

Industry research report on renewable energy market in India

Rayzon Solar Ltd

Review and outlook | September 2026



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Module 1: Global macroeconomic overview

India to outpace major economies in fiscal 2027

The global economy is navigating two opposing forces: the adverse impact of the ongoing conflict in the West Asia and the positive impulse from an accelerating global technology cycle led by advances in artificial intelligence (AI). While geopolitical tensions continue to weigh on economic activity through higher energy prices and supply chain disruptions, stronger technology-related investment and demand have provided important support to growth.

The global economy has so far remained resilient despite the conflict. Commodity prices remain elevated and inflationary pressures have resurfaced in several economies; however, stronger technology-driven activity, fiscal support in some countries and relatively accommodative financial conditions have helped cushion the impact. The effects vary across economies depending on their exposure to higher energy prices and their participation in the global technology value chain.

For calendar year 2026, the International Monetary Fund (IMF) projects the global economy to grow by 3.0%, slowing from 3.5% in 2025. The moderation reflects the impact of the West Asia conflict, partly offset by stronger demand arising from the technology cycle.

China's GDP growth is projected to slow to 4.6% in 2026 from 5.0% in 2025. Higher global oil prices, prolonged uncertainty and structural headwinds are expected to weigh on activity. However, public infrastructure investment and strength in high-technology manufacturing continue to provide support.

Table 1: India is expected to emerge relatively stronger amid the global economic uncertainty

On-year (%)	CY19	CY20	CY21	CY22	CY23	CY24	CY25	CY26P
World	3.0	-2.7	6.6	3.8	3.5	3.3	3.5	3.0
Advanced economies	1.9	-3.9	6.0	3.0	1.7	1.8	1.9	1.7
- Euro area	1.6	-6.0	6.4	3.6	0.4	0.9	1.4	0.9
- US	2.6	-2.1	6.2	2.5	2.9	2.8	2.1	2.3
- UK	1.6	-10.3	8.6	4.8	0.4	1.1	1.4	1.0
- Japan	-0.4	-4.2	2.7	1.0	1.2	-0.2	1.1	0.6
Emerging and developing economies	3.8	-1.8	7.0	4.3	4.7	4.3	4.5	3.8
- China	6.1	2.3	8.6	3.1	5.4	5.0	5.0	4.6
- India ^{*^}	3.9	-5.8	9.7	7.6	7.3	7.2	7.8	6.6

**India numbers are on a fiscal year basis (April-March), with calendar year 2026 corresponding to fiscal 2027; other countries are on a calendar year basis. Estimates for India as per the Ministry of Statistics and Plan Implementation (MoSPI) and Crisil Intelligence; E – estimated; P – projected; Euro area includes Germany, France, Italy and Spain*

Source: IMF World Economic Outlook, July 2026; Crisil Intelligence

The United States economy is projected to grow 2.3% in 2026. Activity is expected to be supported by fiscal policy, accommodative financial conditions and continued technology-related business investment and productivity gains. The impact of the Middle East conflict is expected to remain limited given the country's status as a net energy exporter.

The euro area's growth is projected at 0.9% in 2026 compared with 1.4% in 2025. Growth is expected to be weighed down by higher energy prices, weak consumer confidence and soft underlying momentum, despite some fiscal support measures.

The United Kingdom's GDP growth is projected to moderate to 1.0% in 2026 from 1.4% in 2025. The slowdown reflects the impact of higher energy prices arising from the Middle East conflict, although growth is expected to recover as the energy shock gradually fades.

Japan's GDP growth is projected at 0.6% in 2026 compared with 1.1% in 2025. Fiscal support measures are expected to partly cushion the adverse impact of higher energy prices, though overall growth is likely to moderate.

India's growth rate too is expected to slow to 6.6% in fiscal 2027 from 7.8% in fiscal 2026 because of higher crude oil and other commodity prices, softer global growth amid the conflict and forecasts of a below-normal monsoon.

Conflict weighs on global inflation

The effects of the conflict are also weighing on global inflation. As per IMF World Economic Outlook 2026, the global headline inflation is projected to rise to 4.4% in 2026 from 4.1% in 2025. The main drivers are expected to be higher energy prices, supply chain disruptions, and pressure on inflationary expectations, with the impact expected to be more pronounced in commodity-importing and more vulnerable economies.

The inflation in the US is projected to rise to 3.2% in 2026 from 2.7% in 2025. Although the US is relatively less exposed as a net energy exporter, it is still expected to face upward pressure from higher global energy prices and broader commodity-market spillover linked to the conflict.

Similarly, the inflation in the euro area is expected to rise to 2.6% in 2026 from 2.1% in 2025 mainly driven by higher energy prices and supply chain disruptions associated with the West Asia conflict.

The inflation in the UK on the other hand is expected to ease to 3.2% in 2026 from 3.4% in 2025. The decline mainly reflects the fading impact of earlier one-off changes in regulated prices.

China's inflation is expected at 1.2% in 2026 from 0% in 2025 owing to the low base.

The inflation in India is expected to rise sharply to an average of 5.1% in fiscal 2027 from 2.0% in fiscal 2026, mainly due to a low base and broader price pressures across key segments. Upside risks stem from a possible pass-through of higher global crude oil prices, rising input and logistics costs linked to the West Asia conflict and a weaker rupee, and potential food inflation from below-normal rainfall associated with El Niño conditions.

Table 2: Inflation movement across key economies

On-year (%)	CY22	CY23	CY24	CY25	CY26P
Advanced economies					
Euro area	8.4	5.4	2.4	2.1	2.6
US	8.0	4.1	3.0	2.7	3.2
UK	9.1	7.3	2.5	3.4	3.2
Germany	8.7	6.0	2.5	2.3	2.7
Japan	2.5	3.3	2.7	3.2	2.2
Emerging markets and developing economies					
China	2.0	0.2	0.2	0.0	1.2
India	6.7	5.4	4.6	2.0	5.1

E – estimated; P – projected

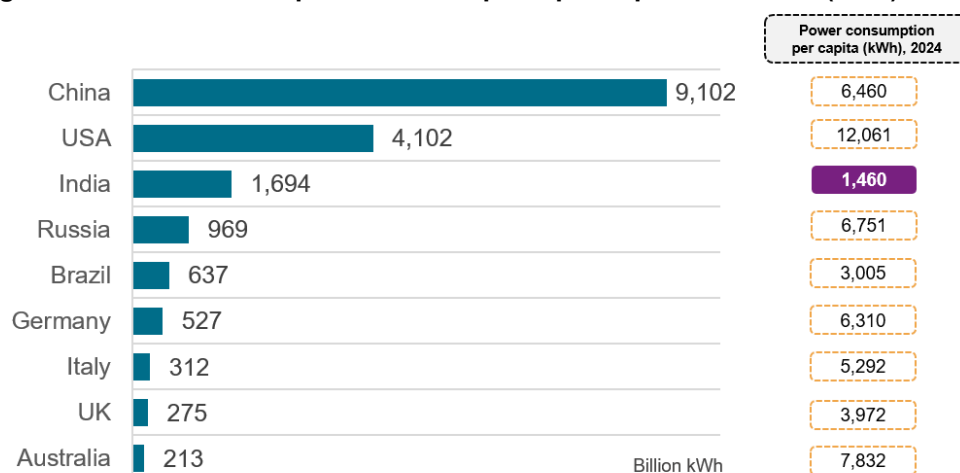
Note: The above table is on calendar year basis; for India, data is based on fiscal year, with fiscal 2027 shown in 2026. Inflation for India is Crisil Intelligence outlook.

Source: IMF World Outlook, April 2026, Crisil Intelligence for India

India ranks third in global electricity consumption

In terms of global power consumption, India ranks third with electricity consumption of approximately 1,694 billion kWh in 2024, behind China (9,102 billion kWh) and the US (4,102 billion kWh). Despite being one of the world's largest power consumers in absolute terms, India's per capita electricity consumption stood at 1,460 kWh in fiscal 2025, significantly lower than that of other major economies, highlighting the country's substantial untapped potential for future electricity demand.

Figure 1: India has lower power consumption per capita as of 2024 (kWh)



Note: Per capita power consumption for India is based on FY25 power consumption data; for all other countries, CY2024 power data is used. Population for all countries is for CY2024.

Sources: CEA, IEA, World Bank, Crisil Intelligence

India's low per capita electricity consumption, despite its large and growing economy, underscores the significant scope for demand expansion as industrialisation, urbanisation and rising household incomes continue to increase electricity usage. While advanced economies have largely matured in terms of electricity consumption growth, emerging economies such as India are expected to be key contributors to incremental global power demand over the coming decades. Although India's total power consumption has risen steadily, per capita consumption remains well below levels observed in China, the US and other developed economies. Furthermore, considerable disparities persist across states, with highly industrialised and urbanised regions reporting much higher electricity usage than predominantly agrarian states. These factors suggest substantial headroom for sustained growth in electricity demand, supported by economic development, manufacturing expansion and increasing electrification across sectors.

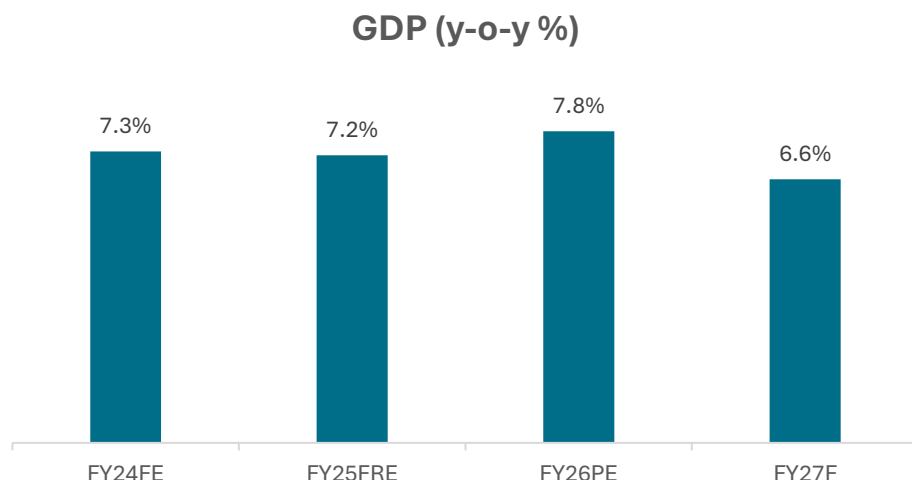
Module 2: Indian macroeconomic overview

Domestic drivers to boost India's growth

India's real gross domestic product (GDP) is projected to grow at 6.6% on-year in fiscal 2027 from 7.8% in fiscal 2026 because of higher crude oil and other commodity prices, softer global growth amid the West Asia conflict and forecasts of a below-normal monsoon.

Input cost pressures from the spike in crude oil and gas prices will weigh on growth. Global supply chain disruptions and the reduced availability of gas and other inputs will add to the pressure. The manufacturing sector, which is heavily dependent on imported inputs, is particularly vulnerable.

Figure 2: India's economy expected to grow at 6.6% in fiscal 2027



Note: FE stands for First Estimates. FRE stands for First Revised Estimates. PE stands for Provisional Estimates. F stands for Forecast.

Source: MOPSI, Crisil Intelligence

A new GDP series improves the relevance and measurability quotient

A new national accounts series has been released with 2022-23 as the base year, superseding the 2011-12 series. The revised series incorporates new segments and administrative data sets, alongside methodological improvements such as double deflation in manufacturing wherever possible and the use of granular price data for deflators.

- The new series pegs GDP growth for fiscal 2026 at 7.8% (PE), up from the 7.4% in the first advance estimate (FAE) based on the old series. The new series underlines private consumption as the driver of growth in fiscal 2026, while the FAE under the older series called out fixed investments.
- For fiscal 2023-26, real GDP growth stands at 7.4% under the new series, compared with 7.8% under the old series, led by broad-based downward revisions across private final consumption expenditure, gross fixed capital formation and government consumption. On the supply side, growth has been supported by the manufacturing and services sectors, which recorded GVA CAGRs of 10% and 8%, respectively, during fiscal 2023-2026, while agriculture registered a comparatively moderate CAGR of 3% over the same period.

- The size of the economy, measured by nominal GDP, is smaller at Rs 345 lakh crore, compared with Rs 357 lakh crore under the old series for fiscal 2026. In US dollar terms, India is slightly below a \$4 trillion economy.

Over fiscals 2022 to 2026, the Indian economy has outperformed its global counterparts. Going forward as well, the Indian economy will remain strong and would continue to be one of the world's fastest-growing major economies.

In per capita terms, India's net national income at constant prices expanded 7.8% in fiscal 2026.

Table 3: Outlook for fiscal 2027

Macro parameters	FY25	FY26	FY27F	Rationale for outlook
Real GDP growth (on-year %)	7.2	7.8	6.6	Growth will be slow due to higher crude oil and other commodity prices, softer global growth amid the conflict and forecasts of a below-normal monsoon. Higher inflation on account of the disruptions to agricultural production and higher commodity prices will constrain household budgets and restrain private consumption.
CPI inflation (on-year %)	4.6	2.0	5.1	Inflation is set to rise, driven by a low-base effect and expectations of broadening price pressures across major segments. A sharp rise in the cost of energy and other inputs, as well as trade and transportation, is expected to be passed by producers to consumers, raising core inflation
10-year government security yield (March average %)	6.7	6.7	7.0	A prolonged conflict will increase pressure on government finances through higher petroleum and fertiliser subsidies, even as a slowdown in domestic growth will impact tax collection. Rising yields in advanced economies are likely to keep foreign capital flows into the debt segment volatile, with a bias towards outflows.
Current account balance (% of GDP)	-0.6	-0.8	-2.2	Higher oil prices are expected to exert greater pressure on India's CAD. Goods exports are expected to be hit by global trade disruption and weakening global demand.
Exchange rate (March average, Rs/\$)	84.6	92.8	93.5	India's external vulnerability has increased due to the conflict. A widening CAD will mean higher demand for the dollar, while elevated global uncertainty may lead to foreign capital outflows from emerging markets, including India, putting pressure on the rupee.

Source: NSO, RBI, Budget documents, Ministry of Finance, Crisil

Contribution of key sectors to gross value added

India's gross value added (GVA) has grown consistently over the years, except in fiscal 2021, when it was affected by the pandemic-induced lockdown. The services sector is a significant contributor, with growth in services exports, which account for half of the country's overall exports, has outpaced economic growth.

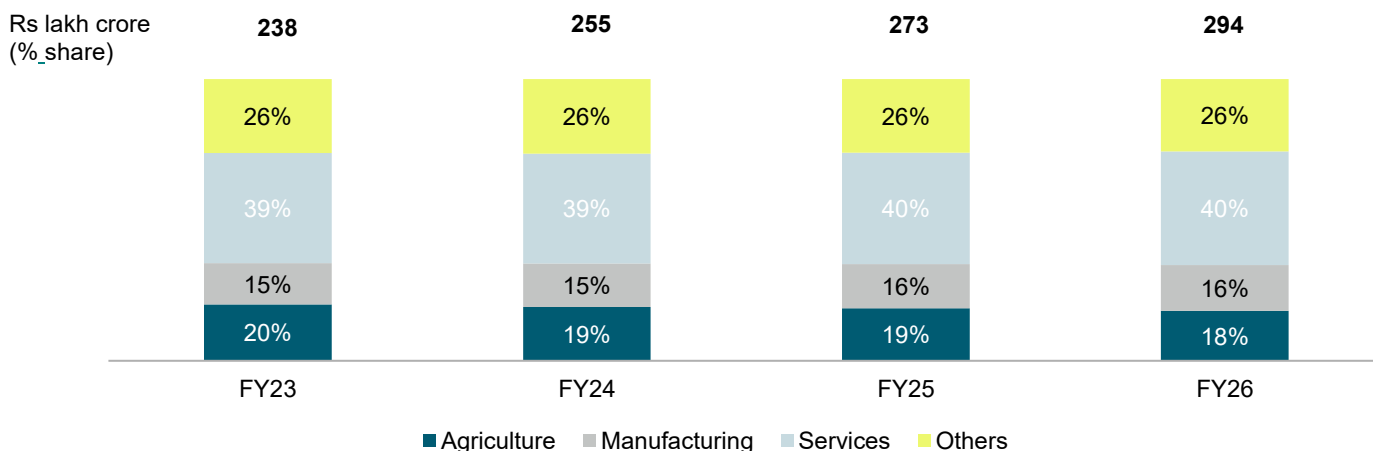
The manufacturing sector has contributed to the resilient performance of the economy across three consecutive financial years after rebasing, recording strong growth rates of 11% in fiscal 2024, 10% in fiscal 2025, and 9% in fiscal 2026, underscoring its sustained role as a key driver of economic growth.

The growth in manufacturing GVA is attributable to government initiatives such as the Atmanirbhar Bharat campaign, Make in India and the Production Linked Incentive (PLI) scheme. While the share of industry in GVA averages 15%, a

large percentage of the PLI capex that is yet to be commissioned is expected to boost the share of both manufacturing and exports.

Agriculture GVA clocked a CAGR of 3% between fiscals 2023 and 2026, driven by the subsidy support to farmers and other government initiatives such as the Pradhan Mantri Krishi Sinchayee Yojana, Dhan Dhaanya Krishi Yojana etc. Normal monsoon, government schemes and favourable agricultural commodity prices over the past two fiscals have aided the growth.

Figure 3: Contribution of key sectors (industry, agriculture and services) to GVA



Source: MoSPI, Crisil Intelligence; 2024-2025 numbers are second revised estimates, and 2025-2026 numbers are second advance estimate

Private consumption expected to hold up in fiscal 2027

With a share of more than 56% in the GDP, private consumption remains the key driver of the economy. The positive effects on private consumption from fiscal support, including income tax cuts, rationalisation of goods and services tax (GST) rates and unconditional cash transfers by states, are expected to support consumption demand in fiscal 2027. Some moderation in consumption growth is expected towards the latter part of fiscal 2027 as the one-time benefits of the tax cuts fade.

• **Tax relief measures to prop up consumption:** The rejig of income tax rates under the new tax regime will increase the disposable income of the middle class. The tax rebate limit has been raised to Rs 12 lakh from Rs 7 lakh, which will lead to tax savings of ~Rs 80,000 annually for an individual earning Rs 12 lakh. Tax slabs have also been revised, which will reduce the tax burden across income levels. These measures will durably support spending by the middle class beyond fiscal 2026 as well, though some of the increase in disposable income can also go towards savings and debt repayment.

• **GST rate revision:** The revised GST, which came into effect on September 22, 2025, reduced the tax rates on mass consumption items, including automobiles and consumer durables such as air conditioners and televisions, and fast-moving consumer goods. This is expected to provide a boost to domestic consumption. The timing of the revision was also favourable given the prevailing global economic uncertainty and the onset of the festival and wedding seasons, when consumer spending typically rises. Lower GST rates are expected to translate into reduced prices across key categories such as FMCG, consumer durables and automobiles. In these segments, the benefit is likely to be passed on directly to consumers. However, in sectors such as construction, the extent of the impact will need to be monitored. Further, the

GST anti-profiteering provisions could limit any significant improvement in margins, as companies will be required to pass on a substantial portion of the tax savings to consumers

• **Rate cuts:** The Monetary Policy Committee (MPC) of the Reserve Bank of India (RBI) maintained the policy stance and decided to keep the policy rates unchanged at 5.25% in July 2026. Lower interest rates are expected to support consumption as they are gradually transmitted to other interest rates (such as those on auto and housing loans), thereby lowering borrowing costs.

• **Support to consumption from key flagship schemes continues:** FY27BE indicates a significant increase in allocations for major rural infrastructure programmes. Allocations for Pradhan Mantri Gram Sadak Yojana (PMGSY) and Pradhan Mantri Awaas Yojana - Gramin (PMAY-G) are budgeted to grow by 79% and 69%, respectively, in FY27BE, compared with growth rates of -26% and 1% in FY26RE. This marks a sharp turnaround following a period of moderation in allocations, particularly for PMGSY, which recorded declines during FY24-FY26, and PMAY-G, which saw fluctuating growth over the same period. The strong increase in FY27BE suggests renewed policy emphasis on rural infrastructure, housing, and connectivity, which could help support rural incomes, employment, and consumption demand.

Table 4: Higher allocations for key flagship programmes in fiscal 2027

Flagship programmes	FY23A	FY24A	FY25A	FY26RE	FY27BE
PMGSY	40%	-27%	-5%	-26%	79%
PMAY-G	71%	-49%	40%	1%	69%

Source: Budget documents, Crisil Intelligence

Regulatory and policy developments that could drive the private capex cycle

Regulatory and policy developments that could drive the private capex cycle

• **Government push for infrastructure development:** The National Infrastructure Pipeline (NIP) envisaged infrastructure investment of Rs 111 lakh crore during FY2020-FY2025, with major investments planned in sectors such as energy, roads, urban infrastructure and railways. Infrastructure planning and execution are now being supported through the PM Gati Shakti National Master Plan, which seeks to improve multimodal connectivity and coordination across ministries and states.

As of August 2026, 396 infrastructure projects with a total estimated cost of about Rs 18.66 lakh crore have been evaluated through the Network Planning Group (NPG) mechanism. Of these, 256 projects have been sanctioned, of which 198 are currently under implementation.

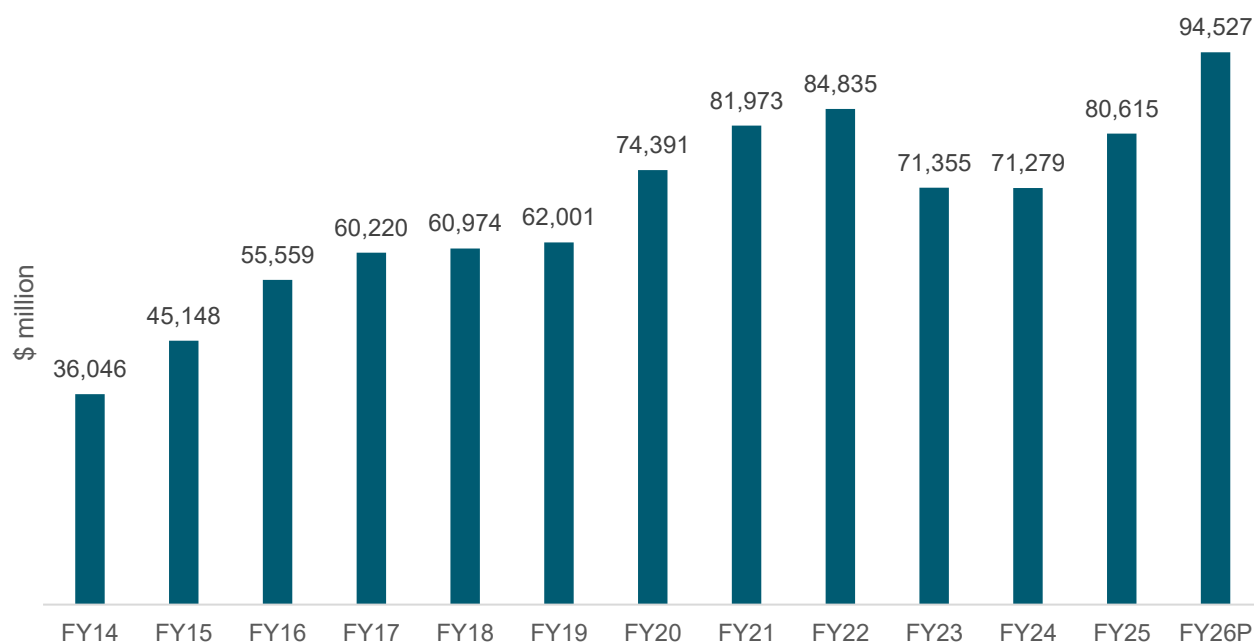
• **Private sector participation:** As public capital expenditure growth normalises from the elevated levels seen in recent years, a sustained revival in private sector investment will be important for maintaining the investment cycle. Recent indicators point to improving private capex momentum, supported by healthier corporate and banking sector balance sheets. According to the National Statistics Office's Forward-Looking Survey on Private Corporate Sector CAPEX Investment Intentions, aggregate private corporate capex is estimated at Rs 11.44 lakh crore in FY2025-26, with around 65% of planned investments expected to be financed through internal accruals. The survey also indicates a high realization rate of investment plans in FY2024-25, suggesting continued capacity expansion and investment activity. A broader revival in private investment would continue to depend on growth in manufacturing capacity, machinery and equipment investment, and innovation-led capital formation.

• **PLI scheme:** The Production Linked Incentive (PLI) scheme has continued to strengthen India's manufacturing ecosystem across 14 identified sectors. As of March 31, 2026, the scheme had attracted over Rs 2.40 lakh crore of actual investment

and generated more than 14.15 lakh direct and indirect jobs. Cumulative exports enabled under the scheme exceeded Rs 15.2 lakh crore since inception. Earlier, as of 31 December 2025, the scheme had approved 836 applications, attracted cumulative investments of over Rs 2.16 lakh crore, recorded production and sales of more than Rs 20.41 lakh crore, generated over 14.39 lakh direct and indirect jobs, facilitated cumulative exports of over Rs 8.3 lakh crore, and disbursed incentives amounting to Rs 28,748 crore. The scheme has delivered notable outcomes in sectors such as mobile manufacturing, telecommunications and pharmaceuticals, supporting domestic value addition, import substitution and export growth.

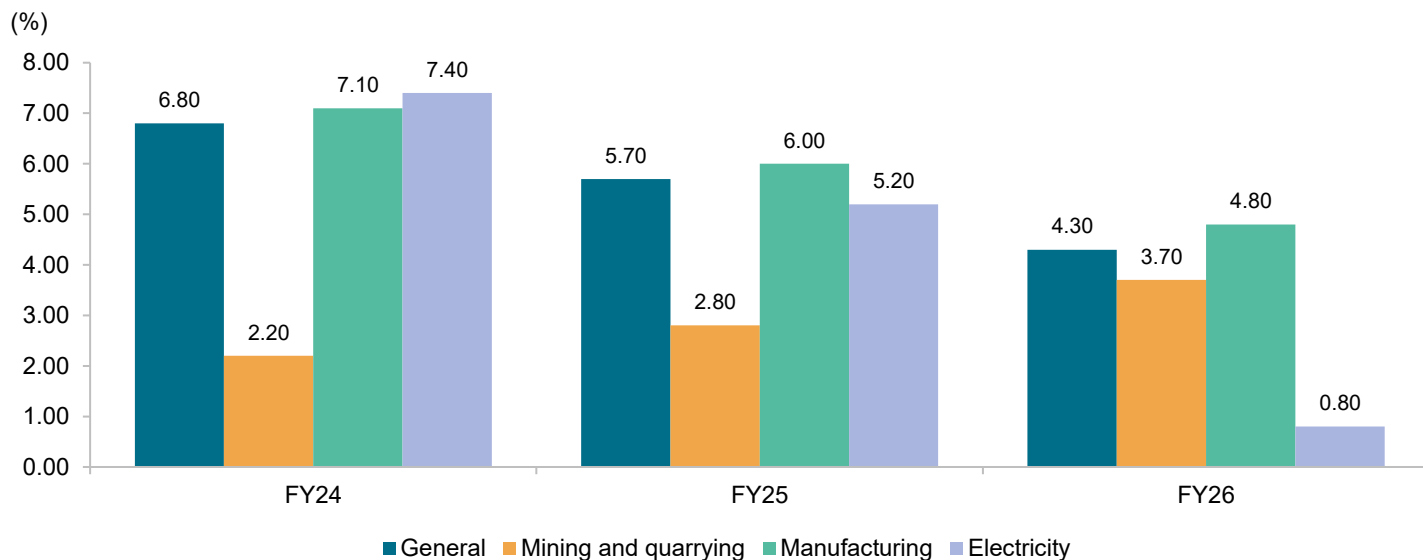
• **Foreign direct investment:** India's gross foreign direct investment (FDI) inflows have surpassed US\$1 trillion since April 2000, reflecting the country's growing attractiveness as a global investment destination. After moderating to US\$71.3 billion in fiscal 2024, gross FDI inflows rebounded by 13.1% year-on-year to US\$80.6 billion in fiscal 2025 and further increased to a record US\$94.5 billion in fiscal 2026, more than doubling from US\$36.0 billion in fiscal 2014. The sustained increase in FDI inflows underscores investor confidence in India's policy environment, domestic market potential and long-term growth prospects. FDI continues to play an important role in supporting capital formation, technology transfer and employment generation, aided by initiatives such as Make in India, sector-specific reforms and the implementation of the Goods and Services Tax (GST).

Figure 4: Total FDI inflow (US\$ million)



Source: DPIIT

Figure 5: Index of industrial production on-year growth trend



Note: Base year of 2022-23 considered.

Source: MoSPI, Crisil Intelligence

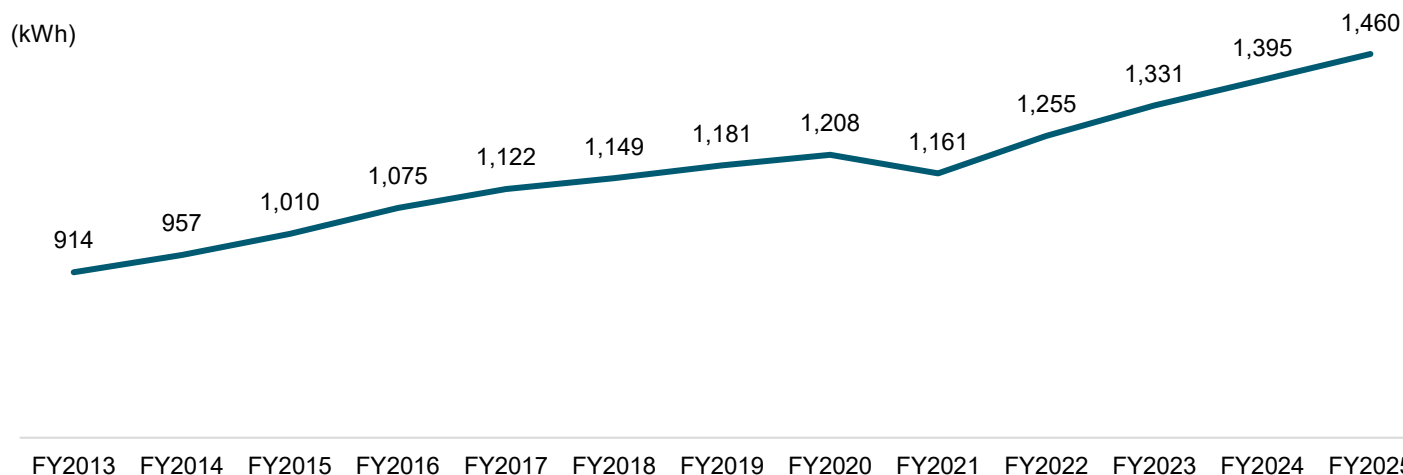
Power demand shows strong correlation with GDP per capita

A 30-year data assessment indicates a strong correlation between power demand and overall GDP growth. Cross-country and cross-state comparisons also indicate the same. Hence, tracking GDP growth and its impact on per capita power demand is considered an established means of understanding the prospects of the power sector. The results of this analysis point to power demand tracking GDP by 100 bps on average over the past three decades.

The ongoing supply-chain de-risking strategy of global players amid geopolitical disruptions, the Indian government's focus on initiatives such as Make in India and PLI, and the emergence of new-age sectors amid energy transition creating new manufacturing needs are set to improve the contribution of manufacturing to India's GDP. This would further boost power demand prospects.

Alongside these developments, an efficient transmission and grid infrastructure would help reduce aggregate technical and commercial (AT&C) losses and improve energy efficiency in the power sector.

Figure 6: Per capita electricity consumption logged 3.7% CAGR between fiscals 2013 and 2025



Source: CEA, PIB, Crisil Intelligence

Atmanirbhar Bharat Abhiyan

PLIs in the 14 sectors for the Atmanirbhar Bharat vision received an outstanding response, with the potential to create 60 lakh new jobs (government estimates). The PLI scheme for Solar PV modules was launched in April 2021 to promote domestic manufacturing of high efficiency

Table 5: Atmanirbhar Bharat vision for select sectors

Sector	Government spending	Key schemes
Renewable energy	~Rs 1,35,000 crore	- Rs 4,500 crore under PLI scheme for 'National Programme on High Efficiency Solar PV Modules', launched on April 7, 2021. The amount was increased further by Rs 19,500 crore in the budget for fiscal 2023, taking it to Rs 24,000 crore; 8.7 GW capacity in Tranche I and 39.6 GW capacity in Tranche II were allocated for domestic solar module manufacturing capacity under PLI. As of March 2026, around 30 GW of solar module manufacturing capacity, 10.5 GW of solar cell manufacturing capacity and 2 GW of ingot-wafer manufacturing capacity had been established under the scheme, supporting the development of a domestic solar manufacturing ecosystem. - PM Surya Ghar Muft Bijli Yojana has a proposed outlay of Rs 75,021 crore and aims to light up 1 crore households (rooftop solar) by providing up to 300 units of free electricity every month. Over 50 lakh households covered by August 2026 with 16 GW rooftop capacity. - Implementation of Pradhan Mantri Kisan Urja Suraksha evam Utthaan Mahabhiyan (PM-KUSUM) scheme; the Ministry of New and Renewable Energy (MNRE), in November 2020, expanded the PM-KUSUM scheme to add 30.8 GW by 2022 with central financial support of Rs 34,422 crore. The scheme has been extended until March 31, 2027. As of July 2026, nearly 2 GW of capacity was set up under component A. A total of 11.7 lakh pumps were set up under component B. - Pradhan Mantri Surya Sarovar Yojana (PM-SSY), approved in July 2026 with a total outlay of Rs 5,070 crore to support the development of 5 GW of floating solar project integrated with 10,000 MWh of energy storage systems. The

Sector	Government spending	Key schemes
		scheme provides central financial assistance of Rs 1 crore/MW for eligible projects and aims to accelerate deployment of floating solar on reservoirs and inland water bodies. - Approved Models and Manufacturers of Solar Photovoltaic Modules (Requirements for Compulsory Registration) Order, 2019 - List of manufacturers and models of solar PV modules and cells recommended under Approved List of Models and Manufacturers order - Scheme of grid-connected wind-solar hybrid power projects - Basic customs duty (BCD) and AIDC of 27.5% on solar cells, 20% on solar invertors and 40% on modules following a revision in fiscal 2026
Power distribution companies (discoms)	~Rs 97,000 crore	- Rs 1.35 lakh crore liquidity infusion for discoms via Power Finance Corporation/ Rural Electrification Corporation (PFC/ REC) against receivables - Rebate for payment to be received by generation companies (gencos) to be passed on to industrial customers - Revamped Distribution Sector Scheme (RDSS) to help discoms improve their operational efficiencies and financial sustainability by providing result-linked financial assistance. Outlay of Rs 3,03,758 crore over 5 years, i.e., fiscals 2022 to 2026, including an estimated government budgetary support (GBS) of Rs 97,631 crore
New energy	~Rs 38,800 crore	- Rs 18,100 crore under PLI scheme for 'Advanced Chemistry Cell (ACC) Battery Storage in India' launched in October to achieve 50 GWh manufacturing capacity - Green Hydrogen Policy launched in February 2022 to facilitate production of green hydrogen/green ammonia - PLI scheme for green hydrogen manufacturing, with an initial outlay of Rs 19,744 crore, to boost domestic production of green hydrogen

Source: Official portal of the Government of India; various ministries, PIB press releases, Crisil Intelligence

Supply chain diversification gaining importance globally

Supply-chain diversification remains a key strategic priority for the global solar industry as governments and manufacturers seek to reduce concentration risks associated with China-dominated supply chains. While India benefited from the initial phase of diversification by emerging as an alternative module manufacturing hub, a significant portion of its exports, particularly to the US, has historically been based on modules assembled using imported solar cells. Recent US trade actions, including duties on solar cells and modules sourced through key Asian manufacturing hubs, have increased scrutiny across the supply chain and reduced some of the cost advantages associated with existing procurement channels. As a result, competitiveness is increasingly dependent on securing diversified and resilient upstream supply chains rather than relying on a single geography for critical inputs. At the same time, several regions, including the US, the European Union, the Middle East and Australia, are accelerating efforts to establish domestic solar manufacturing capabilities through subsidies, localisation requirements and industrial policies, intensifying competition for global investments. Consequently, supply-chain diversification is evolving from a short-term response to trade disruptions into a long-term strategic necessity, with manufacturers increasingly diversifying production footprints, sourcing networks and end-markets to mitigate geopolitical, trade and supply risks.

Global focus on energy transition and decarbonisation getting sharper

The urgent need to address climate change is driving the shift towards renewable energy, with international initiatives such as the Paris Agreement and RE100 promoting its adoption. To limit global warming, a transition to renewable energy is critical. The global clean energy transition has been boosted by solar power, which has experienced remarkable capacity additions in 2025. It rose by around 12%, surpassing 600 GW for the first time. This expansion brought cumulative solar PV capacity to around 2,800 GW, becoming the technology with the largest installed capacity globally. Governments have supported the solar industry through policies such as feed-in tariffs, tax incentives and subsidies, accelerating global growth in solar PV and driving the sector's expansion. However, the progress of global climate initiatives has not been without setbacks, as evidenced by the US withdrawal from the Paris Agreement, which had significant consequences, including the abrupt end to climate finance. Notably, the Obama Administration's commitment to contributing to the Green Climate Fund (GCF), which helps developing countries mitigate and adapt to the impacts of climate change, was discontinued, highlighting the challenges that remain in securing international cooperation and funding to support the global transition to renewable energy.

The 26th United Nations Climate Change Conference of the Parties (COP26) was held in Glasgow, Scotland, in October-November 2021, and a draft agreement was circulated with respect to climate change action. The timeframe for NDCs were updated in August 2022, which are as follows:

- To reduce emissions intensity of its GDP by 45% by 2030 from the 2005 level
- To achieve about 50% cumulative electric power installed capacity from non-fossil fuel-based energy resources by 2030
- To achieve Net Zero by 2070

The Indian government has initiated efforts to combat climate change through multiple programmes and schemes, such as the National Action Plan on Climate Change (NAPCC), which comprises missions in specific areas of solar energy, energy efficiency, water, sustainable agriculture, Himalayan ecosystem, sustainable habitat, health, Green India, and strategic knowledge for climate change. The National Solar Mission under the NAPCC is a key initiative to promote sustainable growth while addressing India's energy security, with the total ground-mounted solar PV energy potential estimated at 3.3 TW peak by the MNRE. Measures taken by the Centre to promote renewable power in India include the following:

- a) Allowing FDI up to 100% under the automatic route
- b) Declaration of trajectory for renewable purchase obligations (RPOs) until 2030
- c) Introduction of schemes such as PM-KUSUM, PM Surya Ghar: Muft Bijli Yojana, Rooftop solar Phase II, and 12,000 MW Central Public Sector Undertaking (CPSU) Phase II, PM Surya Sarovar Yojana
- d) Laying of new transmission lines and creating new sub-station capacity under the Green Energy Corridor scheme for evacuation of renewable power
- e) Standard bidding guidelines for tariff-based competitive bidding process for procurement of power from grid-connected solar PV system, wind and hybrid projects
- f) Notification of promoting renewable energy through Green Energy Open Access Rules, 2022
- g) Mandates that power shall be dispatched against letter of credit or advance payment to ensure timely payment by distribution licensees to renewable energy generators

The Indian government has implemented several initiatives to promote the use of renewable energy. One such initiative is the RPO, which requires distribution licensees to purchase a percentage of electricity from renewable sources. Further, the

government has introduced the domestic content requirement (DCR) initiative, which mandates the use of domestically manufactured solar cells and solar modules in orders or projects under government schemes and grid-connected rooftop solar programmes, such as the CPSU scheme, PM-KUSUM scheme.

The PM-KUSUM scheme, launched in 2019, aims to set up 10,000 MW of decentralised grid-connected renewable energy power plants and solarise 2.5 million agriculture pumps. The scheme has been expanded to support 2 million farmers with standalone solar-powered pump systems and 1.5 million farmers with solarisation of their grid-connected pump sets. The PLI scheme, introduced in 2021, aims to boost the manufacturing of high-efficiency solar PV modules and reduce import dependence for solar energy.

PM Surya Ghar Muft Bijli Yojana aims to provide up to 300 units of electricity generated from rooftop solar systems across 10 million households. Furthermore, India has contributed to the setting up of the International Solar Alliance (ISA), a global coalition of solar-resource-rich countries that aims to promote the use of solar energy and provide a platform for cooperation among member countries. These initiatives demonstrate India's commitment to increasing the use of renewable energy and reducing its dependence on fossil fuels.

The long-term growth outlook for renewable energy remains strong. In its Transmission Plan for Integration of over 900 GW of Non-Fossil Fuel Capacity by fiscal 2036, the Central Electricity Authority (CEA) projects India's total installed power capacity to reach around 1,121 GW by fiscal 2036, of which approximately 786 GW is expected to come from non-fossil sources. Solar energy is projected to account for about 509 GW, representing nearly 45% of total installed capacity, while solar and wind together are expected to contribute around 664 GW. The projected expansion is supported by a robust pipeline of utility-scale renewable projects, continued government-led tendering activity, transmission infrastructure development and policy support for distributed renewable energy and domestic manufacturing.

India's manufacturing: a key GDP driver

India's manufacturing push driven by government policies

Recognising the importance of manufacturing in driving economic growth, exports, job creation and technological advancement, and in supporting the vision of *Viksit Bharat 2047*, the Government of India has introduced a range of initiatives over the past decade, including *Make in India*, *Atmanirbhar Bharat*, the *Production Linked Incentive (PLI) Scheme*, the *India Semiconductor Mission (ISM)* and, more recently, the *National Manufacturing Mission*. These initiatives are aimed at attracting investments, deepening domestic value addition, strengthening India's position in global value chains, promoting high-technology and clean-tech manufacturing, and creating a globally competitive manufacturing ecosystem. According to the Economic Survey 2025-26, India's industrial sector continues to gain momentum, supported by increasing investments in electronics, semiconductors, pharmaceuticals, advanced manufacturing and clean-energy technologies, with medium- and high-technology activities accounting for 46.3% of India's manufacturing value added.

Module 3: Overview of the power market

Power demand scenario in India

Overview of power demand with outlook (until fiscal 2031)

Power demand has maintained robust growth momentum, expected to continue

India's electricity consumption has grown at a steady pace, expanding at a 4.4% CAGR between fiscals 2016 and 2026 to 1,708 TWh, driven by economic growth, population growth, urbanisation, and improved transmission and distribution infrastructure.

In fiscal 2026, power demand grew 0.8% on year. Growth was supported by 7.8% GDP growth but constrained by weather-related disruptions. Although the growth rate moderated, the increase in absolute terms remains significant. Between fiscal 2021 and 2026, India added 432 BU of power demand. Therefore, the moderation in the growth rate is largely attributable to the high base.

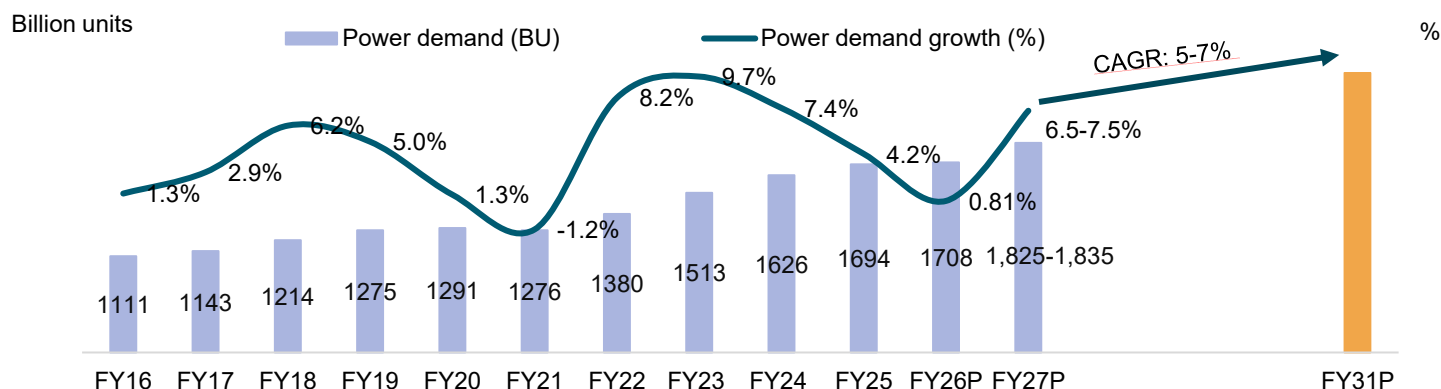
In Q1 fiscal 2027, power demand increased 8.6% on year, with growth of 3.3% in April, 11.7% in May, and 10.8% in June. The rise was largely driven by elevated temperatures and widespread heatwave conditions, which boosted cooling-related electricity consumption. In May 2026, several northern, central, and western regions experienced heatwaves, with West Madhya Pradesh and Vidarbha recording over 10 heatwave days. Cooling demand strengthened further in June as rainfall remained significantly below normal. The country received 102.5 mm of rainfall, 38% below the long-period average, with deficits of 50% in Central India, 32% in Northwest India, and 38% in East and Northeast India.

In the previous fiscal, in Q1 fiscal 2026, demand was adversely affected by unseasonal rainfall, the early onset of the southwest monsoon, and cooler temperatures, which reduced cooling demand, while slower industrial activity and a high base from Q1 fiscal 2025 further weighed on growth. Demand recovered modestly in Q2 fiscal 2026, increasing by 3.3% year on year, but remained largely flat in Q3 fiscal 2026, declining marginally by 0.3%, as temperatures stayed close to long-term averages and limited both cooling and heating demand. In Q4 fiscal 2026, demand growth moderated to 1.9% year on year, with a mild winter and delayed onset of summer containing weather-driven electricity consumption.

The estimated GDP growth of 6.6% in fiscal 2027 is expected to sustain power demand, with absolute power demand projected to reach 1,825-1,835 billion units, up from 1,708 billion units in fiscal 2026.

Between fiscals 2027 and 2031, power demand is expected to sustain a growth trajectory of 5-7% CAGR on the back of healthy economic growth, urbanization trends and weather vagaries. The government's continued infrastructure and industrial manufacturing push is expected to drive power demand as well, with climate change-induced temperature fluctuation also becoming a key reason for peak demand surges.

Figure 7: Snapshot of power demand



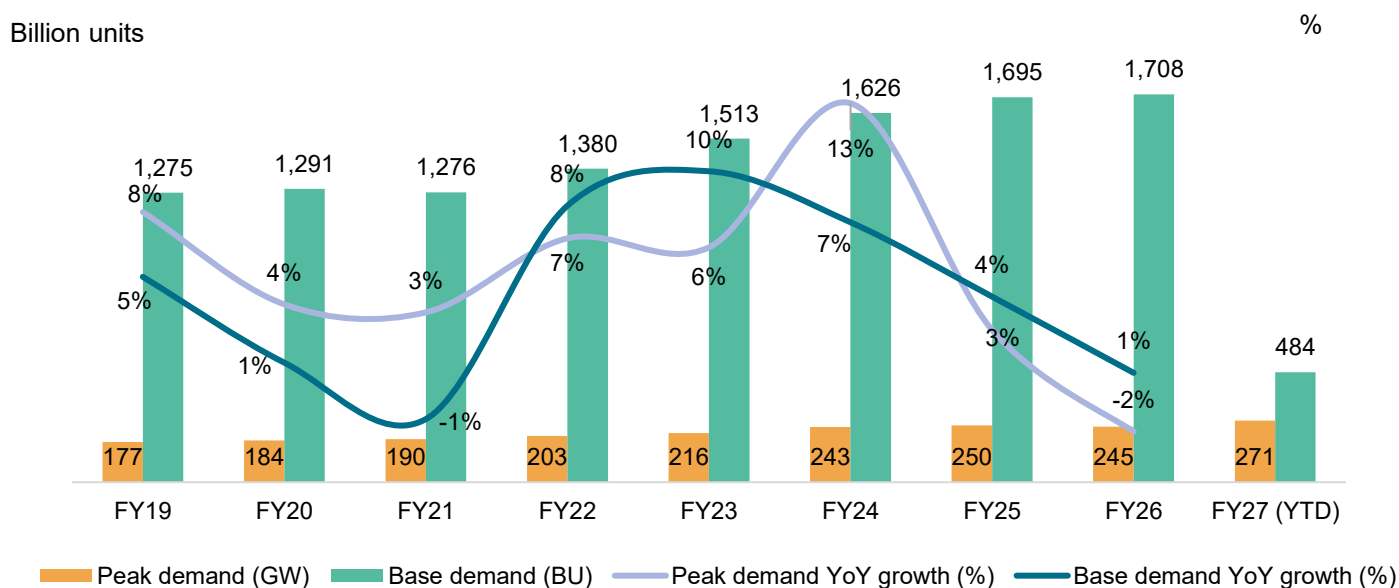
Note: P – Projected

Source: CEA, Crisil Intelligence

Peak demand has historically outpaced base demand growth

While base demand follows a consistent pattern, peak demand is an instantaneous surge in power requirements, often occurring when many consumers use electricity simultaneously, such as in the evenings. In India, peak demand has grown from 177 GW in fiscal 2019 to 271 GW in fiscal 2027 (April-June). This increase is attributed to rising cooling demand due to warmer temperatures as several regions across the country witnessed severe and prolonged heatwaves. Additionally, a surge in economic activity as highlighted by a 5.8% on year increase in the IIP also contributed to rise in peak demand during the quarter.

Figure 8: Peak demand growth outpaces base demand growth on several occasions



Note: Fiscal 2027 YTD is April-June 2026

Source: CEA, Crisil Intelligence

Power demand drivers in India

Table 6: Weather vagaries increasingly at the forefront of power demand growth

Power demand drivers	Description
Rising temperature with heatwave incidence to boost cooling demand	India's tropical climate and historically low access to cooling are driving a rapid rise in cooling demand. With rising incomes, residential air conditioner ownership is projected to increase from about 8% in 2022 to nearly 65% by 2050, while severe heatwaves—expected to become up to 30 times more frequent by the end of the century—will further increase electricity demand for cooling. Crisil Intelligence estimates that cooling-related power demand will rise by an average of 20-25 BU annually between fiscals 2028 and 2031.
Broad-based manufacturing and infrastructure push to boost power demand	India's power demand is expected to increase due to various factors, including GDP growth, industrial activity and government initiatives. Emerging areas such as data centres, green hydrogen and industrial expansion will contribute to this growth. Data centre capacity increased from 677 MW in Calendar year (CY) 2021 to an estimated 1,917 MW in CY 2026 and is estimated to grow to 4,654 MW in CY 2031. Additionally, the country's goal of producing 5 million tonnes of green hydrogen by 2030 will require approximately 125 GW of renewable energy.
Railway electrification and metro projects	Indian Railways is the lifeline of the nation providing transportation facility over the length and breadth of the country. Indian Railways (IR) is one of the world's largest rail networks. As of July 2026, Broad gauge (BG) electrification on Indian Railways has been extended to 99.6% of the total BG Railway Network. The government aimed to achieve 100% electrification of the network by December 2023 to become a net-zero emitter by 2030. However, delays caused by the pandemic-induced lockdown and the subsequent sluggish pace of work mean that 100% electrification is likely to be achieved in the near term. This is expected to lead to average incremental power demand of 28-30 BU per year between fiscals 2027 and 2031, also driven by the laying of new tracks by IR. The Ministry of Railways has been allocated a capital outlay of Rs 2.9 trillion in the Union Budget 2026-27. This is expected to provide impetus to the sector in terms of creation of new lines, doubling existing lines and electrification of existing lines. Of this, Rs 5,000 crore has been allocated towards electrification projects. Further development of urban transit systems will also be critical power consumers. Electricity consumption by urban metro systems is mainly attributable to train traction and station operations. Currently, though, metro projects constitute a marginal share of the total incremental power demand. However, the share is expected to increase owing to a large quantum of planned metro projects. As of August 2026, ~1,010 km of metro routes were operational across India. Also, ~612 km of metro lines were under construction, while ~311 km of routes had been approved and ~1,002 km remained proposed across various parts of the country. This segment is, therefore, expected to contribute to incremental power demand of 1-2 BU on a cumulative basis between fiscals 2027 and 2031.
Gradual transition to EVs	The government's push for EV adoption, aiming for 30% of cars to be electric by 2030, is expected to add 6-8 billion units of power demand per year, totalling 30-40 BU between 2027 and 2031.

Source: CEA, Industry publications, Crisil Intelligence

Power supply

Power capacity base and fuel mix by fiscal 2031

Installed capacity to reach 900-920 GW by fiscal 2031, renewables (ex-hydro) to account for 55-60%

The Indian power sector has witnessed a significant surge in its total electricity installed capacity, with a 12% on year increase as of fiscal 2026. A notable aspect of this growth is the substantial contribution of renewable energy sources, excluding large hydro, which accounted for 81% of the total capacity addition. Within renewable energy, solar energy has emerged as the dominant segment, with 87% of total renewable energy capacity additions (ex-hydro) attributed to solar. As a result, solar energy has been the primary driver of capacity addition in India, accounting for 71% of the total power capacity added between March 2025 and March 2026.

The current installed capacity statistics as of June 2026 in India reveal a total renewable energy capacity of 289 GW including large hydro, and 237 GW excluding large hydro. Non-fossil capacity (including large hydro and nuclear) accounted for 54.18% of India's total energy mix as of June 2026, highlighting India's ability to achieve its target to increase the non-fossil share to 50% by fiscal 2030 before time. The solar installed capacity was 162.2 GW in June 2026, while the wind installed capacity was 57.4 GW. The total power installed capacity was 548.9 GW.

Over the past year, solar capacity has exhibited significant growth of 42%, increasing from 105.64 GW in fiscal 2025 to 150.3 GW in fiscal 2026. According to government estimates, this upward trend is expected to continue, with a projected on-year growth of 13% until fiscal 2036, targeting a capacity of 506 GW. In contrast, wind energy witnessed growth of 12% in fiscal 2026, highlighting the varying trajectories of different renewable energy sources in the Indian market.

India's installed generation capacity increased to 548.9 GW in June 2026 from 356 GW in fiscal 2019, driven by healthy renewable energy capacity additions (including solar, wind, hybrid and other sources) even as additions in coal and other fuels remained subdued. Renewables (ex-hydro) accounted for 43% of the total installed capacity in June 2026, up from ~20% in fiscal 2018, whereas coal-based capacity tapered to 40.8% in June 2026 from 55% in fiscal 2019.

Renewable energy capacity (ex-hydro) is expected to increase to 500-510 GW by fiscal 2031, on the back of strong capacity additions over fiscals 2027-2031 (ex-hydro and storage elements). This capacity would account for 55-60% of the total capacity of 900-920 GW by fiscal 2031.

On the other hand, coal-based capacity additions of 32-37 GW are expected to reduce coal's share to 25-30% by fiscal 2031. Other fossil fuels (including lignite, gas and diesel) are expected to remain stagnant due to negligible capacity additions. Inclusion of hydro and nuclear power in clean energy is expected to provide a fillip to non-fossil capacity, taking it to 550-600 GW by fiscal 2031 (including storage). And it is expected to account for a staggering 60-70% of the total installed capacity.

The CEA released new guidelines in February 2025, mandating all standalone solar installations to incorporate energy storage systems (ESS). The ESS would be required to have a minimum backup of two hours and must be installed equal to at least 10% of the solar capacity of the project.

Table 7: Non-fossil fuel sources, along with storage, to account for over 60% of total installed capacity by fiscal 2031

	FY19	FY20	FY21	FY22	FY23	FY24	FY25	FY26	FY27P	FY31P
Coal	55%	54%	53%	51%	50%	48%	46%	42%	37-39%	25-30%
Natural gas	7%	7%	7%	6%	6%	6%	5%	4%	2-4%	1-3%
Diesel	0%	0%	0%	0%	0%	0%	0%	0%	0-1%	0-1%
Hydro	12%	11%	11%	11%	10%	10%	9%	8%	7-9%%	5-7%
Pumped hydro	1%	1%	1%	1%	1%	1%	1%	1%	0-2%%	1-3%
Lignite	2%	2%	2%	2%	2%	2%	1%	1%	0-2%%	0-2%
Nuclear	2%	2%	2%	2%	2%	2%	2%	2%	1-3%	1-3%
Solar	8%	9%	10%	13%	16%	18%	21%	27%	31-33%	41-43%
Wind	10%	10%	10%	10%	10%	10%	11%	11%	10-12%	10-12%
Other renewable energy sources (RES)	4%	4%	4%	4%	4%	4%	4%	3%	2-4%	2-4%
Battery	0%	0%	0%	0%	0%	0%	0%	0%	0-2%	3-5%

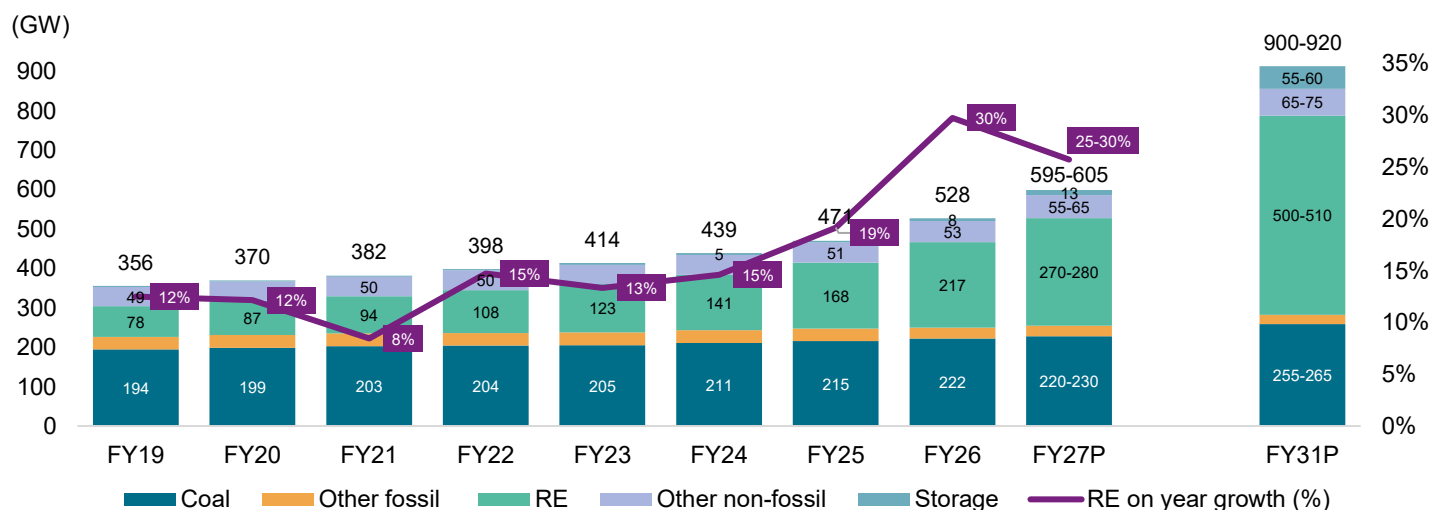
Note: Other RE includes small hydro and bio power. Other fossil fuels include lignite, gas and diesel. Storage includes Battery energy storage system (BESS) and Pumped storage project (PSP). RE includes open access. The forecast excludes off-grid solar.

Figures may not total 100% because of rounding

P – Projected

Source: CEA, Crisil Intelligence

Figure 9: Renewable energy penetration in installed capacity and growth trends



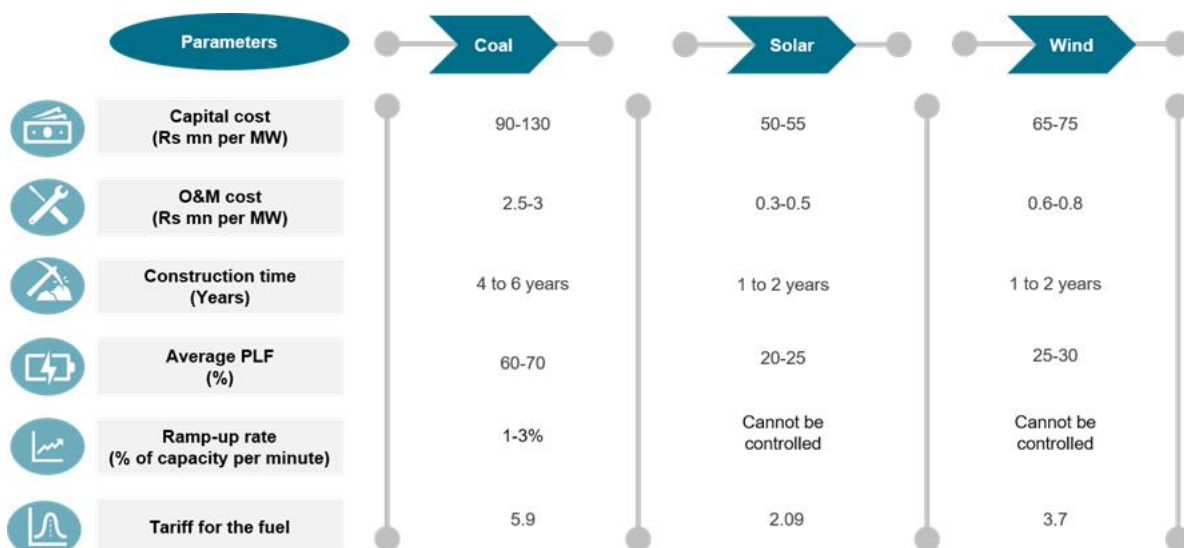
Note: Other RE includes small hydro and bio power. Other fossil fuels include lignite, gas and diesel. Other non-fossil fuels include hydro and nuclear. Storage includes BESS and PSP. RE includes open access. The forecast excludes off-grid solar.

P: Projected

Source: CEA, Crisil Intelligence

Solar and wind capacity addition is expected to rise over the next five years, with most of the projects deploying efficient technologies to improve utilisation. Similarly, utilisation of PSPs is likely to improve in line with significant capacity addition during the period. Consequently, generation from renewable sources and storage capacity may rise significantly, lowering the requirement for coal supply. As a result, coal-based plant load factor (PLF) is expected to moderate amid higher renewable energy and storage-based utilisation. However, as large-scale storage capacity will take time to develop, coal will continue to play a critical role in India's power mix in the interim

Figure 10: Solar projects fare better on cost and duration



Note: Capital cost for solar represents capex of domestic content requirement cell-based module

Source: Crisil Intelligence

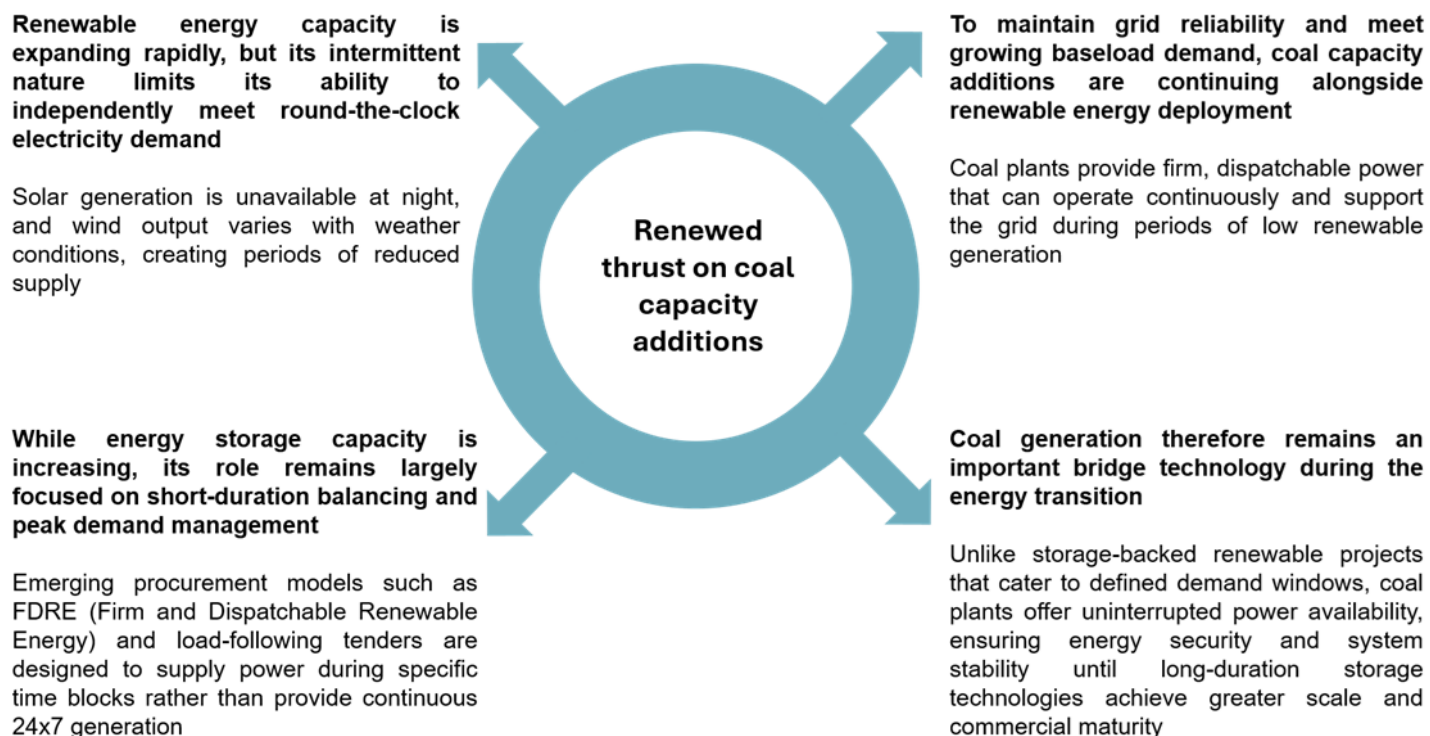
Key factors that are leading to a revival of coal-based capacity addition

Over fiscals 2027-2031, Crisil Intelligence expects 32-37 GW of coal-based power capacity to be commissioned, supported largely by projects that are already planned or under development. These additions are expected to be driven by coal's continued importance in meeting peak power demand, replacing older coal-based plants and providing firm capacity as renewable penetration increases. Coal-based plants commissioned over the past decade, as well as those in the commissioning pipeline, are also expected to be increasingly used for flexible operations, given their ability to ramp generation up or down in line with intermittent demand and renewable generation patterns.

This firm and reliable capacity remains vital for frequency regulation, voltage stability and grid reliability. In a rapidly growing power market such as India, coal-based capacity provides an anchor against renewable intermittency until large-scale storage and advanced grid technologies become cost-effective at scale. Coal plants also act as a hedge during stress events such as sudden demand surges, transmission constraints and seasonal shortages. The government's policy for flexibility in utilisation of domestic coal, the new linkage policy - Scheme for Harnessing and Allocating Koyala Transparently

in India (SHAKTI), and higher domestic coal production aimed at import substitution are expected to improve coal availability over the next three to five years for power plants.

Figure 11: Key factors behind the revival of coal-based power plants



Source: Crisil Intelligence

Power generation to clock 6-8% CAGR over fiscals 2027-2031

Power generation across fuels is expected to increase at a CAGR of 6-8% between fiscals 2027 and 2031. Crisil Intelligence expects total power generation including open access generation to rise 10-15% on year to 2,045-2,055 BU in fiscal 2027. The share of coal in overall power generation including open access generation is expected to fall to 52-55% by fiscal 2031 from 65-67% in fiscal 2027, indicating the fuel will remain a key part of the nation's energy supply mix even in the long term but will moderate in contribution.

The contribution of renewable energy (ex-hydro) to total power generation including open access generation is estimated to increase to 18-23% in fiscal 2027 from 9% in fiscal 2019. Solar energy is estimated to dominate this segment with a 60-65% share in renewable energy generation and 12-14% share in total energy generated in fiscal 2027.

Solar and wind energy generation grew an impressive 21% and 28% respectively, on year in fiscal 2026 over the last year. This suggests that India's renewable energy sector is transforming, with renewable energy emerging as a leading source. The growth of solar energy projects has been more than wind in terms of capacity and is expected to continue, driven by lower costs and favourable government policies.

Crisil Intelligence projects RE-based generation including from open access to surge at a CAGR of 20-25% between fiscals 2027 and 2031. Robust capacity addition and improving solar and wind capacity utilisation on the back of technological improvements are expected to help, along with an increased storage mix to aid RE's intermittent issues. RE generation,

including from open access, is expected to increase sharply and account for around 32-37% of the generation mix by fiscal 2031. Share of fossil fuels (coal, natural gas, diesel and lignite) in India's energy mix is expected to be in the range of 54-59% by fiscal 2031. With strong additions in RE sources, the share of non-fossil sources (RE, nuclear and hydro) is expected to increase to 42-50% in fiscal 2031 from 28-36% in fiscal 2027.

Table 8: Fuel-wise power generation in India

	FY19	FY20	FY21	FY22	FY23	FY24	FY25	FY26P	FY27P	FY31P
Coal	72%	70%	68%	69%	71%	73%	72%	69%	65-67%	52-55%
Other fossil	6%	6%	6%	5%	4%	4%	4%	3%	2-4%	2-4%
Solar	3%	4%	4%	5%	6%	7%	8%	10%	12-14%	24-26%
Wind	5%	5%	4%	5%	4%	5%	5%	6%	6-8%	8-10%
Other RES	2%	2%	4%	4%	2%	2%	1%	2%	1-3%	1-3%
Other non-fossil	12%	14%	14%	13%	12%	10%	11%	11%	9-11%	9-11%

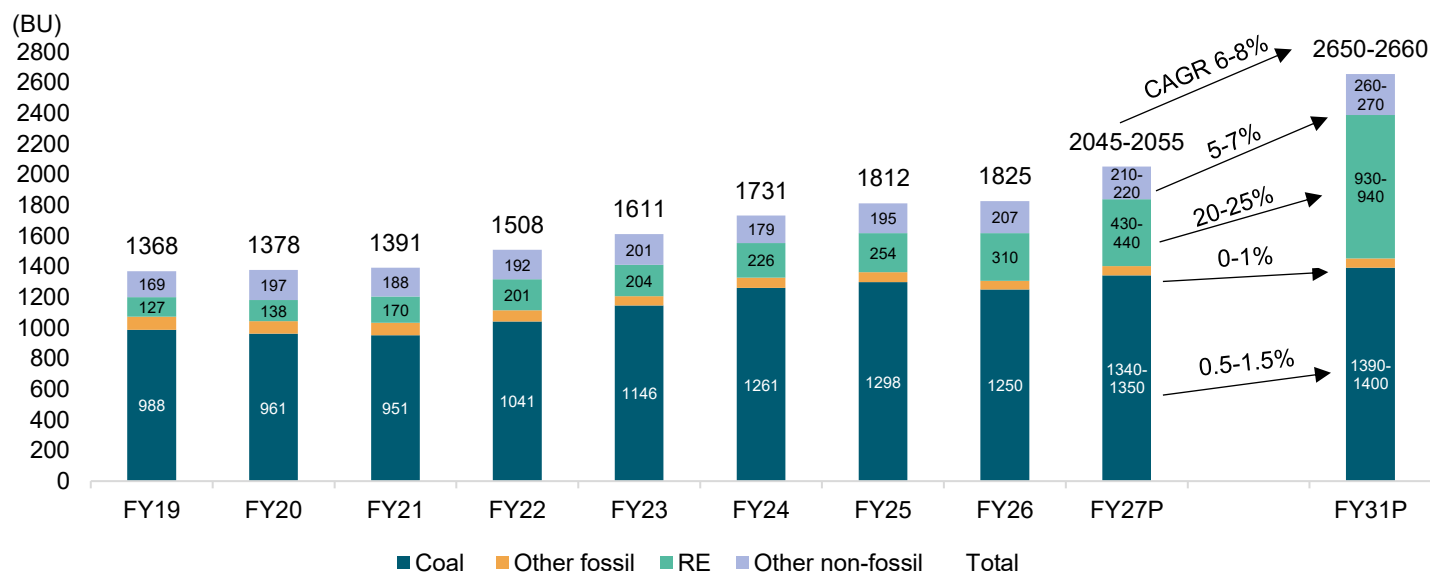
Note: Generation mix refers to total power generation, including open-access generation

P – Projected

Figures may not total 100% because of rounding

Source: CEA, Crisil Intelligence

Figure 12: Fuel-wise power generation in India by fiscal 2031



Note: Generation mix refers to total power generation, including open-access generation

RE includes solar, wind and other renewable sources such as biomass, small hydro, waste to energy. Other fossil fuels include lignite, gas, and diesel. Other non-fossil fuels include hydro and nuclear.

P: Projected

Source: CEA, Crisil Intelligence

Policy framework and watershed regulations

The Electricity Act, 2003, was key to the power sector reforms process as it consolidated previous policies, thereby streamlining the sector and improving efficiency. In 2008, the government introduced Open Access Regulations for establishment of power exchanges. In 2016, the government amended the National Tariff Policy with increased focus on renewable energy and the objectives of the Ujwal DISCOM Assurance Yojana (UDAY). In 2023, the Ministry of Power issued the Electricity (Amendment) Rules that change the qualifying criteria for a captive generating plant and in 2024, the Electricity (Third Amendment) Rules which aimed at reducing dependence on non-renewable energy sources. In 2024, the Central Electricity Regulatory Commission (CERC) further notified the tariff regulations for the period from April 1, 2024, to March 31, 2029. The details of each legislation/policy are as follows:

- **Electricity Act, 2003:** De-licensed power generation, introduced open access in transmission and distribution, and unbundled state electricity boards to promote competition
- **Open Access Regulations, 2008:** Facilitated short-term bilateral trade in power and introduced power exchanges for anonymous trading
- **National Tariff Policy, 2016:** Aimed for 24/7 power supply, promoted use of renewable energy and encouraged energy efficiency
- **Electricity (Amendment) Rules, 2023:** Simplified rooftop solar installations, introduced connections for EV charging stations and expedited new electricity connections
- **Electricity (Third Amendment) Rules, 2024:** Promoted sustainability and reduced dependence on non-renewable energy sources
- **CERC Tariff Regulations, 2024:** Changed tariff calculations and introduced incentives for efficient thermal generation stations
- **National Electricity Policy (NEP) 2026:**
 - The Electricity Act, 2003, led to the formulation of the first National Electricity Policy (NEP) in 2005, which aimed to address the power deficit and achieve universal access to electricity. At that time, peak power deficit was over 12%, rural electrification was low, and the grid was fragmented. While the policy mentioned financial turnaround, the emphasis was heavily tilted towards protecting consumer interest through regulation and targeted subsidies. Cross subsidies were considered as a necessary mechanism to fund universal access.
 - The policy acknowledges that while physical infrastructure has scaled, the commercial viability of the sector remains precarious due to non-cost-reflective tariffs and high aggregate technical and commercial (AT&C) losses. The policy's horizon extends to 2047, targeting a per capita electricity consumption of over 4,000 kWh, up from an estimated 1,460 kWh in fiscal 2025. To achieve this, the policy focuses on ensuring financial solvency of Discoms, managing the complexity of a grid with high RE penetration, and meeting climate targets.
 - One of the major bottlenecks in India's power sector has been the delayed tariff petitions by Discoms and tariff orders by State Electricity Regulatory Commissions (SERCs). This has resulted in a substantial gap between the Average Revenue Realised (ARR) and the Average Cost of Supply (ACS),

- resulting in financial distress for discoms. To mitigate this, the policy mandates that tariffs must be linked to a suitable index for automatic annual revision, effectively eliminating the role of SERC's approval in case of delays. However, it is critical for investor confidence as it transforms discoms' revenue into a predictable, formula driven approach.
- As part of cost reflective tariff structure, the policy also proposes that tariffs progressively recover fixed costs through demand charges, insulating discoms from risk of reduced power consumption. The policy also calls for the exemption of cross-subsidies and surcharges for the manufacturing sector, railways, and metro systems, which is a direct industrial policy intervention to increase manufacturing competitiveness with global players.
 - The policy places an emphasis on technology as a driver of energy security. The draft pushes for nuclear energy, positioning it as the baseload backbone of a Net-Zero India, with a target of 100 GW of nuclear capacity by 2047. Additionally, the policy targets market-based deployment of Battery Energy Storage Systems (BESS) and Pumped Storage Projects (PSP), to facilitate the integration of intermittent renewable energy sources and ensure a stable and resilient power grid.

Module 4: Indian solar market

Industry overview

Technology improvements have aided solar energy adoption

Technological advancements in solar and wind energy have significantly reduced the costs, making them more economically viable than fossil fuels in many regions.

Technological innovations have led to significant improvements in conversion efficiency, material usage and energy efficiency per module. Over the past decade, the efficiency of commercial monocrystalline silicon modules has increased from about 17% to just under 25%, while generation costs have decreased substantially.

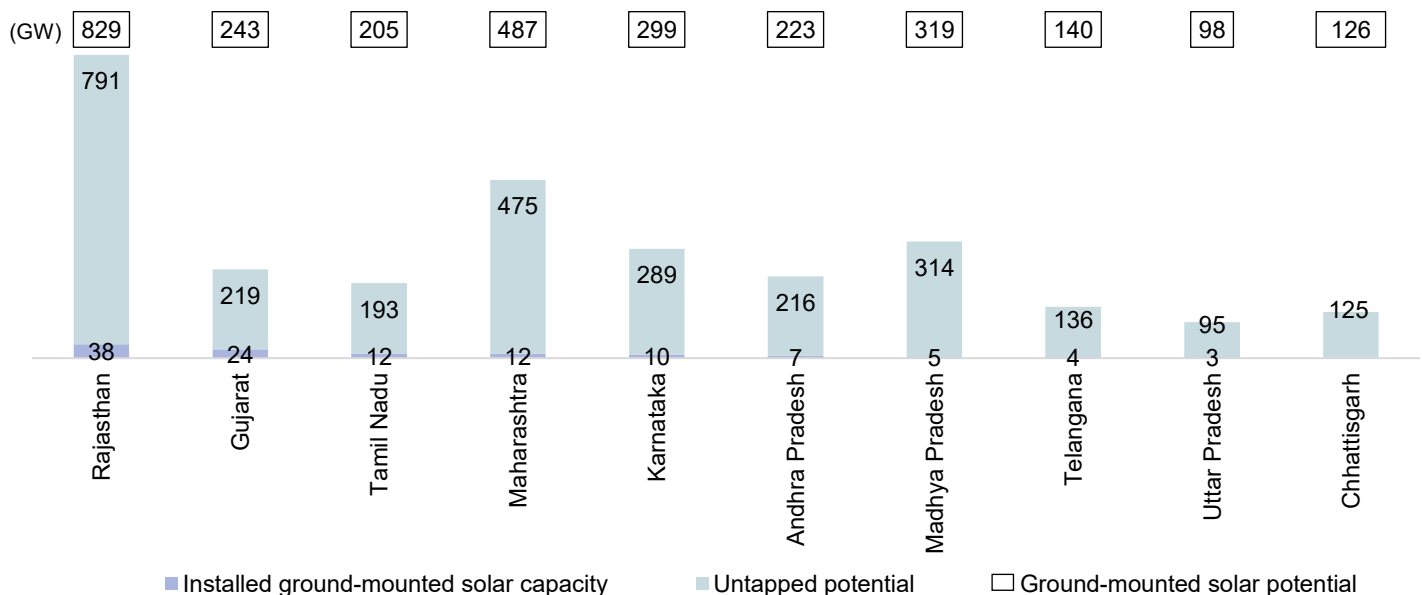
Bifacial modules have gained widespread commercial adoption as per Fraunhofer, especially in utility-scale projects, because of their higher energy yield. From a cell perspective, silicon wafer-based technology accounted for about 98% of global PV production in 2025, with n-type wafers accounting for 86%. Monocrystalline n-type TOPCon technology has become dominant. This shift is driven by the high efficiency and long lifespan of monocrystalline solar panels. Moreover, HJT technology is also gaining commercial adoption, although its market share remains below that of TOPCon. Ongoing investments in research and development (R&D) will further support innovation, cost reduction and efficiency gains in the solar PV sector, reduce material intensity, particularly silicon and silver consumption, and minimise supply-chain vulnerabilities. TOPCon has replaced p-type PERC as the dominant technology, while HJT is gradually gaining adoption.

In India, manufacturers, mirroring the global trend, are transitioning from mono passive emitter rear contact (mono-PERC) to higher-efficiency tunnel oxide passivated contact (TOPCon) technology. While mono-PERC continues to form part of the existing manufacturing base, TOPCon adoption is increasing, with domestic manufacturers commissioning new production lines or operating both technologies in parallel.

India has ground-mounted solar potential of 3,343 GW and wind potential of 1,164 GW at 150 meters above ground level

India enjoys rich solar potential on account of the tropical geography

Figure 13: Top 10 states utilised only 35% of their solar potential as of June 2026

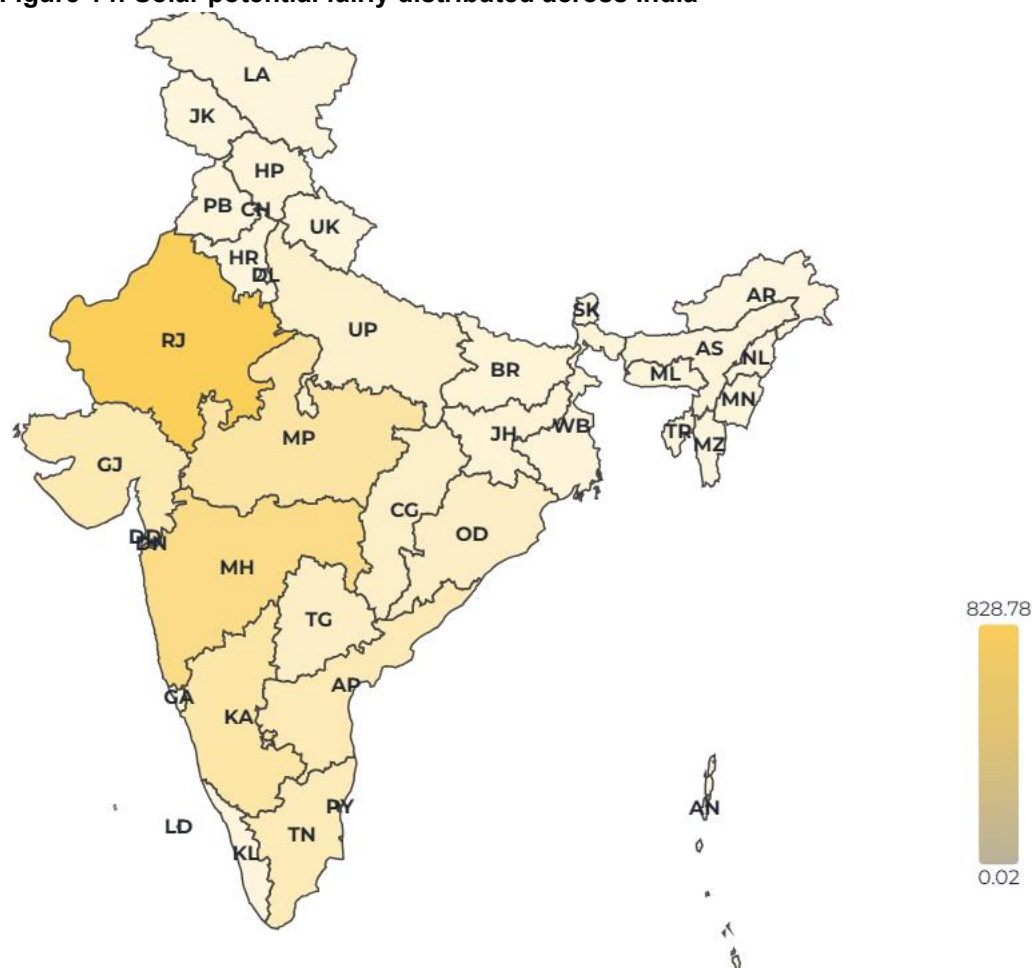


Source: NITI Ayog, MNRE, Crisil Intelligence

India has immense solar energy potential, with only ground-mounted solar PV estimated at 3,343 GW by the MNRE, assuming just 6.69% of the country's wasteland is covered with solar PV modules. The country's location receives 300 days of sunshine annually, which makes it an ideal spot for harnessing solar energy.

The Global Horizontal Irradiance (GHI) in India ranges from 3.77-5.64 kWh/m². The GHI varies across the north-eastern hilly regions and the western cold desert areas. Certain states such as Gujarat, Rajasthan, Madhya Pradesh, Maharashtra, Andhra Pradesh, Karnataka, and Tamil Nadu receive more solar irradiance than others, which makes them prime locations for solar projects.

Figure 14: Solar potential fairly distributed across India



Note: The gradient scale is in MW

Source: ICED Niti Aayog, Crisil Intelligence

As of June 2026, Rajasthan had the highest installed ground-mounted solar capacity at 38.1 GW, against an estimated potential of about 828.8 GW, indicating utilisation of approximately 4.6%. Gujarat ranked second, with installed ground-mounted solar capacity of 24.1 GW, representing approximately 9.9% of its estimated potential of 243.2 GW.

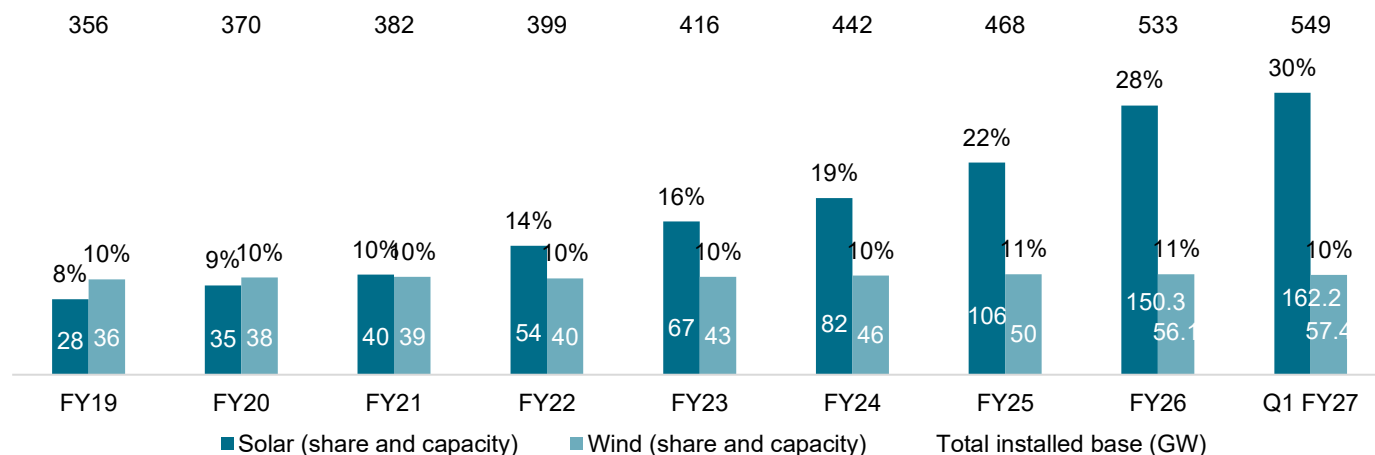
Tamil Nadu had the third-highest installed ground-mounted solar capacity at 12.4 GW, equivalent to approximately 6.1% of its estimated potential of 204.7 GW. Maharashtra had installed 12.1 GW, representing approximately 2.5% of its estimated potential of 486.7 GW. Karnataka had installed 10.0 GW ground-mounted capacity, utilising approximately 3.3% of its estimated potential of 299.3 GW.

Solar overtakes wind as India's leading renewable source

The installed capacity of solar and wind together accounted for about 40% of India's total installed power capacity at the end of Q1 fiscal 2027, compared with 18% in fiscal 2019. Solar accounted for about 30% of total installed capacity at the end of Q1 fiscal 2027, up from 8% in fiscal 2019. Clocking a CAGR of about 26% between fiscals 2019 and 2026, solar capacity increased from 29.1 GW in fiscal 2019 to 150.3 GW in fiscal 2026 and further to 162.2 GW at the end of Q1 fiscal 2027.

Wind accounted for about 10% of total installed capacity at the end of Q1 fiscal 2027, broadly unchanged from fiscal 2019. Clocking a CAGR of about 7% between fiscals 2019 and 2026, installed wind capacity increased from 35.6 GW in fiscal 2019 to 56.1 GW in fiscal 2026 and further to 57.4 GW at the end of Q1 fiscal 2027.

Figure 15: Solar's share in total installed capacity increased to about 30% in Q1 FY27



Note: Installed base is total power installed base for the corresponding fiscal year. Numbers mentioned inside the columns pertain to installed base of respective segment in GW.

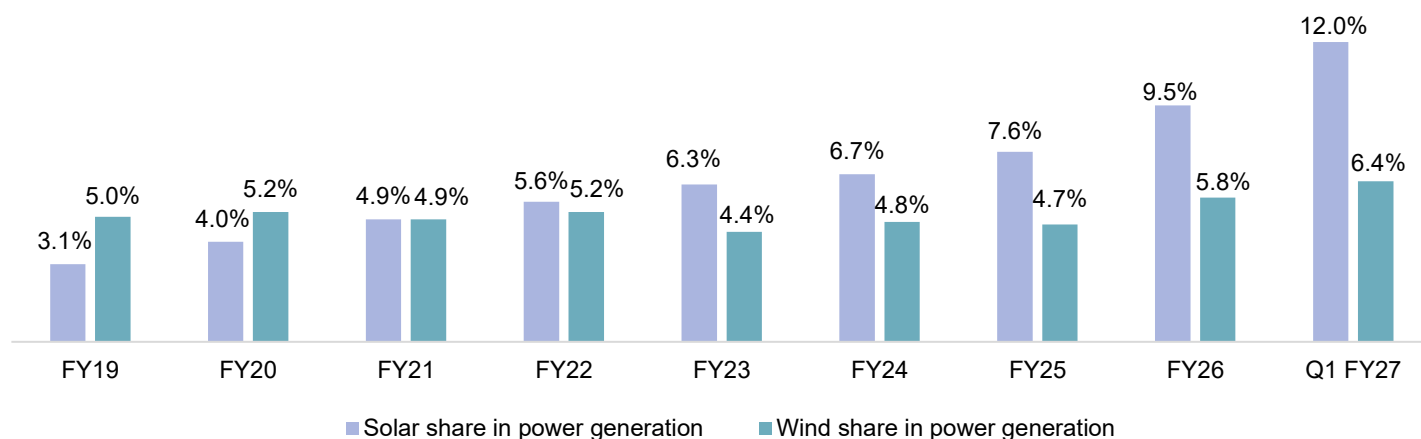
Source: CEA, Crisil Intelligence

In Q1 fiscal 2027, India added about 11.9 GW of solar capacity, taking cumulative installed solar capacity to 162.2 GW as of June 30, 2026.

Despite the growth in capacity, the share of solar and wind energy in total power generation remained relatively low, with both accounting for 18.4% of power generation in Q1 fiscal 2027. The share of solar in power generation rose to 12.0% in Q1 fiscal 2027 from 3.1% in 2019, while wind accounted for 6.4%, compared with 5.0% in fiscal 2019.

Conventional sources still dominate power generation on account of lower wind and solar utilisation rates.

Figure 16: Increasing share of solar in installed capacity is reflected in its generation share



Source: CEA, Crisil Intelligence

While the share of solar and wind in generation has improved, power supply from these sources, by nature, is intermittent. To tackle this, the government is focusing on energy integration using a multi-fuel and storage model to provide round-the-clock power supply and mitigate standalone renewable energy intermittency.

Domestic drivers for solar power

Focus on policy support to RE-aided solar growth

The total installed capacity of solar energy in the country increased to ~162.2 GW at the end of Q1 fiscal 2027 from a negligible 1 MW at the end of March 2011, driven by various state policies as well as a central solar mission. Large allocations under central schemes such as the National Solar Mission (NSM; phase I and phase II), Inter-state Transmission System (ISTS) projects awarded by the Solar Energy Corp of India (SECI), projects implemented by REIAs (Renewable Energy Implementing Agencies) and other state-level schemes have helped increase the installed base of solar in India.

Policy-wise, India is committed to achieving 500 GW of non-fossil capacity by 2030 as part of its climate commitments. To further ensure integration of renewables in the grid, the Ministry of Power has introduced energy storage obligation and has waived transmission charges for solar projects, to promote interstate sale of power. The government also provides benefits such as a 40% accelerated depreciation (AD) allowance, financial assistance under PM Surya Ghar: Muft Bijli Yojana and net-metering provisions for rooftop solar PV projects. These measures are expected to drive capacity additions in India.

Jawaharlal Nehru National Solar Mission (JNNSM)

The JNNSM, launched in 2010, initially aimed to establish 20 GW of grid-connected solar power by 2022, which was later increased to 100 GW in 2015.

The first phase of the JNNSM allocated 970 MW of solar capacity in two batches, besides 84 MW under the Migration Scheme. Solar PV projects broadly met the scheme timelines, although several solar thermal projects experienced delays. A total of 718 MW was commissioned under Phase I as of August 2015.

Phase II introduced viability gap funding (VGF), with the Solar Energy Corporation of India (SECI) designated as the nodal agency. Phase II Batch-I covered 750 MW of grid-connected solar PV projects, equally divided between the domestic content requirement and open categories. The tariff was fixed at Rs 5.45 per unit for 25 years, or Rs 4.75 per unit where the accelerated depreciation benefit was availed.

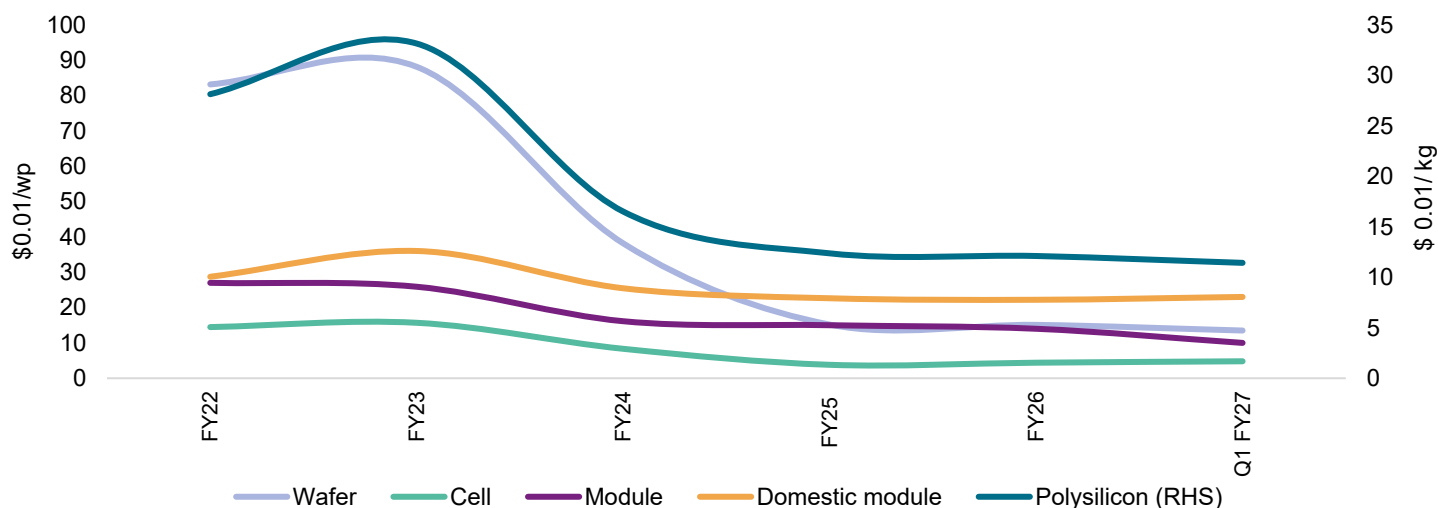
Batch-II of phase II aimed to implement 15,000 MW of grid-connected solar PV plants in three tranches but was curtailed to only tranche I due to declining solar tariffs. Subsequent batches, including batch III and IV, involved setting up 2,000 MW and 5,000 MW of solar power projects, respectively, with VGF support and fixed tariffs.

Falling component prices result in lower capital costs

A key factor determining capital costs is component pricing, with solar modules accounting for 55-60% of the total capital expenditure for a solar project. Weighted-average standalone solar tariffs declined to Rs 2.63 per unit in fiscal 2025 from Rs 2.9 per unit in fiscal 2020, primarily due to lower upstream component prices. Large-scale manufacturing capacity additions and technological improvements led to a sustained correction in solar-component prices after their fiscal 2023 peak. Cell prices declined from around 15 cents/Wp in fiscal 2023 to approximately 5 cents/Wp in the first quarter of fiscal 2027. During the same period, wafer and module prices fell to around 13-15 cents/Wp and 9-11 cents/Wp, respectively,

while domestic module prices remained relatively higher at approximately 23 cents/Wp. Polysilicon prices also declined sharply from their fiscal 2023 peak and moderated further in the first quarter of fiscal 2027.

Figure 17: Prices plunge as world sees a supply glut



Note: The units of kg above correspond to polysilicon, while wp is applicable for all other components.

Wafer prices up to fiscal 2025 relate to Mono p-type wafers of 182-183.75mm/150μm. The prices of this wafer have been discontinued and prices for Mono n-type 182 mm wafers has been used for fiscal 2026 onwards.

Q1 FY27 is April-June 2026

Source: Crisil Intelligence

Solar energy tariffs also fall

Large-scale manufacturing capacity additions, technological improvements and R&D-led efficiency gains reduced component and module prices, resulting in lower solar tariffs. Standalone solar weighted-average tariffs declined to around Rs 2.1 per unit in fiscal 2026, from Rs 5.2 per unit in 2016, supported by persistent oversupply across the photovoltaic value chain.

Consequently, solar remained competitive with wind tariffs of Rs 3.8-4.0 per unit. However, the increasing inclusion of energy storage in government-backed renewable-energy tenders has raised discovered tariffs, with solar-plus-storage tariffs generally ranging between Rs 3.2-3.6 per unit, reflecting the additional cost of battery storage while enabling firm and peak-hour power supply.

Payment security mechanisms in-built into utility market

The power purchase agreements (PPAs) for projects signed between the developer and SECI, NTPC Ltd, and NTPC Vidyut Vyapar Nigam Ltd (NVVN) considerably mitigate the risk associated with off-taker credibility, making it more bankable. SECI, NTPC and NVVN better credibility and payment track records compared with distribution companies and are also a part of the tripartite payment security agreement (between certain public sector undertakings [PSUs], government and RBI) which ensures payment from state budget allocations in case these entities default on payments. Also, some central-scheme PPAs also ensure the setting up of a payment security fund covering two to three months of payments to generators.

Ultra-mega solar parks

In December 2014, the MNRE introduced a scheme to establish minimum 25 solar parks and ultra mega solar power projects, adding over 20 GW of installed solar capacity. This was later increased to 40 GW and to develop a minimum of 50

solar parks of 500 MW and above capacity each by fiscal 2020. In July 2018, the MNRE extended the timeline to develop solar parks and ultra-mega solar projects totalling 40 GW from 2019-20 to 2021-22.

The scheme was extended until March 2026. According to the CEA, as of June 2026, solar parks and ultra-mega renewable energy power parks (UMREPPs) of 42.1 GW aggregate capacity were sanctioned for development in the country. Within these parks, ~30.7 GW has been awarded (of which ~21.3 GW has been commissioned, while another ~9.1 GW is under construction), and another 11.2 GW is under award/tendering process.

Table 9: Status of solar parks in India as of June 2026

State in which solar parks are located	Sanctioned capacity (MW)	Commissioned capacity (MW)
Andhra Pradesh	4,300	3,050
Chhattisgarh	100	100
Gujarat	12,850	6,960
Jharkhand	1,137	0
Karnataka	2,000	2,000
Kerala	255	105
Madhya Pradesh	4,530	2,608
Maharashtra	1,150	200
Mizoram	20	20
Odisha	40	0
Rajasthan	11,805	5,089
Uttar Pradesh	3,740	430
All India (Total)	42,107	21,312

Note: The data is as reported by CEA as of June 2026.

Source: CEA, Crisil Intelligence

Push to states in the form of renewable purchase obligation also a factor

The renewable purchase obligation (RPO) is a regulatory requirement set by the State Electricity Regulatory Commission, mandating entities to procure a minimum percentage of their energy from renewable sources, as outlined by the Ministry of Power. In 2016, the Indian government modified the National Tariff Policy to encourage solar power adoption, setting a solar RPO target. States established their own targets based on their renewable energy potential, and in 2018, the ministry introduced a revised national RPO trajectory.

In October 2023, the central government introduced the distributed renewable energy (DRE) component and revised renewable consumption obligation (RCO) targets. In September 2025, the Ministry of Power notified a revised RCO framework, superseding the October 2023 notification. The framework applies to distribution licensees, open-access consumers and captive users, and covers eligible DRE projects with a capacity of up to 10 MW.

Table 10: Revised RCO trajectory

Category	FY25	FY26	FY27	FY28	FY29	FY30
Wind	0.67%	1.45%	1.97%	2.45%	2.95%	3.48%

Hydro	0.38%	1.22%	1.34%	1.42%	1.42%	1.33%
Distributed RE	1.50%	2.10%	2.70%	3.30%	3.90%	4.50%
Other RE	27.35%	28.24%	29.94%	31.64%	33.10%	34.02%
Total	29.91%	33.01%	35.95%	38.81%	41.36%	43.33%

Source: Ministry of Power, Crisil Intelligence

Excess energy from “other” renewable sources can offset shortfalls in the wind or hydro categories. Compliance may remain challenging due to the steep increase in RCO targets, unless obligated entities procure the required renewable power or renewable energy certificates (RECs). Some states, such as Telangana, Karnataka and Gujarat, may be better placed to comply due to rapid solar capacity additions, while Delhi, Uttar Pradesh and Punjab may face challenges.

Despite instances of non-compliance, enforcement of renewable energy obligations has been historically limited due to the weak financial position of discoms. Lower prices of solar renewable energy certificates (RECs) may improve compliance, as discoms can purchase more RECs. Strict enforcement is needed, but the proposed amendment to the Electricity Act, which imposes a penalty on non-compliance, is pending. RCO requirements and penalties for non-compliance are covered under the Energy Conservation Act, 2001, as amended in 2022, and the associated RCO framework.

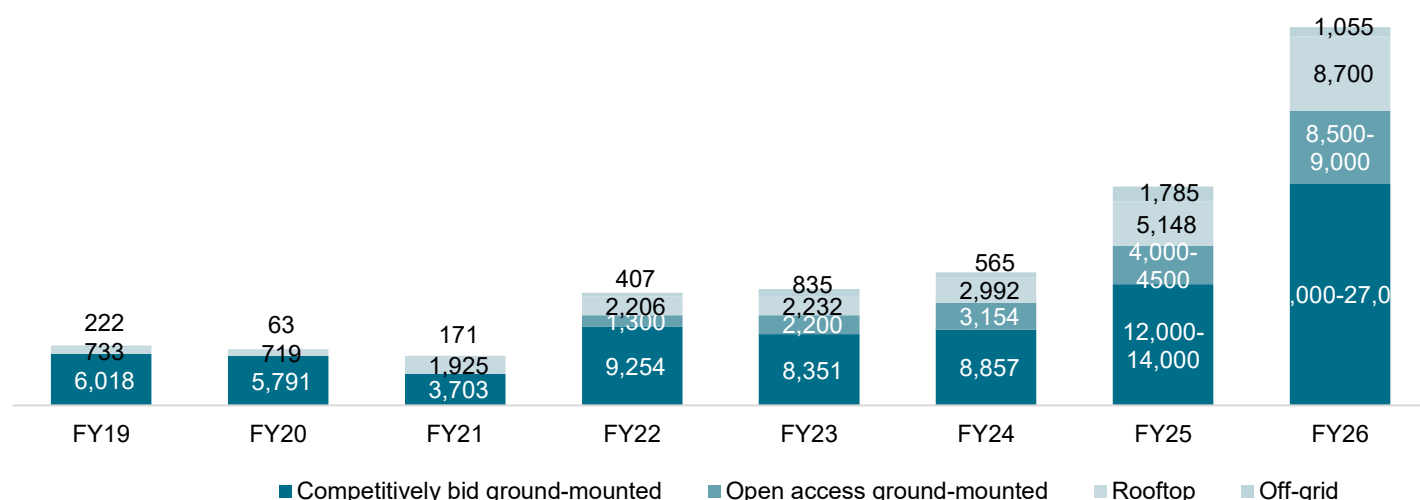
Solar power market

Capacity of ~133 GW added between fiscals 2019 and Q1 fiscal 2027

The solar PV generation segment witnessed a record capacity addition of 44.6 GW in fiscal 2026, compared with ~24 GW in fiscal 2025. At the prevailing pace of capacity expansion, total installed solar capacity is projected to exceed 200 GW significantly ahead of fiscal 2031. The growth outlook remains supported by the ongoing transition towards renewable power generation, driven by environmental considerations, favourable policies for domestic equipment manufacturing and renewable power offtake, and increasing participation from public and private-sector entities. Furthermore, supportive government initiatives are expected to facilitate strong growth in the rooftop solar market over the period through fiscal 2031.

Figure 18: Incremental capacity addition led by competitively bid ground-mounted segment

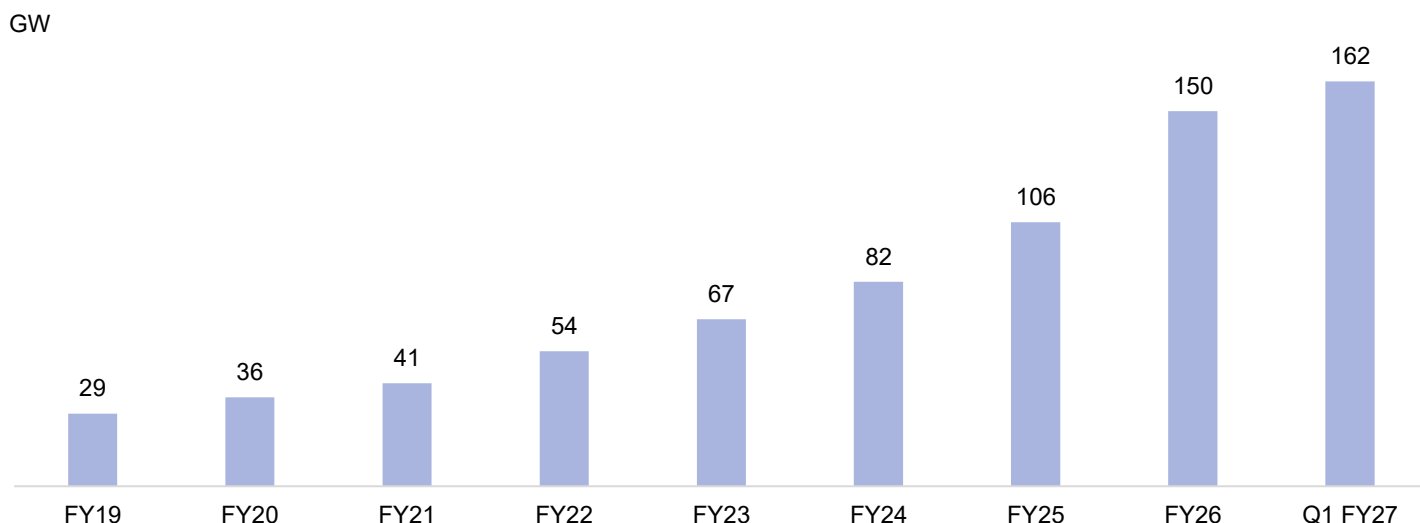
(MW)



Note: The split of open access and competitively bid capacity are Crisil Intelligence estimates

Source: MNRE, Crisil Intelligence

Figure 19: Installed solar capacity grew at a CAGR of 26% from fiscal 2019 to fiscal 2026



Source: MNRE

Capacity additions in fiscal 2026 and the first quarter of fiscal 2027 were primarily driven by the competitively bid segment, which accounted for approximately 55-60% of total additions, followed by rooftop solar at around 20%. Similarly, in fiscal 2025, competitively bid utility-scale projects contributed 50-55% of capacity additions, while rooftop solar accounted for 22%, supported by an easing of supply-chain pressures during the year.

Rajasthan and Gujarat dominated the country's installed solar capacity base. As of June 2026, the two states had a combined installed solar capacity of approximately 76.5 GW, accounting for about 47% of India's total solar capacity.

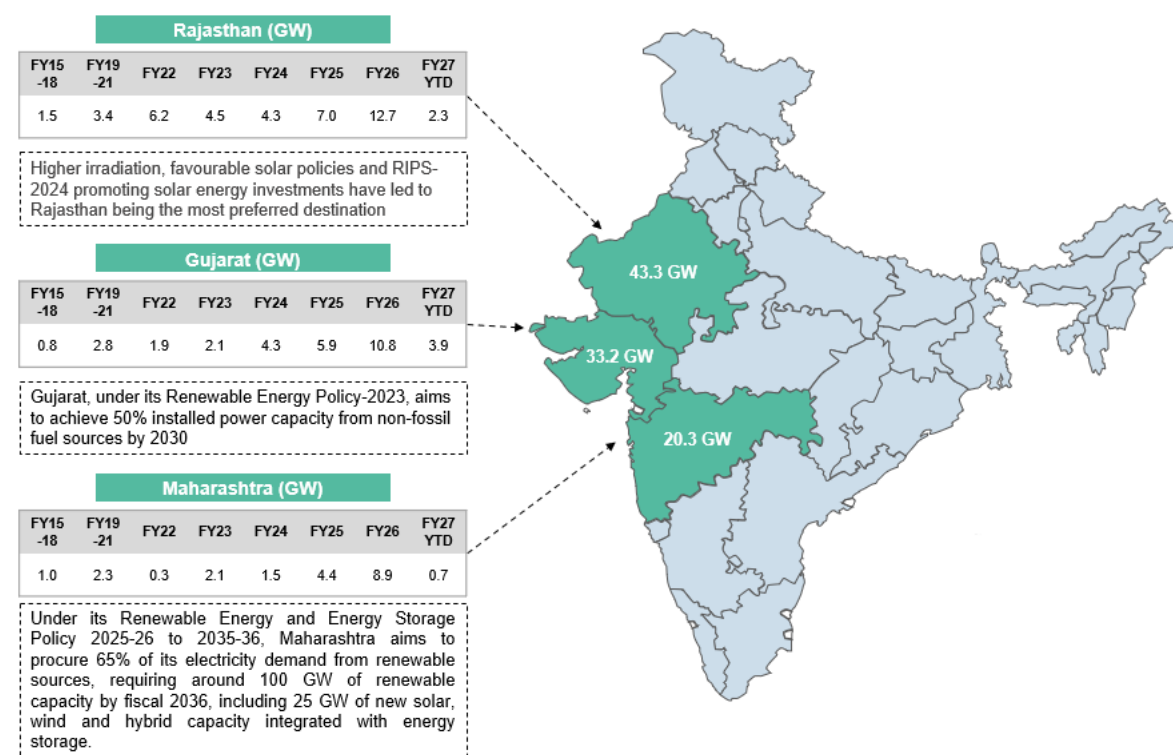
Table 11: Key projects commissioned in Rajasthan and Gujarat, which alone contributed to ~53% of the capacity in fiscal 2026 and Q1 fiscal 2027

Scheme name	States	Capacity (MW)
GUVNL Gujarat Solar Tranche-XX, 800 MW, Jul-2023	Gujarat	1,600
SECI Pan India Solar, 7,000 MW (Manufacturing-linked), Jan-2020	Gujarat	1,465
GUVNL Pan India Solar Tranche-XIX, 500 MW, Apr-2023	Gujarat	680
NHPC Pan India Solar, 2,000 MW, Apr-2020	Rajasthan	651
SECI Pan India Solar Tranche-IX, 2,000 MW, Jun-2020	Rajasthan	600
GUVNL Gujarat Solar Tranche-XVII, 600 MW, May-2023	Gujarat	600
SECI Pan India Solar Tranche-VIII, 1,200 MW, Feb-2020	Rajasthan	500
SECI Rajasthan Solar Tranche-IV, 1,785 MW, Dec-2021	Rajasthan	425
GUVNL Pan India Solar Tranche-XVIII, 500 MW, Jan-2023	Gujarat	420
RUVNL Rajasthan Solar, 1,000 MW, May-2023	Rajasthan	400
GUVNL Gujarat Solar Tranche-XXI, 600 MW, Jan-2024	Gujarat	400
GUVNL Gujarat Solar Tranche-XIV, 500 MW, Jun-2022	Gujarat	317
SECI Pan India Solar-Wind Hybrid Tranche-IV, 1,200 MW, Aug-2021	Gujarat	300

SECI Pan India Solar Tranche-XVIII, 1,000 MW, Dec-2024	Rajasthan	300
SECI Pan India Solar-Wind Hybrid Tranche-III, 1,200 MW, Dec-2020	Gujarat	263
RECPDCL Pan India Solar, 500 MW, Apr-2023	Gujarat	200
SJVN Pan India Solar-Wind-Storage Hybrid (Firm Power), 1,500 MW, Nov-2023	Rajasthan	135
GUVNL Gujarat Solar Tranche-XIII, 500 MW, Mar-2022	Gujarat	120
NHPC Pan India Solar-Wind Hybrid, 1,500 MW, Feb-2024	Rajasthan	74
GUVNL Gujarat Solar Tranche-XII, 500 MW, Mar-2021	Gujarat	60

Source: Industry, Crisil Intelligence

Figure 20: Top three states comprised ~60% of national solar installed base as of June 2026



Note: The table presents state-level capacity additions.

FY27 YTD represents April-June 2026

Source: MNRE, Crisil Intelligence

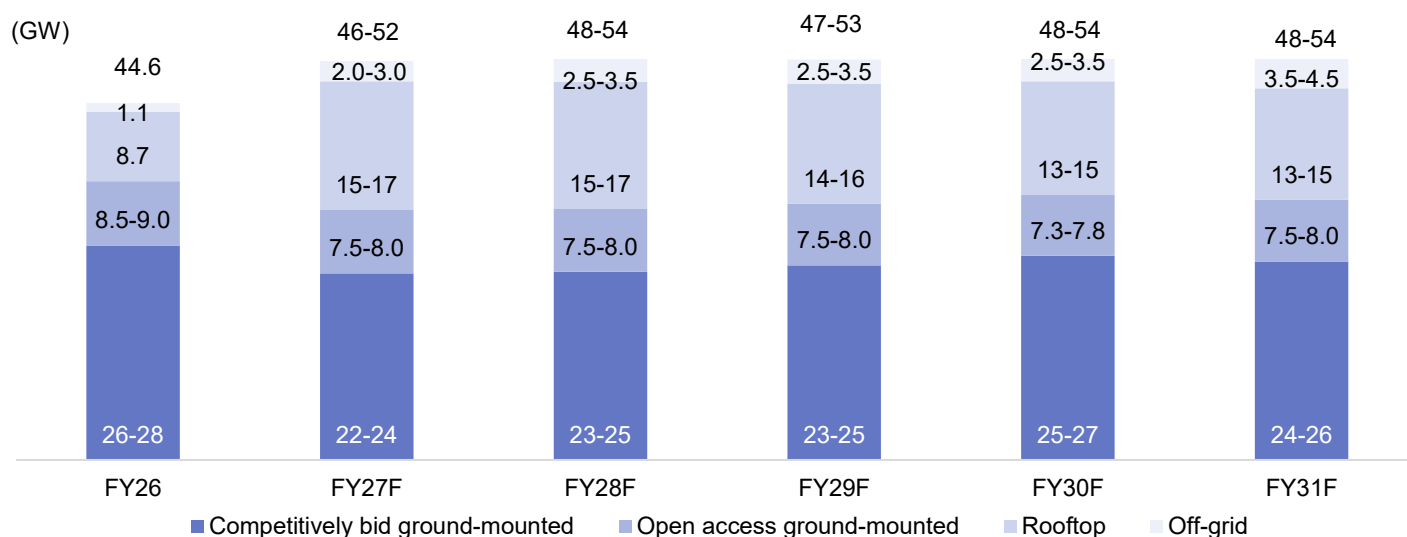
As illustrated in the chart, solar capacity additions remained concentrated in Rajasthan, Gujarat and Maharashtra. The three states had a combined installed solar capacity of approximately 96.9 GW as of June 2026, accounting for about 60% of India's installed solar capacity. Rajasthan and Gujarat accounted for approximately 53% of total additions in fiscal 2026 and 52% in Q1 fiscal 2027, supported by favourable state policies, high solar irradiance and ample land availability. Rajasthan and Gujarat have also set renewable energy targets of 90 GW and 100 GW, respectively, by fiscal 2030.

Solar capacity additions of 230-270 GW expected over fiscals 2027-2031

Crisil Intelligence expects 230-270 GW of total solar capacity additions over fiscal 2027-2031. This will be driven by additions under:

- Schemes launched by SECI (ISTS, floating solar tenders, newer structure tenders, state-specific schemes, etc)
- Capacity tendered by distribution companies in various states to fulfil renewable purchase obligation (RPO).
- Capacity tendered by cash-rich public sector undertakings (PSUs) such as NTPC, NLC (formerly Neyveli Lignite Corporation) and Coal India Ltd (CIL)
- Rooftop solar
- Open-access solar
- Off-grid solar

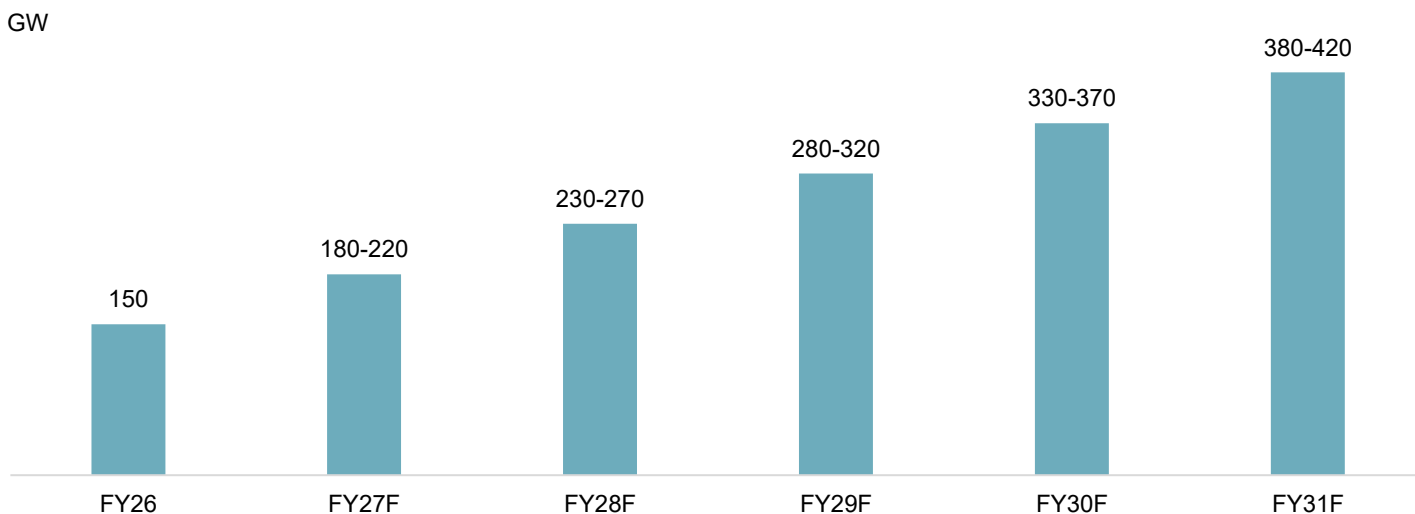
Figure 21: The majority of solar additions until fiscal 2031 are expected to come from the competitively bid segment



Note: F is forecast

Source: Crisil Intelligence

Figure 22: Projected solar installed base



Source: Crisil Intelligence

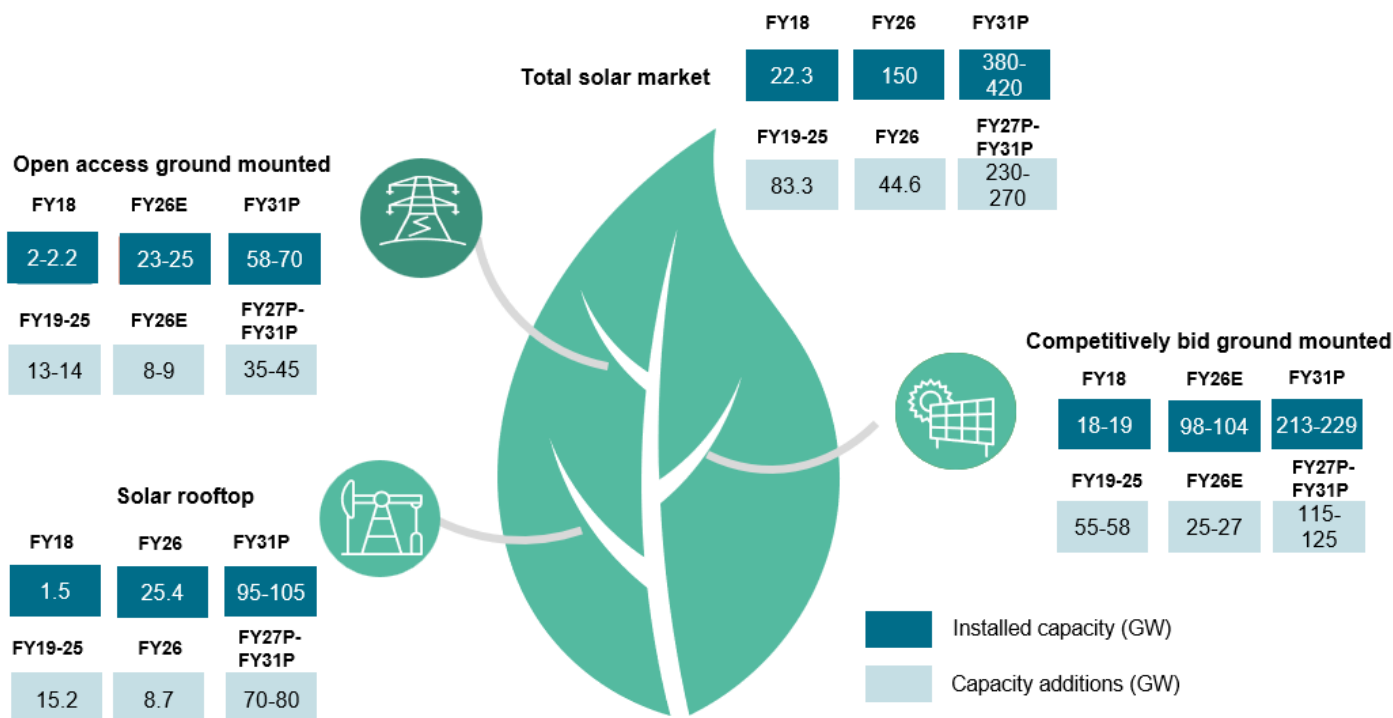
Additionally, public sector undertakings (PSUs) are also expected to drive solar capacity additions. The CPSU programme under Jawaharlal Nehru National Solar Mission (JNNSM) was extended from 1 GW to 12 GW in February 2019. The government is also encouraging cash-rich PSUs to set up renewable energy projects. NTPC, for example, has already commissioned over ~1.5 GW of capacity at the end of 2025 under various schemes. It has a target of installing ~60 GW of solar energy capacity by fiscal 2032.

CPSUs such as NHPC, ONGC, and GAIL have also planned to generate solar power. The Indian Railways has committed to the target of going net zero by 2030.

Solar capacity is anticipated to approach 380-420 GW by fiscal 2031, with the market projected to grow at a CAGR of 20-23% between fiscals 2026 and 2031. This growth is driven by decreasing costs of solar energy generation and favourable government incentives.

To arrive at capacity additions, Crisil Intelligence has considered the progress of capacity allocations from the schemes mentioned above. Crisil Intelligence has also factored in the economic feasibility of tariffs, the extent of payment security, the financial health of state discoms, RPO targets as well as execution risks.

Figure 23: Capacity addition avenues for Indian solar market



Note: The split of open access and competitively bid capacity are Crisil Intelligence estimates

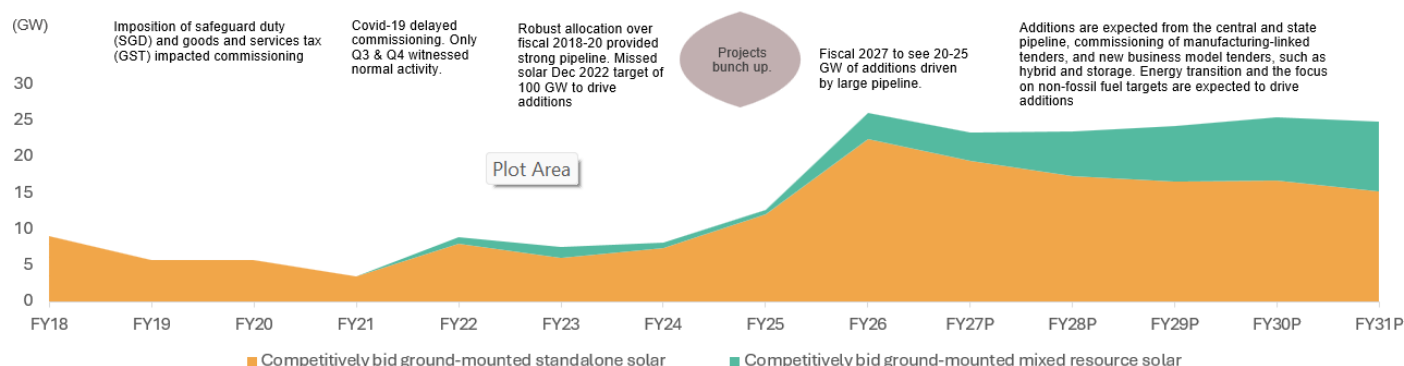
Source: Crisil Intelligence

Crisil Intelligence has summarised the main policies considered in its outlook for capacity additions:

- SECI and other central implementing agencies have tendered capacity under various schemes as of June 2026, which remains in the pipeline, with ~3.7 GW in the tendering stage and ~58 GW allocated.

- Under the state schemes, ~23 GW of projects are under construction and are expected to be commissioned over fiscals 2027-2031.
- The government has expanded the 1 GW CPSU programme to 12 GW to encourage cash-rich central PSUs to set up renewable energy projects. About 922 MW, 1,104 MW and 5,000 MW were allocated under tranches I, II and III of the schemes, respectively. Crisil Intelligence expects 5-6 GW from this scheme to be commissioned by fiscal 2027.
- Crisil Intelligence expects 35-45 GW of projects to be commissioned under the open access utility segment between fiscals 2027 and 2031, driven by the go-green initiatives/sustainability targets of commercial and industrial (C&I) consumers; effective long-term policies in key states such as Karnataka, Uttar Pradesh and Maharashtra; lower offtake risk combined with conducive policies such as the Green Open Access Regulations. The extension of the ALMM List-II compliance deadline for net-metering and open-access projects until December 2026 is also expected to support near-term execution and reduce supply-side disruption in fiscal 2027.
- Crisil Intelligence expects 70-80 GW of projects to be commissioned under the rooftop solar segment between fiscals 2027 and 2031, led by capacity added under Pradhan Mantri (PM) Surya Ghar Yojana; capacity allocated by the state governments; and commissioning of capacity by government institutions such as metro, railways and airports. Capacity will also be added by industrial and commercial consumers under net/gross metering schemes of various states.

Figure 24: Solar capacity additions under competitively bid utility scale to see healthy growth by fiscal 2031

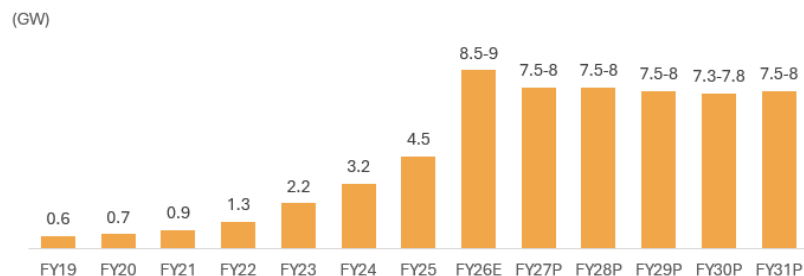


Source: MNRE, Crisil Intelligence

Open access market to see addition of 35-45 GW by fiscal 2031

The open access segment added an estimated 8.5-9 GW in fiscal 2026, compared to an estimated record addition of 4.5 GW in fiscal 2025. The ISTS waiver is expected to enable consumers to enter long-term contracts or buy power from the spot market as well as from various market segments such as the Green Term Ahead Market (GTAM) and Green Day Ahead Market (GDAM) that cater to green power requirements.

Figure 25: Green open-access regulations provide a boost to the segment



FY24 - Capacity additions soared as developers hastened project commissioning prior to ALMM abeyance expiration in March 2024
FY25- Capacity addition continued upward trajectory in lieu of impending ISTS charges waiver
FY26- Installations rose as developers accelerated execution ahead of ALMM list-II norms, supported by favorable policies, faster approvals, and stronger outreach.
FY27 to FY31P - Green Energy Open access rules, corporate green initiatives, and long-term policies in key states to drive capacity additions. The extension of the ALMM List-II compliance deadline for net-metering and open-access projects until December 2026 is also expected to support near-term execution and reduce supply-side disruption in fiscal 2027.

With the scheduled phase-down of ISTS charge waivers, solar/wind/hybrid projects commissioned after June 30, 2025, will face progressively higher transmission charges. The waiver declines from 75% for projects commissioned up to June 2026 to 50% up to June 2027 and 25% up to June 2028, before being fully withdrawn thereafter. As a result, projects commissioning in fiscal 2030 may see higher landed tariffs, posing a downside risk to additions.

Note: P is projected

Source: Crisil Intelligence

Rooftop solar additions of 70-80 GW over fiscals 2027-31

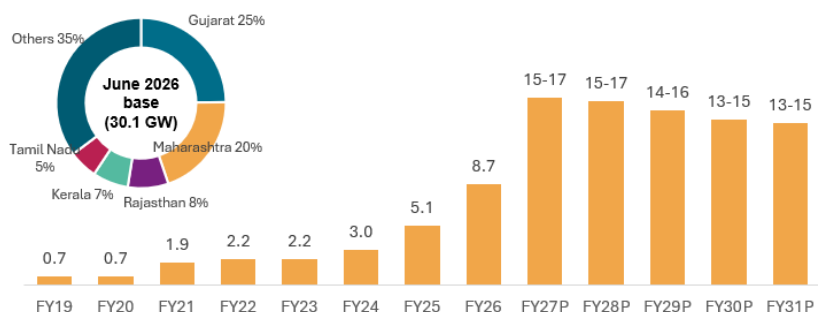
Rooftop solar projects comprise small-scale solar PV systems installed on residential, commercial and industrial rooftops and may be either grid-connected or off-grid. India's installed rooftop solar capacity increased from 17.0 GW at the end of fiscal 2025 to 25.7 GW at the end of fiscal 2026 and further to 30.1 GW as of June 2026. The segment added a record 8.7 GW in fiscal 2026, compared with 5.1 GW in fiscal 2025, supported by increasing consumer awareness, technological improvements and subsidy initiatives implemented by the central and state governments.

As of June 2026, Gujarat accounted for approximately 25% of India's installed rooftop solar capacity, followed by Maharashtra at 20%, Rajasthan at 8%, Kerala at 7% and Tamil Nadu at 5%. Other states collectively accounted for the remaining 35%.

The residential rooftop segment, which had historically lagged the commercial and industrial segment, received a significant boost from PM Surya Ghar: Muft Bijli Yojana, launched in February 2024. The scheme aims to facilitate rooftop solar installations across 1 crore households by fiscal 2027 and provides central financial assistance for eligible residential rooftop systems.

State-level initiatives have also supported rooftop solar adoption. Historically, the Gujarat Surya Urja Rooftop Yojana provided subsidies of 40% for installations of up to 3 kW and 20% for installations between 3 kW and 10 kW. Gujarat also introduced provisions allowing consumers to lease their premises or rooftops to third parties for electricity generation. In addition, the state's MSME policy, introduced in September 2019, enabled solar installations exceeding 100% of sanctioned load or contract demand and allowed MSMEs to sell surplus power to the state at Rs 3.5 per unit.

Figure 26: Solar rooftop capacity additions of 70-80 GW expected over fiscal 2027-2031



Gujarat and Maharashtra led additions under the PM Surya Ghar Yojana, accounting for ~50% of subsidy received

PM Surya Ghar Yojana, which targets installation of 10 million residential rooftop solar systems, is expected to remain a key driver of rooftop solar growth over the decade. As of July 2026, more than 14 GW of residential rooftop solar capacity has been installed, covering over 47 lakh households. With the government targeting 75 lakh households by December 2026, capacity additions are expected to accelerate sharply in fiscal 2027.

C&I segment's increased demand driven by sustainability targets and MNRE's simplified guidelines for residential consumers will fuel capacity additions between fiscals 2027-31. In addition, the government's 'Give It Up' subsidy option, encouraging financially capable consumers to voluntarily forgo subsidies, could help improve subsidy availability

However, capacity additions have been projected conservatively given the uncertainty around future subsidy support, as subsidies play a key role in rooftop solar adoption. Further, once the government's household installation targets are achieved, the pace of residential rooftop additions may moderate unless subsidy support is extended or replaced by other demand-enabling measures. That said, continued awareness, improving affordability and rising adoption are expected to support sustained market momentum over the medium term.

Note: P is projected

Source: MNRE, Crisil Intelligence

From a pan-India perspective, roadblocks to the segment's growth include the higher cost of rooftop projects compared with utility-scale projects, limited availability of finance for rooftop projects, lack of uniform policies across states, weak infrastructure of power discoms and divergence between state policies and implementations.

Crisil Intelligence expects approximately 70-80 GW of rooftop solar capacity to be commissioned over fiscals 2027-31. Of this, 55-60 GW is expected from the residential segment, while 15-20 GW is expected from the commercial and industrial segment under net- and gross-metering arrangements. Capacity additions will be influenced by consumer awareness, access to affordable financing and grid availability. Overall, the rooftop solar segment is expected to attract investments of Rs 4.5-5.0 lakh crore over fiscals 2027-31.

Further, the Ministry of Power's approval to allow net metering up to 1 MW gives a much-needed fillip to the sector, leading to an increase in demand for rooftop installations. To promote quicker adoption of residential rooftop solar systems, MNRE has issued a simplified procedure for consumers. The following are the highlights of the move:

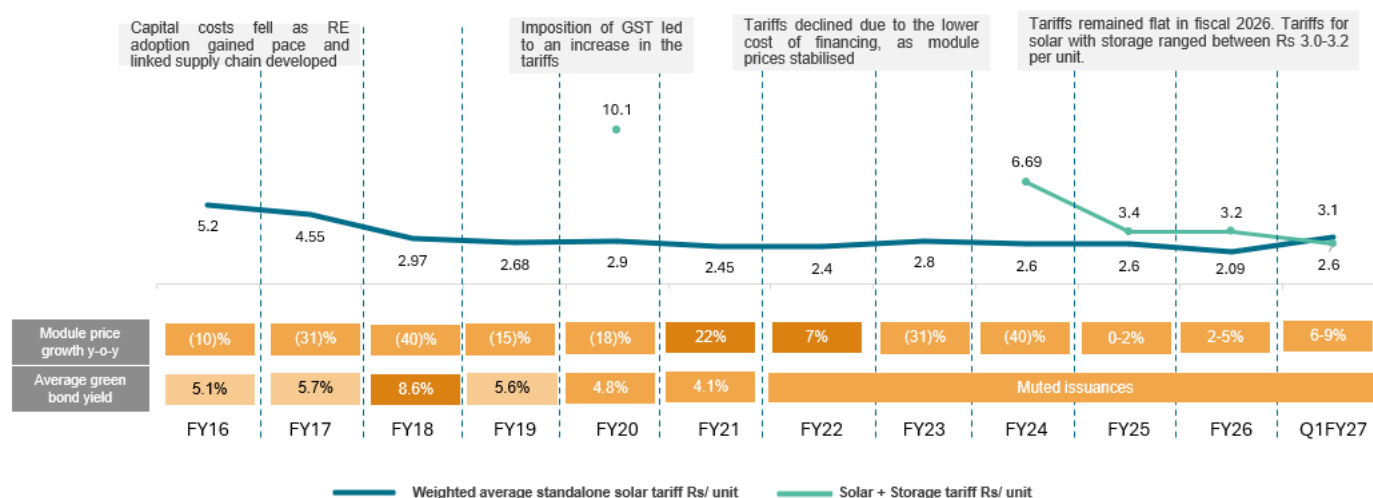
- A national portal for registering applications from beneficiaries has been developed
- Rooftop solar plants can be installed by consumers themselves or through any vendor of their choice
- The new process allows household beneficiaries to apply online for rooftop solar installation subsidies, which can be claimed once the application is approved through the national portal.

Solar power can act as an alternative for states with high load shedding as seen in the past such as Tamil Nadu, Uttar Pradesh and Punjab, which are also served by diesel generator sets, and for rural areas with poor grid connectivity.

Module pricing, financing cost impact solar tariffs

Solar tariffs saw a rapid decline after the implementation of the competitive bidding process, along with a rapid fall in component prices, technological improvements in efficiency and the government's policy push. However, there was a blip in fiscal 2023 when the tariffs rose 16% to Rs 2.8 per unit owing to supply-side disruptions. The global energy crisis, geopolitical tensions and supply-side disruptions at key locations in China led to a reversal in module price trend, with prices climbing to \$0.35 per watt-peak during the fiscal for mono-crystalline bifacial technology. However, after the normalisation of supply and a fall in prices of upstream components in fiscal 2024, the tariffs declined to Rs 2.61 per unit, a drop of ~7% and remained stable at Rs 2.63 per unit in fiscal 2025.

On the pricing front, solar tariffs showed a rapid decline, with a rapid fall in component pricing, technological improvements in efficiency, and the government's policy push. The Central Electricity Authority (CEA) in February 2025 released new guidelines, advising mandatory incorporation of storage with standalone solar. Energy Storage Systems (ESS) would need to have a minimum backup equivalent to two hours and be installed at 10% of the project's solar capacity. Auctions previously conducted under this format have seen tariffs range from Rs 3.2 to Rs 3.6 per unit. The solar-plus-storage projects saw a weighted average tariff of Rs 3.16 per unit in fiscal 2026. This declined from the fiscal 2025 level, when the weighted average tariff was Rs 3.4 per unit. The solar-plus-storage tariff declined further in Q1 fiscal 2027 to an all-time low of Rs 2.6 per unit.

Figure 27: Weighted average solar tariff trend


Note: Despite solar+storage mandate from fiscal 2026, a local standalone-solar tender of 100 MW was issued by Madhya Pradesh in fiscal 2026 and 500 MW project issued by Punjab State Power Corporation Limited (PSPCL) in Q1 fiscal 2027

Source: Crisil Intelligence

A key factor driving tariffs is capital cost for a solar project. Previously, component prices were mainly dependent on imports from China. The cost of solar modules accounts for 55-60% of a project's total capital cost, making it the key component of the project cost.

MNRE and the Ministry of Finance have approved a BCD of 40% on photovoltaic modules and 25% on photovoltaic cells.

In July 2018, the Directorate General of Trade Remedies (DGTR) imposed a safeguard duty of 25% on all imported cells and modules (including those imported from China and Malaysia). The duty raised capital costs by 10-15%, despite module prices falling from \$0.30 per Wp in March 2018 to \$0.25 per Wp by September 2018.

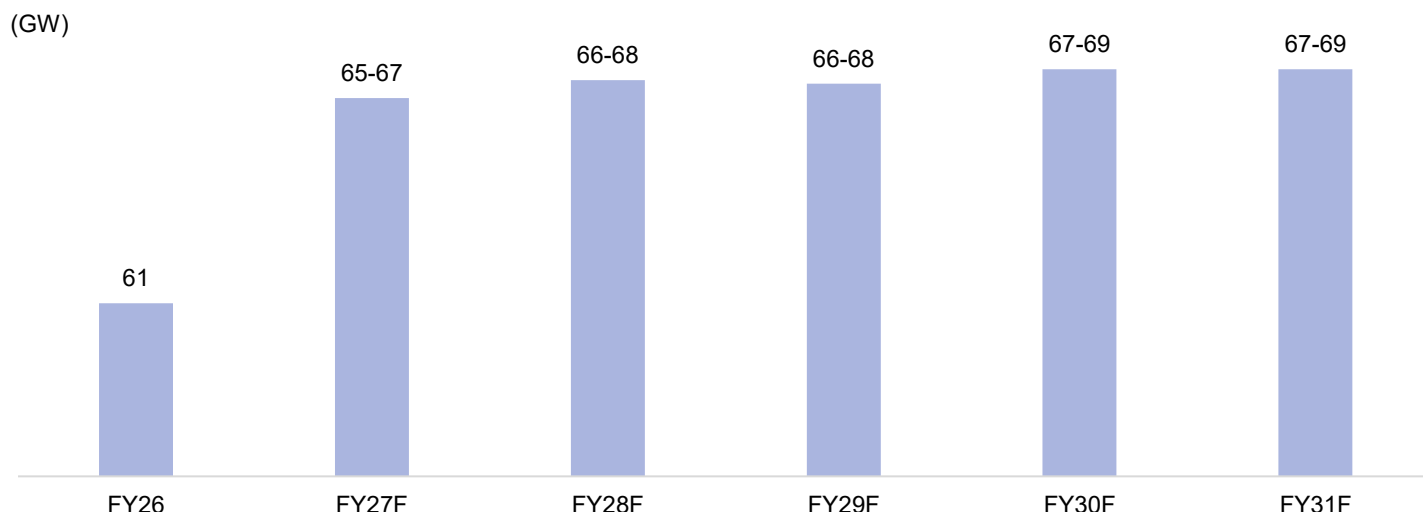
However, the duty rate declined in subsequent years. The declining duty trajectory provided relief, as after June 2019 procurement for all new bids could be made at a duty of 15%. DGTR further cut the safeguard duty to 14.9% from July 30, 2020, and then to 14.5% from January 30, 2021, for another six months. The decline in duty eased cost pressures and tariffs also started to fall. However, with the imposition of BCD from April 1, 2022, capital costs increased to Rs 5.5-6.0 crore/MW for imported mono-crystalline modules and corresponding tariffs rose accordingly, depending on module procurement.

The decline in polysilicon and solar-component prices amid persistent global overcapacity kept project costs relatively low during much of fiscal 2026. Consequently, capital costs for projects using domestic modules manufactured with imported cells are estimated to have remained at around Rs 3.5-4.0 crore per MW, after accounting for the 25% basic customs duty on imported cells. However, the benefit from lower upstream prices was partly offset towards the end of the fiscal by an increase in cell prices, higher silver and aluminium costs, and depreciation of the rupee.

As India continued to rely significantly on imported cells for module manufacturing, domestic module prices remained closely linked to movements in global cell prices and the rupee. Module prices remained subdued during most of fiscal 2026 because of excess global manufacturing capacity but increased towards the end of the fiscal following a rise in cell and commodity prices.

However, with the implementation of ALMM List-II from fiscal 2027, projects covered under the mandate will be required to use modules manufactured using cells included in the approved list, effectively increasing the use of domestic cell-based modules. Given the higher cost of domestically manufactured cells and modules relative to imported cell-based modules, the capital cost of such projects is estimated to rise to around Rs 5.0-5.5 crore per MW in fiscal 2027. Consequently, project costs will remain sensitive to the pace of domestic cell capacity commissioning, utilisation levels, technology availability, commodity prices and the supply-demand balance for ALMM-compliant cells.

Figure 28: Solar cell demand to log ~2% CAGR between fiscals 2026 and 2031, post sharp jump in fiscal 2027



Note: Demand for solar cells is calculated based on 40% overloading on the expected capacity additions

Source: Crisil Intelligence

ALMM List-II for solar PV cells became effective on June 1, 2026, mandating the use of domestically manufactured cells. However, eligible net-metering and open-access projects commissioned by December 31, 2026, were exempted from this requirement. Consequently, domestic demand for solar cells is expected to remain broadly stable at an average of 66-68 GW per year during fiscals 2027-2031.

Crisil Intelligence expects fiscal 2027 module prices of \$0.15-0.17/Wp for modules made using imported cells and \$0.24-0.26/Wp before GST for modules based on domestic cells. The latter corresponds to a project capital cost of Rs 5.0-5.5 crore per MW, including 40% DC-side overloading.

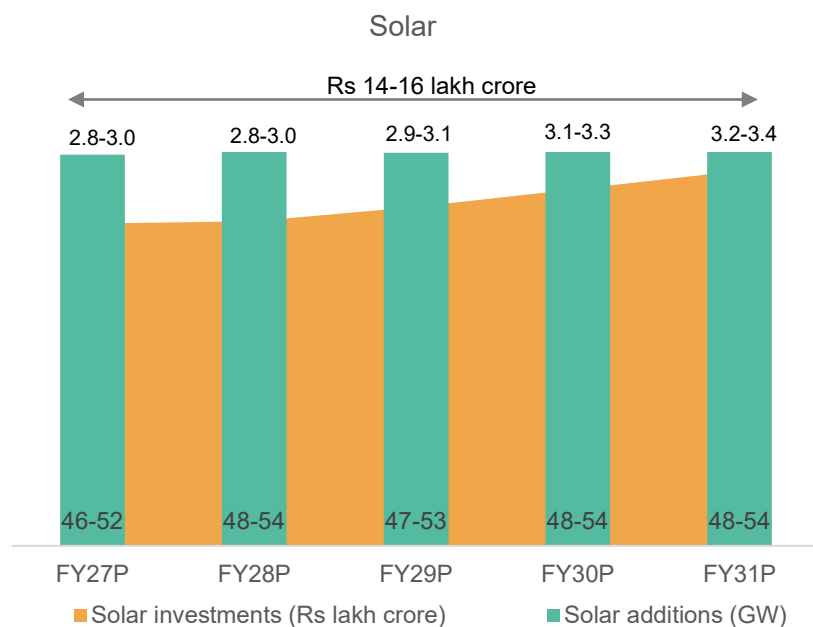
Solar glass is another key input used in module manufacturing. The central government imposed a 10% basic customs duty on solar glass imports with effect from October 1, 2024, following an anti-dumping investigation into imports from China and Vietnam. While the measure is expected to support domestic manufacturing and reduce import dependence, its impact on overall project costs is likely to remain limited, given the relatively small share of solar glass in total module and project costs.

Solar investments over fiscals 2027-2031 seen at Rs 14-16 lakh crore

Crisil Intelligence expects investments of Rs 14-16 lakh crore in solar energy over fiscals 2027-31. Developers are expected to prefer solar owing to its relatively low upfront investment requirements and operating costs. Solar investments will also be supported by expected capacity additions of 230-270 GW over the period.

The utility-scale segment is expected to record significant growth, supported by the existing project pipeline, upcoming tenders and an increased focus on integrating renewable energy into the grid through innovative tender structures and energy storage solutions. The difference between private-market power prices and discom tariffs is expected to support the open-access market, driving solar installations among commercial and industrial consumers. Moreover, the government's focus on expanding residential rooftop solar under PM Surya Ghar: Muft Bijli Yojana is expected to support further capacity additions.

Figure 29: Solar investments to be driven by built-up pipeline and policy support



Source: Crisil Intelligence

Module 5: Solar PV cells

The rapid growth of the sector, accompanied by intense competition in the supply chain, has increased the focus on enhancing product efficiency. As a result, technology has undergone significant advancements, transitioning from multi-crystalline to mono passive emitter rear contact (PERC) cell-based modules, and now to more advanced cell technologies, such as tunnel oxide passivated contact (TOPCon) and heterojunction (HJT). A consistent increase in solar-module wattage has also reduced the land required for the same electricity output.

Evolution of cell technology

The rapid growth of the sector, accompanied by intense competition in the supply chain, has increased the focus on enhancing product efficiency. As a result, technology has undergone significant advancements, transitioning from multi-crystalline to mono passive emitter rear contact (PERC) cell-based modules, and now to more advanced cell technologies, such as tunnel oxide passivated contact (TOPCon) and heterojunction (HJT). A consistent increase in solar-module wattage has also reduced the land required for the same electricity output.

From a technological standpoint, mono PERC cells dominated the market in 2019, followed by back surface field (BSF). While mono PERC remained the dominant technology globally as of 2023, TOPCon and HJT have started to gain traction. On average, TOPCon and HJT cells are expected to offer an incremental efficiency gain of at least 1% over mono PERC cells. This has enabled the possibility of higher electricity generation.

However, the capital cost intensity for establishing manufacturing facilities also increases with the initial capex for HJT estimated to be 2.5-3.0 times that of mono PERC and 1.5-2.0 times that of TOPCon. Nevertheless, large-scale manufacturing, combined with the ongoing research and development, is expected to bring about economies of scale benefits in the future for these higher-efficiency cell technologies.

Table 12: HJT and TOPCon cells: Higher efficiency, higher cost

	Mono PERC	TOPCon	HJT
Cell efficiency	Up to 22%	22.5-24%	23-25%
Module efficiency	Up to 22%	22-24%	22-24%
Losses and damages	P-type mono PERC cells are prone to LID and PID losses, which are the highest in the group	PID and LID losses in TOPCon are lower than in mono-PERC cells, but slightly higher than in HJT cells	Not prone to PID and LID losses since general cell construction is n-type
Complexity	Moderately complex	Less than HJT	Most complex

Note: PID is potential-induced degradation, and LID is light-induced degradation.

Source: Industry, Crisil Intelligence

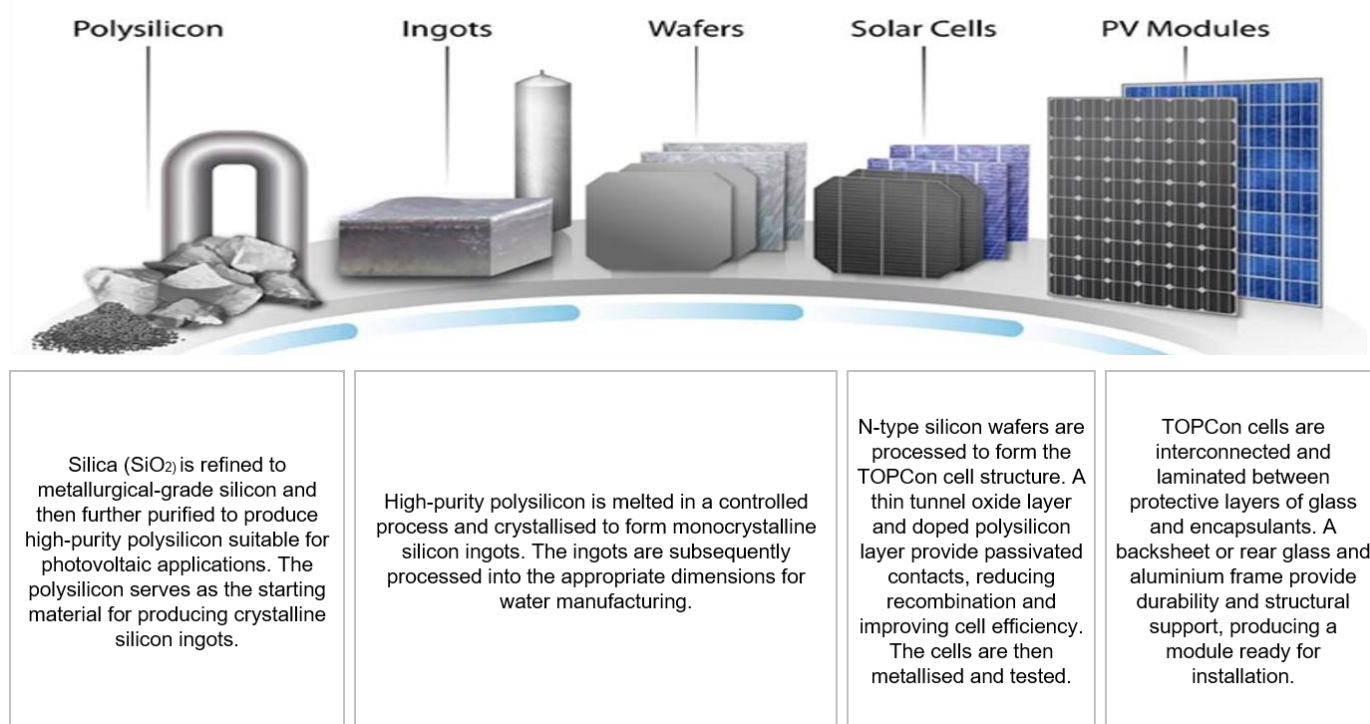
The solar PV industry is constantly at risk of technological disruption. According to the Fraunhofer Institute for Solar Energy Systems ISE, emerging technologies, such as Perovskite, III-V on Si (2-terminal), and III-V-Multi Junction Concentrator solar cells, had achieved efficiencies of ~34%, ~36% and ~48%, respectively, in laboratory settings in the first half of 2024.

Overview of solar PV module value chain

The solar PV module manufacturing value chain encompasses five critical processes for transforming raw materials into the final product, i.e., polysilicon into solar modules that are ready for electricity generation. It is a complex and globalised network, with each step contributing to the final product's cost, performance and sustainability.

The industry standard for testing solar modules includes a series of stringent procedures such as thermal cycling, humidity-freeze testing, damp-heat testing, hail testing and mechanical-load testing. These tests are designed to simulate extreme environmental conditions and mechanical stresses that the modules might encounter during their operational life.

Figure 30: PV manufacturing value chain



Note: Value chain and components used can differ based on the technology of solar cells; the above process is the most widely used cell technology (TOPCon) in the world as of 2026

Source: Crisil Intelligence

Brief descriptions of solar cell and module components

Solar cells

Solar cells are electrical devices that convert the energy of light directly into electricity by the photovoltaic effect, which is a physical and chemical phenomenon. It is a form of photoelectric cell, defined as a device whose electrical characteristics, such as current, voltage or resistance, vary when exposed to light. Individual solar cell devices are often the electrical building blocks of photovoltaic modules. The following key raw materials and components are used in the manufacture of solar cells:

Silicon wafers: Sliced from ingots made of ultra-pure silicon, these form the foundation of solar cells. The exceptional quality and purity of this silicon material is essential to ensure the optimal performance of solar cells.

Silver paste: This is a crucial component in solar cell manufacture. It is used to create the conductive contacts on the front side of the cells. Applied through a screen-printing process, this paste plays a vital role in facilitating the collection and transfer of electrical current generated by silicon wafers, enabling the efficient flow of energy.

Aluminium paste: A layer of aluminium paste is applied to the rear of the solar cell. When heated in a furnace, it creates a reflective surface that bounces electrons back into the silicon, allowing them to be harnessed as electrical current, thereby boosting the cell's overall efficiency.

Other gases and chemicals: The manufacturing process of solar cells relies on a range of gases and chemicals, each playing a critical role at various stages. For example, specialised dopants, such as phosphorus oxychloride, are used to create n-type semiconductors, while boron is employed for p-type doping. Additionally, a variety of chemicals, including hydrofluoric acid, are utilised in wafer preparation to strip away the silicon dioxide layer and other solvents for thorough cleaning, ensuring the wafers are pristine and ready for further processing.

Solar modules

A solar module is an assembly of solar or photovoltaic cells mounted in a framework for installation. Solar panels use sunlight as an energy source to generate direct-current electricity. In India, solar modules are currently assembled using monocrystalline and TOPCon cells. The primary raw materials and components used in the manufacture of solar modules are solar cells. The following key raw materials and components are used in the process:

Backsheet: This is a critical component of a solar module, serving multiple purposes to ensure optimal performance and longevity. It provides mechanical strength, electrical isolation and moisture resistance, while also acting as a reflective layer to redirect photons back towards the solar cell, enhancing energy generation. Additionally, the backsheet forms a protective barrier against external factors such as ultraviolet rays, temperature fluctuations and humidity changes, which could otherwise compromise the module's performance. Its inner surface also ensures a secure bond with the encapsulant, holding the entire cell assembly in place for extended periods, while its outer surface provides a safe and shock-resistant interface for installers.

Encapsulants: These play a vital role in a solar module's performance, serving three primary functions: transmitting light, holding the cell assembly together and adhering to the glass and backsheet. Their high light transmittance ensures that the cell assembly receives adequate supply of photons to generate maximum power output. Encapsulants also act as a mechanical bonding agent, keeping the solar cells separated, preventing short circuits through its gel content, which provides intermolecular strength. Additionally, they help minimise shrinkage, which is critical to prevent misalignments and short circuits. Further, encapsulants must form a strong and durable bond with the glass on the front side and backsheet on the back side of the module, while withstanding elevated temperatures and high UV exposure over extended periods.

Glass and other auxiliary products: The glass component in solar modules is crucial for optimising energy output by minimising reflection and maximising light transmission. As the first point of contact for incoming light, the glass surface must be optimised to reduce reflection, which can result in significant power losses. To address this, an anti-reflective coating is applied to the front surface, reducing reflection to as low as 1% in many cases. Additionally, the glass is tempered to provide mechanical strength and rigidity, protecting the solar module from weather conditions, shocks and other environmental factors. It is essential to use specialised solar glass with specific components to ensure long-term stability and performance. Beyond solar cells and the mentioned components, other critical inputs required for solar module manufacturing include aluminium frames, ribbon and junction box, all of which work together to create a high-performing and durable solar module.

Cell manufacturing is more complex than module manufacturing

The fabrication of solar cells relies on several high-purity semiconductor-grade gases and chemicals, which are critical inputs at each stage of the manufacturing process. To ensure safe, efficient and high-yielding solar cell production, the effective management of utilities is paramount.

Table 13: Complexities in solar cells and modules

Complexity	Solar cell	Solar module
Raw materials processing	The manufacture of solar cells requires the use of ultra-high-purity silicon, which in turn demands complex and precise refining and processing procedures to achieve the necessary level of quality.	The manufacturing of solar modules is facilitated by the use of pretreated silicon cells, which simplifies the manufacturing process by reducing the complexity of subsequent processing steps.
Technological requirements	The manufacture of solar cells involves the deployment of advanced technologies designed to optimise cell efficiency and perfect complex production methodologies.	The production of solar modules is primarily driven by advancements in assembly technologies, with relatively less attention devoted to innovative breakthroughs at the individual cell level.
Skilled labour	The fabrication of solar cells requires a highly skilled workforce with expertise in chemical processing and semiconductor manufacturing methodologies, ensuring precision and quality in the production process.	The assembly of solar modules demands a skilled workforce, although with a broader range of skills compared to cell fabrication, as it involves a combination of assembly and quality control expertise.
Production scale	Scaling up solar cell production is inherently challenging because the manufacturing process requires precise and delicate handling, which can constrain capacity expansion and throughput improvements.	In contrast, solar-module manufacturing can be scaled up to larger production volumes, owing to the implementation of efficient assembly processes and relatively simpler design, which reduces complexity and enables high-volume production.
Technological advancement	The rapid pace of technological innovation in the solar industry poses a significant threat to solar-cell manufacturers, as it can quickly make current production methods outdated, necessitating continuous adaptation to stay competitive.	In contrast, the solar module manufacturing industry undergoes a more gradual pace of technological progress, with innovations typically leading to incremental enhancements rather than revolutionary changes that would suddenly make existing production processes obsolete.
Supply chain management	The production of solar cells involves an intricate supply chain management process, necessitated by the wide range of raw materials and specialised chemicals required for fabrication, which can pose logistical challenges and increase operational complexity.	In contrast, the supply chain for solar module manufacturing is relatively straightforward, primarily focusing on the sourcing of solar cells and auxiliary components, with fewer complexities and dependencies compared to solar cell production.

Source: Industry, Crisil Intelligence

Going forward, as solar cells are included under ALMM and domestic cell-manufacturing capacity increases, the domestic ecosystem required for development such as skilled manpower and availability of technology are also expected to improve.

Global solar cell and module demand rising

Global solar-cell and module demand reached an estimated 600-650 GW in 2025, according to the IEA. In 2025, lower prices and technological advancements were major drivers of additions.

PV module demand driven by policy and renewable push

China

PV module demand in China has been driven by installations, propelled by government targets announced in 2020, under which Beijing plans to achieve peak emissions by 2030 and carbon neutrality by 2060.

US

Renewable capacity additions in the United States remained strong in 2025, primarily driven by rapid increases in solar PV. The IEA expects this momentum to continue in 2026 as well, driven by utility-scale solar capacity. Growth will be supported by rising power demand from data centres, electrification and cooling, although policy, permitting and grid-integration challenges could constrain future development.

Germany

Demand for solar modules in Germany has been driven by the Renewable Energy Sources Act and solar auction programme. The March 2026 ground-mounted solar auction was more than twice oversubscribed, receiving 4.62 GW of bids against 2.30 GW tendered, while the average award price declined to 4.94 euro cents per kWh. The rooftop solar auction ceiling was also reduced to 10.00 euro cents per kWh for 2026, reflecting falling costs and strong competition.

India

India's solar module demand has been driven by solar energy additions of 121.2 GW between fiscal 2019-2026. After a subdued trend in 2020, additions picked up pace, driven by the government's Panchamrit pledge at COP26 in 2021, under which the country aims to install 500 GW of non-fossil fuel capacity by fiscal 2030. Furthermore, according to the CEA's National Generation Adequacy Plan released in March 2026, India's non-fossil power capacity is projected to reach around 786 GW by 2035-36, led by a near-tripling of solar capacity from approximately 176 GW in 2026-27 to 509 GW by 2035-36.

Overall

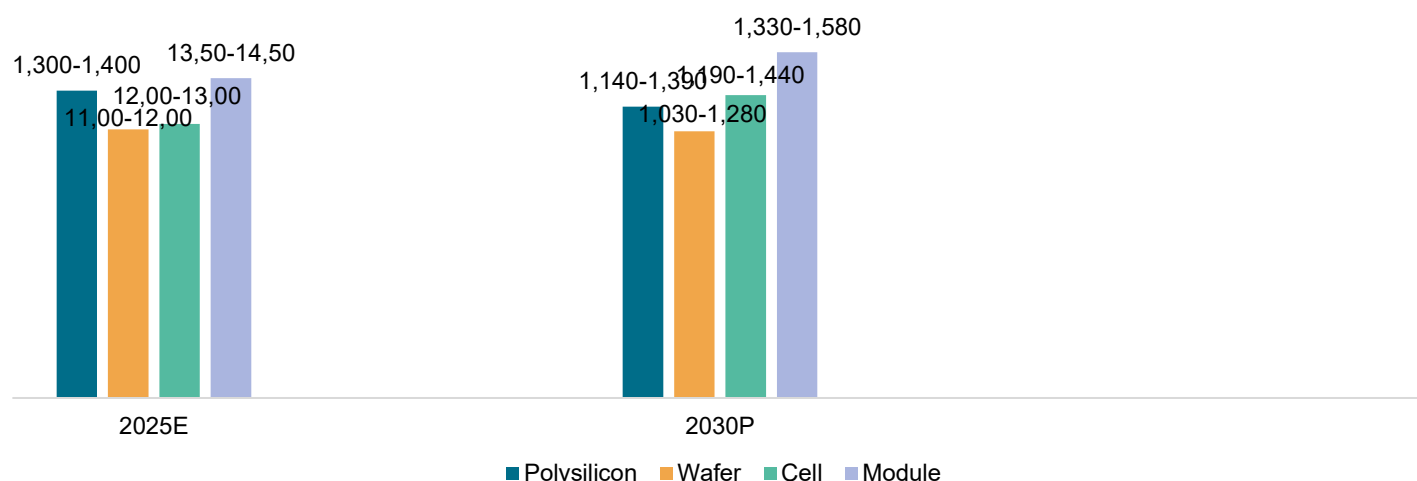
These countries have driven solar module demand through a cumulative installed solar capacity target exceeding 5,000 GW by 2030. However, their ability to meet this demand through domestic PV manufacturing remains constrained. China is the only country with a well-established, integrated manufacturing base capable of catering to both domestic and international demand, leading to widespread global dependence on Chinese imports.

Global solar module manufacturing outpaces demand

According to the IEA, global solar module manufacturing capacity is estimated to have risen to 1,350-1,450 GW in 2025 more than double the annual deployment of PV systems. This growth has outpaced demand, with solar module demand in 2024 at only 42% of the total available module manufacturing capacity. In tandem, the production of upstream components also saw significant expansion by 2025.

According to the IEA, net additions to global solar manufacturing capacity during 2025-2030 are projected to reach 230 GW for modules, 190 GW for cells and 80 GW for wafers. In contrast, global polysilicon capacity is expected to decline by 60 GW over the same period, primarily due to capacity rationalisation in China under the country's anti-involution policy, which aims to address industry overcapacity and improve market discipline.

Figure 31: Average PV manufacturing capacity across the value chain to reach about 1,300 GW by 2030



E – estimated; P – projected

Note: 2025E and 2030 capacity numbers are approximate numbers.

Source: IEA, Crisil Intelligence

From 2017 onwards, the limited availability of PV-grade polysilicon manufacturing capacity emerged as a significant constraint in the PV supply chain. This bottleneck became apparent in 2021, when a combination of underinvestment and a fire at a major manufacturing facility led to a global polysilicon shortage, causing prices to triple. However, by 2024, China had significantly expanded its polysilicon production capacity, increasing it 5 times vs 2021 levels. This substantial overcapacity has contributed to persistently low module prices, which are expected to trigger a slowdown in supply chain expansion from 2025 to 2030, particularly in China, as per the IEA.

By 2030, module manufacturing capacity is expected to reach ~1,330-1580 GW.

Policy support key for solar cells and module manufacturing

Supply chain diversification has played a major role for Indian cell and module manufacturers.

Table 14: Government policies and Acts having a bearing on PV manufacturing

Country/Association	Policy/Act/Agreement	Impact
US	Inflation Reduction Act, subsequently amended by the One Big Beautiful Bill Act	Renewable projects in the United States may qualify for a 6% Clean Electricity Investment Tax Credit, increasing to 30% for projects that satisfy prevailing-wage and apprenticeship requirements. Additional incentives are available for projects meeting domestic-content requirements or located in designated energy communities. However, the One Big Beautiful Bill Act, signed in July 2025, accelerated the withdrawal of federal support for solar and wind. Projects beginning construction after July 4, 2026 must be placed in service by the end of 2027 to qualify for investment or production tax credits, while stricter restrictions on inputs and entities linked to specified foreign countries may further limit eligibility. These changes have increased policy, supply-chain and financing uncertainty for renewable energy projects.

US	Uyghur Forced Labour Prevention Act 2022	Restrictions on solar products linked to Xinjiang initially created export opportunities for Indian module manufacturers, with the US accounting for nearly 97% of India's module exports during FY2023-FY2025. However, the opportunity has weakened following higher US tariffs and trade-remedy investigations. India's solar panel exports to the US declined by around 18% in 2025, while the proposed countervailing duties on Indian cells and modules have increased uncertainty over future shipments.
US	Antidumping duty on Southeast Asian imports	In 2025, the US imposed Antidumping and countervailing duties (AD/CVD) orders on solar cells and modules from Cambodia, Malaysia, Thailand and Vietnam, with dumping margins varying significantly by exporter and reaching up to 271.28%. These duties substantially reduced the commercial viability of imports from several Southeast Asian suppliers. The shift in sourcing towards India, Indonesia and Laos triggered new US investigations in August 2025. In 2026, the US Department of Commerce announced preliminary combined AD/CVD exposure of approximately 234% for India, 121-178% for Indonesia and 103% for Laos, significantly reducing their competitiveness and increasing supply-chain uncertainty for US solar developers
India	Approved List of Models and Manufacturers I	ALMM I mandate requires the usage of modules as enlisted in the ALMM I List issued by the government. As of August 3, 2026, the module-manufacturing capacity enlisted under ALMM List-I stood at nearly 215.7 GW.
India	Approved List of Models and Manufacturers II	ALMM List-II mandates the procurement of solar cells from the approved list with effect from June 2026, providing a significant impetus to backward integration. However, Open Access (OA) projects and C&I rooftop installations have been granted an exemption until December 2026, as per the MNRE notification. As of July 22, 2026, the solar cell manufacturing capacity enlisted under ALMM List-II stood at nearly 32 GW.
India	Goods and services tax (GST)	The GST Council in India has reduced the GST rate for solar cells and modules from 12% to 5%, effective September 22, 2025. This tax cut aims to increase the affordability and adoption of solar cells among consumers. The reduced GST rate also applies to other renewable energy devices, including solar power-based devices. This move is expected to benefit the solar industry by reducing capital costs, leading to lower power purchase costs for distribution companies and promoting the growth of ongoing and upcoming projects.
India	Rajasthan Investment Scheme 2024 - Rajasthan Promotion	Rajasthan Investment Promotion Scheme 2024 has replaced the earlier 2019 scheme and offers eligible manufacturing units flexible investment incentives, exemptions from key state levies and additional benefits for priority sectors, employment generation and large investments. Renewable energy remains a focus sector, while projects involving investment above Rs 500 crore may qualify for customised incentive packages. Key benefits include exemptions on electricity duty, transmission and wheeling charges, reimbursement of stamp duty, state taxes, and market fees, with additional support for captive power projects, solar cell manufacturing, and green hydrogen production.
India	Gujarat Industrial Policy 2026 - Viksit Gujarat	The Gujarat Industrial Policy 2026 replaced the 2020 policy effective from June 1, 2026. It provides incentives ranging from 15% to 45%, depending on project size, sector and location, and introduces a "Choose Your Incentive" framework allowing eligible investors to select an appropriate mix of capital, interest and power-related support. The policy particularly promotes advanced, green and high-value manufacturing.

India	Tamil Nadu – Tamil Nadu Solar Policy 2019 and TN Industrial Policy 2021	Tamil Nadu continues to support solar component manufacturing through the provision of industrial infrastructure, land facilitation and structured incentive packages. Although the Industrial Policy 2021 was formally in force until March 2025, its guiding framework, along with subsequent sector-specific policies, continued to underpin investment support during FY2025-26. The state is also in the process of formulating a new comprehensive industrial policy to further strengthen and consolidate its expanding manufacturing incentive ecosystem.
India	West Bengal – West Bengal New and Renewable Energy Manufacturing Promotion Policy 2023	Effective for five years from November 2023, the policy supports new as well as expanding renewable energy manufacturing units through exemptions from land conversion charges, stamp duty and electricity duty, in addition to relief on water cess. The policy aims to address supply-side gaps and strengthen the domestic manufacturing ecosystem for renewable energy equipment and associated ancillary components.

Source: Gujarat, Rajasthan, Tamil Nadu and West Bengal governments, MNRE, US *government*, Crisil Intelligence

Global competitive landscape

Over the past decade, China has emerged as the top solar PV manufacturer owing to favourable government policies, continuous innovation and accelerated investments in the segment, surpassing Europe, Japan and the US. The combined PV module shipments reported by LONGi Solar, Trina Solar, Jinko Solar, JA Solar and Canadian Solar in their latest disclosures crossed 100 GW.

Table 15: Comparative summary of global manufacturers

Parameter	LONGi Solar	Trina Solar	Jinko Solar	JA Solar	Canadian Solar
Experience in PV manufacturing	26 years	29 years	20 years	21 years	25 years
Operational capacity	Module: 120 GW Cell: 80 GW Wafer: 170 GW	Module: 95 GW Cell: 75 GW Wafer: 55 GW	Module: 120 GW Cell: 95 GW Wafer: 130 GW	Module: 100 GW Cell: >70 GW Wafer: >80 GW	Module: 59 GW Cell: 36 GW Wafer: 37 GW Ingot: 31 GW
Product shipments	Module & Cell: 12.6 GW Wafer: 20.5 GW	NA	Module: 29.6 GW	Module & Cell: 69.6 GW	Module: 5.6 GW
Key products and services	Solar PV modules, wafers, solutions for C&I utility, and rooftop	Solar PV modules, solar trackers, utility solutions, and engineering, procurement, construction, and management services	Solar PV modules, energy storage systems, and C&I and rooftop solutions	Solar PV modules, and energy storage systems for domestic and C&I use	Solar PV modules, energy storage systems, inverters, and EPC services
Key technologies offered	TOPCon, Mono PERC	PERC, TOPCon, HJT	Tiling ribbon technologies, PERC and TOPCon	TOPCon, Mono PERC	TOPCon, HJT modules, dual cell PERC

Note: Jinko Solar's shipment figures are as of H1 2026 (January to June 2026), while its operational capacity reflects the position as of December 2024. For Canadian Solar, shipment figures are as of H1 2026 (January to June 2026), whereas operational capacity is as of June 2025. LONGi Solar's shipment figures are as of Q1 2026 (January to March 2026), while its operational capacity is as of

December 2023. JA Solar's shipment figures are as of December 2025, and its operational capacity is as of March 2025. Trina Solar's operational capacity is as of December 2023.

Source: Company websites, Crisil Intelligence

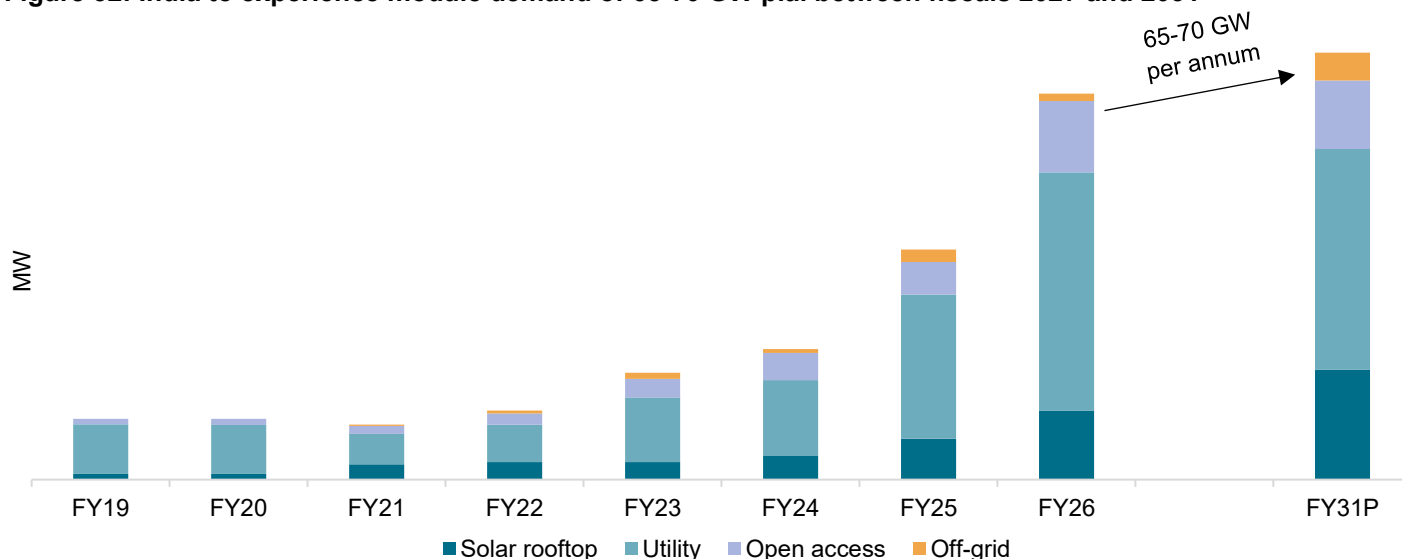
Domestic solar PV manufacturing in expansion phase

The domestic PV segment has been driven by domestic demand for solar modules from various segments, such as rooftop, utility scale and open access. From the beginning of fiscal 2019 to the end of fiscal 2026, India has seen estimated cumulative solar module demand of 183 GW.

Domestic demand for solar modules to grow robustly as power goes green

Over fiscals 2019-2026, domestic demand for solar modules was driven by the competitively bid utility segment, with a 64% share, followed by the rooftop (17%) and open access (16%) segments and the remainder by off-grid projects. Average demand per annum is expected to at 65-70 GW CAGR between fiscals 2027 and 2031.

Figure 32: India to experience module demand of 65-70 GW p.a. between fiscals 2027 and 2031



Note: Demand includes DC overloading

Source: Crisil Intelligence

Demand drivers include declining module prices, supportive government policies and increasing awareness of the benefits of distributed solar energy.

The competitively bid segment witnessed significant growth, with cumulative solar module demand reaching 183 GW by the end of fiscal 2026, more than double the level recorded in fiscal 2019. Demand estimates have been calculated after accounting for overloading in capacity additions and were supported by initiatives under the National Solar Mission, solar parks, renewable purchase obligations (RPOs) and the Panchamrit commitments announced at COP26.

Central tender allocations, led by SECI, accounted majority of the additions while state allocations contributed the remainder. States with high irradiance, such as Rajasthan and Gujarat, witnessed the most significant additions.

The rooftop solar segment also experienced material growth, with installed capacity increasing nearly fourteenfold by the end of fiscal 2026 over fiscal 2019, driven by subsidies under the national rooftop mission, PM Suryaghar Yojana, and state-specific initiatives such as Gujarat's Surya Urja Yojana. Favourable policies, including net metering in some states, further incentivised adoption. The top three states, Gujarat, Maharashtra and Rajasthan, accounted for 53% of the installed base by June 2026. The rooftop segment is poised to add 70-80 GW of capacity during fiscals 2027-2031.

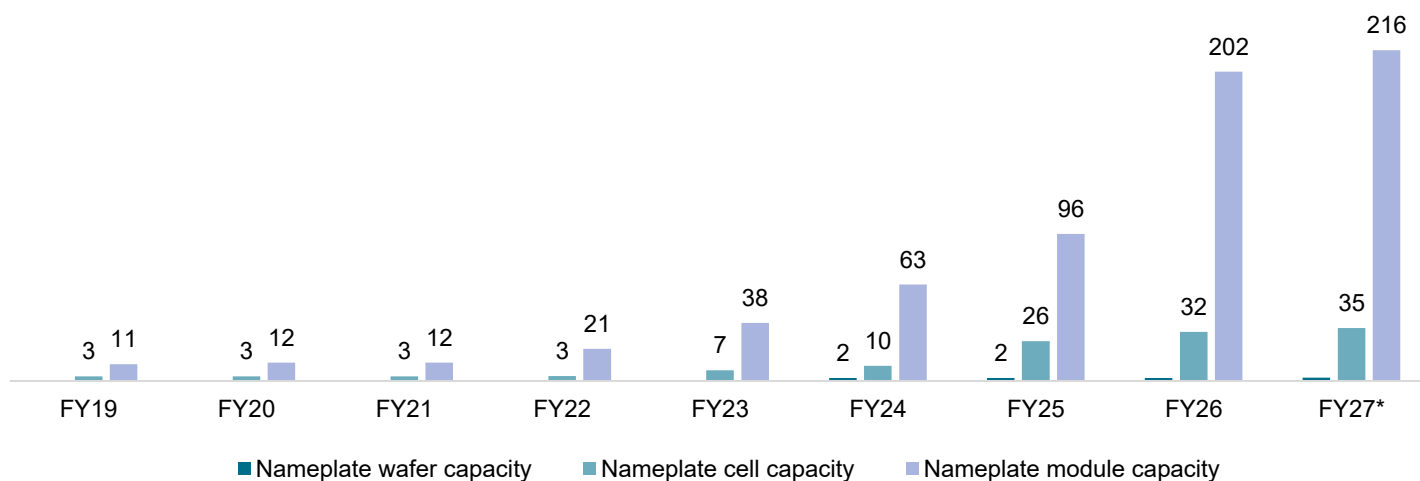
Open access solar, which allows consumers to purchase solar energy directly from producers, strengthened the demand for solar modules. This segment attracted large commercial and industrial consumers seeking cost savings and sustainability benefits. The Green Energy Open Access Rules of 2022 stimulated growth by reducing the minimum load requirement, making open access projects more attractive and financially viable. The open access solar segment is expected to witness 35-45 GW of capacity additions during fiscals 2027-2031.

Domestic manufacturing capabilities have grown rapidly in the past 5 years

India's solar PV module and cell manufacturing capacity expanded from 21 GW and 3.2 GW in March 2022 to an estimated 216 GW and 35 GW, respectively, by June 2026. This growth was driven by a strategic combination of government policies, market dynamics and a growing commitment to renewable energy.

Despite robust demand for solar modules, India's manufacturers have remained focused on the downstream component stage due to the capital-intensive nature of upstream components such as wafers and polysilicon. The availability of cheaper alternatives from China has also contributed to this concentration.

Figure 33: Expansion of capacity in cell to module stage



Note: The above data points are estimates. FY27 data is as of June 2026.*

Source: Company reports, Crisil Intelligence

Between fiscal 2022 and June 2026, India's module and cell manufacturing capacity expanded significantly, by ~194 GW and ~32 GW, respectively. This expansion was driven by the government's efforts to reduce dependence on imported solar components, particularly from China.

However, cell-manufacturing capacity has expanded at a slower pace than module-manufacturing capacity.

To support local manufacturing, the Indian government introduced a range of protective measures, including a safeguard duty on imported solar cells and modules from July 2018 to 2021. In fiscal 2023, a BCD of 40% on modules and 25% on cells was introduced to enhance the competitiveness of India-made products. The government simplified the duty structure in the Union Budget 2025-26 with a change in duty calculations on inclusion of Agriculture Infrastructure and Development Cess (AIDC). Duties on solar modules were split into BCD and AIDC at 20%, while that in cell was restructured to 20% and 7.5% of BCD and AIDC, respectively. Additionally, a domestic content requirement was imposed on certain schemes, such as the CPSU scheme phase-II, PM Surya Ghar Yojna and PM KUSUM.

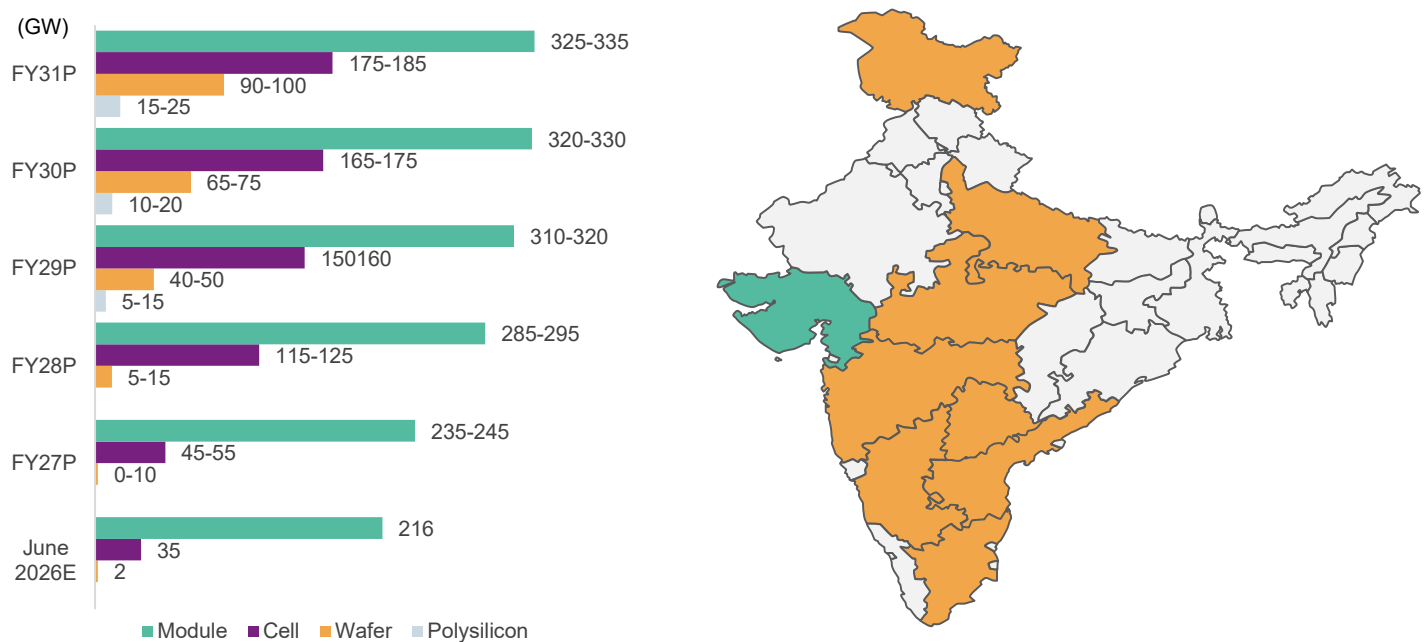
The government also implemented measures such as the ALMM to ensure quality control and encourage capacity additions in the downstream stages. Furthermore, the PLI scheme for high-efficiency solar modules, launched in 2021, provided financial incentives to manufacturers based on their incremental production. This scheme played a crucial role in encouraging manufacturers to expand capacity, invest in new technologies and pursue backward integration.

Domestic PV manufacturing to continue expanding

By the end of fiscal 2031, India's domestic module and cell manufacturing industries are projected to experience significant growth, with nameplate capacity (rated capacity or maximum manufacturing capability) expected to increase by ~1.5 times and ~5 times, respectively, from June 2026. Overall, the module manufacturing space has witnessed announcements of over 100 GW owing to rising demand. In India, cell manufacturing capacity is estimated to be 35 GW as of June 2026, which is expected to grow to 45-55 GW by fiscal 2027. In an effort to boost domestic manufacturing and enhance the competitiveness of Indian-made products, ALMM List-II took effect on June 1, 2026, under an MNRE notification. It mandates the use of enlisted domestically manufactured solar cells for covered modules and projects and is expected to boost the usage of domestically produced cells for module manufacturing. On the other hand, the country is expected to see the establishment of large-scale wafer and polysilicon facilities, with capacity reaching 90-100 GW and 15-25 GW, respectively, by fiscal 2031. Increase in manufacturing capacity provides an opportunity for India to expand its production and establish its position in export markets. Hence, expansion in supply chain will cater to both domestic demand as well as exports.

The substantial expansion in capacity, particularly in the upstream components, is expected to be driven by a combination of trade, non-trade interventions and the PLI scheme, which aims to encourage investment and growth in the domestic solar manufacturing industry.

Figure 34: Upstream supply chain announcements to be driven by PLI and ALMM requirements, Gujarat a favourite for PV



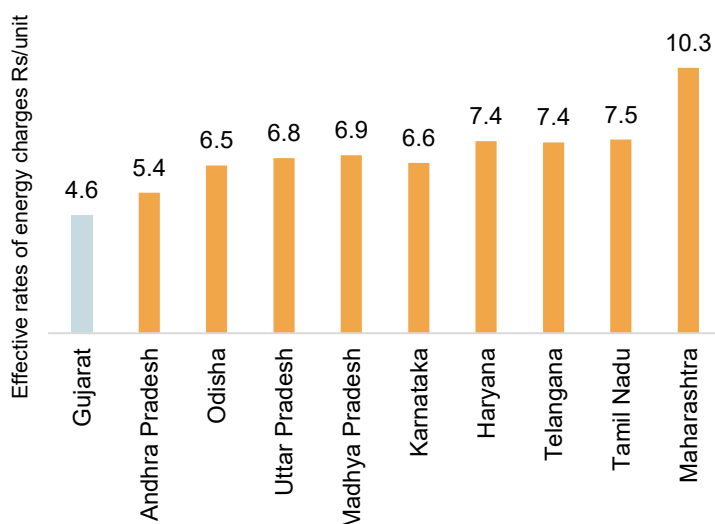
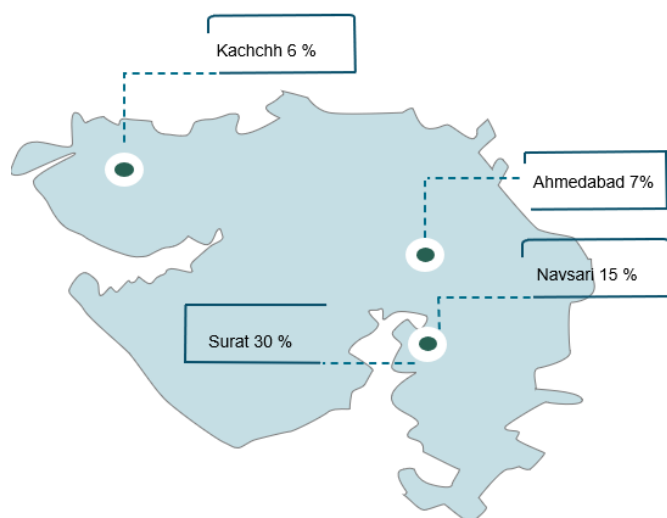
Note: The above capacity is based on market announcements available in the public domain.

Source: Company reports, Crisil Intelligence

Integrating solar PV manufacturing plants that produce wafers, cells and modules under one roof has certain advantages such as improved efficiency and cost reduction. With reduced transportation costs and economies of scale, these plants can optimise their production flow and have better quality control. Integrated solar PV manufacturing plants also provide greater flexibility and supply chain security. Manufacturers can respond to changes in demand efficiently, reduce the dependence on external suppliers by getting access to advanced technologies, and gain competitive advantage in terms of quality and price.

Gujarat is expected to be the epicentre of PV manufacturing capacity additions because it has one of the lowest effective power rates for the industrial sector in India.

Figure 35: High concentration in Gujarat, with nearly 59% of capacity in the state located in four districts



Note: The effective rate of energy charges is of fiscal 2026

Source: ALMM, MNRE, REC, Crisil Intelligence

Until fiscal 2026, India's solar industry was in its early stages, heavily reliant on imports for upstream components such as cells and wafers. Hence, the availability of ports and trade routes also makes Gujarat an attractive location for manufacturing. Based on the pipeline, the state is expected to continue dominating capacity additions in the future.

Over the next five years, the industry's technology setup is expected to undergo an upgrade. While mono PERC remained the predominant technology in India's installed solar-cell manufacturing capacity as of fiscal 2026, the industry has begun transitioning rapidly towards higher-efficiency TOPCon technology, while a few manufacturers have chosen to expand into HJT technology.

The growth in nameplate module manufacturing capacity for cells and modules is expected to help India reduce its reliance on imports by fiscal 2031.

Import reliance to fall, while new market penetration critical for exports

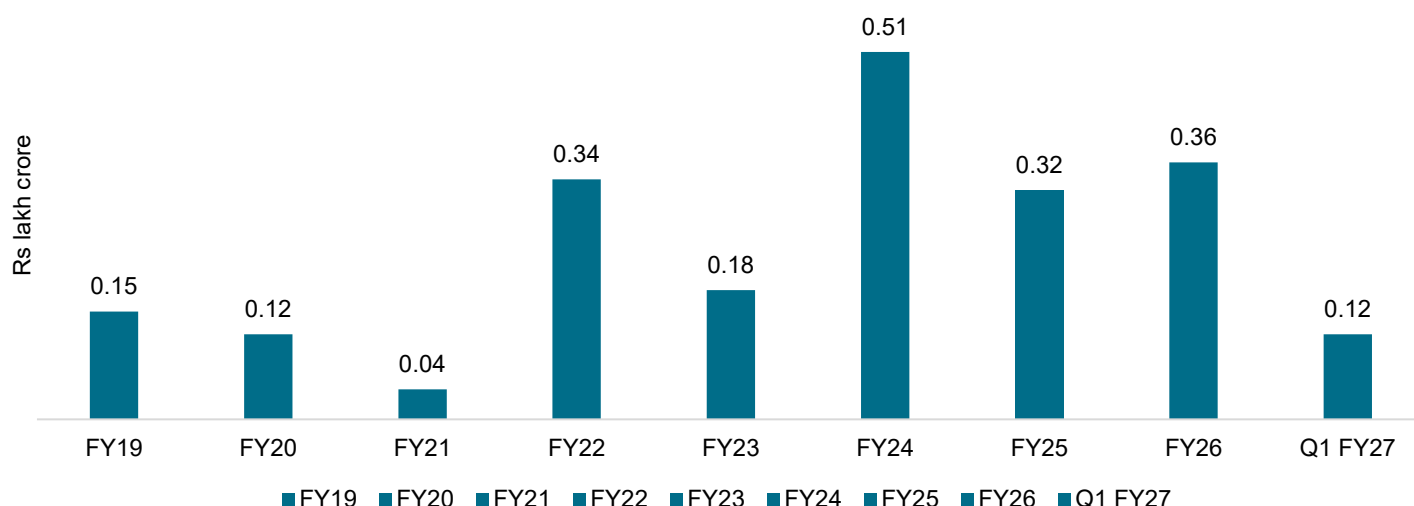
Share of Chinese imports falls

Between fiscals 2019 and 2026, Indian companies made significant investments in solar cell and module manufacturing capacities. However, domestic manufacturers remained dependent on export markets, as Indian solar developers largely preferred lower-cost imported modules. Domestic manufacturers primarily catered to segments with domestic content requirements, which represented a relatively small share of the overall renewable energy sector. As a result, more than 55% of the solar modules installed in India during this period were imported, owing to inadequate domestic capacity, competitive pricing of imports and technology preferences.

As of June 2026, India had ~35 GW installed capacity of solar cells and ~216 GW of modules. Even though India is one of the top 10 solar module producers, it is far behind its biggest competitor, China. In fiscal 2022, imports increased by a staggering 696% on-year to Rs 0.34 lakh crore (from Rs 0.04 lakh crore in fiscal 2021). This sudden and sharp surge in

imports was due to an easing of restrictions, coupled with the expiry of time extensions provided to projects under the Covid-19 relief. After falling 46% on-year in fiscal 2023, imports jumped 184% on-year in fiscal 2024 owing to ALMM abeyance to meet rising solar power demand in the country. Imports fell in fiscal 2025 to Rs 0.32 lakh crore owing to the reimposition of ALMM from April 2024, with case-to-case exemptions on projects at an advanced stage of construction. Imports further rose by 12% on-year in fiscal 2026, primarily due to a shift in the import mix towards upstream components such as solar cells. Imports during April-June 2026 stood at Rs 0.12 lakh crore, as manufacturers front-loaded purchases ahead of the implementation of ALMM II.

Figure 36: Imports rose in fiscal 2026 and Q1 fiscal 2027 ahead of ALMM II implementation

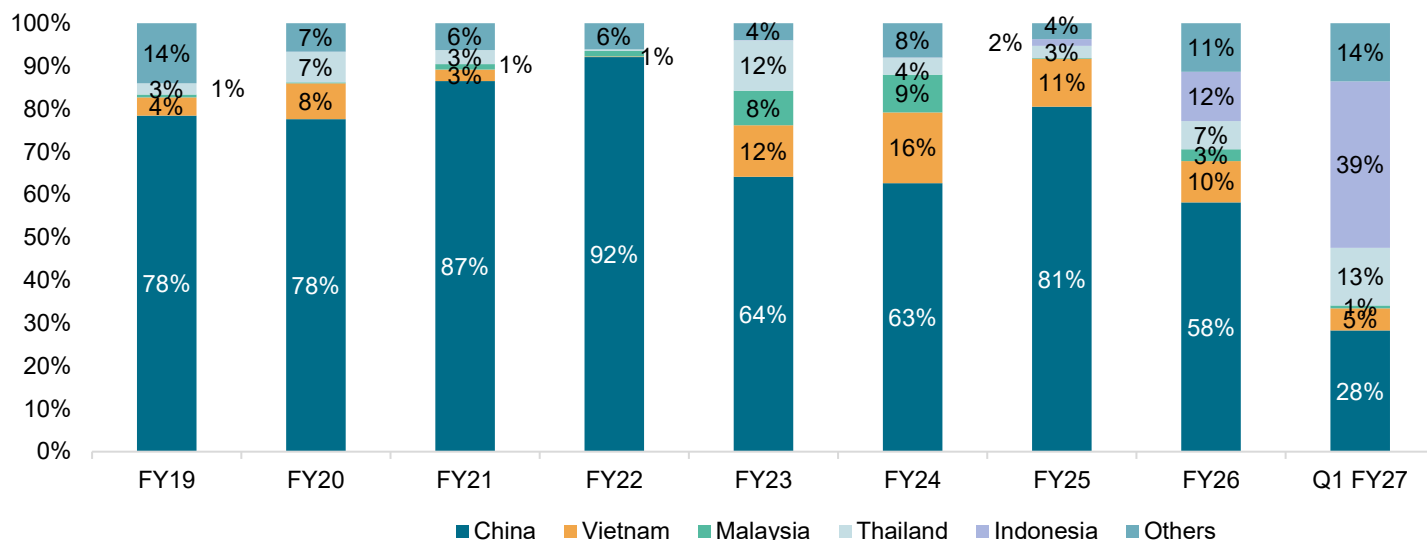


Note: HS Code 85414011 and 12 used till fiscal 2022 and 85414200 and 300 used from fiscal 2023.

Source: Ministry of Trade and Commerce, Crisil Intelligence

The share of China in India's import basket has varied between fiscal 2019 and Q1 fiscal 2027, averaging 70%. Furthermore, with increase in manufacturing capacity in the ASEAN nations, the share of Vietnam, Malaysia and Thailand has averaged 16% during the same period.

Figure 37: Share of China volatile in India's import basket but still dominant



Note: HS Code 85414011 and 12 used till fiscal 2022 and 85414200 and 300 used from fiscal 2023.

Source: Ministry of Trade and Commerce, Crisil Intelligence

While China's share declined by approximately 29 percentage points, from 92% in fiscal 2022 to 63% in fiscal 2024, the share increased to 81% in fiscal 2025 with increase in cell imports. The import mix has diversified significantly since fiscal 2025, with China's share declining from 81% in fiscal 2025 to 58% in fiscal 2026 and 28% in the first quarter of fiscal 2027. Indonesia emerged as the largest source in the first quarter of fiscal 2027, accounting for 39% of imports, compared with 12% in fiscal 2026. Thailand's share also increased from 3% in fiscal 2025 to 7% in fiscal 2026 and 13% in the first quarter of fiscal 2027, while Vietnam accounted for 5% in the latest quarter. The shift reflects growing diversification towards Southeast Asian suppliers, even as China remains an important source of solar cells and modules.

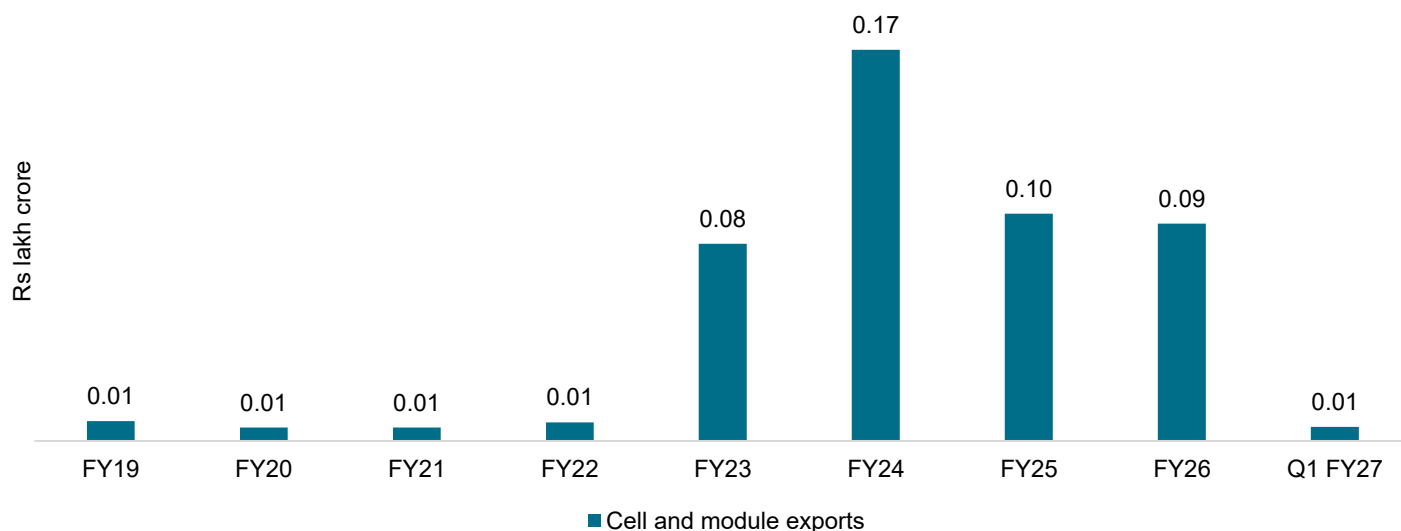
The lack of adequate domestic solar-cell capacity continued to necessitate imports, with the import mix increasingly shifting towards upstream components such as cells. Imports remained elevated ahead of the implementation of ALMM List-II, as manufacturers and developers front-loaded procurement. International pricing also remained favourable for domestic developers, with imported cell-based domestic modules generally priced below domestically manufactured modules, although the price differential varied depending on technology, duties and sourcing country.

India's exports grow multifold, so does geographical concentration

India's solar cell and module exports averaged a modest Rs 0.01 lakh crore between fiscals 2019 and 2022. However, a significant boost in manufacturing capacity and shifting geopolitical dynamics led to a remarkable surge in exports, with a 11-fold on-year increase in fiscal 2023, followed by a twofold increase in fiscal 2024.

Driven by the reimposition of ALMM, domestic demand rose sharply in fiscal 2025, resulting in increased use of domestic produce. The fall in the value of exports was also attributable to the reduced prices of solar modules on-year in fiscal 2025. Exports remained low in fiscal 2026 as well owing to US tariff uncertainty. Further, the imposition of preliminary ADD/CVD duties weighed on exports in Q1 fiscal 2027.

Figure 38: US tariff and duty-related uncertainties and higher domestic consumption weigh on export value

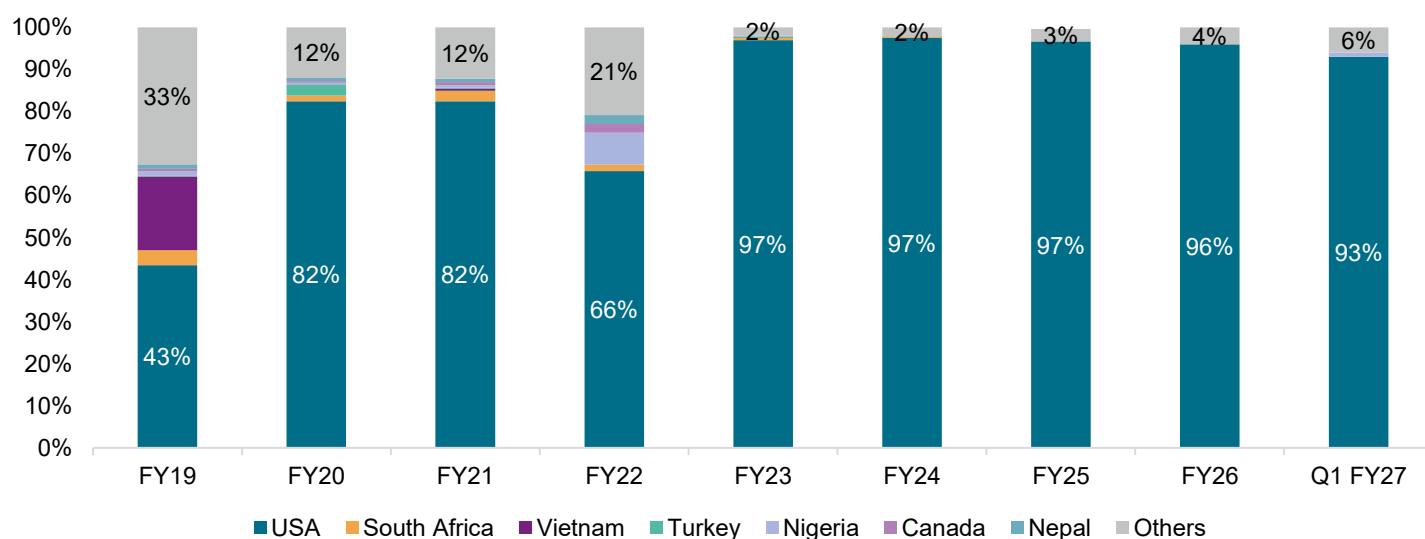


Note: HS Code 85414011 and 12 used till fiscal 2022 and 85414200 and 300 used from fiscal 2023.

Source: Ministry of Trade and Commerce, Crisil Intelligence

While the share of the US in India's export basket averaged 69% between fiscals 2019 and 2022, it jumped to 97% during fiscals 2023, 2024 and 2025. Fiscal 2026 share remained elevated at 96%. Following the announcement of preliminary CVD and AD measures on Indian products in February and April 2026, respectively, the share of US exports declined to 93% in Q1 fiscal 2027.

Figure 39: The US accounts for 93% of India's solar exports as of Q1 fiscal 2027



Note: HS Code 85414011 and 12 used till fiscal 2022 and 85414200 and 300 used from fiscal 2023.

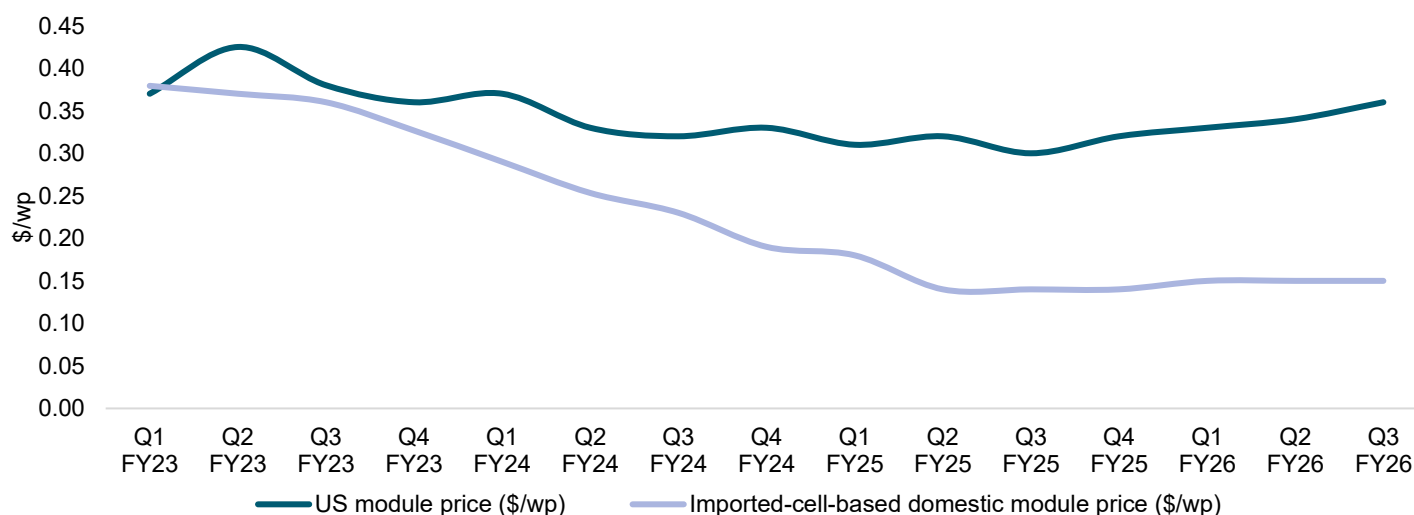
Figures may not total 100% due to rounding

Source: Ministry of Trade and Commerce, Crisil Intelligence

The US imposed sanctions on imports from China's Xinjiang region in 2022, due to concerns over forced labour. This has led to a ban on imports of polysilicon and other components from the region. As a result, Indian module manufacturers using domestic cells had a unique opportunity to export to the US. However, this advantage has weakened following US AD/CVD investigations into solar cells and modules from India, Indonesia and Laos. In 2026, the US announced preliminary CVD and AD rates of 125.87% and 123.04%, respectively, for Indian exporters, which could materially affect their price competitiveness.

India's US export opportunity is therefore increasingly dependent on the final duty outcome, company-specific rates and supply-chain traceability. Over the medium term, expanding US cell, wafer and ingot capacity could further reduce import dependence, favouring Indian manufacturers with competitive, backward-integrated and compliant operations.

Figure 40: Gap between the US and India rates enables premium sales for domestic module makers



Note: Price for monocrystalline technology-based modules.

Source: EIA, Crisil Intelligence

On average, the difference between the module price of US and Indian produce was ~\$0.11/Wp between fiscal 2023 and Q3 of fiscal 2026. The US imposed a 26% reciprocal tariff on Indian goods in April 2025, followed by an additional 25% penalty tariff in August 2025, taking the overall tariff burden to around 50%. The penalty tariff was removed in February 2026, and the IEEPA-based reciprocal tariff was subsequently withdrawn, eliminating the general additional tariff burden on Indian modules.

However, preliminary US AD/CVD duties on Indian-origin solar cells, including modules assembled using such cells, remain a significant risk. Indian module exporters may therefore procure cells from countries facing lower duties, subject to US country-of-origin and anti-circumvention rules. While Indian modules retain a price advantage over US-manufactured modules, potential AD/CVD duties and rising US manufacturing capacity could constrain exports going forward.

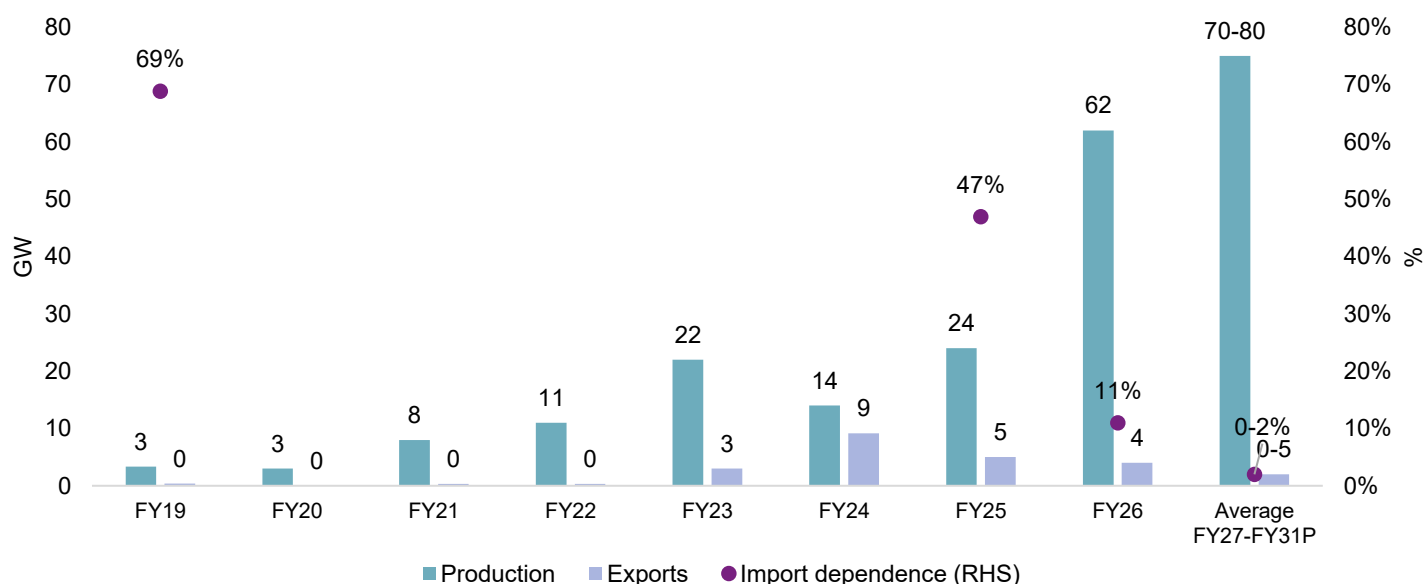
Export-import balance to improve over the next five fiscals

While the demand for solar modules remains robust, projected at 65-70 GW per year over fiscals 2027-2031, the growth in production of modules has been sufficient from fiscal 2026 onwards, making room for exports. Module manufacturing compared with domestic demand between fiscals 2027 and 2031 is expected to create an export opportunity. While absolute exports will increase, the share of exports in production is expected to moderate between 0%-10% over the years owing to rising domestic consumption needs. India's competitiveness remains under pressure from the ongoing US AD/CVD

proceedings. Preliminary determinations indicated an AD margin of 123.04% and a CVD rate of 125.87% for Indian solar cells and modules, although the ultimate impact will depend on final determinations and exporter-specific rates.

Nevertheless, rising US manufacturing capacity and volatile trade policies are likely to constrain Indian exports, increasing manufacturers' reliance on domestic demand. Supported by expanding nameplate capacity, the reimposition of ALMM List-I from fiscal 2025, and the implementation of ALMM List-II for cells from January 2027, India's module import dependence is expected to decline substantially by fiscal 2031. However, lack of fully integrated capacity will sustain high import reliance for upstream inputs, particularly polysilicon and wafers.

Figure 41: Import dependence to fall to 0-2% by fiscal 2031



Notes: P – Projected

Export potential may remain dynamic owing to the ongoing AD/CVD proceedings and other applicable US trade measures.

Source: Crisil Intelligence

Consequently, with the reimposition of ALMM List-I from fiscal 2025 and implementation of ALMM List-II from January 2027, import dependency for modules is expected to fall from 65-75% in fiscal 2020 to an average of 0-2% by fiscal 2031. However, a low base of fully integrated capacity would still result in high reliance on imports for upstream components such as polysilicon and wafers.

Sharp fall in the prices of PV components due to supply glut

The prices of upstream solar components witnessed unprecedented volatility over the last few years. Polysilicon prices surged during fiscal 2023 due to power rationing and energy shortages in China, but the subsequent aggressive capacity expansion by Chinese manufacturers led to a prolonged oversupply cycle. As a result, Chinese polysilicon prices declined sharply by calendar year 2025. Despite continued demand growth, persistent oversupply, elevated inventories and low utilisation levels across the supply chain have kept prices subdued. Industry inventories remained high at over 500,000 tonnes as of mid-2026, indicating that oversupply conditions are likely to persist through calendar 2026.

The decline in polysilicon prices cascaded through the value chain, resulting in significant reductions in wafer, cell and module prices. Wafer prices fell to around \$0.17/piece by Q4 CY2025 and are expected to soften further during CY2026 owing to sluggish demand, limited restocking activity and continued inventory overhang. While manufacturers are attempting to clear excess inventories and stabilise pricing through production curtailments, slow market absorption is expected to limit any meaningful price recovery in the near term.

Consequently, global module prices have remained under pressure due to weak demand in Europe and excess manufacturing capacity in China. The oversupply environment is expected to continue supporting relatively low module prices through fiscal 2027, benefiting project developers and reducing procurement costs. However, modules manufactured using domestic Indian cells continue to command a significant premium over modules assembled with imported cells owing to higher local manufacturing costs and domestic-content requirements.

At the same time, signs of supply-side rationalisation are emerging. Leading Chinese polysilicon manufacturers have announced production cuts and additional capacity rationalisation is expected as the industry seeks to restore profitability. As a result, Chinese polysilicon prices are projected to remain stable through CY2026.

Indian-cell-based modules are at least 1.5 times more expensive than modules based on imported cells

The need for economies of scale is essential to achieve competitive pricing for domestically manufactured modules. Domestic content requirement ensures that projects utilise solar cells and modules produced in India. Although the current approved list of models and manufacturers (ALMM) provides price resilience to domestic manufacturers, the absence of large-scale cell capacity has resulted in modules assembled using local cells being at least 1.5 times more expensive than the modules utilising imported cells and ~2 times more expensive than an imported Chinese module without BCD.

Figure 42: Indian cell-based module prices ~2 times higher than imported modules without BCD in fiscal 2026

\$ cent / wp



Note: Prices are fiscal 2026 averages and reflect TOPCon-based cell technology. They exclude GST.

Source: Crisil Intelligence

As a result, comprehensive policy initiatives have been instrumental in driving significant expansion of domestic module manufacturing capacity, with a positive impact on the module segment of the value chain. This policy push is also expected to support the expansion of cell manufacturing capacity. However, the industry's reliance on imported upstream components is likely to remain in the long term, which may lead to import dependence shifting to upstream Chinese component imports. Furthermore, the export market is expected to be driven by policy-led diversification strategies, where Indian products will stand to gain if competitively priced against domestic alternatives. Despite the high price differential, the demand for domestically made modules is expected to increase because ALMM List-II mandates the use of domestically manufactured cells in covered segments.

Policy support key for photovoltaic manufacturing expansion

The PV manufacturing industry has received both demand and supply incentives during fiscals 2019-2026. The benefits of these demand- and supply-side incentives are expected to materialise over the coming years.

1. **Annual tendering of 50 GW of renewable-energy capacity:** The government has decided to invite bids for 50 GW of renewable energy capacity annually for the next five years (fiscal 2024 to fiscal 2028). Since RE projects take 18-24 months for commissioning, the bid plan is to help add 250 GW of renewable energy and ensure 500 GW of installed capacity by 2030.
2. **ALMM:** The approved list of models and manufacturers is an initiative by the Ministry of New and Renewable Energy of India to ensure that only high-quality solar models are used, and high-quality manufacturers are engaged in projects supported by the government. The initiative introduced in 2021 has acted as a non-tariff barrier for global manufacturers to enter the Indian market. The list has been updated several times between March 2021 and August 2026 with increasing enlistments. The capacity enlisted touched 215.7 GW as of August 3, 2026, ~18 times more than that listed in March 2022.

Figure 43: Enlisted capacity grows ~18 times



Note: Capacity inside the doughnut is the total enlisted capacity as per ALMM

Source: MNRE, Crisil Intelligence

The initiative does not involve any foreign manufacturer plants globally as of August 2026, providing price resilience to domestic manufacturers.

3. ALMM List-II: The Ministry extended the ALMM framework to solar cells with effect from June 1, 2026. However, Open Access and net-metering projects have been granted an exemption from the ALMM List-II cell sourcing requirement until December 31, 2026, with compliance becoming mandatory from January 1, 2027. With over 150 GW of cell manufacturing capacity announced, ALMM List-II is expected to drive capacity addition and strengthen domestic manufacturing in this segment of the value chain. Therefore, the timely commissioning of announced cell manufacturing capacities remains critical.
- 4.
5. Supply chain diversification: This strategy encourages companies to diversify their operations by expanding outside of China while still maintaining a presence in the country. India is one of the potential destinations for solar manufacturing due to its low labour cost, as well as a favourable political and regulatory environment for manufacturing. A rise in the manufacturing base has enabled domestic manufacturers to tap the export potential, with nearly 96% of exports focused on the US alone as of fiscal 2026.
6. PLI scheme: In April 2021, MNRE launched tranche I of the PLI scheme for high-efficiency solar modules, allocating 8.7 GW to three manufacturers with an outlay of Rs 4,500 crore. However, this was later increased, and a second round of allocation was conducted based on an oversubscription witnessed in tranche I. MNRE then announced tranche II of the PLI scheme in September 2022, to allocate 39.6 GW of fully integrated/partially integrated solar manufacturing with an outlay of Rs 19,500 crore, and 13 unique manufacturers were chosen across various stages of the value chain.
7. Basic customs duty (BCD): From time to time, the government of India has intervened to reduce the price disparity between Indian and international modules in the form of safeguard duties and basic custom duty. Rising imports had discouraged manufacturing capacity expansion in the past, and thus various players from the Indian domestic solar component manufacturing industry (mainly modules) filed additional duty petitions against imports.

Despite the safeguard duty, imports dominated module supplies. Indian producers sought an extension, and the duty was extended for a year, then removed after July 2021. However, the government subsequently imposed BCD with effect from April 1, 2022. Although the imposition of ~40% BCD on modules and 25% on cells led to an increase in the capital cost, the price differential between a domestic-assembled module and an imported one narrowed from 7-8 US cents/Wp to 1-2 US cents/Wp, resulting in the demand for domestic modules.

The Union Budget for fiscal 2026 simplified the duty structure applicable to solar cells and modules. Under the old structure, imports attracted BCD along with Social Welfare Surcharge (SWS). Under the new structure, SWS has been removed and the Agriculture Infrastructure and Development Cess (AIDC) has been introduced, while BCD rates have been rationalised.

Table 16: New and simplified duty structure

Solar module	Old duty structure	New duty structure
BCD	40%	20%
SWS	4%	-
AIDC	-	20%

Solar cell	Old duty structure	New duty structure
BCD	25%	20%
SWS	2.5%	-
AIDC	-	7.5%

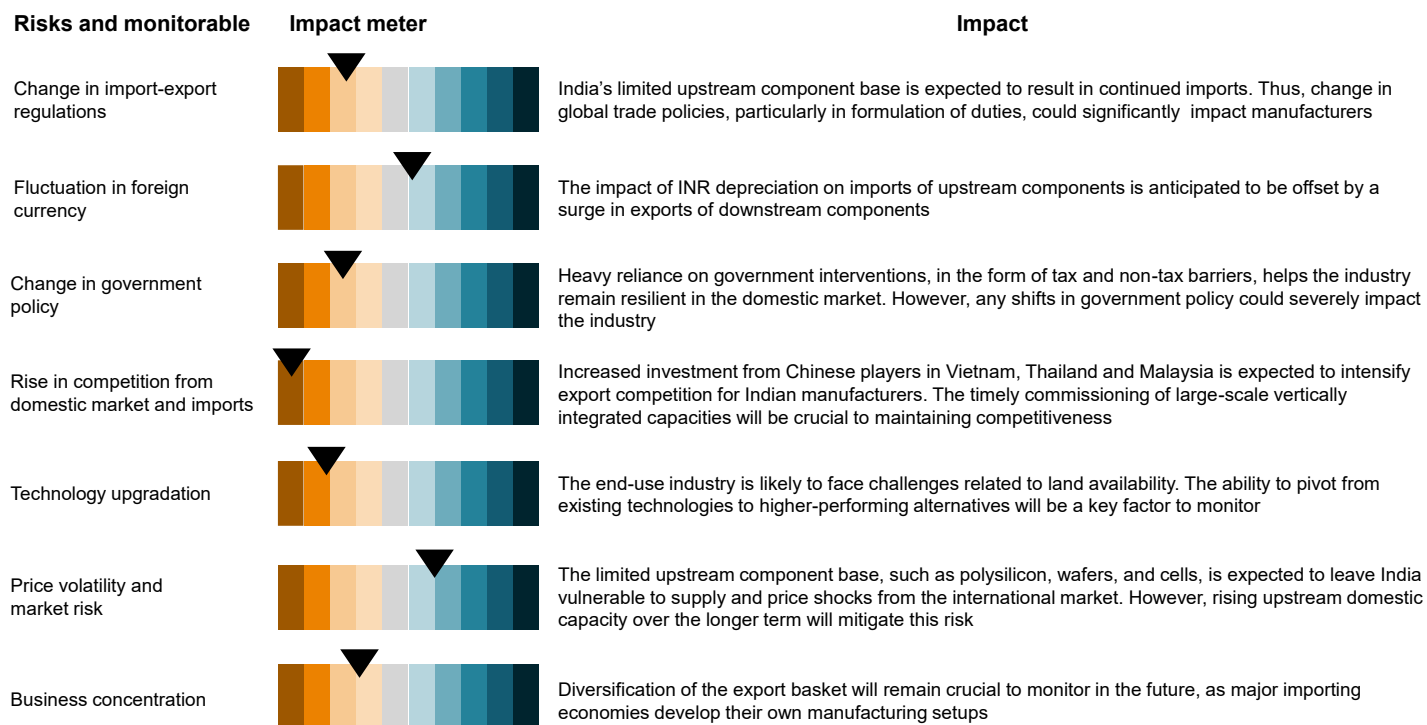
Source: Crisil Intelligence

Although the landed prices of imported cells and modules are estimated to decrease, the implementation of ALMM and ALMM II is likely to protect the demand for domestic produce.

8. Domestic tariff area (DTA): The DTA refers to the geographical region within a country where goods and services are freely available for trade, subject to domestic duties and taxes, as opposed to Export Oriented Units (EOUs) or Special Economic Zones (SEZs), where special exemptions apply. For solar cells and module manufacturers in India, the DTA policy framework plays a pivotal role in fostering domestic production. By ensuring that imported goods, such as solar cells or modules, incur tariffs under the BCD or other trade protections, the DTA helps create a level-playing field for domestic manufacturers. This measure is particularly relevant, given India's target of 500 GW of renewable energy capacity by 2030, with solar energy constituting a significant proportion. The imposition of duties on imported solar cells and modules, particularly from countries such as China, helps reduce dependency on imports and provides a competitive edge to local manufacturers.
9. Goods and services tax (GST): The GST Council in India has reduced the GST rate for solar cells and modules from 12% to 5%, effective September 22, 2025. This tax cut aims to increase the affordability and adoption of solar cells among consumers. Additionally, the GST rate has been reduced to 5% for other renewable energy devices, including solar power-based devices, windmills, and biogas plants. This move is expected to benefit the solar industry by reducing capital costs, leading to lower power purchase costs for distribution companies and promoting the growth of ongoing and upcoming projects.

Risks and monitorables

Although the growth drivers are expected to propel the industry, module manufacturers are vulnerable to multiple risks such as change in government regulations, exchange-rate volatility, input-price volatility, and market and competition risk, among others.

Figure 44: Government regulations, commissioning capability and technological progress key for the industry


Note: Red zone denotes high risk, amber denotes moderate risk and green denotes low risk

Source: Crisil Intelligence

Manufacturing base widens, with several mature players in the fray

As of August 3, 2026, the top seven players in the industry other than Rayzon Solar Ltd, namely Waaree Energies, Emmvee Photovoltaic, Goldi Solar, Vikram Solar, Saatvik Green Energy, Premier Energies and Solex Energy, accounted for about 35% of the total domestic ALMM enlisted module manufacturing capacity of ~215.7 GW.

Comparative summary of domestic module manufacturers

Table 17: Comparative summary of domestic module manufacturers

Parameter	Waaree Energies Ltd	Goldi Solar Private Ltd	Vikram Solar Ltd	Rayzon Solar Ltd	Emmvee Photovoltaic Power Private Ltd	Saatvik Green Energy Ltd	Solex Energy Ltd	Premier Energies Ltd
Geographical presence within India/outside	Gujarat, USA	Gujarat	West Bengal and Tamil Nadu	Gujarat	Karnataka	Haryana	Gujarat	Telangana
Enlisted capacity in ALMM as of August 3, 2026 (GW)	18.6	15.6	7.7	11.3	8.8	4.9	3.8	5.2
Market share as per ALMM	8.6%	7.2%	3.6%	5.2%	4.1%	2.3%	1.8%	2.4%

Parameter	Waaree Energies Ltd	Goldi Solar Private Ltd	Vikram Solar Ltd	Rayzon Solar Ltd	Emmvee Photovoltaic Power Private Ltd	Saatvik Green Energy Ltd	Solex Energy Ltd	Premier Energies Ltd
Order book (GW)	25.2 as of Q1 FY27	NA	7.9 as of Q1 FY27	4.7 as of Q1 FY27	9.9 as of Q1 FY27	6.35 as of Q1 FY27	NA	9.8 as of Q1 FY27
Order book (Rs crore)	61,500 as of Q1 FY27	NA	NA	6,052 as of Q1 FY27	NA	NA	3,400 as of Q1 FY27	15,000 as of Q1 FY27
Installed module capacity ¹ (GW)	25.8 as of Q1 FY27	15.2 as of Q1 FY27	15.5 as of Q1 FY27	10 as of FY26	10.3 as of Q1 FY27	4.8 as of Q1 FY27	4 as of Q1 FY27	11.1 as of Q1 FY27
Effective annual capacity (GW)	24.2 as of Q1 FY27	NA	NA	~7 GW for FY26	2.1 as of Q1 FY27	0.91 for Q1 FY26	NA	NA
Actual annual production (GW)	12.6 as of FY26	NA	3.3 for FY26	4.7 for FY26	3 as of FY26	1.47 as of H1 FY26	NA	3.57 as of FY26
Capacity utilisation	50% as of Q1 FY27	NA	75% in FY26	68% for FY26	45% in Q1 FY27	84% in FY26	NA	63% as of Q1 FY27
Type of products and services	Solar PV modules, inverters, batteries, EPC services, rooftop solutions, O&M services and solar water pumps	Solar modules, EPC services, solar pumps	Modules, EPC, rooftop solutions, and solar water heater solutions	Solar PV modules	Modules, EPC, rooftop solutions, and solar water heater solutions	Solar PV modules and EPC services	Solar PV modules and EPC services	p-type and n-type mono and bifacial solar modules
Primary technology of manufacturing	TOPCon, Mono and poly crystalline PV modules, Mono PERC	Mono-crystalline, poly-crystalline PV modules	TOPCon, Mono PERC, polycrystalline modules	Mono PERC and TOPCon	TOPCon, Mono PERC, polycrystalline modules	Mono PERC and TOPCon	Mono PERC and TOPCon	Mono PERC and TOPCon

Note: The above is populated as per latest data available from corporate filings as on date of preparation of the report

*Installed module capacity of Waaree includes 1.3 GW from Indosolar, 1.6 GW from USA and recent acquisition of asset of Meyer Burger in US.

¹Installed module capacity represents the operational module manufacturing capacity.

Source: Company reports, rating rationales, ALMM and Crisil Intelligence

Financial analysis

Table 18: Financial comparative analysis of manufacturers in India

Particulars	Rayzon Solar Ltd			Waaree Energies Ltd			Premier Energies Ltd		
	FY26	FY25	FY24	FY26	FY25	FY24	FY26	FY25	FY24
Revenue from operations (Rs million)	60,647	28,188	12,728	265,368	144,445	113,976	78,244	65,187	31,438
Revenue growth (%)	115%	121%	82%	84%	27%	69%	20%	107%	120%

Total income (Rs million)	60,684	28,331	12,754	2,72,449	1,48,461	1,16,328	80,259	66,521	31,713
EBITDA (Rs million)	7,745	4,744	989	59,086	17,788	15,744	31,211	17,809	4,778
EBITDA margin (%)	13%	17%	8%	22%	12%	14%	40%	27%	15%
PAT (Rs million)	4,678	3,283	609	38,842	19,281	12,744	15,097	9,371	2,314
PAT margin (%)	8%	12%	5%	15%	13%	11%	19%	14%	7%
Raw material cost (Rs million)	52,783	21,078	11,010	169,109	82,652	83,565	42,588	34,364	22,280
Gross debt (Rs million)	7,674	2,874	1,029	24,915	9,395	3,173	36,168	18,935	13,922
Net debt (Rs million)	6,534	1,389	779	-42,368	-68,084	-34,618	15,273	-1,088	9,895
Debt/Equity (times)	0.75	0.52	1.18	0.17	0.10	0.08	0.84	0.67	2.11
Net debt to EBITDA (times)	0.84	0.29	0.79	-0.72	-3.83	-2.20	0.49	-0.06	2.07
ROCE (%)	52%	86%	65%	35%	18%	39%	42%	38%	24%
ROE (%)	59%	103%	107%	32%	28%	42%	42%	54%	43%
Net WC (Rs million)	3,644	2,716	339	48,693	41,915	25,899	26,678	24,495	2,959
Net WC days	21.93	35.17	9.73	66.97	105.92	82.94	124.45	137.15	34.36
FA turnover ratio (times)	8.90	10.24	16.83	NA	3.33	4.61	3.07	5.36	2.92
Inventory turnover ratio (times)	6.63	9.46	18.85	3.87	3.86	3.31	2.79	3.44	2.85
Receivable turnover ratio (times)	16.80	22.38	35.87	14.97	14.27	17.75	8.77	9.25	9.41
Trade payable turnover ratio (times)	10.45	10.87	17.52	6.39	5.75	10.87	4.42	4.14	3.42

Notes:

1. *The financial information of all players has been considered on a consolidated basis, except for Rayzon Solar Limited for fiscal 2024, for which financial information has been considered on a standalone basis, based on the information provided by the company.*
2. *Revenue from operations represents the revenue from operations of the Company, as reported in its financial statements for the relevant financial period.*
3. *Total income represents the aggregate of revenue from operations and other income, as reported in the financial statements of the Company for the relevant financial period.*
4. *EBITDA is calculated as revenue from operations less cost of materials consumed, changes in inventories of finished goods, stock-in-trade and work-in-progress, power and fuel costs, employee benefit expenses, other manufacturing expenses and other expenses, excluding interest and finance charges and depreciation and amortisation expenses, for the relevant financial period.*
5. *EBITDA Margin is calculated as EBITDA divided by revenue from operations*
6. *Profit after tax (PAT) is calculated as EBITDA less interest and finance charges, depreciation and amortisation expenses, and tax expenses, before considering other comprehensive income and the share of profit or loss of joint ventures, for the relevant financial period.*
7. *PAT Margin is calculated as PAT divided by revenue from operations for the relevant financial period.*
8. *Raw material cost represents the costs of materials consumed by the company during the relevant financial year.*
9. *Gross debt is calculated as the aggregate of long-term debt and short-term debt outstanding as at the end of the relevant financial period.*
10. *Net debt is calculated as gross debt less cash and cash equivalents and other bank balances outstanding as at the end of the relevant financial period.*
11. *Debt-to-equity ratio is calculated as gross debt divided by tangible net worth as at the end of the relevant financial period.*
12. *Net debt-to-EBITDA ratio is calculated as net debt divided by EBITDA for the relevant financial period.*
13. *Return on Capital Employed (RoCE) is calculated as EBIT divided by the average of the aggregate of total equity and gross debt as at the end of the current and immediately preceding financial years.*
14. *Return on Equity (RoE) is calculated as PAT divided by the average total equity as at the end of the current and immediately preceding financial year.*
15. *Net working capital is calculated as current assets less current liabilities as at the end of the relevant financial period.*
16. *Net working capital days is calculated as net working capital divided by revenue from operations for the relevant financial period.*
17. *Fixed asset turnover ratio is calculated as revenue from operations for the relevant financial year divided by the average net fixed assets as at the end of the current and immediately preceding financial years.*
18. *Inventory turnover ratio is calculated as the cost of goods sold for the relevant financial year divided by the average inventory as at the end of the current and immediately preceding financial year.*
19. *Receivables turnover ratio is calculated as revenue from operations for the relevant financial year divided by the average trade receivables as at the end of the current and immediately preceding financial years.*
20. *Trade payable turnover ratio is calculated as the cost of goods sold for the relevant financial year divided by the average trade payables as at the end of the current and immediately preceding financial years.*
21. *NA: Not available*

Source: Crisil Intelligence

Here are some pointers that provide a perspective on Rayzon's position in the competition landscape of the photovoltaic industry:

- Rayzon commenced its operations in 2017 as a partnership firm called M/s Rayzon Green Energies

- Rayzon is the third largest manufacturer of solar photovoltaic (PV) modules in India, with ALMM-enlisted capacity of 11.3 GW as of August 3, 2026.
- According the ALMM-I, Rayzon Solar had a 5.2% share of the total ALMM-enlisted capacity as of August 3rd, 2026.
- Rayzon operates two manufacturing facilities in Karanj and Sava, Gujarat, spread across 26.61 acres and 56.34 acres, respectively.
- The company has added 4 GW of module manufacturing capacity in fiscal 2026, resulting in an installed capacity of 10 GW as of March 31, 2026
- Rayzon has expanded its manufacturing capacity for solar PV modules from 40 MW as on March 31, 2018, to 2.10 GW as on March 31, 2024, to 6 GW as on March 31, 2025, and 10 GW as on March 31, 2026.
- Rayzon's revenue from operations has grown at a CAGR of 118% from fiscal 2024 to fiscal 2026
- Rayzon had an FA turnover ratio of 8.90 times and net working capital ratio of 16.64*¹ as of fiscal 2026
- The company had a debt/equity ratio of 0.75 in fiscal 2026 and its revenue from operations grew 115% on-year in fiscal 2026

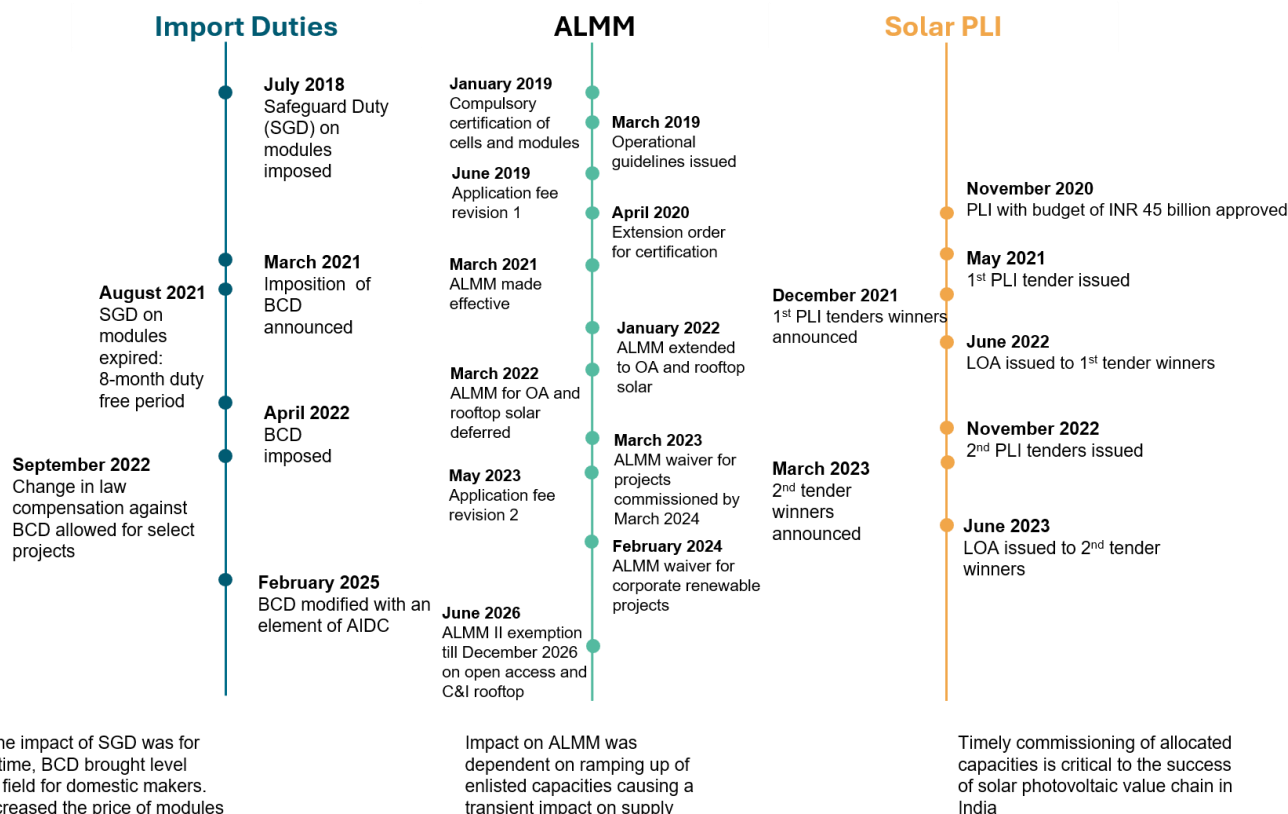
Threats and challenges

1. Policy challenges

The solar energy industry is heavily reliant on government policies, which significantly influence the solar module manufacturing landscape in India. Crucial policy measures, such as the ALMM, safeguard duty, Basic Customs Duty (BCD), and the Production-Linked Incentive (PLI) scheme for solar module manufacturing, have a profound impact on the sector. However, despite the government's supportive stance, the policy framework often changes, requiring the industry to adapt.

¹ *The net working capital ratio is calculated as the revenue from operations for the period divided by the net working capital for the financial year.

Figure 45: Policy uncertainty and reversals have impacted the industry in the past



Source: Crisil Intelligence

2. Industry challenges

The Indian solar PV manufacturing industry has witnessed an allocation of 24 GW of polysilicon, 40 GW of wafers and 48.3 GW of cells and modules in two PLI tranches. Over and above this, the industry has seen multiple announcements in the cells to module segment. Domestic cell-to-module capacity is expected to increase through fiscal 2030, resulting in lower import dependence. However, the dependence on the import of wafers and polysilicon will continue owing to the limited capacity expansion plan over the next five years.

3. Export market concentration

The solar module capacity has expanded to 216 GW in June 2026 from 21 GW in fiscal 2022, opening the doors for export opportunities. The industry received a further boost from the Uyghur Forced Labour Prevention Act. This has resulted in over 90% exports being driven to the US market during fiscals 2023 to 2026. However, India does not share an export agreement with the US. Therefore, any change in the US policies can impact Indian exporters. Given that Indian manufacturers largely focus on the US market, their presence in the import basket of other top importing nations such as the Netherlands, Germany, Spain and Brazil remains low.

4. Technology advancements

Solar PV manufacturing is advancing towards more efficient and cheaper modules. Any changes in solar technology can shift demand towards newer products, rendering existing inventory less desirable. Most technological know-how, manufacturing lines and installation expertise for new PV cell and module facilities are sourced from Chinese suppliers.

Therefore, maintaining high-quality standards and keeping up with rapid technological advancements can be challenging for this industry.

5. Environment and sustainability

The manufacturing process involves the use of materials that can generate hazardous waste. The production process involved in solar PV manufacturing, such as etching, doping and coating, can generate greenhouse gases, volatile organic compounds and acid gases, which can contribute to air pollution. Some of the materials used to make solar cells, such as cadmium, lead, arsenic and selenium are toxic and can pose health and environmental risks if not handled properly. Water consumption is also significant, especially for the production of silicon wafers, which need to be purified, cut, and polished with a large quantity of water. These challenges can impact costs, operational efficiency and the overall feasibility of the project.

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