India’s Solar Energy Capacity Surges to Global Leadership Through Policy Support, Manufacturing Growth and Clean Energy Transition

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Recent Developments:

- **India’s installed solar power capacity** increased more than fiftyfold from about **3 GW in 2014** to **162.15 GW** as of **30 June 2026**, making solar power the largest contributor to the country’s renewable energy capacity.
- India’s solar expansion has been driven by a combination of **policy reforms, transmission infrastructure, domestic manufacturing, competitive bidding** and increasing public participation through rooftop solar and agricultural solarisation.
- The recently approved **Pradhan Mantri Surya Sarovar Yojana (PM-SSY)** seeks to accelerate floating solar deployment integrated with **Energy Storage Systems (ESS)**, strengthening renewable energy generation while addressing land constraints and grid stability.

India’s Solar Energy Expansion:

Growth of India’s Solar Capacity:

- India has emerged as one of the fastest-growing solar power markets, with **37 GW** of solar capacity added during **2025**, surpassing the United States in annual additions and becoming the **world’s second-largest solar growth market**.
- During **FY 2025–26**, India added a record **44.61 GW** of solar capacity, nearly doubling the **23.83 GW** added during **FY 2024–25**, reflecting the rapid pace of renewable energy deployment.
- Solar power now constitutes the largest share of India's renewable energy portfolio, significantly contributing to the country's clean energy transition and long-term energy security.

Regional Distribution of Solar Capacity:

- **Rajasthan, Gujarat, Karnataka, Tamil Nadu, Andhra Pradesh** and **Maharashtra** account for a major proportion of India's installed solar capacity because of favourable solar resources, supportive policies and large-scale infrastructure development.
- These States have emerged as leading renewable energy hubs by attracting substantial public and private investments in utility-scale as well as distributed solar projects.

Utility-Scale Solar Projects:

- Large utility-scale solar projects contribute around **118.79 GW** of India's installed solar capacity.
- Major projects include **Bhadla Solar Park (Rajasthan), Pavagada Solar Park (Karnataka)** and **Rewa Ultra Mega Solar Park (Madhya Pradesh)**, which demonstrate economies of scale, competitive tariffs and efficient project implementation.

- Utility-scale projects continue to form the backbone of India's renewable electricity generation while supporting large industrial and urban demand centres.

Rooftop and Distributed Solar:

- **Grid-connected rooftop solar systems** contribute approximately **27.88 GW** to India's installed solar capacity.
- Additional capacity is generated through **hybrid renewable projects**, integrating solar power with battery storage or other renewable sources, and **off-grid systems** supplying electricity to remote and unconnected areas.
- Distributed solar has expanded consumer participation by enabling households, commercial establishments, industries and farmers to generate electricity closer to the point of consumption.

Expansion of Domestic Manufacturing:

- India's domestic **solar photovoltaic module manufacturing capacity** increased from approximately **2.3 GW in 2014** to nearly **172 GW by March 2026**, significantly reducing dependence on imported solar equipment.
- Expansion of domestic manufacturing has strengthened supply chain resilience, promoted technological self-reliance and supported the objectives of **Atmanirbhar Bharat** and **Make in India**.

Growth of Non-Fossil Fuel Capacity:

- India's total **non-fossil fuel electricity capacity** reached **283.46 GW**, including **274.68 GW** of renewable energy capacity.
- **FY 2025–26** recorded India's highest-ever annual addition of **non-fossil fuel capacity**, reaching **55.29 GW**, reflecting sustained progress towards long-term climate commitments.
- Renewable energy sources met **51.5%** of India's electricity demand on **29 July 2025**, representing the highest recorded renewable share in the country's electricity mix during the period.

Policy Architecture Driving India’s Solar Expansion:

Creating Long-Term Vision through Climate Commitments:

- India announced its **Panchamrit Commitments** at **COP26 (Glasgow)**, including achieving **500 GW of non-fossil fuel capacity by 2030** and **Net-Zero emissions by 2070**, which were subsequently incorporated into its updated **Nationally Determined Contributions (NDCs)** under the **Paris Agreement**.
- **Mission LiFE (Lifestyle for Environment)** complements these commitments by promoting sustainable consumption patterns and encouraging environmentally responsible behavioural change among citizens.

Creating Market Demand through National Missions:

- The **National Solar Mission** laid the foundation for India's large-scale solar expansion by establishing long-term capacity targets, policy certainty and institutional support for the sector.
- **Renewable Purchase Obligations (RPOs)** require electricity distribution companies and other obligated entities to procure a specified proportion of electricity from renewable sources, thereby creating sustained market demand and long-term investment certainty.
- The **RPO trajectory** has been notified up to **2029–30**, with the target for **2026–27** fixed at **35.95%**.
- Flagship programmes such as **PM Surya Ghar Muft Bijli Yojana** and **PM-KUSUM** have broadened participation by promoting rooftop solar, decentralised generation, solar-powered irrigation and feeder solarisation across households and the agricultural sector.

Reducing Costs through Competitive Bidding:

- India has significantly reduced solar power tariffs through transparent **competitive bidding** based on the **e-Reverse Auction** mechanism, under which developers compete to offer electricity at the lowest tariff.
- Agencies such as the **Solar Energy Corporation of India (SECI)** have institutionalised competitive procurement, reducing solar tariffs from nearly **?18 per unit in 2010** to a record low of **?2.44 per unit** during the **Bhadla Solar Park** auction in **2017**.
- Declining tariffs have made solar electricity among the most affordable sources of power, with the **Levelised Cost of Electricity (LCOE)** for utility-scale solar projects estimated at about **USD 35/MWh in 2025**, compared with the global average of **USD 44/MWh**, thereby improving India's international cost competitiveness.

Developing Enabling Infrastructure:

- The **Solar Parks Scheme** provides developers with ready access to land, transmission connectivity and common infrastructure, reducing project risks and accelerating utility-scale deployment.
- The Scheme's target was expanded from **20 GW** to **40 GW** in **2017**, and by **February 2026**, **54 Solar Parks** with a combined sanctioned capacity of **39,188 MW** had been approved.
- **Gujarat** leads with **12,150 MW** across seven parks, followed by **Rajasthan (10,726 MW)** and **Madhya Pradesh (4,208 MW)**.
- Projects such as **Bhadla, Pavagada** and **Rewa Ultra Mega Solar Park** demonstrate how integrated infrastructure, transmission facilities and common land development can attract investment while lowering electricity tariffs.
- The **Green Energy Corridor Programme** complements solar parks by strengthening interstate transmission infrastructure for renewable electricity evacuation, enabling **24,567.8 MW** by **February 2026**, while ongoing projects across ten States are expected to support nearly **44 GW** of additional renewable capacity.

Promoting Domestic Manufacturing:

- The **Production Linked Incentive (PLI) Scheme** for high-efficiency solar photovoltaic modules was launched in **2021** with an allocation of **?4,500 crore** and expanded in **2022** with an additional **?19,500 crore** to strengthen domestic manufacturing and reduce import dependence.
- By **October 2024**, the Scheme had attracted investments of around **?35,000 crore** and generated nearly **10,000 direct employment opportunities**.
- The **Approved List of Models and Manufacturers (ALMM)** framework ensures that solar modules and cells used in specified projects comply with prescribed quality standards while simultaneously promoting indigenous manufacturing.

<u>Strengthening India’s Domestic Solar Energy Architecture:</u>

PM Surya Ghar Muft Bijli Yojana:

- Launched in **February 2024** with an outlay of **?75,021 crore**, the **PM Surya Ghar Muft Bijli Yojana** promotes residential rooftop solar adoption through **Central Financial Assistance (CFA)**, collateral-free loans and a dedicated national online portal.
- The Scheme aims to reduce household electricity expenditure, increase decentralised renewable energy generation and empower consumers to become **prosumers** by generating electricity for their own use while exporting surplus power to the grid.
- More than **43 lakh households** had been solarised by **June 2026**, while **?14,771.82 crore** had been disbursed as Central Financial Assistance by **December 2025**.
- More than **7.7 lakh households** reported **zero electricity bills** by **December 2025**, demonstrating the Scheme's potential to improve household energy affordability and energy security.

- The **World Bank** has also approved financial support to strengthen the implementation and expansion of India's residential rooftop solar programme.

PM-KUSUM Scheme:

- Launched in **2019**, the **Pradhan Mantri Kisan Urja Suraksha evam Utthaan Mahabhiyan (PM-KUSUM)** promotes decentralised solar power generation through **solar power plants, standalone solar agricultural pumps** and **solarisation of grid-connected agricultural feeders**.
- The Scheme provides reliable daytime electricity for irrigation, reduces dependence on diesel pumps, lowers agricultural input costs and enables eligible farmers to earn additional income by selling surplus electricity to distribution companies.
- PM-KUSUM targets the creation of nearly **34,800 MW** of solar capacity by **2026–27**, supported by **Central Financial Assistance of ?34,422 crore**.
- By **June 2026**, nearly **11.49 lakh off-grid solar pumps** had been installed, more than **15.89 lakh agricultural pumps** had been covered through feeder-level solarisation and approximately **1,726 MW** of decentralised solar capacity had been commissioned on farmers' land.
- More than **21.77 lakh farmers** have benefited from the Scheme, making it one of India's largest decentralised renewable energy programmes.
- Distributed solar contributed around **16.3 GW**, or nearly **36%**, of the **44.61 GW** solar capacity added during **FY 2025–26**, including **7.6 GW** under **PM-KUSUM** and **8.7 GW** through rooftop solar installations.

<u>Strengthening Global Solar Cooperation:</u>

International Solar Alliance (ISA):

- **India** and **France** jointly launched the **International Solar Alliance (ISA)** during **COP21 (Paris, 2015)** to promote global cooperation in solar energy deployment, technology transfer, capacity building and climate-resilient energy systems.
- The ISA facilitates collaboration among member countries by improving access to finance, encouraging innovation and supporting the large-scale deployment of affordable solar technologies, particularly across developing countries and the **Global South**.
- Countries including **Bhutan, Maldives, Germany, Greece, Italy, Luxembourg** and **Argentina** participate in the Alliance, strengthening international cooperation for renewable energy transition.

One Sun, One World, One Grid (OSOWOG):

- Proposed by India in **2018**, **One Sun, One World, One Grid (OSOWOG)** seeks to establish an interconnected global electricity grid capable of transmitting renewable energy across regions and time zones.
- Cross-border transmission can improve energy security, optimise renewable energy utilisation, reduce dependence on fossil fuels and balance electricity demand and supply across participating countries.

Green Grids Initiative (GGI):

- India and the **United Kingdom** launched the **Green Grids Initiative – One Sun One World One Grid (GGI–OSOWOG)** during **COP26 (Glasgow, 2021)** with support from countries such as **Australia, France, the United States** and the **International Solar Alliance**.
- The Initiative promotes international cooperation for renewable energy integration, modern transmission infrastructure and cross-border electricity trade.

India’s Leadership in Global Renewable Energy Transition:

- Through the **International Solar Alliance**, **Mission LiFE** and other multilateral partnerships, India promotes technology sharing, institutional capacity building and renewable energy access across developing countries.
- During its **G20 Presidency**, India played a significant role in building international consensus on the goal of **tripling global renewable energy capacity by 2030**, reinforcing its position as a leading advocate of global climate action and sustainable development.

Related UPSC Concepts:

Floating Solar Photovoltaic (FSPV):

- **Floating Solar Photovoltaic (FSPV)** systems install solar panels on water bodies such as reservoirs, lakes and irrigation tanks, thereby reducing land requirements, lowering water evaporation and improving panel efficiency through natural cooling.
- The recently approved **Pradhan Mantri Surya Sarovar Yojana (PM-SSY)** aims to accelerate floating solar deployment integrated with **Energy Storage Systems (ESS)**, improving grid reliability and renewable energy generation.

Energy Storage Systems (ESS):

- **Energy Storage Systems** store surplus renewable electricity for use during periods of low generation or peak demand, thereby improving grid flexibility, reliability and integration of intermittent renewable energy sources such as solar and wind.

Levelised Cost of Electricity (LCOE):

- **LCOE** represents the average lifetime cost of generating one unit of electricity after accounting for capital expenditure, operation and maintenance costs, fuel costs and financing expenses, making it a standard indicator for comparing the economic competitiveness of different power generation technologies.

Renewable Purchase Obligation (RPO):

- **Renewable Purchase Obligation (RPO)** is a statutory requirement that obligates electricity distribution companies and specified consumers to procure a prescribed percentage of electricity from renewable energy sources, thereby creating long-term demand for clean energy and encouraging investment in renewable power projects.

Conclusion:

- India's solar sector has evolved from a policy-driven initiative into a globally competitive renewable energy ecosystem supported by **large-scale deployment, affordable tariffs, domestic manufacturing, modern transmission infrastructure and active citizen participation**.
- Initiatives such as **PM Surya Ghar Muft Bijli Yojana, PM-KUSUM, Solar Parks Scheme, Green Energy Corridor Programme** and the newly approved **Pradhan Mantri Surya Sarovar Yojana** are strengthening energy security, reducing fossil fuel dependence and accelerating progress towards **500 GW of non-fossil fuel capacity by 2030** and **Net-Zero emissions by 2070**.
- Sustained investments in manufacturing, energy storage, grid modernisation and international cooperation will remain essential for establishing India as a global leader in clean energy and achieving long-term climate and sustainable development objectives.

Value Addition for UPSC:

Quick Revision Facts:

- **Installed Solar Capacity (30 June 2026): 162.15 GW**
- **Solar Capacity Added in FY 2025–26: 44.61 GW**

- **Total Non-Fossil Fuel Capacity: 283.46 GW**
- **Renewable Energy Capacity: 274.68 GW**
- **Solar Module Manufacturing Capacity (March 2026): ~172 GW**
- **National Solar Mission:** Flagship mission for large-scale solar deployment under the **National Action Plan on Climate Change (NAPCC)**.
- **PM Surya Ghar Muft Bijli Yojana:** Promotes residential rooftop solar through subsidies and concessional finance.
- **PM-KUSUM:** Supports decentralised solar generation, solar pumps and feeder solarisation for agriculture.
- **Pradhan Mantri Surya Sarovar Yojana (PM-SSY):** Promotes **Floating Solar Photovoltaic (FSPV)** projects integrated with **Energy Storage Systems (ESS)**.
- **International Solar Alliance (ISA):** India–France initiative launched at **COP21 (2015)** to promote global solar cooperation.
- **One Sun, One World, One Grid (OSOWOG):** India's initiative for creating an interconnected global renewable electricity grid.
- **Green Energy Corridor Programme:** Strengthens transmission infrastructure for renewable energy evacuation.
- **Approved List of Models and Manufacturers (ALMM):** Ensures quality standards while promoting domestic solar manufacturing.
- **Renewable Purchase Obligation (RPO):** Mandates procurement of a specified share of electricity from renewable sources.
- **Mission LiFE:** Promotes sustainable lifestyles to complement India's climate and clean energy commitments