

Solar Energy Annual Report 2024–25

SANTHOSSH.K.G

23EE046

1. Overview

The fiscal year **2024–25** marked a crucial period for India's solar energy sector. With ambitious renewable energy targets and rising global emphasis on climate action, the sector experienced **sustained growth in capacity addition, policy support, financial performance, and technological adoption**. India's solar mission continues to align with both national commitments under the Paris Agreement and international collaborations through the **International Solar Alliance (ISA)**.

This report provides a **comprehensive review** of the sector's performance during 2024–25, covering installed capacity growth, financial results, technology and innovation, sustainability outcomes, challenges, and a roadmap for 2025–2030.

2. Key Highlights

- **Installed Solar Capacity Growth:** Utility-scale solar parks, rooftop solar systems, and hybrid (solar-wind + storage) solutions recorded robust additions. Rooftop solar, in particular, crossed **10 GW cumulative installations**, making it a strong contributor to urban and commercial power needs.
 - **Government Support:** Policies such as **PLI (Production-Linked Incentive) schemes**, subsidies, concessional loans, and priority sector lending significantly boosted adoption rates.
 - **Rural Electrification:** Expansion of **microgrids** and **decentralized solar solutions** powered remote villages, reducing dependence on costly diesel generators.
 - **International Collaboration:** India enhanced its role in the **International Solar Alliance (ISA)**, facilitating cross-border partnerships, capacity-building programs, and knowledge-sharing initiatives.
-

3. Financial Performance

- **Revenue Growth:** Solar generation contributed to higher revenues both from **domestic power sales** and **export of solar equipment and services**.
 - **Cost Optimization:** The **per-unit cost of solar generation** fell further due to economies of scale, competitive bidding, and cheaper financing.
 - **Investments:** Strong capital inflows were observed in **solar research, large-scale solar parks, and storage technologies**, with foreign direct investment (FDI) rising compared to the previous year.
-

4. Technology & Innovation

- **High-Efficiency Solar Panels:** The deployment of **PERC (Passivated Emitter Rear Cell)**, **bifacial modules**, and **thin-film technologies** significantly improved energy yields.
 - **Hybrid Systems:** Expansion of **solar-wind hybrids** and integration of **battery storage** enhanced reliability and grid stability.
 - **IoT & AI Applications:** Predictive monitoring systems using **AI and IoT** improved fault detection, performance analytics, and reduced downtime.
 - **Emerging Solutions:** Pilot projects in **floating solar** (on reservoirs and dams) and **agrivoltaics** (solar integrated with agriculture) showed promising results for dual land use.
-

5. Sustainability & Impact

- **Carbon Emission Reduction:** The solar sector avoided the release of **millions of tons of CO₂ emissions**, contributing to India's climate commitments.
 - **Employment Generation:** Thousands of jobs were created across **manufacturing, project development, installation, and maintenance**.
 - **Environmental Benefits:** Solar adoption led to lower **fossil fuel dependence**, **improved air quality**, and reduced stress on thermal power plants.
-

6. Challenges

Despite strong progress, the sector faces structural challenges:

- **Land Acquisition:** Large-scale solar parks require significant land, often leading to delays.
 - **Intermittency:** Power fluctuations in the absence of adequate storage infrastructure remain an issue.
 - **Supply Chain Dependency:** Heavy reliance on **imports of solar cells and modules** exposes the sector to global disruptions.
 - **Grid Infrastructure:** Upgradation of **transmission networks** and integration of **smart grids** are urgently required for handling higher renewable penetration.
-

7. Current Renewable Energy Landscape in India

- **Total Installed Power Capacity:** ~428 GW.
- **Renewable Energy Share:** ~185 GW (~43% of total).
- **Breakdown:**
 - Solar: ~82 GW
 - Wind: ~44 GW
 - Bioenergy: ~10 GW
 - Small Hydro: ~5 GW

- **Rooftop Solar:** Crossed 10 GW cumulative installations.
 - **Progress:** India achieved **174 GW against the 175 GW target (2022)**, maintaining momentum toward the **2030 target of 500 GW renewable capacity**.
-

8. Future Roadmap (2025–2030)

Looking forward, the solar energy roadmap focuses on **scaling, localization, and innovation**:

1. **Scaling Up Capacity:** India is committed to achieving **500 GW renewable energy capacity by 2030**, with solar expected to contribute the largest share.
 2. **Rooftop Solar:** Stronger promotion of rooftop solar for **urban households, institutions, and industries**.
 3. **Domestic Manufacturing:** Establishment of **solar module and storage manufacturing hubs**, reducing import dependency.
 4. **Green Hydrogen:** Expansion of **solar-powered green hydrogen projects**, enabling India to emerge as a global hub for hydrogen exports.
 5. **International Cooperation:** Deeper **public-private partnerships** and cross-border collaborations through ISA and regional energy frameworks.
-

9. Conclusion

The year **2024–25** reaffirmed India's leadership in solar energy adoption and innovation. With a balanced mix of **policy support, private investment, and global cooperation**, the sector continues to drive sustainable growth. Overcoming challenges related to **land, storage, and supply chain dependencies** will be critical for meeting the **2030 renewable energy target** and ensuring a **clean, affordable, and reliable energy future for India**.