



Lighthouse

Info Systems Pvt. Ltd.



The Solar Supernova

Navigating the Triumphs &
Turbulence of India's Energy
Revolution

An Unprecedented Surge in Capacity, Ambition, and Complexity

104.6 GW

Total installed capacity by March 2025, fueled by a record **23.5 GW** added in FY2025.

A robust **68 GW** project pipeline ensures continued momentum.

>100 GW

Domestic module manufacturing capacity has soared past **100 GW**, driven by the PLI scheme.

However, critical dependencies on imported cells and wafers remain.

~20x

Solar emits nearly **20 times less** CO₂ than coal, but the industry faces challenges: manufacturing oversupply, trade barriers (e.g., **50% US tariff**), and tight profit margins.

India at the Forefront of the Global Solar Boom

Capacity Surge



23.5 GW

New **solar power** added in FY2025 alone (17.4 GW large-scale, 5.15 GW rooftop).

Global Ranking



3rd

India's global rank in total installed solar capacity, surpassing Japan.

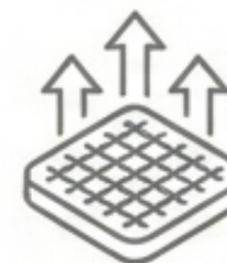
Economic Momentum



US\$24.9B

Projected **market size** by 2030, growing at a CAGR of ~13.4%.

Technological Edge



< **\$0.09/W** module prices have fallen, while innovations like tandem cells approach **30% efficiency**.

Utility-Scale and Rooftop Segments Fuel the Growth Engine

Dominance of Utility-Scale Projects

India's solar expansion is led by large-scale projects, with a strong pipeline of **68 GW** already auctioned. Execution, however, is often constrained by land acquisition and grid integration challenges.

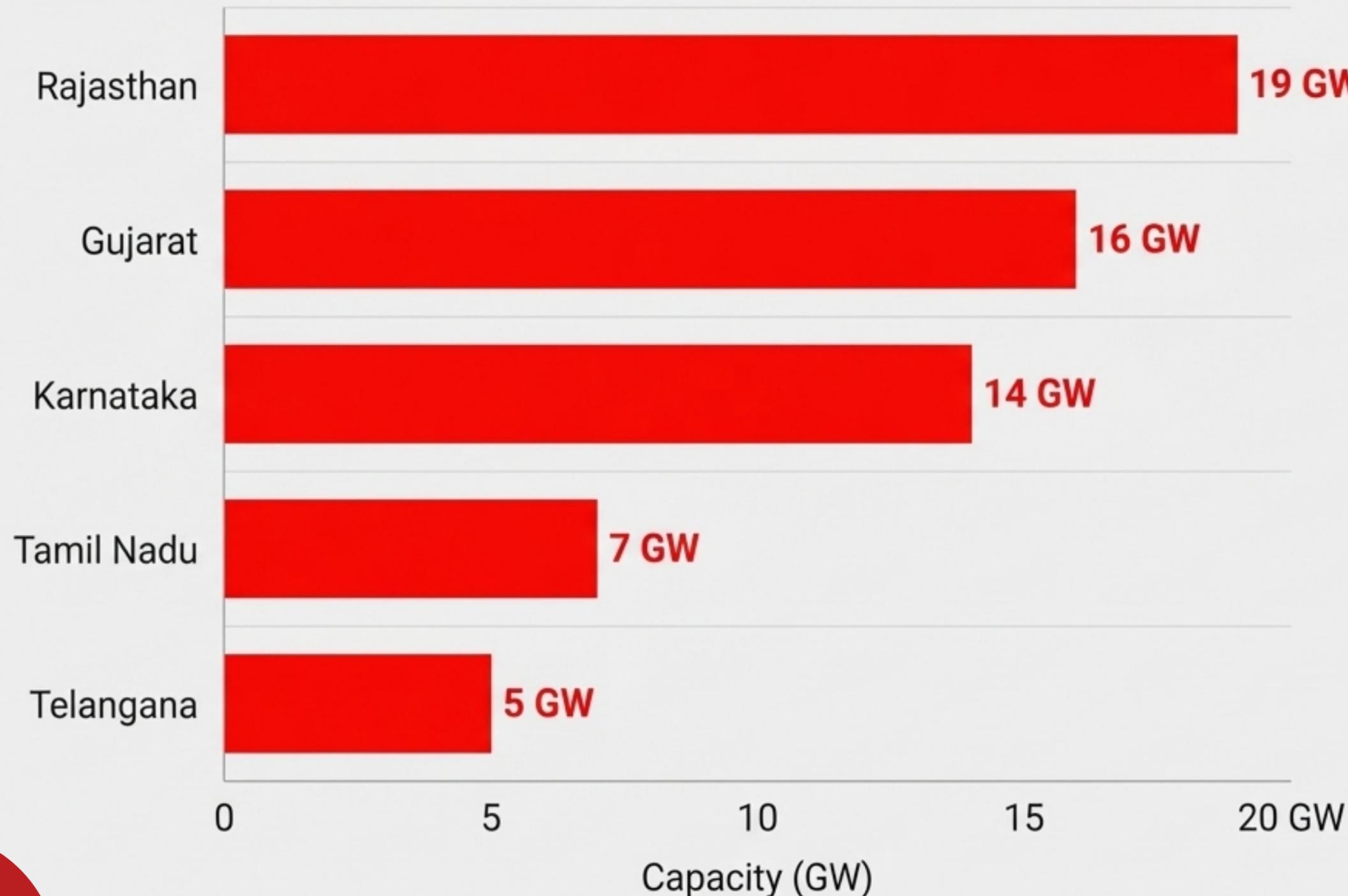
The Rise of Rooftop Solar

The rooftop segment is accelerating, adding **5.15 GW** in FY2025. Government initiatives like the **PM Surya Ghar scheme** are **critical drivers** for this distributed capacity growth.

Investor Confidence & Margin Pressure

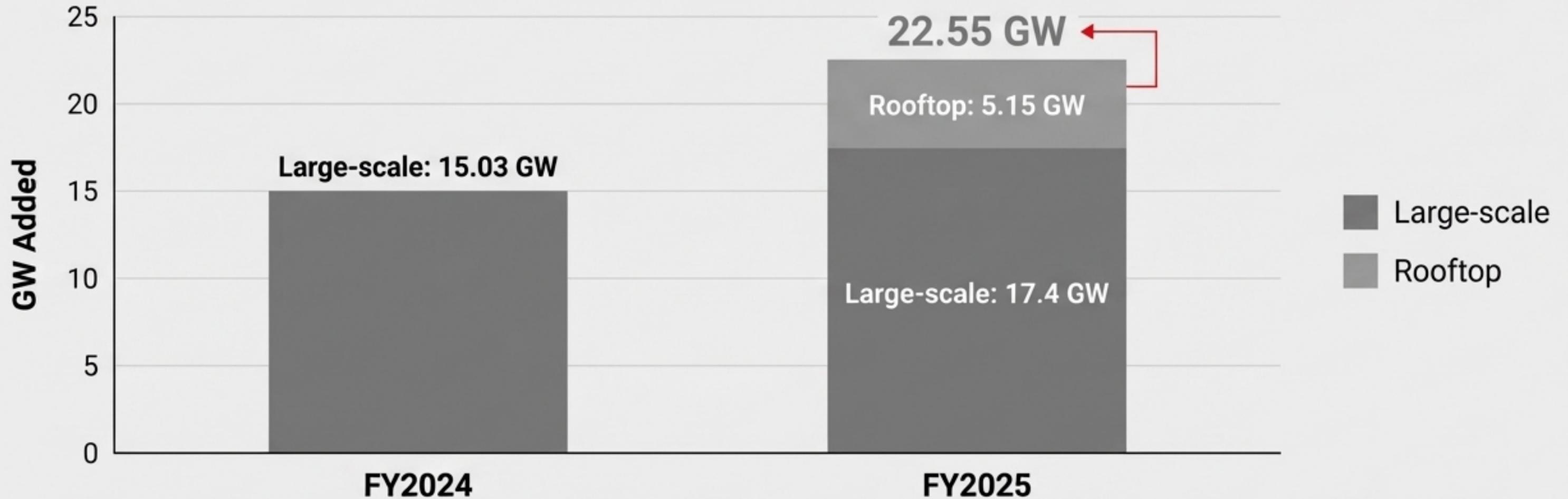
Stable policies and Renewable Purchase Obligations (RPOs) maintain **high investor confidence**. Despite this, **thin margins** from aggressive tariff bidding and rising input costs are **squeezing project profitability**.

Where the Power Lies: State-Level Solar Capacity (FY2025)



The top three states—Rajasthan, Gujarat, and Karnataka—collectively account for nearly 50 GW, showcasing significant regional concentration of solar capacity.

Accelerating the Transition: Annual Capacity Additions by Segment



FY2025 saw a significant jump in total additions, with rooftop solar's growing share indicating a maturing and diversifying domestic market.

Building from Within: The Domestic Manufacturing Surge

From **2.3 GW** (2014) to over **100 GW** (2025)



Policy-Driven Expansion

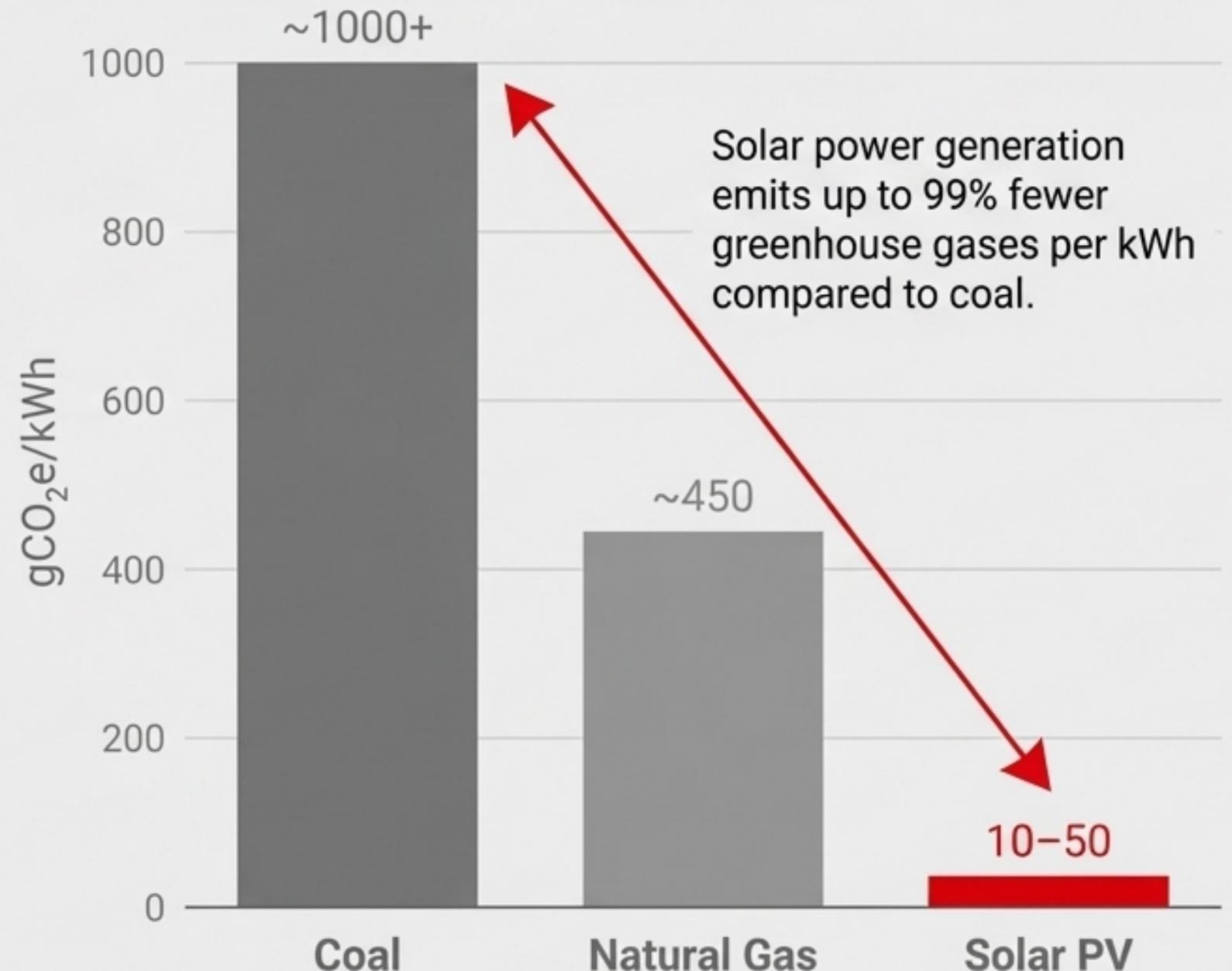
The Production Linked Incentive (PLI) scheme has been the primary catalyst, attracting investments of **₹48,120 crore** and fostering expansion by major firms like Waaree, Adani, and Tata Power.

The Persistent Gap

Despite massive module capacity, India remains dependent on imports for critical upstream components like polysilicon, wafers, and cells, representing a key strategic vulnerability.

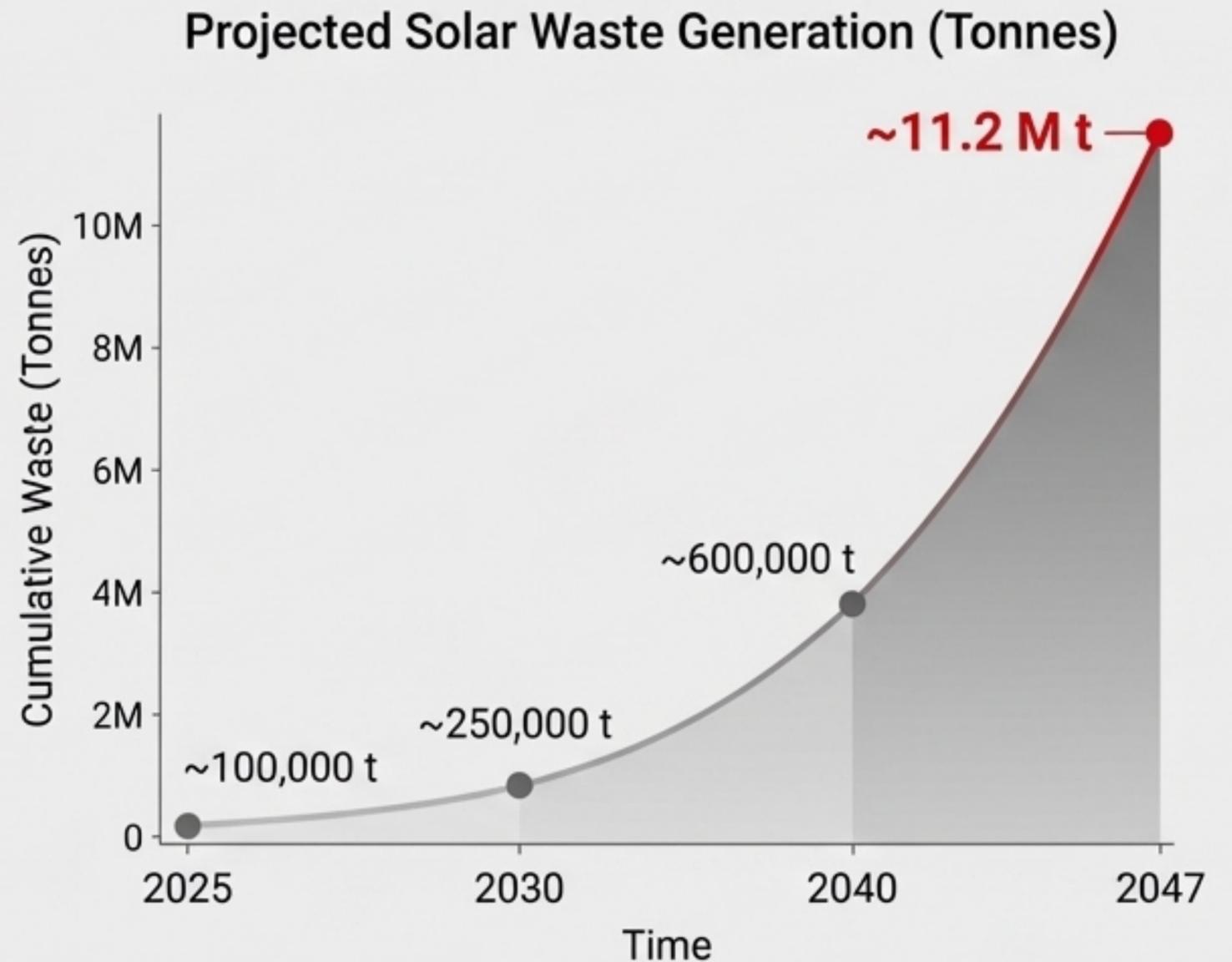
The Clean Energy Imperative: Solar's Decisive Environmental Advantage

- **Solar power** is a cornerstone of India's goal to **achieve 50% non-fossil energy by 2030**.
- Beyond cutting GHG emissions, solar projects significantly reduce air pollution and conserve vast amounts of water by eliminating the need for thermal cooling.



The Long Shadow: Quantifying the Solar Waste Challenge

- With over **100 GW** of installed capacity, India faces a significant end-of-life challenge for solar panels.
- The government is proactively addressing this by introducing **Extended Producer Responsibility (EPR)** rules.
- These rules will mandate that manufacturers manage the collection and recycling of decommissioned panels.



From Waste to Wealth: The Circular Economy Opportunity

Resource Recovery Value



₹3,709 Crore

Potential value of materials (silicon, glass, metals) recoverable from PV waste by 2047 (Source: CEEW).

Emissions Avoidance



37 Million Tonnes

CO₂ emissions that can be avoided by recovering and reusing materials instead of sourcing virgin resources.

Technological Innovation

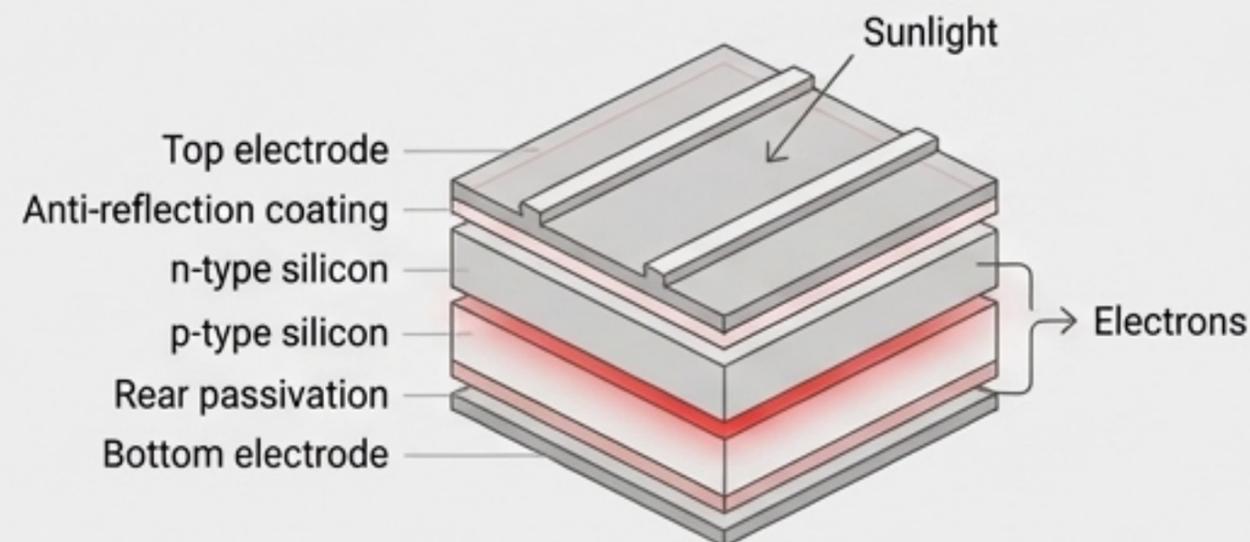


Indian firms are actively exploring advanced recycling methods like **laser separation** and **solvent recovery** to ensure solar energy remains truly sustainable from production to end-of-life.

The Technology Frontier: Driving Higher Efficiency and Yield

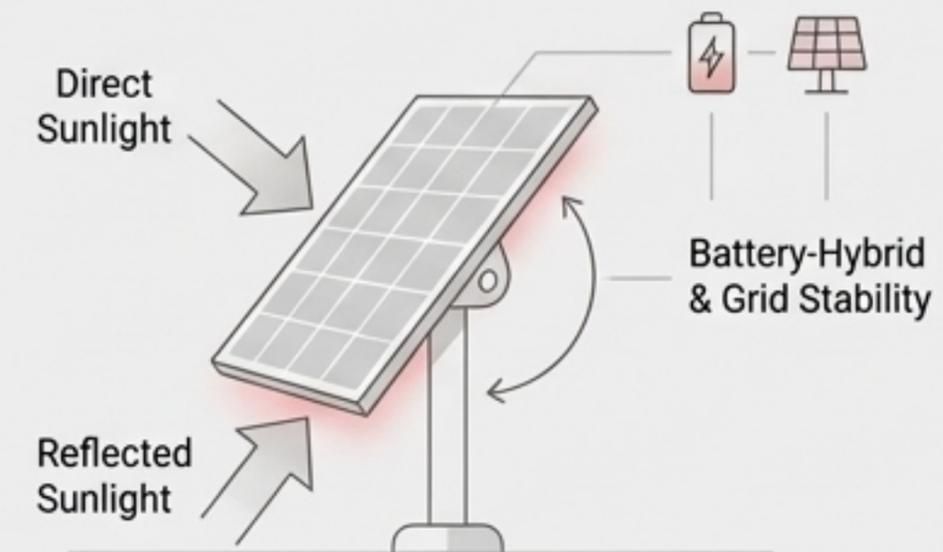
Panel Innovation

Crystalline silicon technologies (PERC, TOPCon) dominate with **20–25% efficiency**. Emerging HJT, IBC, and perovskite-tandem cells are pushing efficiency towards **30%**, maximizing power per unit area.



System Enhancement

The adoption of **bifacial panels**, **sun-trackers**, and **AI-driven monitoring** boosts project yield by **10–30%**. **Battery-hybrid projects** are becoming standard to improve grid stability and flexibility.

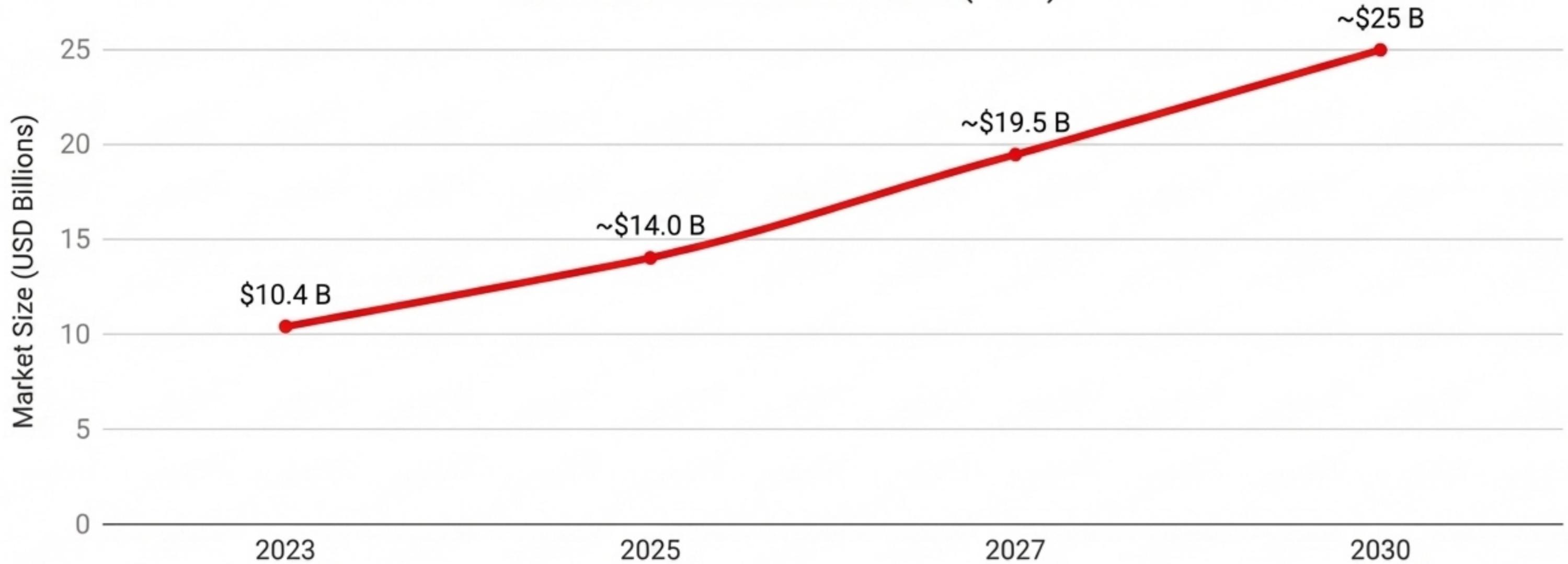


Solar's Levelized Cost of Energy (LCOE) has fallen by 90% since 2010, offering project paybacks of 6-10 years.

The Financial Engine: Fueling a Market Set to Reach \$25 Billion

Driven by over 85 GW of new installations planned in the next three years and falling costs, India's solar market is projected to grow at a compound annual rate of ~13.4%.

Revenue Growth Forecast (USD)



Capitalizing the Revolution Amidst Margin Pressure

Massive Capital Expenditure

~US\$360 Billion needed for renewables by 2030.

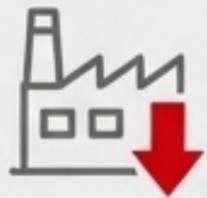
- **\$190-215 B** of this is earmarked for solar infrastructure.
- The **PLI scheme** alone has spurred **~\$5.5 B** in manufacturing capex for 31 GW of planned capacity.

Squeezed Profitability

Intense competition is driving down returns.

- Record-low tariffs of **₹2.0–2.3/kWh** leave developers with extremely thin margins.
- IEEFA warns PLI awardees face potential losses of **~\$4.8 B** if manufacturing targets are missed amid global overcapacity.

Headwinds on the Horizon: Navigating Critical Risk Areas



Manufacturing Overcapacity

Domestic capacity (~125 GW) is projected to far outpace annual demand (~35 GW), risking price wars and inventory surplus.



Trade & Policy Barriers

US/EU tariffs (e.g., 50% US duty) are cutting export viability. Frequent changes to domestic rules (ALMM/BIS) add uncertainty.



Supply Chain Dependence

Heavy reliance on imported **polysilicon, wafers, and glass** exposes the industry to global price volatility and geopolitical disruptions.



Grid & Curtailment

Limited transmission infrastructure and a lack of energy storage can lead to power curtailment, directly impacting project revenue.



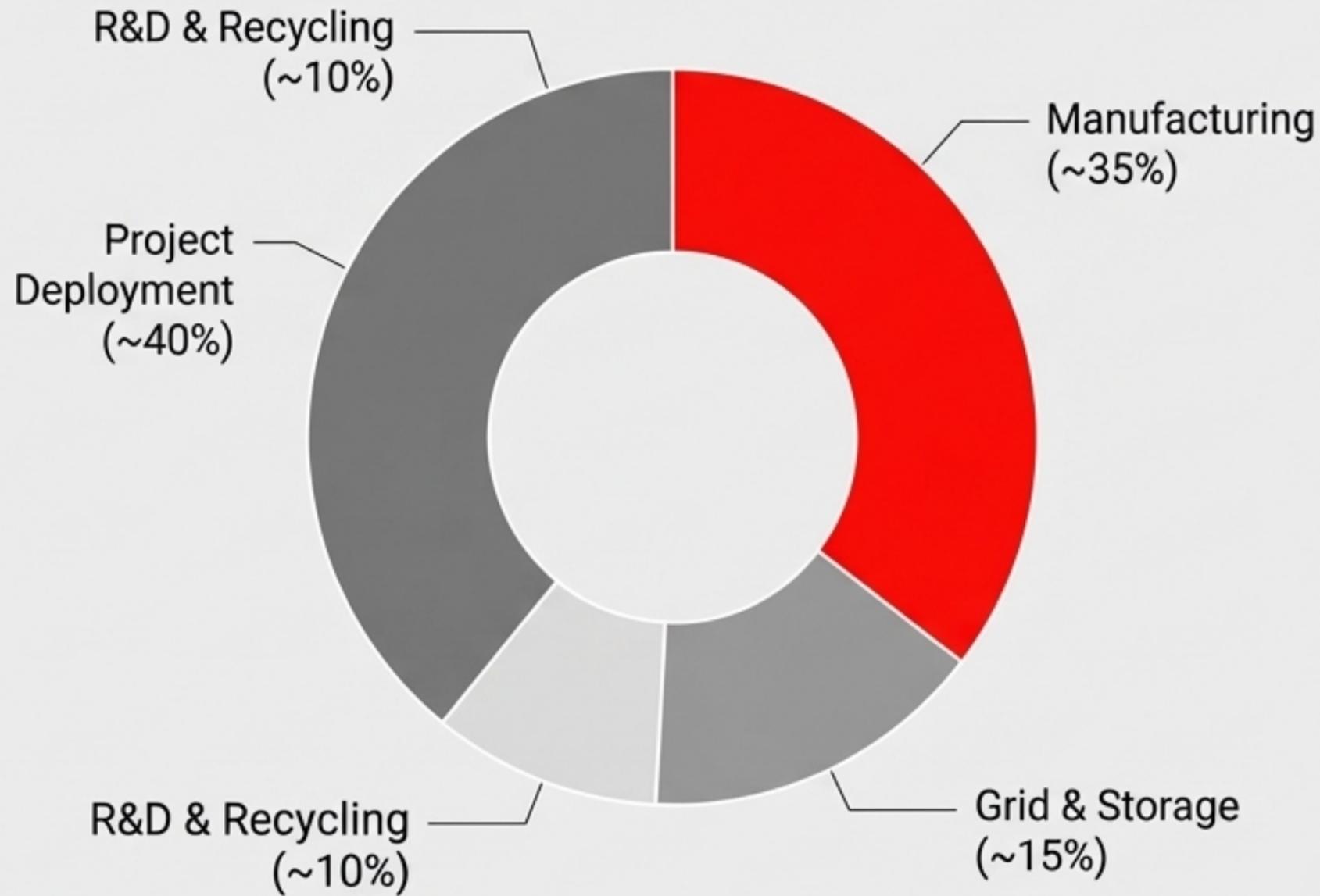
Financial Pressure

Thin margins make projects highly vulnerable to **cost overruns, interest rate hikes, and foreign exchange risks**.

The Challenge of Scale: Manufacturing Overcapacity vs. Demand (2025 Forecast)



Charting the Future: Solar Investment Distribution (2025–2030)



A Maturing Investment Profile

Future investment flows reflect a maturing industry, with significant capital moving beyond project deployment into upstream manufacturing, grid infrastructure, and critical R&D for next-gen technology and circularity.

Strategic Imperatives for Sustainable Growth

1. Secure the Supply Chain

Invest in domestic **polysilicon and wafer capacity** via extended PLI support and global JVs.

2. Lead with Innovation

Expand R&D in **high-efficiency PV tech** (tandem, perovskite) and integrated solutions like storage and green hydrogen.

3. Diversify Markets

Reduce export risk by targeting new regions (**Africa, Asia, LATAM**) and boosting domestic segments like **agrivoltaics**.

4. Enhance Operational Excellence

Focus on digital asset management and superior O&M to protect thin project margins.

5. Advocate for Policy Stability

Engage with policymakers to create transparent, long-term rules that foster investor confidence.

6. Champion the Circular Economy

Build **solar recycling infrastructure** and pioneer take-back programs to turn EPR compliance into a business opportunity.

The Indian Solar Outlook: A Synthesis

Triumphs & Opportunities

- **Booming Scale:** Over **104 GW** installed, with record growth and a massive pipeline.
- **Manufacturing Prowess:** **>100 GW** of domestic module capacity creates self-reliance but also oversupply risk.
- **Economic Engine:** A **\$10B+ market** with huge investment potential (~\$360B by 2030).
- **Sustainable Core:** A critical tool for climate action, with **20x fewer emissions** than coal.

Turbulence & Imperatives

- **Key Risks:** Trade barriers, supply chain gaps, and thin margins threaten profitability.
- **Emerging Challenges:** Solar waste management (**600k tonnes by 2040**) requires immediate action.
- **Strategic Mandate:** Success demands **vertical integration** (upstream and recycling), **technological leadership**, and **financial discipline**.
- **The Path Forward:** Fostering stable policies and investing in a circular economy are essential for long-term health.

PAN INDIA & GLOBAL PRESENCE



8R, Sector 18, Mihan, SEZ



14/4 I.T. Park ,Opp. VNIT



Lighthouse

Info Systems Pvt. Ltd.

Regd Office & DTA Unit
14/4, IT Park, Gayatri
Nagar, Nagpur-440022 (India)

SEZ EoU Unit
Plot 8R, Mihan SEZ, Khapri,
Nagpur - 441108, India

PBX : +91 8600004931, 8600004932
+91 9890168703, 8600068765

✉ mktg@lighthouseindia.com

🌐 www.lighthouseindia.com

🌐 www.lighthouseerp.com

🌐 www.lighthousecrm.com

🌐 www.lighthousehrm.com

🌐 www.b2bsangam.com