

Solar Modules: Domestic Production Capacity to Reach 215 -220 GWp by FY28

November 03, 2025 | Industry Insights

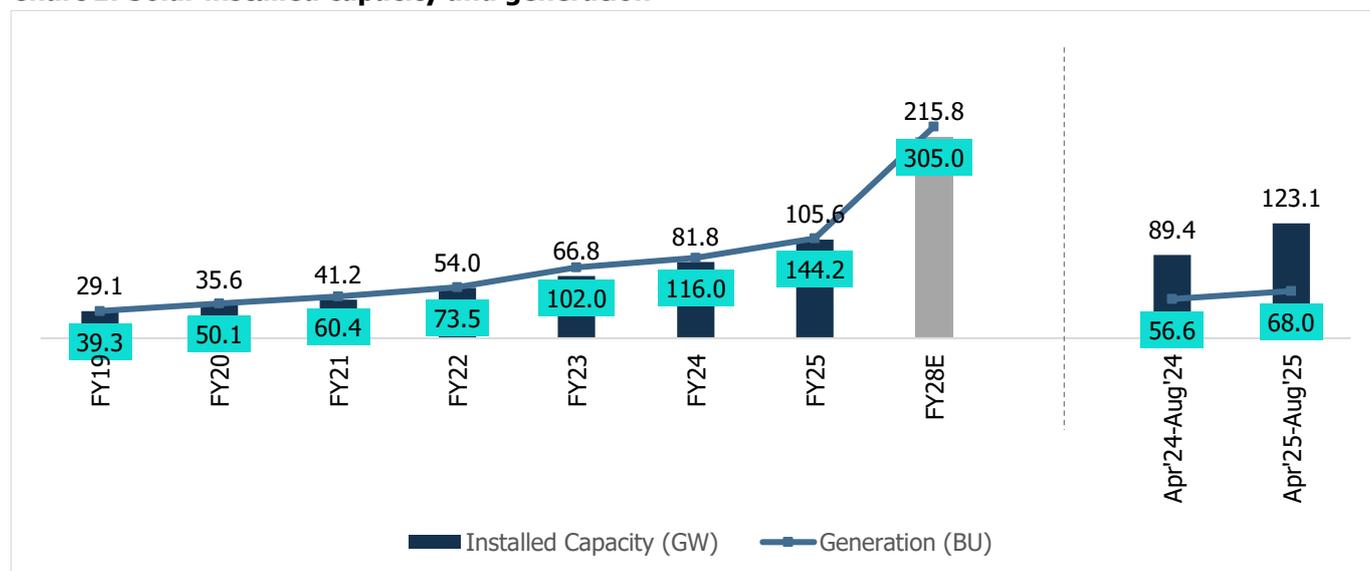
Synopsis

- **Exponential Growth:** India’s solar installed capacity surged ~32× in a decade, reaching 127.3 GW as of September 2025 and contributing 25.7% of total installed capacity.
- **Solar Module Export Surge:** India’s exports of solar photovoltaic (PV) products have surged by more than 10 times between FY19 and FY25, primarily to the US.
- **Policy Push:** Government initiatives like PLI, BCD, and ALMM expanded domestic solar module capacity to 100 GW, ranking 4th globally.
- **Backward Integration:** Leading players (Adani, Waaree, Tata Power Solar, Vikram, Premier) are integrating upstream (cells, wafers, ingots) to cut imports and boost exports, which hit Rs 94.6 billion in FY25.
- **Outlook:** India is targeting ~216 GW of solar capacity by FY28, supported by PLI schemes that have already approved multiple tranches for integrated manufacturing across polysilicon, ingot, wafer, cell, and module stages. Strong response to applications under these schemes is enabling rapid capacity expansion. At the same time, efficiency gains—where 1,700–2,200 panels (at 500 Wp) are typically deployed for every 1 MW of solar power—are reinforcing scale advantages in project execution.

Overview

India's solar energy sector has emerged as a key participant in grid-connected power generation capacity. It contributes to the government's objective of sustainable growth while evolving as a key anchor in meeting the nation's energy demands and ensuring energy security. As of August 2025, solar energy accounted for nearly 24% of India's installed power capacity. Further, the contribution of solar energy to India’s power generation has grown from 2.8% in March 2019 to 8.5% in August 2025. As of September 2025, India had a total installed solar capacity of 127.3 GW, comprising ground-mounted solar plants, grid-connected solar rooftops, hybrid projects, and off-grid solar systems. Solar capacity has increased more than 32 times, from 3.9 GW in FY15 to 127.3 GW as of September 2025, including a record 23.83 GW added in FY25 alone. India’s solar capacity and generation are expected to reach 215.8 GW and 305.0 BU, respectively, over the coming years.

Chart 1: Solar installed capacity and generation



Source: CEA, Niti Aayog, CareEdge Research; Note: GW – Gigawatt, BU – Billion Units

Among the components used in solar projects, modules account for the largest share of costs, typically contributing about 50–55% of the total project expenditure. Setting up 1 MW of solar capacity in India requires 1,700–2,200 panels, underscoring the central role of the module manufacturing ecosystem in shaping the country’s clean energy journey.

Back in FY14, domestic module manufacturing capacity was around 2.3 GW per annum, where more than 88% of module requirements were met through imports, primarily from China, leaving the sector vulnerable to pricing shocks and supply chain risks. However, the COVID-19 pandemic in CY20 exposed vulnerabilities in global supply chains, including those related to solar equipment. This situation prompted the Government of India to adopt a more self-reliant approach to reduce external dependence.

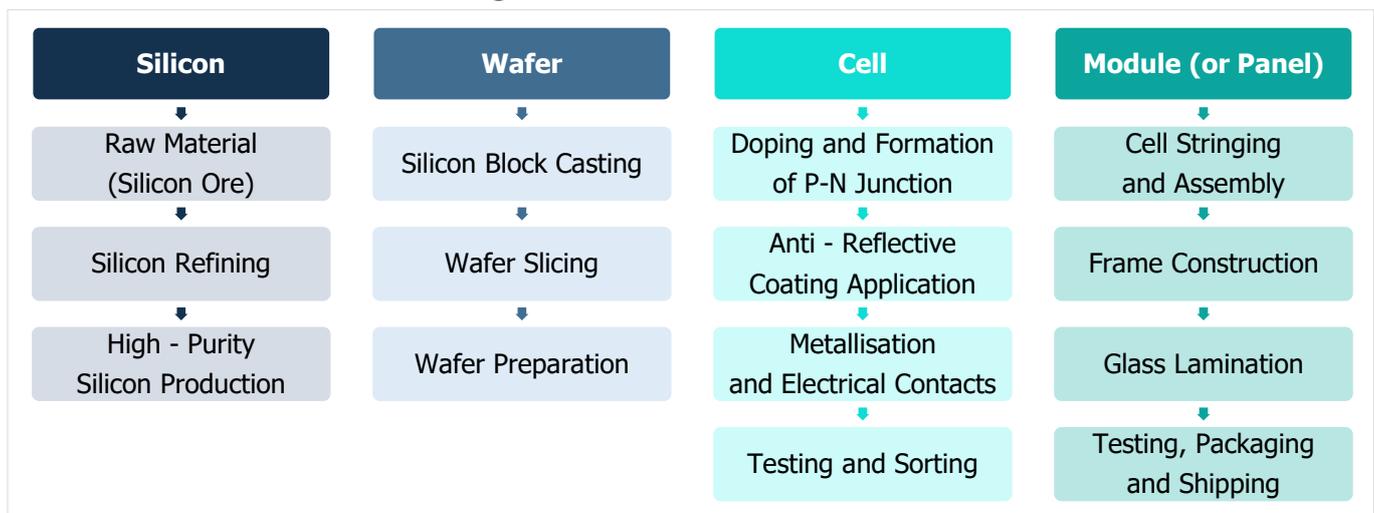
As a result, the import dependency has reduced to 65-70%, but it is still inadequate to meet domestic demand. The players import components such as polysilicon, ingots, and wafers, incurring high costs because India lacks a sufficient manufacturing base for them. Indian solar power producers are still dependent on imports of solar modules, with China accounting for nearly 80% of total imports, followed by Hong Kong and Malaysia. To address these vulnerabilities, the Government of India rolled out a series of measures, including the Production Linked Incentive (PLI) scheme, the imposition of Basic Customs Duty (BCD) on imports, and the introduction of the Approved List of Models and Manufacturers (ALMM) framework to ensure quality and promote domestic players. In August 2025, India achieved a landmark milestone of 100 GW of solar PV module manufacturing capacity listed under the ALMM for Solar PV Modules.

By FY28, India will require an estimated 36–47 crore solar panels (at 500Wp) to achieve its targeted solar capacity of 215-220 GW. This massive demand underscores the need for a robust, scalable domestic manufacturing ecosystem to ensure adequate supply and reduce reliance on imports.

Solar Manufacturing Value Chain: Process and Capacity Snapshot

The solar module manufacturing value chain is a complex process that spans several stages, from the extraction of raw materials to the final assembly of solar modules (solar panels). Each step in the value chain adds value to the product and helps transform basic materials into finished, functional solar modules used to generate electricity. Below is an overview of the key steps in this value chain.

Chart 2: Solar module manufacturing value chain



Source: CareEdge Research

Table 1: Segment-wise Solar PV Manufacturing Capacities in India (in GWp)

Segment	FY25 (GWp)	FY28 (GWp)	Components required per 1 MW Solar Plant	Remarks
Module	105	215-220	1,700–2,200 panels	Currently, it has the largest module manufacturing facility outside China and is expected to achieve self-sufficiency by 2028.
Cell	25	100-105	1,00,000-1,25,000	Rapid expansion supported by PLI incentives and ALMM policy.
Wafer	2	34.69		Manufacturing to start at scale. Backed by PLI Tranche I & II.
Ingot	2	23.86	2-3 tonnes	Manufacturing to start at scale. Backed by PLI Tranche I & II.
Polysilicon	NA	NA	NA	No commercial-scale production yet. Adani and Reliance have announced plans.

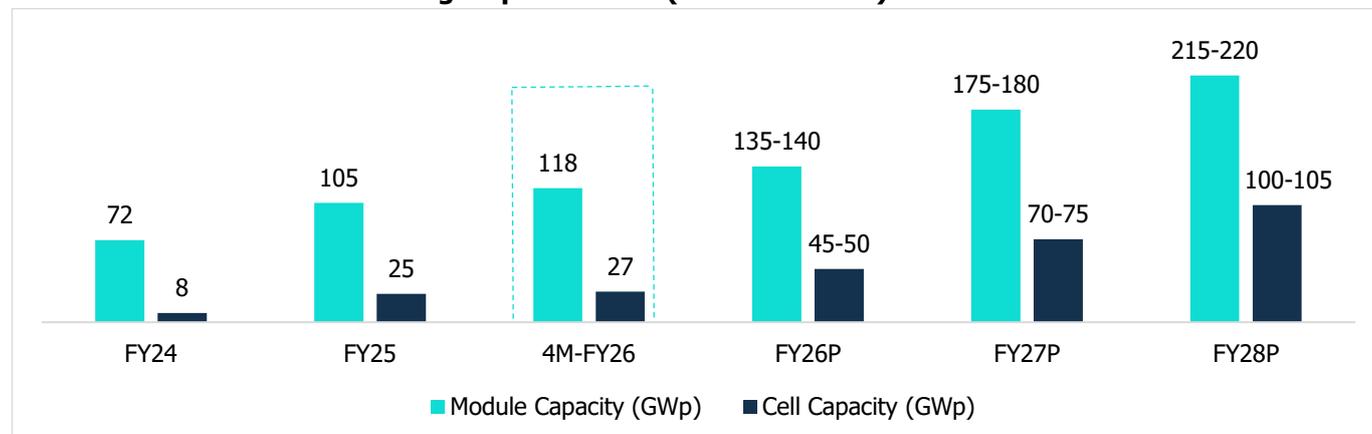
Source: CareEdge Research; Note: Components required per 1 MW Solar Plant may vary with size, capacity, and design of the plant; Note: Module is estimated at ~500Wp while cells are estimated at 8-10 Wp.

Rise in solar module capacity despite domestic cell shortages

India’s solar module manufacturing capacity has surged from about 72 GWp in March 2024 to nearly 118 GWp in July 2025. It is expected to reach more than 200 GWp by FY28, reflecting strong policy support and rising demand. Domestic solar cell capacity remains limited, having expanded more modestly from 8 GWp to around 27 GWp in the same period and is expected to reach 100 GWp by FY28. This accelerated capacity expansion has been driven by increased solar installations, proactive policy support, and improved access to financing avenues.

The annual production is estimated at 50-60 GWp for modules and 8-10 GWp for cells, resulting in a cell import dependency of 40-45 GWp. This imbalance has made imports of solar cells essential, with many module makers heavily dependent on foreign supply, primarily from China, to keep up production. To address this gap and promote self-reliance, the government is tightening regulations: the ALMM (Approved List of Models and Manufacturers) mandates domestic modules for certain projects, and upcoming frameworks, such as ALCM/ALMM rules for cells, are expected to push for greater domestic cell usage as well.

Chart 3: Domestic Modules using Imported cells (with 25% BCD)



Source: CareEdge Research

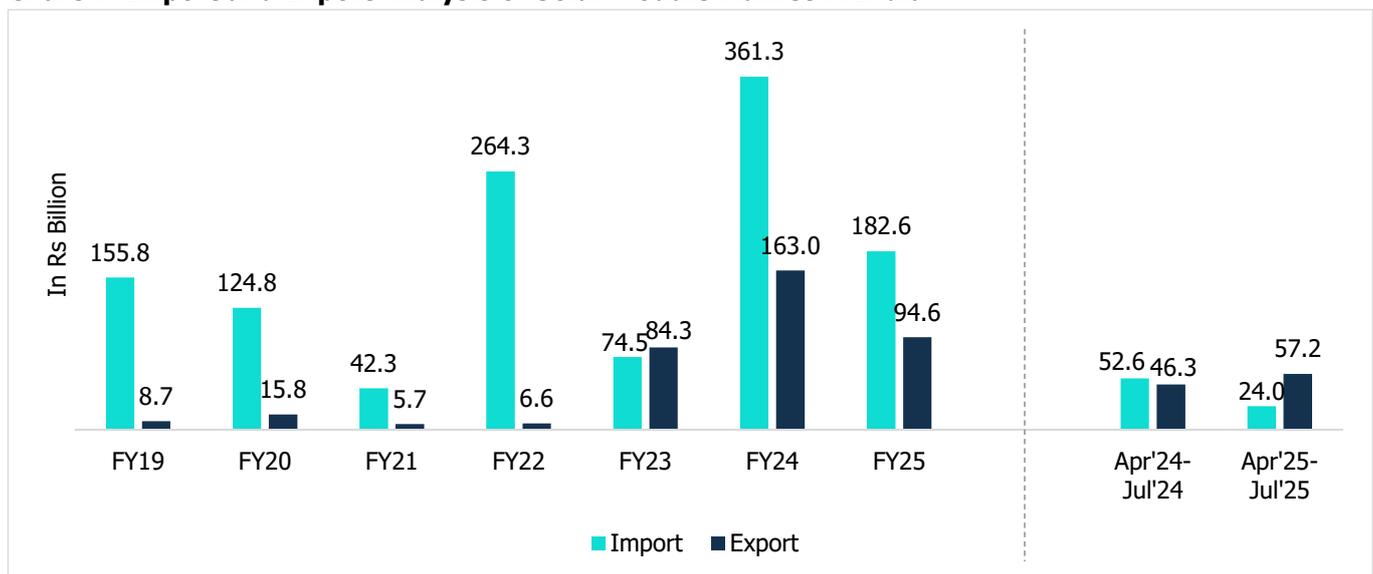
Backward Integration: The Road to Self-Sufficiency

India’s module manufacturing capacity is expected to add ~100 GWp by the end of FY28, nearly three to four times the average annual module demand of 50–60 GWp over the next three years. This growth is supported by planned capacity additions of over 110 GWp from established and new players, totalling more than Rs 14,000 crore in capex. Domestic cell manufacturing capacity is projected to reach 100 GWp during the same period, with capex exceeding Rs 55,000 crore, driven by backward integration efforts. As a result, CareEdge expects module production to increasingly rely on exports, even as cell production is also likely to eclipse domestic demand in the medium term. This indicates that in the coming years, India’s module and cell output will exceed domestic requirements, positioning exports as the key growth driver for the sector.

India’s operational wafer manufacturing capacity currently stands at only 2 GWp. However, leading domestic players have announced expansion plans totalling over 30 GWp, expected to come online in the medium term. These projects involve an estimated capital outlay of more than Rs 20,000 crore.

As a result of the rise in backward Integration, India has steadily shifted from a net importer to a net exporter of photovoltaic (PV) products. Exports have grown sharply from Rs 8.7 billion in FY19 to Rs 94.6 billion in FY25, with momentum peaking in FY23–FY24 when shipments briefly surpassed imports. The surge was also largely driven by U.S. developers diversifying away from China, though exports to markets outside the U.S. have remained relatively stable. In FY25, exports fell mainly due to a steep drop in U.S.-bound shipments, which had accounted for over 95% of India’s module exports. The decline was due to scrutiny of US imports under the Uyghur Forced Labour Prevention Act. Notably, exports to the U.S. rebounded in the first four months of FY26, as developers accelerated shipments ahead of tariff deadlines, even as domestic demand absorbed most locally produced cells. Meanwhile, imports fell by 54% in this period, underscoring India’s progress toward solar self-sufficiency.

Chart 4: Import and Export Analysis of Solar Module Market in India



Source: Ministry of Commerce; CareEdge Research

Note: HS Codes for FY19-FY21: 85414011, FY22: 85414012, FY23-FY25: 85414300.

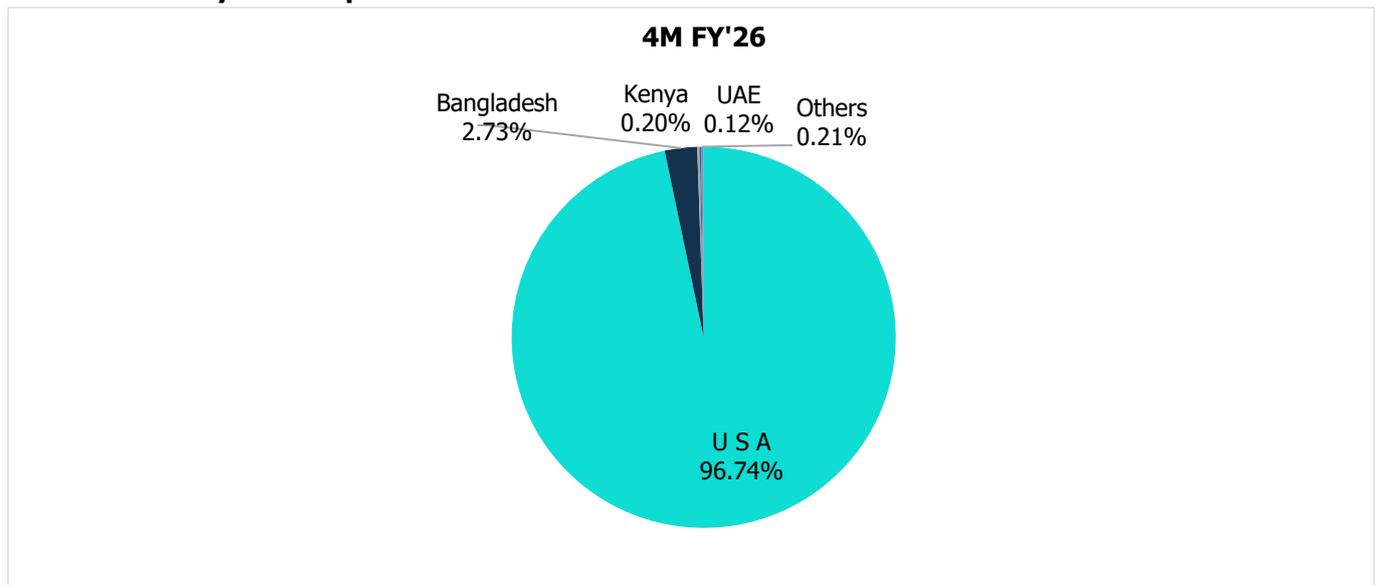
Subsequently, from FY 2022-23, the Solar PV Cells and Solar PV Modules (other than those exclusively used with ITA-1 items) are put under HS Codes 85414200 and 85414300, respectively.

India’s solar module exports to the U.S. are priced about 3–4 cents/W/W higher than shipments to other markets. This higher price in the US market stems from restrictions on solar cells sourced from China’s Xinjiang region, a

major low-cost component supplier. To serve the U.S. market, Indian producers are sourcing cells from countries like Indonesia, Thailand, and other Southeast Asian hubs, where costs are relatively higher.

In value terms, the increase in exports during 4M-FY26 was primarily driven by shipments to the USA, which rose by Rs 1,104.09 crore. However, the most significant growth was recorded in exports to Kenya, which expanded by 55.5 times year on year.

Chart 5: Country-wise Exports



Source: Ministry of Commerce; CareEdge Research

India also exports PV products to South Africa, Somalia, Afghanistan, Nepal, and other countries. Several countries are considering India as a viable option for their “China Plus One” strategy, and an opportunity for domestic PV manufacturers to diversify their revenue base and sell their products at a higher premium abroad. Exporters are likely to encounter additional headwinds from the USA as the U.S. Department of Commerce has initiated anti-dumping and countervailing duty investigations on imports of crystalline silicon photovoltaic cells, whether assembled into modules or not, from India, Indonesia, and Laos.

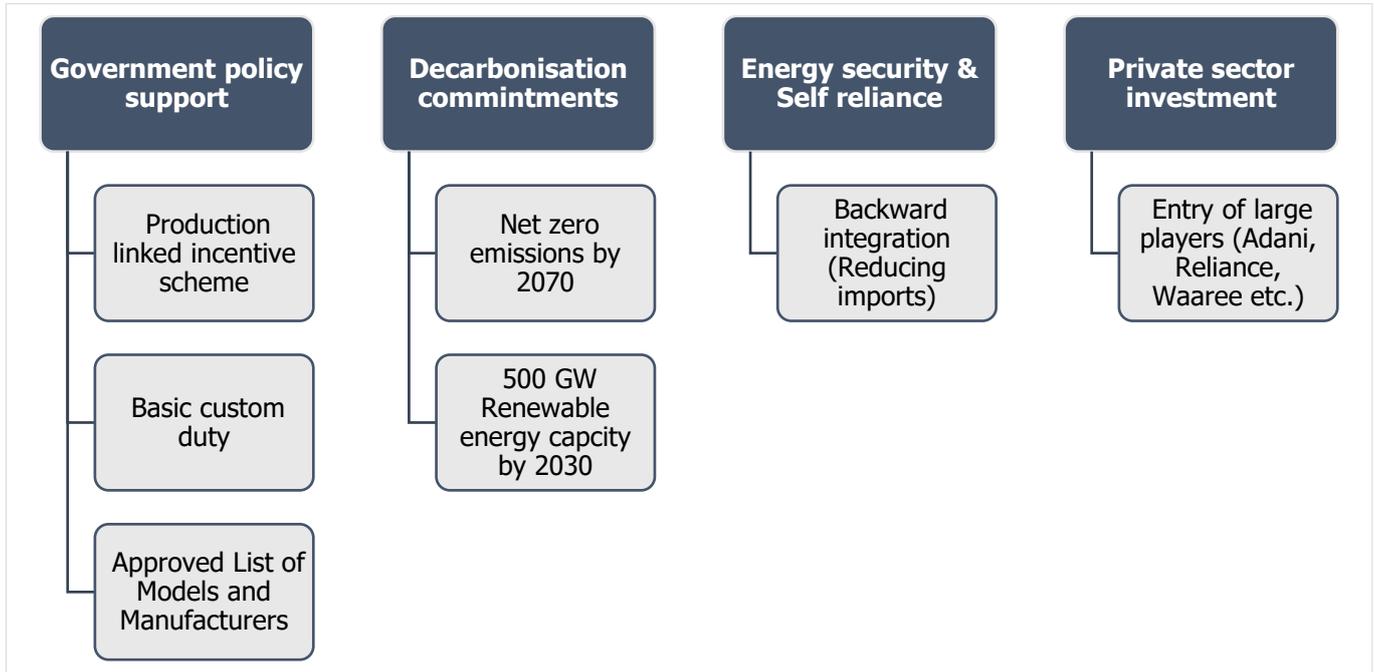
India’s wafer capacity is presently 2 GWp, with over 30 GWp in planned additions entailing investments of around Rs 20,000 crore.

With investments directed towards ingot, wafer, and polysilicon production under initiatives like the Swadeshi Solar plan, supported by schemes such as PLI, DCR-linked procurement rules, and viability gap funding (VGF) for solar parks, India is working to build a fully integrated solar value chain. This backward integration will reduce reliance on external suppliers, shield the sector from global price shocks, and position India for sustained export growth over the coming years, even as short-term fluctuations persist.

Key Drivers for Growth in Solar Module Manufacturing in India

Advancements in technology and rising investor confidence are fuelling rapid growth in India’s solar manufacturing sector. Strengthened local supply chains are enhancing resilience against global market uncertainties, positioning India as a competitive hub for clean energy.

Chart 6: Key drivers



Conclusion

India is steadily transitioning from an import-dependent economy to a solar-exporting country, driven by robust policy support, capacity expansion, and backward integration across the solar value chain. While challenges remain in polysilicon production, large-scale integrated facilities under development are expected to bridge these gaps. By achieving full backward integration, India can insulate itself from global supply shocks, secure long-term energy independence, and emerge as a global leader in solar manufacturing. With the current trajectory, India is on track to achieve self-sufficiency in the next 4-5 years and strengthen its position as a clean energy powerhouse.

“Planned module capacity of over 215-220 GWp by FY28 is expected to entail investments of more than Rs 14,000 crore, with an estimated 25–30% of panels likely to be exported,” says Tanvi Shah, Senior Director, Care Analytics and Advisory Private Limited.

“The domestic cell manufacturing capacity is expected to reach around 100 GWp, supported by cumulative capex exceeding Rs 55,000 crore. India is not just creating jobs and innovation, it’s powering a cleaner, brighter future for millions,” says Nitu Singh, Associate Director, Care Analytics and Advisory Private Limited.

However, given the early stage of upstream integration, continued dependence on Chinese supply chains, uncertainty regarding export scalability, and slower progress in renewable capacity augmentation due to systemic constraints, these aspects remain key monitorable risks over the medium term.

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