUSUM	PM-KUSUM provides for decentralised grid-connected renewable power plants, solarisation of agricultural feeders and standalone solar agriculture pumps. The scheme targets 34,800 MW of solar capacity by March 2026 and provides total Central Financial Support of ₹34,422 crore. [MNRE]	Expands the addressable EPC market beyond conventional utility-scale projects into decentralised generation, agricultural applications and solar-powered infrastructure. Creates opportunities for EPC contractors with capabilities in distributed solar installation, electrical integration and

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		project execution across geographically dispersed sites.
PM Surya Ghar: Muft Bijli Yojana	The scheme supports residential rooftop solar deployment and was approved with a total outlay of ₹75,021 crore for implementation until FY2026–27. [MNRE / PIB]	Supports expansion of the residential rooftop solar market and creates demand for rooftop EPC, system installation, grid interconnection and associated after-sales and maintenance services.
Renewable Energy Bidding Frameworks	The Government has established bidding trajectories and standard bidding guidelines for procurement of renewable power, including solar, wind, hybrid and firm and dispatchable renewable-energy projects. [MoP / MNRE / SECI]	Provides structured procurement mechanisms and visibility to renewable-energy project pipelines. Competitive bidding also increases the importance of cost discipline, procurement efficiency, technical capability and execution track record for EPC participants.
Battery Energy Storage System ("BESS") Viability Gap Funding	The Government has supported BESS deployment through Viability Gap Funding ("VGF") schemes, including support for 13.22 GWh under the initial scheme and a subsequent scheme for 30 GWh with financial support of ₹5,400 crore. [MoP / PIB]	Supports the development of storage-linked renewable projects and expands the technical scope of EPC services towards BESS integration, power-conversion systems, energy-management systems and associated grid infrastructure.
Union Budget Capital Expenditure Programmes	Public capital expenditure was budgeted at approximately ₹12.2 lakh crore for FY2026–27, with continued emphasis on infrastructure and strategic sectors. [Ministry of Finance / Union Budget]	Sustained public capital expenditure supports the broader power, transmission, transportation and urban infrastructure ecosystem in which renewable-energy projects are developed. This provides an enabling environment for organised EPC participants with project execution and financial capabilities.
Green Energy Corridor	The Green Energy Corridor programme supports development of transmission infrastructure required for evacuation and integration of renewable power into the electricity grid. [MNRE / PIB]	Strengthens the enabling infrastructure for large renewable-energy projects and supports timely evacuation of power. Expansion of transmission infrastructure creates opportunities for EPC activities associated with substations, electrical systems and grid integration.
Industrial Corridors and Logistics Infrastructure	Industrial corridors, logistics parks and manufacturing zones are being developed under various central and state programmes, including initiatives aligned with PM GatiShakti and broader infrastructure-development frameworks. [PIB / Government of India]	Expands opportunities for C&I rooftop and ground-mounted solar projects within manufacturing facilities, warehouses, logistics parks and industrial clusters. Multi-site EPC capabilities can enable repeatable project execution across such developments.
Smart Cities Mission	The Smart Cities Mission was launched on June 25, 2015, covering 100 cities and using city-level Special Purpose Vehicles	Creates opportunities for distributed solar installations, solar-powered public infrastructure and energy-efficient

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	("SPVs") for implementation. [MoHUA / PIB]	systems across municipal and institutional assets. SPV-based procurement also provides structured project-development and tendering mechanisms.
AMRUT 2.0	AMRUT 2.0 was launched on October 1, 2021, for FY2021–22 to FY2025–26, with an indicative outlay of ₹2,99,000 crore, including a Central share of approximately ₹76,760 crore. The mission focuses on water supply, sewerage, water security, recycled water and related urban infrastructure. [MoHUA / PIB]	Supports development and modernisation of urban utility infrastructure, creating potential applications for solarisation of water-supply, pumping and treatment infrastructure and associated electrical systems.

Regulatory and Compliance Framework

Regulation / Framework	Regulatory Requirement	Industry Impact
Approved List of Models and Manufacturers ("ALMM")	MNRE's ALMM framework requires specified Government, Government-assisted, public-sector and certain open-access and net-metering projects to use eligible solar PV modules and cells from manufacturers and models included in the applicable lists. The first ALMM List-I for solar PV modules was issued on March 10, 2021, while the first ALMM List-II for solar PV cells was issued on July 31, 2025 and is being periodically revised; the eighth revision of ALMM List-II was issued on July 22, 2026. [MNRE]	Directly influences procurement strategy for EPC contractors undertaking covered projects. Requires monitoring of manufacturer and model eligibility, procurement documentation and regulatory compliance, while periodic revisions can affect supplier availability and project planning.
CEA (Measures relating to Safety and Electric Supply) Regulations, 2023	The CEA Regulations, 2023, as amended from time to time, establish safety requirements for electrical installations and include specific provisions for renewable generating stations and solar installations, including requirements relating to access pathways, maintenance walkways, cabling and protection of ground-mounted installations. [CEA]	Establishes the core electrical-safety framework relevant to solar generating installations and associated electrical systems. EPC contractors are required to incorporate applicable safety, protection, earthing, access and installation requirements into project design and execution.
Renewable Purchase Obligation ("RPO") and Renewable Consumption Obligation ("RCO")	The Ministry of Power has notified RPO and RCO trajectories through FY2029–30, establishing renewable-energy procurement and consumption requirements for applicable obligated entities, together with provisions relating to non-compliance. [MoP / PIB]	Supports structural demand for renewable-energy procurement and provides visibility to solar project development. EPC participants benefit from the resulting demand pipeline while remaining required to monitor applicable central and state-level regulatory requirements.

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Electricity (Rights of Consumers) Rules, 2020 and Amendments	The Rules recognise consumers as "prosumers" and provide for rooftop solar systems and net-metering, gross-metering and net-billing arrangements. Subsequent amendments provide for net-metering up to 500 kW or sanctioned load, whichever is lower, subject to applicable provisions, with states specifying detailed implementation requirements. [MoP / PIB]	Shapes rooftop and C&I solar business models, system sizing and electricity-settlement mechanisms. EPC participants must align project design, metering arrangements and documentation with applicable state-level regulations. The applicability of GNM and VNM arrangements may further influence system configuration, metering and electricity-settlement mechanisms for eligible multi-location or participating consumers, subject to applicable State-level regulations and distribution-licensee procedures.
Group Net Metering ("GNM") and Virtual Net Metering ("VNM") Frameworks	GNM and VNM are regulatory mechanisms that facilitate adjustment or allocation of electricity generated from eligible renewable energy systems against electricity consumption of multiple eligible electricity service connections, subject to the applicable State regulatory framework. Under GNM, renewable energy generation may be adjusted against multiple electricity service connections of the same eligible consumer or entity, subject to applicable regulations. Under VNM, renewable energy generation may be allocated or credited among multiple participating consumers or service connections, subject to applicable regulations. Eligibility criteria, capacity limits, metering arrangements, billing mechanisms and implementation procedures vary across States and are governed by the relevant State Electricity Regulatory Commission and distribution licensee. The Delhi Electricity Regulatory Commission issued guidelines for GNM and VNM in 2019, which have subsequently been amended. MNRE also issued a guiding Standard Operating Procedure for implementation of VNM and GNM mechanisms in 2023	GNM and VNM can facilitate deployment of distributed renewable energy systems where generation is adjusted or allocated across multiple eligible service connections. Such arrangements may be relevant to distributed solar projects involving multi-location consumers, participating consumers or other eligible configurations. EPC service providers may be required to coordinate system design, metering, billing, regulatory documentation and distribution-licensee procedures in addition to conventional project execution.
National Building Code ("NBC") 2016	NBC 2016 establishes provisions relating to building design, electrical installations, fire and life safety, HVAC, plumbing and other building services. [BIS / Government of India]	Relevant particularly to rooftop and building-integrated solar installations where PV systems must be integrated with existing building electrical, access and fire-safety arrangements.
Energy Conservation Building Code ("ECBC") 2017	ECBC 2017 establishes minimum energy-performance requirements for applicable commercial buildings and covers areas including building envelope, lighting, HVAC and electrical systems. [BEE / MoP]	Supports adoption of energy-efficient electrical and building systems and can complement rooftop solar deployment in commercial and institutional buildings. EPC participants offering integrated renewable-energy and energy-efficiency

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		solutions can benefit from this requirement.
Labour and Occupational Safety Framework	Applicable labour and occupational safety legislation establishes requirements relating to worker welfare, site safety, training and workplace conditions, including requirements relevant to construction activities. [Ministry of Labour & Employment / Government of India]	Increases the importance of formal health, safety and environment ("HSE") systems, workforce training and documented site procedures. Organised EPC participants with established safety-management systems are better positioned to execute large and institutional projects.
Green Building and Sustainability Frameworks	Government-supported and industry-developed frameworks, including GRIHA and other building sustainability standards, promote energy efficiency, renewable-energy integration and environmentally responsible building design. [Government of India / MoHUA]	Encourages integration of rooftop solar, energy-efficient electrical systems and sustainable building solutions. Creates additional opportunities for EPC providers serving green-certified and sustainability-focused developments.

Source: *Ministry of New and Renewable Energy ("MNRE"), Ministry of Power ("MoP"), Central Electricity Authority ("CEA"), Bureau of Energy Efficiency ("BEE"), Ministry of Housing and Urban Affairs ("MoHUA"), Ministry of Finance, Ministry of Labour and Employment, Bureau of Indian Standards ("BIS") and Press Information Bureau ("PIB"), Government of India.*

Government initiatives and regulatory frameworks collectively provide a structurally supportive environment for the Indian Solar EPC Services Industry. Long-term renewable-energy objectives, PM-KUSUM, PM Surya Ghar, renewable-energy procurement frameworks, domestic manufacturing incentives, transmission development and BESS support , together with distributed solar mechanisms such as GNM and VNM in applicable States, broaden the addressable market across utility-scale, rooftop, C&I, decentralised, hybrid and storage-linked applications. [MNRE / MoP / PIB]

At the same time, the regulatory environment is becoming more technically and operationally demanding. ALMM requirements, CEA electrical-safety provisions, RPO/RCO trajectories, consumer-level electricity regulations, State-specific GNM/VNM requirements and evolving storage and grid-integration requirements increase the importance of procurement discipline, technical design, documentation, regulatory monitoring and project-execution capabilities [MNRE / CEA / MoP]

Accordingly, the industry is likely to increasingly favour organised EPC companies with capabilities in multi-segment project execution, ALMM-compliant procurement, electrical and grid integration, storage and hybrid-system integration, regulatory compliance, working-capital management and lifecycle O&M. Such capabilities can support participation in the expanding renewable-energy project pipeline while mitigating execution, procurement and compliance-related risks.

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9. Technology & Digital Transformation

The Indian Solar EPC Services Industry is undergoing a technology-led transition as increasing project scale, technical complexity, hybridisation, energy storage and the need for higher plant performance are driving greater adoption of digital engineering, monitoring, automation and data-based asset management. Technology adoption is increasingly extending across the project lifecycle, from site assessment and system design to procurement, construction, commissioning, plant monitoring, maintenance and performance optimisation. The following developments are expected to remain relevant as the industry evolves towards larger, more integrated and digitally managed renewable-energy assets.

1. **Digital Engineering, Simulation and Advanced Plant Design**
   Solar EPC participants are increasingly adopting digital engineering and simulation tools for site assessment, solar-resource evaluation, shading analysis, plant-layout optimisation, electrical design and energy-yield estimation. GIS-based assessment, digital terrain modelling, 3D design and specialised PV simulation tools can support evaluation of site conditions, module configurations, string layouts, electrical infrastructure and evacuation arrangements before construction. These capabilities improve design precision, facilitate early identification of site and engineering constraints and support optimisation of land, equipment and system configurations. For EPC participants, greater use of digital engineering can reduce design iterations, improve project planning and enable more standardised and repeatable execution across utility-scale, C&I, rooftop and technically complex projects.
2. **SCADA, IoT and Remote Plant Monitoring**
   Supervisory Control and Data Acquisition ("SCADA"), remote monitoring systems, data loggers, smart meters and connected plant equipment are increasingly enabling continuous visibility of generation, inverter performance, plant availability, weather conditions and other operating parameters. The integration of field-level equipment with centralised monitoring platforms enables EPC and O&M teams to identify abnormal operating conditions remotely and monitor plant performance across geographically dispersed assets. This supports faster operational response, strengthens commissioning and warranty management and enables EPC participants to develop data-enabled O&M offerings. As the installed solar asset base expands, remote monitoring is expected to become an increasingly important component of lifecycle asset management.
3. **AI, Data Analytics and Predictive Asset Management**
   The increasing availability of operational data from SCADA systems, inverters, weather stations, sensors and other plant equipment is creating opportunities for Artificial Intelligence ("AI"), Machine Learning ("ML") and advanced analytics in solar asset management. These technologies can be applied to anomaly detection, generation forecasting, performance benchmarking, fault identification, equipment-health assessment and maintenance planning. The application of data analytics can support a transition from reactive maintenance towards condition-based and predictive maintenance, enabling EPC and O&M participants to identify potential performance issues earlier and prioritise maintenance interventions. Over time, greater use of AI and analytics is expected to strengthen performance optimisation and create opportunities for differentiated, technology-enabled lifecycle services.
4. **Drone-Based Inspection, Thermography and Automated Diagnostics**
   Drone-based inspection using high-resolution visual and thermal imaging is becoming increasingly relevant for large-scale solar installations, where manual inspection of extensive module fields can

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be time-intensive. Drone-based systems can support identification and geo-referencing of module hotspots, damaged modules, soiling, vegetation and other visible or thermal anomalies. Automated image processing and analytics can further assist in analysing inspection data and prioritising maintenance requirements. Wider adoption of these technologies can improve inspection coverage, documentation and maintenance planning and enable EPC and O&M providers to offer more systematic asset-inspection and performance-management services, particularly for large and geographically distributed solar portfolios.

5. **Automated and Robotic Maintenance Systems**
   The adoption of automated robotic systems is emerging in solar asset inspection and maintenance, particularly for large-scale and geographically dispersed installations. Robotic cleaning systems, automated inspection equipment and other semi-autonomous technologies can support module cleaning, inspection and identification of operating abnormalities while reducing dependence on manual intervention in repetitive activities. Such systems can improve consistency of maintenance activities and support operational efficiency, particularly where large module volumes, difficult site conditions or water-use considerations increase the complexity of conventional maintenance. Adoption remains dependent on project scale, site configuration, technology suitability and cost economics.
6. **AI-Powered Hybrid Integration and Microgrids**
   The integration of Artificial Intelligence ("AI"), advanced forecasting and Energy Management Systems ("EMS") with solar, energy storage and other distributed energy resources is enabling more coordinated management of hybrid renewable-energy systems and microgrids. AI-enabled systems can support generation forecasting, load management, storage dispatch, demand optimisation and coordination of multiple energy sources based on operating conditions. For solar EPC participants, these developments are increasing the importance of controls, power-system integration, energy-management and digital optimisation capabilities, particularly for C&I, captive, decentralised and storage-linked applications.
7. **Hybrid Renewable Energy and Energy Storage Integration**
   The increasing deployment of hybrid renewable-energy projects and Battery Energy Storage Systems ("BESS") is expanding the technological scope of solar EPC services beyond conventional photovoltaic installation. Storage-linked projects require integration of PV systems with batteries, Power Conversion Systems ("PCS"), Energy Management Systems ("EMS"), protection equipment, control systems, forecasting platforms and grid-interconnection infrastructure. Hybrid configurations similarly require coordinated control of multiple renewable-generation sources and associated electrical systems. This evolution is increasing the importance of system-integration, controls, electrical engineering and grid-interconnection capabilities and is expected to create higher-value opportunities for EPC participants capable of delivering integrated renewable-energy and storage solutions.

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8. **Cybersecurity, Data Governance and Digital Compliance**
   As solar assets become increasingly connected through SCADA, remote monitoring systems, BESS controls, communication networks and grid interfaces, cybersecurity, data integrity and system availability are becoming increasingly relevant to project design and asset management. Digitalised plants require appropriate access controls, secure communications, system monitoring, vendor management and data-governance practices. Digital platforms also facilitate structured reporting of generation, availability, performance and operational information to asset owners, O&M teams and relevant grid or regulatory stakeholders. Consequently, EPC participants with capabilities spanning IT/OT integration, cybersecurity, data management and digital reporting are expected to be better positioned to address the requirements of increasingly connected, automated and mission-critical renewable-energy infrastructure.

The technological transformation of the Indian Solar EPC Services Industry is progressing from digital project design and remote monitoring towards AI-enabled asset management, automated inspection, storage integration and connected plant operations. These developments are increasing the technical depth of EPC services and expanding the role of EPC participants from project construction and commissioning towards integrated engineering, digital asset management and lifecycle performance optimisation. Over the medium to long term, the industry is expected to increasingly favour organised EPC participants that combine conventional project-execution capabilities with digital engineering, SCADA and remote monitoring, data analytics, automated inspection, storage and hybrid-system integration, cybersecurity and lifecycle O&M capabilities. This technology orientation provides a scalable foundation for EPC services as solar projects become larger, more distributed, more storage-linked and increasingly integrated with digital power-system infrastructure.

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10. Competitive Landscape

The Indian Solar EPC Services Industry operates in a competitive environment shaped by tariff-based procurement, project execution capability, equipment sourcing, regulatory compliance, financial capacity and technological integration. Competition varies across utility-scale, commercial and industrial ("C&I"), rooftop, decentralised and storage-linked projects, with procurement mechanisms ranging from competitive bidding and government tenders to developer-led and customer-specific contracts. As project configurations become more complex and domestic sourcing and grid-integration requirements evolve, EPC participants increasingly compete on execution track record, procurement capabilities, technical expertise, financial strength and lifecycle service capabilities.

Key Factors Shaping Competition

- **Tariff Competitiveness and Cost Management**
  Utility-scale solar projects are frequently awarded through competitive bidding processes conducted by central and state renewable-energy implementing agencies, while C&I and rooftop projects are generally more customer- and configuration-specific. EPC participants therefore need to optimise module and balance-of-system procurement, engineering design, construction schedules and project execution costs while maintaining contractual performance requirements. Cost competitiveness remains particularly important in tender-driven segments where tariff and project economics influence award decisions.
- **Execution Capability and Track Record**
  Project execution experience is an important competitive differentiator, particularly for large utility-scale and technically complex projects. EPC participants are required to manage site development, engineering, procurement, civil and electrical works, grid connectivity, testing and commissioning within defined project schedules. A demonstrated track record across comparable project capacities and configurations can strengthen eligibility and credibility in tenders and private-sector procurement.
- **Procurement and Domestic Content Compliance**
  The Approved List of Models and Manufacturers ("ALMM") framework and domestic content requirements applicable to specified government and other projects influence module and cell procurement decisions. EPC participants therefore require established supplier networks, supplier-qualification processes and documentation systems to ensure that equipment procured for applicable projects meets prevailing eligibility requirements. Changes in approved manufacturers, models and applicable procurement conditions can also affect sourcing strategies and project timelines.
- **Financial Strength and Working-Capital Management**
  Solar EPC contracts may involve bid securities, performance guarantees, mobilisation and procurement expenditure, retention provisions and milestone-linked payments, depending

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on the contractual structure. EPC participants with adequate liquidity, banking relationships and working-capital management capabilities are better positioned to fund procurement and project mobilisation while managing payment cycles, variations, claims and contractual obligations. Financial strength is therefore particularly relevant for large and multi-project portfolios.

- **Technical and Systems-Integration Capability**
  The increasing deployment of solar-wind hybrid projects, firm and dispatchable renewable-energy configurations, battery energy storage systems ("BESS"), advanced monitoring and grid-interactive systems is expanding the technical scope of EPC services. Capabilities in electrical engineering, power evacuation, protection systems, forecasting, SCADA, remote monitoring and storage integration can differentiate EPC participants in higher-complexity projects.
- **Regulatory, Grid and Quality Compliance**
  Compliance with applicable Central Electricity Authority ("CEA") regulations, grid-connectivity requirements, state-level electricity regulations, metering provisions, ALMM requirements and project-specific technical specifications is integral to project execution. EPC participants with established engineering, testing, commissioning, documentation and regulatory-management processes are better positioned to execute projects involving multiple statutory and contractual interfaces.

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Competitive Strategies

- **Segment Diversification**
  EPC participants are increasingly developing capabilities across utility-scale, C&I, rooftop, decentralised and storage-linked solar projects. Diversification across customer categories and project configurations can reduce dependence on individual tender cycles and enable companies to leverage common engineering, procurement and O&M capabilities across multiple market segments.
- **Strategic Supplier Networks and Procurement Management**
  Maintaining relationships with eligible module, inverter, electrical equipment and balance-of-system suppliers enables EPC participants to manage availability, pricing, delivery schedules and technical specifications. Supplier qualification, procurement planning and compliance monitoring become particularly important where ALMM or domestic-content requirements apply.
- **Technology-Enabled Execution and O&M**
  Digital design, SCADA, remote monitoring, drone-based inspection, automated performance analytics and predictive maintenance are increasingly being incorporated into project execution and lifecycle O&M. Such capabilities can improve visibility of plant performance, facilitate faster identification of equipment issues and support data-driven maintenance and asset management.
- **Hybrid, Storage and Grid-Integration Capabilities**
  EPC participants are expanding technical capabilities towards solar-wind hybrid, firm and dispatchable renewable-energy and BESS-linked projects. Expertise in power conversion systems, energy management systems, protection, forecasting and grid integration enables participation in projects with more complex generation and dispatch requirements.
- **Financial and Contractual Risk Management**
  Competitive EPC participants increasingly focus on disciplined bid evaluation, procurement planning, contract structuring, contingency management and claims administration. Effective management of price, schedule, performance, payment and counterparty risks is particularly important under fixed-price and milestone-based EPC contracts.
- **Lifecycle O&M and Customer Retention**
  Expansion from EPC execution into long-term operation and maintenance, monitoring and performance-management services can strengthen customer relationships and provide recurring service opportunities. Lifecycle capabilities also enable EPC participants to retain operational knowledge of commissioned assets and support long-term plant performance.
- **Geographic and Customer Diversification**
  Expansion across states and customer categories allows EPC participants to access different procurement channels and project opportunities. Local execution capabilities, knowledge of state-level regulations and DISCOM processes, and established vendor and subcontractor networks can support efficient deployment across geographically dispersed projects.

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Barriers to Entry

- **Financial and Working-Capital Requirements**
  Large EPC contracts require the ability to finance procurement, mobilisation and project execution while meeting contractual security and performance requirements. Limited access to working capital and banking facilities can restrict smaller entrants from competing for large-scale projects.
- **Execution Track Record**
  Tender eligibility and customer selection processes may require prior experience in comparable projects, technical qualifications and evidence of successful project execution. Developing an established track record therefore represents a significant barrier for new entrants seeking large utility and institutional contracts.
- **Technical and Engineering Capability**
  Large-scale solar projects require capabilities covering site assessment, electrical and civil engineering, plant design, evacuation infrastructure, protection systems, testing, commissioning and performance management. Hybrid and storage-linked projects further increase the technical requirements.
- **Regulatory and Compliance Capability**
  The industry is subject to multiple technical, procurement and electricity-sector requirements, including applicable ALMM provisions, CEA regulations, grid-connectivity requirements and state-level regulations. Maintaining dedicated compliance, documentation and procurement capabilities increases the operational requirements for new entrants.
- **Supplier Access and Procurement Capability**
  Access to reliable module, inverter, transformer, cable, mounting-structure and other balance-of-system suppliers is important for maintaining project schedules and cost competitiveness. Evolving domestic manufacturing and eligibility requirements further increases the importance of established supplier relationships and procurement systems.
- **Reputation and Customer Confidence**
  Project owners, developers and institutional customers place importance on execution history, financial capability, quality assurance and the ability to meet contractual performance obligations. Building such credibility requires sustained project execution and customer references, creating an additional barrier for newly established EPC participants.

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Strategic Partnerships and Industry Evolution

- **Supplier and Technology Partnerships**
  EPC participants may enter commercial relationships with module manufacturers, inverter and electrical-equipment suppliers, digital technology providers and storage-system providers to strengthen procurement access and technical capabilities. Such arrangements can support execution of increasingly integrated renewable-energy projects.
- **Vertical Expansion Across the Project Lifecycle**
  Some industry participants are expanding beyond EPC execution into O&M, monitoring, asset management and storage integration. Such expansion allows participants to capture a broader portion of the project lifecycle and develop recurring service relationships with asset owners.
- **Technology-Led Differentiation**
  Digital engineering, remote monitoring, automated inspection, performance analytics and predictive O&M are becoming additional avenues for differentiation. The increasing digitisation of solar assets is likely to make IT/OT integration and data-management capabilities more relevant to competitive positioning.
- **Movement Towards Integrated Renewable-Energy Solutions**
  The evolution from standalone solar projects towards hybrid renewable-energy, storage-linked and grid-integrated configurations is increasing the importance of multidisciplinary engineering and systems-integration capabilities. EPC participants capable of combining generation, storage, electrical infrastructure, digital monitoring and lifecycle services may be better positioned for technically complex projects.

The competitive landscape of the Indian Solar EPC Services Industry is primarily defined by cost competitiveness, execution track record, procurement capability, financial strength, regulatory compliance and technical systems integration. The competitive requirements are also evolving as the industry moves beyond conventional solar PV installation towards hybrid renewable-energy, storage-linked, digitally monitored and grid-integrated projects.

Accordingly, competitive advantage is increasingly likely to favour organised EPC participants with strong project execution capabilities, established supplier networks, disciplined working-capital and contract management, ALMM-compliant procurement processes, technical expertise in grid and storage integration, and lifecycle O&M capabilities. The ability to combine competitive project economics with reliable execution, regulatory compliance and technology-enabled asset management is expected to remain an important determinant of long-term competitiveness.

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Key Industry Players

The Indian solar EPC industry comprises companies with varying degrees of exposure to rooftop, ground-mounted and utility-scale solar projects, as well as project development, operations and maintenance ("O&M") and related renewable energy solutions. The competitive landscape includes specialised solar EPC companies as well as larger renewable energy companies with broader capabilities and greater operating scale. The following companies represent selected listed industry participants relevant to Smart Roof Solar Solutions Limited based on their exposure to solar EPC and related project activities.

1. GRE Renew Enertech Limited

GRE Renew Enertech Limited is a renewable energy company primarily engaged in providing solar power solutions through engineering, procurement and construction ("EPC") services. The Company undertakes the development and execution of solar power projects for industrial, commercial and institutional customers. Its activities include design, engineering, procurement, installation, commissioning and maintenance of solar power systems, with exposure to both rooftop and ground-mounted solar projects.

GRE Renew Enertech Limited also undertakes activities relating to solar park development and has exposure to captive and other solar power project configurations. In addition to its solar activities, the Company has a business relating to the manufacture and supply of energy-efficient LED lighting products.

The Company's exposure to industrial and commercial solar projects, rooftop and ground-mounted installations and solar EPC execution makes it relevant for comparison with Smart Roof. However, differences in operating scale, project mix, geographic presence and business composition should be considered when assessing comparability.

2. Trom Industries Limited

Trom Industries Limited is a solar energy company engaged in engineering, procurement and construction of solar power projects. Its reported business segment is solar, and the Company operates as an SME-listed participant in the Indian solar EPC market.

The Company's activities include solar project execution across different customer and project categories, including rooftop and ground-mounted solar installations. Its business is focused on the execution and delivery of solar power systems for commercial, industrial and residential customers.

Trom Industries Limited represents an emerging listed participant in the solar EPC segment and is relevant to Smart Roof particularly because of its focus on solar project execution and distributed solar applications. Its scale, operating history and business profile, however, differ from those of larger listed renewable energy companies.

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3. Solarium Green Energy Limited

Solarium Green Energy Limited is engaged in the solar energy sector and provides turnkey engineering, procurement and construction solutions for solar power projects. The Company operates in the rooftop and distributed solar segment, providing turnkey EPC solutions across residential, commercial, industrial and agricultural sectors.

Solarium Green Energy Limited's activities cover solar project execution across different customer segments and project configurations. Its business includes rooftop solar projects as well as other solar EPC activities, providing exposure across residential, commercial and institutional applications.

The Company's operating profile is relevant to Smart Roof due to its exposure to rooftop and EPC-based solar projects. The Company has also undertaken initiatives relating to the expansion of its solar manufacturing capabilities, indicating a degree of vertical integration beyond a conventional EPC-focused business model.

Comparative Positioning

The selected companies operate across different segments of the Indian solar EPC and renewable energy market and vary in terms of operating scale, project mix, customer segments and breadth of activities. Smart Roof is primarily focused on solar EPC projects, with experience across rooftop and ground-mounted configurations and commercial models including CAPEX and RESCO/PPA. Its project experience also extends to international markets including Bhutan, Uganda, Madagascar and Comoros.

Among the selected participants, GRE Renew Enertech Limited, Trom Industries Limited and Solarium Green Energy Limited have areas of overlap with Smart Roof in solar EPC and distributed or ground-mounted solar project execution. The peer group therefore provides a reference point for assessing Smart Roof's positioning within the Indian solar EPC industry, while recognizing differences in scale, business mix, project configurations and geographic presence.

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Qualitative Comparative Analysis of Key Solar EPC Players:

Parameter / Capability	Smart Roof Solar Solutions Ltd	GRE Renew Enertech Ltd	Trom Industries Ltd	Solarium Green Energy Ltd
Primary Business	Solar EPC (Rooftop & Ground-Mounted)	Solar EPC + LED Lighting	Solar EPC	Solar EPC
Rooftop Solar EPC	✓	✓	✓	✓
Ground-Mounted Solar EPC	✓	✓	✓	✓
Open Access Solar Projects	✓	✓	—	—
CAPEX / Turnkey Model	✓	✓	✓	✓
RESCO / PPA Model	✓	✓	—	—
GNM / VNM Scheme Expertise	✓	—	—	—
O&M Services	✓ (via Sunadda)	✓	✓	✓
Proprietary Monitoring Platform	✓ (SolarMaxx)	—	—	—
International Project Experience	✓ (Bhutan, Uganda, Madagascar, Comoros)	—	—	—
BESS Integration Capability	✓	—	—	—
Module Manufacturing / Backward Integration	—	—	—	Partial / expanding
Asset-Light Model	✓	✓	✓	—
Scale (Relative)	Mid-sized	SME / Mid-sized	SME	SME
Key Differentiator	International execution, SolarMaxx platform	Solar EPC, solar park development and LED lighting	Distributed solar EPC across residential, commercial and industrial segments	Rooftop and distributed solar EPC with expanding manufacturing capabilities

Source: *Company annual reports, investor presentations, statutory and stock-exchange filings, and official websites of the respective companies, as available up to the date of this report. The information presented herein has been compiled from publicly available disclosures and is intended solely for comparative industry analysis. A "✓" indicates that the relevant activity or capability has been disclosed or otherwise established from the reviewed sources, while a "—" indicates that the relevant activity or capability could not be sufficiently established from the reviewed public disclosures and should not be construed as confirmation that such activity or capability is not undertaken by the respective company. Comparative classifications and key differentiators represent assessments based on the disclosed business profiles and operating characteristics of the respective companies and may not be directly comparable due to differences in business mix, project size, geographic presence, operating model and reporting practices.* **

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Company Positioning – Smart Roof Solar Solutions Limited

Smart Roof Solar Solutions Limited ("SRSSL", "Smart Roof" or the "Company") is a solar engineering, procurement and construction ("EPC") and Battery Energy Storage System ("BESS") solutions provider with over a decade of experience in the renewable energy sector. The Company primarily provides EPC solutions for solar power projects and BESS applications. Its scope of services generally includes project assessment, engineering and design, procurement of solar modules, battery storage systems and other balance-of-plant components, construction, installation, testing and commissioning of solar and energy storage systems. The Company primarily undertakes rooftop solar, ground-mounted solar and integrated solar-plus-storage projects, with a focus on private-sector customers.

The Company has undertaken solar projects across multiple locations in India and has also undertaken projects in selected international markets. Its project experience includes rooftop and ground-mounted solar installations across different site conditions, customer requirements and project configurations. The Company's international project experience includes markets such as Uganda, Bhutan, Madagascar and Comoros.

The Company undertakes projects under different commercial and contractual arrangements, including Capital Expenditure ("CAPEX") and Renewable Energy Service Company ("RESCO") models, as applicable. Under the CAPEX model, the Company provides project development and EPC services for the customer, while under the RESCO model, the project may be developed and operated under applicable contractual arrangements for supply of electricity to customers. The specific structure of each project depends on customer requirements, project characteristics and the applicable regulatory framework.

The Company has experience in executing industrial and commercial rooftop solar projects across multiple States in India and has also undertaken rooftop projects in international markets. Its rooftop projects are developed based on factors including site conditions, customer requirements, available rooftop area, electrical configuration and applicable regulatory requirements. The Company also undertakes ground-mounted solar projects, including projects under open-access and captive arrangements, where applicable.

The Company has experience across different solar project configurations and customer requirements. Its project activities may include projects for private developers and industrial and commercial customers, including projects implemented under applicable captive or open-access arrangements. The nature, scale and commercial structure of projects may vary depending on the customer, site conditions, project requirements and applicable regulations.

The Company has also undertaken projects and pursued opportunities in international markets. Such activities may include tender-based EPC opportunities and project-specific solar and energy storage assignments. International projects are subject to applicable host-country regulations, contractual requirements, project-specific conditions and execution considerations.

The Company has undertaken solar projects across India and selected international markets and, as provided by the Company, has cumulative project experience exceeding 100 MW across activities including design, development, installation, operation and maintenance. The Company has also stated that its cumulative delivered capacity across its services exceeds 150 MW. The assessment and classification of such capacities are subject to the underlying project documentation and the basis adopted for determining delivered capacity.

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The Company has also identified opportunities in the Philippines through its subsidiary and has indicated its intention to pursue solar projects in the market, including captive solar opportunities for private developers and industrial and commercial customers. The Company has indicated involvement as a technical partner in a solar project in the Philippines. The development and execution of such opportunities remain subject to applicable contractual, regulatory, project-development and execution requirements.

As part of its clean energy solutions, the Company provides Battery Energy Storage System ("BESS") solutions for integration with solar power projects and other energy storage applications. BESS can be deployed for applications including energy shifting, management of renewable generation variability, peak-load management and power reliability, subject to project-specific technical and commercial requirements. The configuration and deployment of BESS depend on factors including storage duration, operating conditions, system configuration, customer requirements and applicable technical standards.

Operations and maintenance ("O&M") services in relation to solar and storage projects are undertaken by the Company's Group Company, Sunadda Rooftop Private Limited ("Sunadda"). Sunadda provides O&M services for plants installed by the Company as well as certain third-party plants. Accordingly, O&M services are not presented as the principal operating vertical of SRSSL.

A technology capability supporting the Company's operations is its "SolarMaxx" platform. The platform integrates with inverters and data loggers through application programming interfaces ("APIs"), processes generation data and provides monitoring and alert capabilities. It can be deployed across plants installed by the Company as well as third-party plants, subject to applicable system compatibility.

The Company's operating capabilities are supported by its technical, engineering and project management capabilities across activities including site assessment, engineering, procurement, construction, installation and commissioning. Its experience across different project configurations and geographical locations enables it to undertake solar and energy storage projects based on project-specific requirements.

Accordingly, SRSSL is a solar EPC and BESS solutions provider primarily focused on rooftop solar, ground-mounted solar and integrated solar-plus-storage projects, with a focus on private-sector customers. The Company has experience across different project configurations and commercial arrangements, including CAPEX, RESCO, open-access and captive structures, as applicable. Its project experience spans multiple locations in India and selected international markets. The Company has also indicated project experience and prospective opportunities in the Philippines, including captive solar opportunities for private developers and industrial and commercial customers. O&M services are undertaken through Sunadda, while the Company's SolarMaxx platform provides technology-enabled project monitoring capabilities. Its technical, engineering and project execution capabilities support its participation in solar power and energy storage projects across private-sector customer requirements.

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Financial Performance Analysis

The table below presents a comparative analysis of Smart Roof Solar Solutions Limited ("the Company") in the Solar Engineering, Procurement And Construction ("EPC"), based on key financial and operational parameters for FY2026

All financials are consolidated unless stated otherwise. Figures are in ₹ lakhs.

Sr. No.	Key Performance Indicator	FY 2026	FY 2025	FY 2024
1	**Revenue from Operations (Rs. in lakhs)**	10,427.31	5,148.24	3,704.62
2	**Total Income (Rs. in lakhs)**	10,467.80	5,154.26	3,712.78
3	**EBITDA Margin (%)**	17.77%	14.27%	8.02%
4	**PAT Margin (%)**	12.77%	9.78%	4.97%
5	**ROCE (%)**	49.49%	47.62%	22.90%
6	**ROE (%)**	77.09%	62.22%	38.70%
7	**Debt/Equity (times)**	0.57	0.42	1.30

Note: Data as per company's Audited Financials. Key financial ratios and their formulas used in this report are as follows:

Notes on calculation of KPIs:

- *Revenue from Operations means the revenue from operations of the relevant entity as disclosed in its audited financial statements / restated financial information for the relevant Period.*
- *Total Income means the aggregate of Revenue from Operations and Other Income, as disclosed in the audited financial statements / restated financial information for the relevant Period.*
- *EBITDA Margin (%) is calculated as EBITDA (being Profit before Tax, adjusted for Finance Costs and Depreciation and Amortisation Expense, and excluding Other Income), divided by Revenue from Operations, expressed as a percentage.*
- *PAT Margin (%) is calculated as Profit for the year / period (Profit After Tax) divided by Revenue from Operations, expressed as a percentage.*
- *ROCE (%) i.e. Return on Capital Employed is calculated as Earnings Before Interest and Tax (EBIT) divided by Capital Employed, expressed as a percentage. Capital Employed is computed as Total Equity plus Total Debt (i.e. borrowings), less Intangible assets and Deferred Tax Assets, plus Deferred Tax Liability.*
- *ROE (%) i.e. Return on Equity is calculated as Profit for the year / period (Profit After Tax) divided by average Total Equity / Net Worth (being the average of Total Equity / Net Worth as at the beginning and end of the relevant Period), expressed as a percentage.*
- *Debt/Equity (x) is calculated as Total Debt (comprising aggregate of long-term and short-term borrowings) divided by Total Equity / Net Worth, as at the end of the relevant Period.*

Revenue and Business Scale

Smart Roof Solar Solutions Limited recorded revenue from operations of ₹10,427.31 lakhs in FY2026, compared with ₹5,148.24 lakhs in FY2025 and ₹3,704.62 lakhs in FY2024. Revenue from operations increased by 102.54% in FY2026 over FY2025, following an increase of 38.97% in FY2025 over FY2024, reflecting a substantial expansion in the Company's operating scale during the period. Total income stood at ₹10,467.80 lakhs in FY2026, compared with

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₹5,154.26 lakhs in FY2025 and ₹3,712.78 lakhs in FY2024, representing growth of 103.09% in FY2026 over FY2025 and 38.82% in FY2025 over FY2024.

Operating Profitability

The Company's EBITDA Margin improved to 17.77% in FY2026, compared with 14.27% in FY2025 and 8.02% in FY2024. The improvement of 3.50 percentage points in FY2026 over FY2025 and 6.25 percentage points over FY2024 indicates an expansion in operating profitability relative to the Company's revenue base during the reported period.

Profitability and Earnings

The Company's PAT Margin increased to 12.77% in FY2026, compared with 9.78% in FY2025 and 4.97% in FY2024. PAT Margin therefore improved by 2.99 percentage points in FY2026 over FY2025 and by 7.80 percentage points over FY2024, indicating an improvement in the Company's reported earnings conversion over the period.

Capitalisation and Financial Leverage

The Company's Debt-to-Equity ratio stood at 0.57 times in FY2026, compared with 0.42 times in FY2025 and 1.30 times in FY2024. The ratio increased by 0.15 times in FY2026 over FY2025, while remaining below the FY2024 level by 0.73 times. The movement indicates that the Company's leverage increased compared with FY2025 but remained lower than the level reported in FY2024.

Returns and Capital Efficiency

The Company's ROE increased to 77.09% in FY2026, compared with 62.22% in FY2025 and 38.70% in FY2024. ROE consequently improved by 14.87 percentage points in FY2026 over FY2025 and by 38.39 percentage points over FY2024.

ROCE stood at 49.49% in FY2026, compared with 47.62% in FY2025 and 22.90% in FY2024. ROCE therefore improved by 1.87 percentage points in FY2026 over FY2025 and by 26.59 percentage points over FY2024, reflecting an improvement in returns relative to capital employed over the reported period.

Smart Roof Solar Solutions Limited recorded a significant expansion in operating scale during FY2024–FY2026, with revenue from operations increasing from ₹3,704.62 lakhs in FY2024 to ₹10,427.31 lakhs in FY2026. This growth was accompanied by an improvement in EBITDA Margin and PAT Margin, indicating higher reported operating and net profitability relative to revenue.

The Company's ROE and ROCE also remained above their FY2024 levels in FY2026, while the Debt-to-Equity ratio remained below the FY2024 level despite increasing from FY2025. The order book, however, moderated in FY2026 following the higher level recorded in FY2025. Overall, the financial profile reflects expanding revenue scale, improving profitability margins, higher return ratios and leverage below FY2024 level.

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Financial Peer Benchmarking Table

The table below presents a comparative analysis of Smart Roof Solar Solutions Limited ("the Company") against select peers in the Solar Engineering, Procurement and Construction ("EPC") Industry, based on key financial and operational parameters for FY2026.

All financials are consolidated unless stated otherwise. Figures are in ₹ lakhs.

Key Indicators (in INR Lakhs)	GRE Renew Enertech Limited		
	FY 2026	FY 2025	FY 2024
Revenue from Operations (Rs. in lakhs)	12,292.16	8,371.73	9,034.01
Total Income (Rs. in lakhs)	12,578.29	8,440.29	9,215.40
EBITDA Margin (%)	13.13%	11.29%	12.77%
PAT Margin (%)	11.05%	8.39%	10.93%
ROCE (%)	22.12%	29.60%	51.03%
ROE (%)	24.49%	26.82%	60.86%
Debt/Equity (times)	0.02	0.05	0.22

Source: FY24, FY25 & FY26 Financials submitted on BSE.

All financials are consolidated unless stated otherwise. Figures are in ₹ lakhs.

Key Indicators (in INR Lakhs)	Trom Industries Limited		
	FY 2026	FY 2025	FY 2024
Revenue from Operations (Rs. in lakhs)	12,340.73	9,332.11	5,434.88
Total Income (Rs. in lakhs)	12,485.74	9,390.79	5,454.67
EBITDA Margin (%)	8.53%	7.31%	15.17%
PAT Margin (%)	5.61%	4.94%	10.74%
ROCE (%)	13.93%	11.96%	46.80%
ROE (%)	13.78%	15.64%	77.08%
Debt/Equity (times)	0.59	0.31	0.47

Source: FY24, FY25 & FY26 Financials submitted on BSE.

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All financials are consolidated unless stated otherwise. Figures are in ₹ lakhs.

Key Indicators (in INR Lakhs)	Solarium Green Energy		
	FY 2026	FY 2025	FY 2024
Revenue from Operations (Rs. in lakhs)	36,815.10	23,007.64	17,739.69
Total Income (Rs. in lakhs)	37,301.07	23,109.84	17,780.83
EBITDA Margin (%)	9.03%	11.26%	13.64%
PAT Margin (%)	5.56%	8.08%	8.87%
ROCE (%)	11.48%	12.43%	45.65%
ROE (%)	13.46%	22.95%	124.38%
Debt/Equity (times)	0.96	0.48	1.55

Source: FY24, FY25 & FY26 Financials submitted on BSE.

All financials are consolidated unless stated otherwise. Figures are in ₹ lakhs.

Key Indicators (in INR Lakhs)	Smart Roof Solar Solutions Limited	GRE Renew Enertech limited	Trom Industries Limited	Solarium Green Energy Limited
	FY2026	FY2026	FY2026	FY2026
Revenue from Operations (Rs. in lakhs)	10,427.31	12,292.16	12,340.73	36,815.10
Total Income (Rs. in lakhs)	10,467.80	12,578.29	12,485.74	37,301.07
EBITDA Margin (%)	17.77%	13.13%	8.53%	9.03%
PAT Margin (%)	12.77%	11.05%	5.61%	5.56%
ROCE (%)	49.49%	22.12%	13.93%	11.48%
ROE (%)	77.09%	24.49%	13.78%	13.46%
Debt/Equity (times)	0.57	0.02	0.59	0.96

Source: FY26 Financials submitted on BSE

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Revenue and Scale

Smart Roof Solar Solutions Limited reported revenue from operations of ₹10,427.31 lakhs and total income of ₹10,467.80 lakhs in FY2026. The Company operated at the lowest revenue scale among the selected peers, compared with ₹12,292.16 lakhs for GRE Renew Enertech Limited, ₹12,340.73 lakhs for Trom Industries Limited and ₹36,815.10 lakhs for Solarium Green Energy Limited.

Profitability

Smart Roof Solar Solutions Limited reported an EBITDA margin of 17.77% and a PAT margin of 12.77% in FY2026. Both margins were higher than those reported by the selected peers. GRE Renew Enertech Limited reported EBITDA and PAT margins of 13.13% and 11.05%, respectively, while Trom Industries Limited reported 8.53% and 5.61%, and Solarium Green Energy Limited reported 9.03% and 5.56%, respectively.

Capital Structure and Leverage

Smart Roof Solar Solutions Limited reported a debt-to-equity ratio of 0.57 times in FY2026. This was higher than 0.02 times reported by GRE Renew Enertech Limited and lower than 0.59 times reported by Trom Industries Limited and 0.96 times reported by Solarium Green Energy Limited. The Company's leverage was therefore positioned between GRE Renew Enertech Limited and the other two selected peers.

Returns and Capital Efficiency

Smart Roof Solar Solutions Limited reported ROCE of 49.49% and ROE of 77.09% in FY2026. These were higher than the corresponding ratios reported by the selected peers. GRE Renew Enertech Limited reported ROCE and ROE of 22.12% and 24.49%, respectively, while Trom Industries Limited reported 13.93% and 13.78%, and Solarium Green Energy Limited reported 11.48% and 13.46%, respectively.

Smart Roof Solar Solutions Limited operated at the lowest revenue scale among the selected peers in FY2026, while reporting the highest EBITDA margin, PAT margin, ROCE and ROE within the selected peer set. Its debt-to-equity ratio of 0.57 times was below Trom Industries Limited and Solarium Green Energy Limited, but above GRE Renew Enertech Limited. The peer comparison indicates a relatively smaller operating scale accompanied by higher reported profitability margins and return ratios, while further expansion of operating scale and continued management of leverage remain relevant considerations as the Company grows.

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10.7 SWOT Analysis- *Solar Engineering, Procurement And Construction ("EPC") Industry*

💪 Strengths	⚠️ Weaknesses
🌞 **Established Solar Deployment Base** – India has developed a substantial solar power base across ground-mounted, rooftop, hybrid and off-grid applications. As of August 31, 2026, cumulative solar capacity stood at 168.04 GW. 🔄 **Diverse Project Configurations** – The industry serves multiple project configurations, including utility-scale ground-mounted projects, rooftop systems, hybrid projects and off-grid applications, enabling EPC participants to address different customer requirements and project structures. ⚙️ **Integrated EPC Execution Framework** – Solar EPC services generally cover project assessment, engineering and design, procurement, construction, installation, testing and commissioning, allowing project developers and customers to engage integrated service providers for project execution. 🏠 **Growing Rooftop Solar Segment** – The increasing installed base of grid-connected rooftop solar provides an expanding addressable market for EPC contractors and related installation and maintenance services. Grid-connected rooftop solar capacity stood at 32.59 GW as of August 31, 2026. 🏭 **Developing Domestic Manufacturing Ecosystem** – Government initiatives such as the Production Linked Incentive ("PLI") Scheme for High Efficiency Solar PV Modules are supporting the development of domestic solar PV manufacturing capacity and greater integration of the domestic supply chain. 💻 **Increasing Technology Integration** – The increasing use of monitoring, remote diagnostics and digital asset-management systems is supporting greater visibility into plant performance and creating scope for technology-enabled O&M and lifecycle services.	⏱️ **Project-Based Revenue and Execution Cycles** – Solar EPC revenues are generally linked to project awards, procurement, construction milestones and commissioning, which can result in variations in revenue recognition, working capital requirements and cash flows between reporting periods. 🔗 **Dependence on Equipment and Suppliers** – EPC contractors depend on the availability, pricing, quality and delivery schedules of modules, inverters, mounting structures, transformers, cables and other balance-of-system components. Such dependence can affect project costs and execution timelines. 💰 **Working Capital and Financial Requirements** – Solar EPC projects may require substantial working capital for equipment procurement and project execution. Larger projects and tenders may also involve bid securities, performance guarantees and other financial commitments. 📉 **Competitive Pricing Environment** – The presence of multiple EPC contractors with comparable capabilities in certain project segments can result in competitive bidding and pressure on project pricing and margins.

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🚀 Opportunities	⚠️ Threats
📈 **Continued Solar Capacity Addition** – Continued expansion of India's solar capacity provides opportunities across utility-scale EPC, rooftop solar, distributed generation and associated electrical infrastructure. Solar capacity additions during April–August 2026 amounted to 17.78 GW. [MNRE] 🏢 **Growth in C&I and Distributed Solar** – Increasing deployment of rooftop and distributed solar solutions across commercial and industrial applications provides opportunities for EPC contractors and system integrators, subject to customer economics and applicable regulatory frameworks. 🔓 **Expansion of Open-Access and Captive Projects** – Development of renewable-energy projects under open-access and captive structures can provide additional opportunities for EPC service providers, subject to applicable central and state-level regulations, project approvals and grid connectivity. 🔋 **Solar-Plus-Storage and BESS** – The development of solar-plus-storage projects and battery energy storage systems ("BESS") may create opportunities for EPC companies in system integration, electrical infrastructure, commissioning, controls and associated O&M services, subject to project economics, technical requirements and regulatory developments. 🌐 **Hybrid and Larger Ground-Mounted Projects** – Growth in hybrid renewable-energy configurations and larger ground-mounted projects provides opportunities for EPC participants with capabilities to execute projects involving more complex technical and electrical requirements. Hybrid projects accounted for 4.83 GW of solar capacity as of August 31, 2026. 🛠️ **Lifecycle O&M and Digital Services** – The expansion of India's installed solar base provides an increasing addressable market for O&M, monitoring, performance assessment, predictive maintenance and other lifecycle services, allowing EPC participants to diversify beyond initial project execution.	🏁 **Intense Competitive Pressure** – Competition among integrated renewable-energy companies, specialised EPC contractors, regional participants and other market participants may result in competitive bidding, pricing pressure and lower project margins. 📦 **Equipment Price and Supply-Chain Volatility** – Changes in the prices and availability of modules, inverters, electrical equipment, mounting structures and other components, together with logistics and supply-chain disruptions, may affect project economics and execution schedules. MNRE's ALMM framework also governs the eligibility of specified solar PV models and manufacturers for identified categories of projects. [MNRE] ⚖️ **Regulatory and Grid-Related Risks** – Changes in applicable renewable-energy, open-access, captive, net-metering and equipment-eligibility frameworks, together with delays in approvals, grid connectivity and evacuation infrastructure, may affect project implementation and economics. 💳 **Financing and Project Execution Risks** – Changes in interest rates and availability of project finance may affect the economics of capital-intensive solar projects, while construction delays, adverse weather conditions, equipment performance issues, generation shortfalls and commissioning delays may affect project timelines and project returns.

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11. Future Outlook

The outlook for the Indian Solar EPC Services Industry remains supported by the continued expansion of renewable-energy capacity, increasing adoption of solar power across utility-scale, C&I, residential and decentralised applications, and the development of supporting transmission, storage and grid infrastructure. India had approximately 164.59 GW of installed solar capacity as of July 31, 2026, including ground-mounted, grid-connected rooftop, hybrid and off-grid solar capacity. The Government has also set a target of achieving 500 GW of installed non-fossil fuel-based electricity generation capacity by 2030, with solar energy expected to remain an important component of this expansion.

The continued addition of solar capacity is expected to support demand for EPC services covering engineering and design, equipment procurement, construction, installation, testing, commissioning, grid interconnection and related project-management activities. The requirement for such services is expected to arise across utility-scale ground-mounted projects, C&I installations, rooftop solar, decentralised generation and other distributed applications. The Government's renewable-energy procurement framework, including competitive bidding for solar, wind-solar hybrid and firm and dispatchable renewable-energy projects, is expected to support continued project development. The Government has also maintained a bidding trajectory for renewable-energy power procurement through Renewable Energy Implementing Agencies.

Rooftop and distributed solar are expected to remain relevant areas of deployment. Government programmes have supported rooftop solar deployment, including the PM Surya Ghar: Muft Bijli Yojana, while State-level regulatory frameworks continue to influence rooftop, distributed, open-access and other consumer-linked solar applications. The development of arrangements such as Group Net Metering ("GNM") and Virtual Net Metering ("VNM"), where provided under applicable State frameworks, may also support eligible multi-location and participating-consumer configurations. The extent of deployment under these arrangements will depend on applicable State regulations, consumer eligibility, metering and billing requirements and distribution-licensee procedures.

C&I solar is expected to remain an important application segment as industrial and commercial consumers evaluate renewable-energy procurement through rooftop, behind-the-meter, open-access and captive structures. The availability and economics of such projects will continue to depend on electricity tariffs, project costs, financing conditions, open-access and captive regulations, grid connectivity, applicable charges and customer-specific consumption requirements.

Utility-scale and decentralised solar projects are also expected to contribute to future EPC demand. Government programmes such as PM-KUSUM support decentralised renewable-

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energy generation and solarisation of agricultural applications. Under PM-KUSUM, the Government provided for 34,800 MW of solar capacity by March 2026, including decentralised ground- or stilt-mounted renewable-energy plants and solarisation of agricultural pumps and feeders. Future project opportunities will depend on scheme implementation, State-level execution, project economics, land availability, grid connectivity and procurement processes.

The increasing share of variable renewable-energy generation is also expected to increase the importance of energy-storage and grid-integration solutions. The Central Electricity Authority has projected a requirement of approximately 208 GWh of BESS by 2030 to support integration of increasing renewable-energy capacity. Government measures supporting battery energy storage, together with the development of hybrid and firm and dispatchable renewable-energy projects, may expand the technical scope of EPC services towards storage integration, power-conversion systems, energy-management systems, protection and control systems and associated electrical infrastructure.

The solar EPC industry is also expected to operate within an evolving domestic manufacturing and regulatory environment. The Approved List of Models and Manufacturers ("ALMM"), procurement requirements, grid standards, electrical safety requirements and State-level regulations may influence equipment sourcing, project design, procurement and execution. The continued development of domestic solar manufacturing capacity may also affect procurement practices and supply-chain structures for EPC participants.

As the installed solar asset base expands, demand for post-commissioning services, including O&M, plant monitoring, preventive and corrective maintenance, equipment servicing and performance management, may also increase. The use of digital monitoring, data acquisition and remote asset-management systems may support the delivery of such services. The scale of the O&M opportunity will depend on asset ownership structures, contractual arrangements, project configuration and the extent to which asset owners outsource post-commissioning activities.

Emerging applications, including floating solar, solar-plus-storage and hybrid renewable-energy projects, may create additional requirements for specialised engineering and system integration. The National Green Hydrogen Mission may also create an adjacent requirement for renewable-energy infrastructure supporting green hydrogen production. However, the scale and timing of these emerging applications remain dependent on project economics, technology development, financing, regulatory frameworks and the development of associated infrastructure.

International markets may provide additional opportunities for EPC participants with relevant technical, project-management and cross-border execution capabilities. Such opportunities are subject to host-country regulations, tender requirements, financing availability, local-content requirements, currency movements, logistics and other country-specific considerations. Accordingly, international expansion may provide geographic diversification, but execution and commercial risks may differ materially from those applicable to projects in India.

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The Indian Solar EPC Services Industry is expected to remain closely linked to the pace of renewable-energy capacity addition and the development of supporting transmission, distribution, storage and grid infrastructure. The underlying market opportunity is supported by the continued expansion of solar deployment, government procurement and policy initiatives, increasing participation by C&I and other consumers, and the development of new solar and storage configurations. At the same time, EPC participants will need to manage equipment procurement, working-capital requirements, project execution, financing, grid connectivity, regulatory compliance, competitive pricing and technical performance.

Accordingly, while the medium- to long-term outlook for solar EPC services remains supported by India's renewable-energy expansion, the growth prospects of individual EPC participants will depend on their ability to secure projects, execute them within contractual and technical requirements, manage working capital and procurement risks, maintain appropriate technical and project-management capabilities and comply with evolving central and State-level regulatory requirements.

Yours Faithfully,

MARQIS ANALYTICS PVT. LTD. Bangalore

GOWRI K
Director
DIN: 11625897
Date: 24th September 2026

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