



Assessing the Development of **Rooftop Solar PV** in India



2025

Credits

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About Vasudha Foundation

Vasudha Foundation is a non-profit organisation set up in 2010. We believe in the conservation of Vasudha, which in Sanskrit means the Earth, the giver of wealth, with the objective of promoting sustainable consumption of its bounties. Our mission is to promote environment-friendly, socially just and sustainable models of energy by focusing on renewable energy and energy-efficient technologies as well as sustainable lifestyle solutions.

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1. Introduction

Globally, the transition to clean energy is accelerating to reduce emissions and mitigate the effects of climate change. At the forefront of this effort is the expansion of renewable energy (RE) to help decarbonise the electricity grid. India has witnessed a significant transformation in its energy sector, with installed RE capacity increasing from 58 GW in 2010-11 to 228.2 GW as of March 2025, making it the fourth-largest in the world in terms of installed RE capacity¹. This expansion aligns with the country's ambitious RE target of achieving 500 GW from non-fossil sources by 2030².

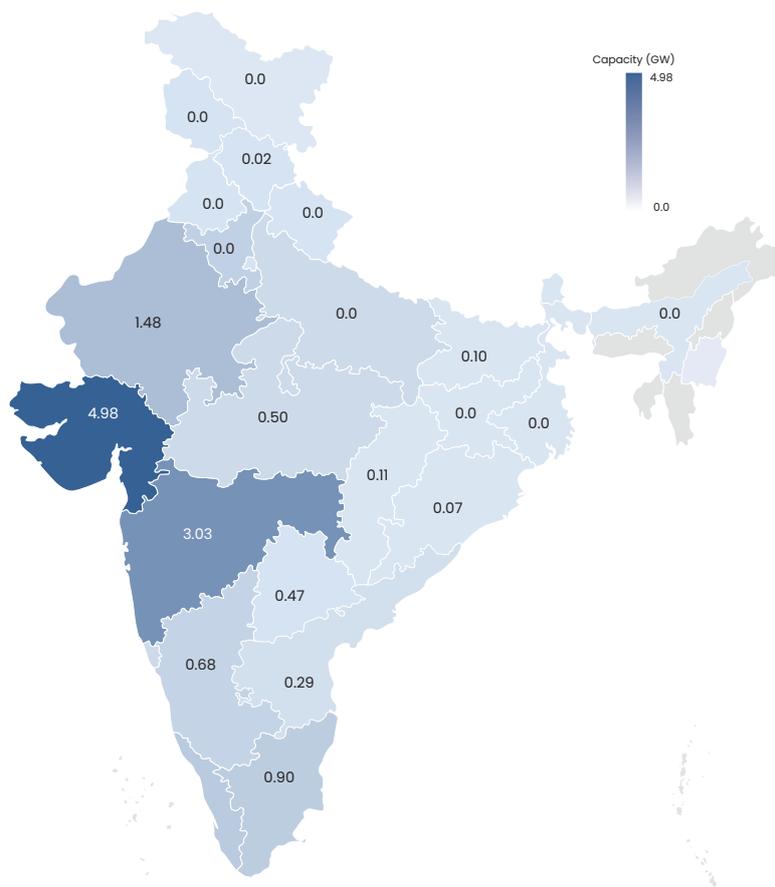


Figure 1: State-wise rooftop solar installed capacity

Solar and wind energy dominate India's RE landscape, accounting for 61 percent and 29 percent of the total installed RE capacity (excluding large hydropower plants), respectively. While the country is continuing its efforts to deploy utility scale solar energy projects, including Round-The-Clock (RTC) and Firm and Dispatchable Renewable Energy (FDRE) projects, harnessing solar energy as a form of Distributed Energy Resource (DER) is also an upcoming typology for deploying RE generators. For the same, the country is making significant efforts to promote Rooftop Solar Photovoltaic (RTPV), especially in the residential sector, enabling households to become electricity prosumers instead of merely electricity consumers. Rooftop solar has seen increased adoption in recent years, driven by favourable policies and upfront incentives from the central government, such as the PM-Surya Ghar: Muft Bijli Yojana. Additionally, state-level policies and regulations, including net metering and net billing, have further supported its growth. The current installed capacity of rooftop solar stands at 16.26 GW. Please refer to Figure 1 for state-wise installed rooftop solar capacity.

1 <https://iced.niti.gov.in/>

2 <https://pib.gov.in/PressReleaseframePage.aspx?PRID=2073038>



Government incentives, net metering policies, and the push for decentralised energy solutions continue to drive rooftop solar adoption across residential, commercial, and industrial sectors. Although the installed capacity has increased significantly, a vast potential remains untapped. In Uttar Pradesh alone, there exists a total potential of 89 GW, along with 62 GW in Maharashtra, and 56 GW in West Bengal, among other states. Additionally, no national-level assessment has been conducted for rooftop solar potential. However, insights can be drawn from studies by various organisations using satellite and drone-based mapping. Using this approach, Vasudha Foundation has identified rooftop solar potential in multiple cities across Uttar Pradesh. The estimated average potential per city, specifically within the Nagar Nigam area, is approximately 2.6 GW. For further details, refer to Figure 2, which presents the findings.

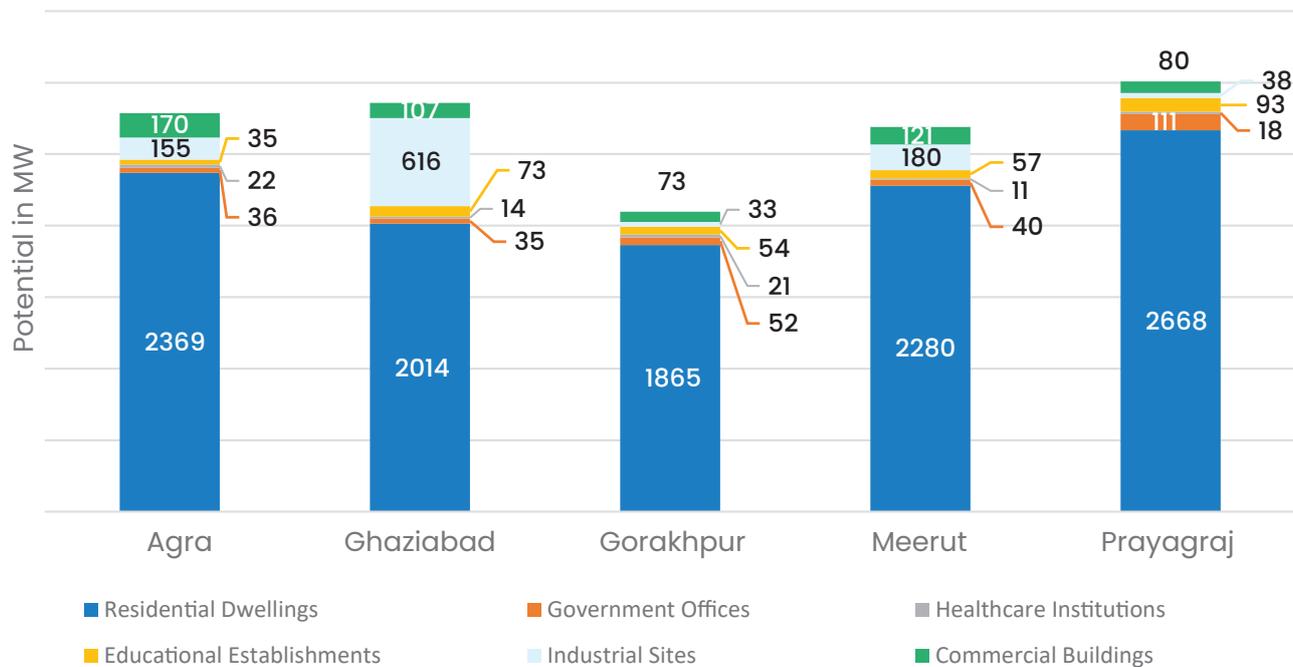


Figure 2: City-wise rooftop solar potential³

This report captures the issues highlighted by various government implementing agencies, RTPV developers, and Original Equipment Manufacturers (OEMs), including possible solutions, which shall lead to increased deployment of RTPV aiding to India’s goal of achieving 50 percent non-fossil fuel energy by 2030.



2. Policy Landscape



As the urgency to combat climate change grows, effective policy and regulatory frameworks play a crucial role in accelerating the shift to cleaner energy. Clear guidelines, incentives, and stable regulations help de-risk investments, attracting both domestic and global players to drive RE and energy storage deployment and progress toward Net-Zero Emissions. In fact, 84 percent of global utility-scale renewable capacity growth from 2024-2030 is expected to be policy-driven⁴. Well-defined policies not only set long-term targets but also create investor confidence by ensuring clarity in implementation.

India's RE landscape has evolved through continuous policy adaptation at both the national and state levels. These reforms are now expanding to address storage integration, ensuring smoother grid balancing and higher RE penetration, positioning the country to achieve its target of 50 percent cumulative electric power capacity from non-fossil fuel sources by 2030⁵. This section highlights key national-level policy and regulatory initiatives for enhanced adoption of rooftop solar PV, followed by a comparative analysis of policies across 10 Indian states⁶, which together represent over 72 percent of the country's renewable energy potential.



⁴ <https://iea.blob.core.windows.net/assets/17033b62-07a5-4144-8dd0-651cdb6caa24/Renewables2024.pdf>

⁵ [https://pib.gov.in/PressReleaseframePage.aspx?PRID=2073038#:~:text=The%20solar%20photovoltaic%20\(PV\)%20sector,the%20end%20of%20the%20year.](https://pib.gov.in/PressReleaseframePage.aspx?PRID=2073038#:~:text=The%20solar%20photovoltaic%20(PV)%20sector,the%20end%20of%20the%20year.)

⁶ States studied- Andhra Pradesh, Gujarat, Rajasthan, Odisha, Tamil Nadu, Karnataka, Telangana, Uttar Pradesh, Maharashtra, Madhya Pradesh



2.1 National Level Initiatives

Table 1 captures the key national-level policy initiatives that have been introduced to promote Rooftop Solar PV projects. The initiatives have been described on their key features, financial layout, expected impact, and implementation timeline.

Table 1: National level policy provisions

Initiative	Objective	Key Features	Financial Support	Impact (Achieved/Expected)	Implementation Timeline
Innovative Project Guidelines under PM-SGMBY	To identify and fund new innovative business models in rooftop solar, like peer-to-peer trading, etc	Financial assistance would be capped at 60% of the total project cost or INR 30 crore, whichever is lower	Financial outlay of INR 500 crore ⁷ has been allocated	N/A	Effective since October 2024
PM Surya Ghar Muft Bijli Yojana	1. 1 crore rooftop solar household installations	Subsidy of INR 78,000 for a 3-kW system Provision of collateral-free loans	Financial outlay of INR 65,700 crore ⁸	10.09 lakh installations out of 1 crore as on March 2025 ⁹	2024- 2027
	2. Model Solar Village with the vision to solarise one village per district	Projects would include rooftop solar, ground-mounted small-scale RE under PM KUSUM and standalone RE installations of capacity less than 10 MW at a single site	Financial outlay of INR 800 crore, with a CFA of INR 1 crore ¹⁰ per model village	N/A	Effective since August 2024
	3. To accelerate rooftop solar installations through RESCO and ULA business models	State Distribution Utilities can access the corpus under the Payment Security Mechanism to make project security payments to the Developers to avoid project delays	A corpus of INR 100 crore ¹¹ has been allocated	Derisk the project by avoiding security payment delays	Effective since December 2024
Virtual Net Metering (VNM) and Gross Net Metering (GNM) ¹²	Standard Operating Procedure guidelines introducing the framework of VNM and GNM	Guidelines provide the energy accounting and settlement methodology for VNM and GNM metering mechanisms	N/A	N/A	Since February 2023
Green Energy Open Access (GEOA) ¹³	Enable buyers to procure RE from any state	Open Access for consumers with 100 kW+ demand	N/A	90.4% growth in open access capacity, reaching 18.7 GW in FY24 ¹⁴	Notified by MoP in June, 2022
PM Surya Ghar: Muft Bijli Yojana National Portal (formerly National Portal for Rooftop Solar) ¹⁵	Single Window Clearance platform for residential rooftop installations	Easy registration process for consumers and vendors Transparent subsidy disbursal Knowledge centre hub	N/A	N/A	Launched in July 2022

7 <https://pmsuryaghar.gov.in/assets/files/6.%20Innovative%20Projects.pdf>

8 <https://pmsuryaghar.gov.in/assets/files/1.%20CFA%20to%20Residential%20Consumers.pdf>

9 [https://www.pib.gov.in/PressReleasePage.aspx?PRID=2110283#:~:text=PM%20Surya%20Ghar%3A%20Muft%20Bijli%20Yojana%20Crosses%20Milestone%20of%2010%20Lakh%20Installations&text=PM%20Surya%20Ghar%3A%20Muft%20Bijli%20Yojana%20\(PMS-GMBY\)%2C%20the,as%20of%2010th%20March%202025.](https://www.pib.gov.in/PressReleasePage.aspx?PRID=2110283#:~:text=PM%20Surya%20Ghar%3A%20Muft%20Bijli%20Yojana%20Crosses%20Milestone%20of%2010%20Lakh%20Installations&text=PM%20Surya%20Ghar%3A%20Muft%20Bijli%20Yojana%20(PMS-GMBY)%2C%20the,as%20of%2010th%20March%202025.)

10 <https://cdnbbsr.s3waas.gov.in/s3716e1b8c6cd17b771da77391355749f3/uploads/2024/08/2024080998431910.pdf>

11 <https://cdnbbsr.s3waas.gov.in/s3716e1b8c6cd17b771da77391355749f3/uploads/2024/12/20241230101814137.pdf>

12 <https://cdnbbsr.s3waas.gov.in/s3716e1b8c6cd17b771da77391355749f3/uploads/2023/10/20231005600102161.pdf>

13 https://greenopenaccess.in/assets/files/Green%20Energy%20Open%20Access_rules.pdf

14 https://ieefa.org/sites/default/files/2024-12/Impact%20of%20Green%20Energy%20Open%20Access_Dec2024.pdf

15 <https://pmsuryaghar.gov.in/#/>

Initiative	Objective	Key Features	Financial Support	Impact (Achieved/Expected)	Implementation Timeline
Electricity Rights of Consumers Rules (Amendment), 2021 ¹⁶	The amendment adds more rooftop metering arrangements, namely Gross-metering, Net-metering and Net-billing/Net feed-in	Based on the state regulations, prosumers can choose between Net-metering, Gross-metering and Net-billing/Net feed-in billing	N/A	N/A	Notified by MoP on April, 2021
Jawaharlal Nehru National Solar Mission (JNNSM)	Phase 1: (2010-13): 100 MW of small rooftop solar installations Grid Connected Rooftop Solar System (GCRTS) Phase 2: 40 GW ¹⁷ of grid-connected rooftop solar systems	Phase 1: MNRE shall provide GBI ¹⁸ to the State Utilities equal to the difference between CERC and base tariff GCRTS Phase 2: CFA of INR 14,588/kW up to 3 kW and INR 7,294/kW for RTS capacity above 3 kW up to 10 kW ¹⁹	INR 15,050 crore as a capital subsidy under Phase 1 ²⁰ Financial outlay of INR 11,814 crores under Phase 2 ²¹	11.87 GW out of 40 GW. (Rooftop capacity added as on March 2024) ²²	2010-2026 ²³ . *(GCRTS Phase-2 is currently subsumed ²⁴ under PM-SGMBY in March 2024)



2.2 State Policy Provisions

Rooftop solar PV adoption across India's leading RE states reflects a mixed policy landscape. While some states have made commendable strides in setting segment-wise targets and enabling mechanisms, others display gaps in clarity and support. Karnataka and Uttar Pradesh stand out with clear rooftop targets (2 GW and 6 GW respectively) divided across consumer segments like residential, Commercial and Industrial (C&I), and government buildings. In contrast, states like Gujarat, Telangana and Rajasthan have included their rooftop solar targets within their overall solar ambitions. Incentives and financial support are also primarily routed through MNRE's Central Financial Assistance (CFA) scheme for residential consumers, with a few states offering state-level benefits.

The concept of virtual net metering and Distributed Energy Resource (DER) aggregation—highlighted in Andhra Pradesh - demonstrate a more progressive approach for group consumers and societies as well. Similarly, Karnataka is experimenting with peer-to-peer trading models through smart contracts, setting a precedent for future innovation.

However, there seems to exist a lack of operational clarity in the policies, such as- DT loading limits, capacity caps, and data transparency. Karnataka provides detailed transformer loading norms (75% DT cap), while most other states defer to SERCs or leave these aspects undefined. Notably, centralised data rooms to track rooftop deployment are absent across the board, which hinders monitoring and policy feedback loops.

In essence, while rooftop solar is recognised as a critical pillar in state RE strategies, policy implementation varies in ambition, depth, and clarity. States that provide differentiated targets, streamlined approvals, and supportive business models are better positioned to scale rooftop adoption rapidly under schemes like PM-Surya Ghar Yojana. Table 2 provides us with a comprehensive view of the rooftop solar PV policy provisions in state-specific policies

¹⁶ https://powermin.gov.in/sites/default/files/Electricity_Rights_of_Consumers_Amendment_Rule_2021.pdf

¹⁷ <https://pib.gov.in/newsite/PrintRelease.aspx?relid=122567>

¹⁸ <https://hareda.gov.in/introduction-jnnsn/#:~:text=Ministry%20of%20New%20%26%20Renewable%20Energy,down%20costs%20towards%20grid%20parity.>

¹⁹ <https://www.pib.gov.in/PressReleasePage.aspx?PRID=1983208>

²⁰ <https://pib.gov.in/newsite/PrintRelease.aspx?relid=122567>

²¹ <https://pib.gov.in/PressReleaseIframePage.aspx?PRID=1947477#:~:text=The%20Minister%20informed%20that%20the,operational%20area%20of%20the%20DISCOMs.>

²² <https://cdnbbsr.s3waas.gov.in/s3716elb8c6cd17b771da77391355749f3/uploads/2024/05/20240524405410771.pdf>

²³ <https://mnre.gov.in/en/grid-connected-solar-rooftop-programme/>

²⁴ https://pmsg-production-public.s3.ap-south-1.amazonaws.com/notifications/Operational_Guidelines_for_Implementation_of_Component_Incentives_to_Discoms.pdf

Table 2: Rooftop solar provisions by states

Parameter	Deployment Target (MW) (segment wise)	Innovative business models (for eg: Peer-to-peer etc.)	Subsidy	Additional incentives	Maximum and minimum rooftop solar installation allowed:	DT loading allowed	Data room provisions	Single-window clearance for rooftop approvals
Andhra Pradesh	At least 10 lakh households are targeted for grid-connected SRTPVS under PM Surya Ghar Yojana. Additionally, the state plans rooftop installations on all government-owned buildings in saturation mode.	The policy introduces Distributed Energy Resource (DER) aggregation, where aggregators coordinate approvals, install SRTPVS, support CFA disbursement, and provide O&M. No peer-to-peer models are explicitly mentioned.	Central Financial Assistance (CFA) is extended under MNRE schemes. The state additionally provides 100% SGST reimbursement for SRTPVS on residential buildings and government structures.	DER aggregators receive INR 1,500/kWp for first 2 kW, and INR 1,000/kWp thereafter as service/aggregation fee from DISCOMs. No administrative charges for SRTPVS below 5 kWp.	Not explicitly defined in MW/kW. However, DER aggregation fee slabs and metering provisions imply promotion of residential-scale systems (1-10 kW).	Not directly mentioned. The policy defers to APERC's metering and banking regulations and encourages DISCOMs to handle approvals through DER aggregators.	No explicit mention of a centralised data portal or room for rooftop solar.	Single-window portal to be developed by NREDCAP for all RE projects, including rooftop solar, for obtaining time-bound statutory clearances.
Gujarat	No explicit target mentioned, but rooftop solar is included under policy scope.	Not explicitly addressed.	Eligible to claim central/state subsidies under respective schemes.	Carbon credit benefits to be passed to DISCOMs for subsidised rooftop systems.	Not defined in the policy.	Not specified; governed by technical feasibility as per GETCO/DISCOM.	Not explicitly mentioned.	GEDA to enable online single-window portal for project registration and approval.
Karnataka	2,000 MW (2 GW) rooftop solar targeted by 2027; further segmented into residential, commercial, and industrial, and government buildings.	Policy encourages third-party models like RESCO and peer-to-peer trading through blockchain and smart contracts (under pilot stage with KERC approval).	MNRE subsidy applicable for residential consumers; state does not provide additional subsidy.	Exemption from electricity tax for rooftop solar under captive use; stamp duty concession on loan agreements.	Minimum: 1 kW; Maximum: 1 MW per consumer as per KERC rooftop guidelines.	Rooftop installations allowed up to 75% of distribution transformer capacity to avoid overloading (as per KERC norms).	No specific mention of a data room, but KREDL is mandated to maintain online RE project information systems.	KREDL designated as single-window clearance agency for rooftop systems; DISCOMs to coordinate approvals via centralised portal.
Madhya Pradesh	4,000 MW targeted under rooftop and distributed solar projects by 2030.	No mention of innovative business models like peer-to-peer trading in the policy.	MNRE subsidy applicable for residential rooftop; state to facilitate central subsidy disbursement.	100% exemption from electricity duty and cess for 10 years; support for group housing societies under RESCO/CapEx models.	As per MPERC guidelines; specific kW limits not detailed in the policy.	No specific mention in the policy. Expected to follow DISCOM technical feasibility norms.	No mention of a centralised data room or portal specifically for rooftop data aggregation.	MPUVNL designated as nodal agency to facilitate approvals through a single-window system; portal-based tracking to be strengthened.
Maharashtra	2000 MW	N/A	N/A	N/A	N/A	MSEDCL will look into the technical feasibility of providing grid connectivity from a location close to the grid distribution network.	N/A	Single window web system for permits and approvals pertaining to various administrative departments to be developed by Maharashtra

Parameter	Deployment Target (MW) (segment wise)	Innovative business models (for eg: Peer-to-peer etc.)	Subsidy	Additional incentives	Maximum and minimum rooftop solar installation allowed:	DT loading allowed	Data room provisions	Single-window clearance for rooftop approvals
Odisha	N/A	N/A	Rooftop consumers will be provided subsidies/ incentives as per the guidelines of Central/State Government	Rooftop consumers will be provided subsidies/ incentives as per the guidelines of Central/State Government	N/A	N/A	N/A	Single window clearances & standard timelines shall be followed in registration and approvals.
Rajasthan	Part of the 90 GW RE target; no separate rooftop-specific MW target specified in policy.	No mention of innovative business models like peer-to-peer trading in rooftop segment.	Policy supports leveraging central financial assistance (CFA) under PM-Surya Ghar Yojana; no additional state subsidy announced	Exemptions from Electricity Duty and benefits under Rajasthan Investment Promotion Scheme (RIPS) 2024.	No specific maximum or minimum capacity caps mentioned beyond those mandated by central regulations (like 500 kW net metering cap).	To be governed by RERC and DISCOM norms; no explicit DT loading specifications in the policy.	No dedicated data room or portal provision mentioned for rooftop solar developers.	Policy states RREC will operate a single-window clearance mechanism for all RE projects, including rooftop.
Tamil Nadu	Achieve an installed solar energy generation capacity of 9,000 MW by 2023	Two business models mentioned: 1. Upfront ownership 2. Deferred Ownership: The solar system is installed and operated by the supplier. The purchaser makes system performance-based payments to the supplier or leases the system from the supplier	N/A	1. Consumer category solar energy will be exempted from the electricity tax for two years from the date of this policy 2. A suitable incentive scheme will be designed to promote solar energy generation in the agricultural sector 3. Solar energy injected into the grid of the distribution licensee by solar energy producers who have no RPOs, including solar energy exports by non-obligated electricity consumers, can be claimed by the distribution licensee towards fulfilment of their RPO	N/A	Not mentioned	Not mentioned	Not mentioned

Parameter	Deployment Target (MW) (segment wise)	Innovative business models (for eg: Peer-to-peer etc.)	Subsidy	Additional incentives	Maximum and minimum rooftop solar installation allowed:	DT loading allowed	Data room provisions	Single-window clearance for rooftop approvals
Telangana	No standalone rooftop solar MW target is specified. However, the state aims to target solar capacity of 7889 MW by FY30 and 26374 MW by FY35	The government will facilitate the pooling of rooftop space in the government educational spaces and offer it to industries/MNCs etc., to develop rooftop solar projects.	100% net SGST reimbursement	N/A	N/A	N/A	The nodal agency will assist the heads of department in the aggregation of rooftop space and finding the potential capacity in their establishments across the state	N/A
Uttar Pradesh	6,000 MW by 2026-27; 4,500 MW Residential; 1,500 MW C&I	No explicit mention of P2P or other business models in the policy document.	CFA under MINRE guidelines applicable. No additional state subsidy mentioned for residential or other segments.	No specific additional state financial incentives mentioned beyond net/gross metering and exemption from electricity duty.	As per UPERC regulations; no specific minimum/maximum defined in policy.	Not explicitly defined in the policy; to be governed by UPERC Rooftop Solar Regulations and DISCOM technical feasibility.	No mention of a centralised data room for rooftop solar in the policy.	UPNEDA's single-window portal intended to support project development, but no specific mention for rooftop-focused clearance mechanism.





3. RTPV Value Chain

To understand the challenges that persist in RTPV project implementation and to find targeted solutions, it is necessary to take stock of the various stakeholders participating in the ecosystem. As depicted below in Figure 3, we observe that there are three primary categories of stakeholders that influence RTPV project implementation.

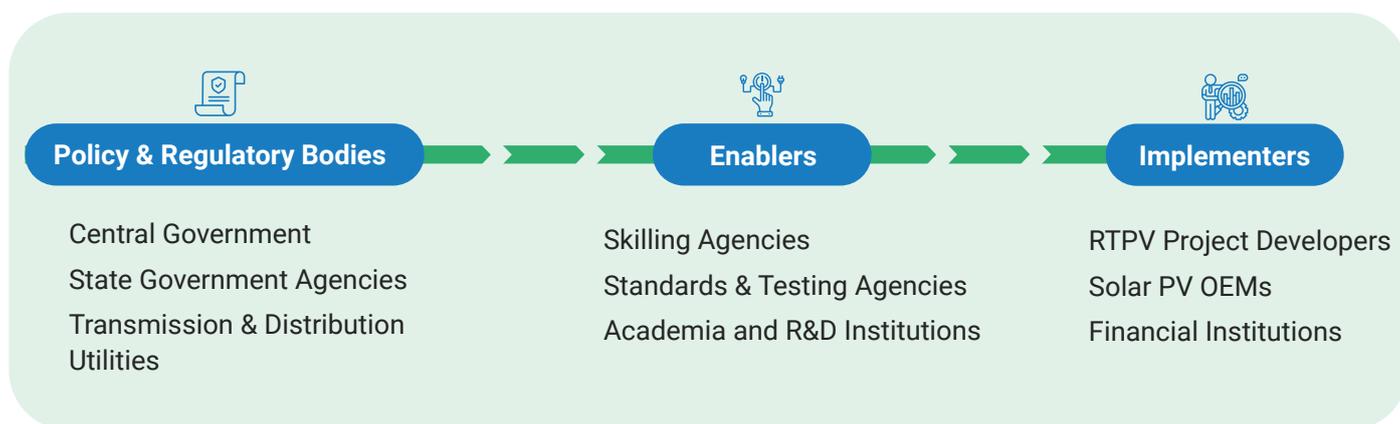


Figure 3: Stakeholder groups in the RTPV ecosystem

3.1 Policy and Regulatory Bodies

As detailed in the previous chapter, a stable policy and regulatory framework is of utmost importance for de-risking RE and energy storage projects, driving more investment into the sector, ensuring smoother implementation of the projects, and thereby leading to faster adoption in the country’s energy mix. There are three major stakeholder groups concerning policy and regulatory affairs:

» **Central Government Bodies**

The central government bodies play an important role in formulating the policy and regulatory frameworks in India. The Centre is expected to draw guidelines, launch subsidies, and release mandates, nationwide, enabling states to gain guidance and formulate their own state-wise policies for the implementation of RE and energy storage projects. Schemes and policies, as discussed in the above section, are created by the central bodies with the interests of project developers and consumers in mind. The central government agencies approached for this study include the Ministry of New and Renewable Energy (MNRE), and the Solar Energy Corporation of India (SECI).

» **State Government Agencies**

State agencies oversee the entire project lifecycle, from tendering and providing state approvals to commissioning. Their responsibilities include potential assessment, forecasting future demand, formulating state-specific RE policies, introducing state-level subsidies, and managing project tendering and implementation in alignment with projected demand. The state government agencies considered as part of this study are shown in Annexure 1. Additionally, for RTPV systems, state implementing agencies also enlist trusted vendors for RTPV system installation in residential sector.



» **Transmission and Distribution Utilities**

Transmission and distribution utilities play a crucial role in shaping the RE landscape of the country. As the custodians of the electricity grid, they are responsible for the efficient evacuation of power from RE plants and providing off-taker guarantees to RE projects. Reliable power, facilitated through energy storage systems, not only enables the integration of more RE into the grid but also helps Distribution Companies (DISCOMs) reduce their dependence on fossil fuels, allowing them to procure green energy from RE projects for supply to both domestic and commercial consumers in their regions. Annexure 2 captures the list of stakeholders operating at the state level and considered for our study.



3.2 Enablers

While policy and regulatory bodies create a favourable environment for the development of RTPV projects, the continued growth of the RTPV sector also depends on a skilled workforce, ongoing research into new technologies, and robust testing processes to ensure the quality of power. The organisations offering skilling programmes for the workforce and those involved in the research and development of RTPV technologies, have been identified, and are shown in Annexure 3.



3.3 Implementers

While policy-making organisations and enablers lay the foundation for the future of RE in India and work towards developing a skilled workforce, the role of implementers is crucial in turning the country's RE potential into reality through RTPV project development. For the requirements of this study, a participation was sought from institutions listed in Annexure 4.





4. Stakeholder Insights

For gaining a holistic view of the RTPV ecosystem in India, in-person interactions were held with various stakeholders of the RTPV value chain, as described in the previous section. These interactions played a crucial role in helping us identify the gaps that exist in the ecosystem, as well as the solutions that may be deployed to address them, ultimately accelerating the deployment of RTPV projects.



4.1 Overview of Key Challenges Identified

💡 **Complex Process for C&I Consumers:**

C&I consumers face significant challenges in deploying rooftop solar systems due to the absence of a well-defined procedure and a dedicated online portal to streamline the process across states. The lack of a standardised, transparent framework makes it difficult for businesses to navigate approvals, permits, and net billing applications efficiently. Additionally, DISCOMs are often reluctant to onboard high-paying consumers for rooftop solar adoption, as it impacts their revenue from large-scale electricity consumers. This resistance leads to delays, a lack of support, and uncertainty in project execution, discouraging widespread adoption of rooftop solar in the C&I sector.

💡 **Ambiguous Bank Processes Despite Collateral-Free Loan Provisions:**

Although the PM-Surya Ghar scheme allows collateral-free loans for rooftop solar, banks continue to demand varying and excessive documentation, such as property ownership proof. A lack of uniform Reserve Bank of India (RBI) guidelines has led to confusion and delays in loan approvals, discouraging potential adopters.

💡 **Lack of Payment Security Mechanism for Vendors:**

Vendors often face financial risks when customers delay or withhold payments after claiming subsidies. To address this issue, a clear payment security mechanism is needed to protect vendors from defaults and ensure timely reimbursement. The central government should issue a directive requiring consumers to clear dues to developers once their subsidies have been released. Failure to do so should result in penalties, ensuring that developers are paid promptly and safeguarding the financial stability of the RE sector.

💡 **Duplicity of Serial Numbers on DCR Modules Hindering Subsidy Disbursal:**

The issue of duplicate serial numbers on domestically manufactured (DCR) solar panels creates confusion during verification, leading to subsidy cancellations or delays. A stricter tracking mechanism and better coordination between manufacturers and approving authorities can resolve this problem.

💡 **Exclusion of Residential Society House Owners from PM-Surya Ghar Subsidy Due to Single Point Electricity Connection:**

As many housing societies have a single metered connection for the entire complex, individual homeowners are unable to install subsidised rooftop solar systems. Policy adjustments allowing sub-metering or alternate subsidy disbursement models could help residents in such societies benefit from the scheme.

💡 **Inadequately Calculated Distribution Transformer (DT) Capacity Capping:**

Currently, DT capping is based on archaic methods, which is ultimately slowing the adoption of RTPV in some regions. The approach needs to be revised and a new methodology for calculating DT capacity limits should be devised.

💡 Shortage of DCR Solar Modules Forcing Consumers to Opt for Non-DCR Panels:

The limited supply of DCR (domestically manufactured) solar modules has led many consumers to opt for non-DCR panels, making them ineligible for subsidies. Availability of DCR modules is especially low in tier 2 and tier 3 cities, further restricting access. The situation is worsened by hoarding practices among some dealers, who artificially inflate prices.

💡 Quality Concerns in Domestically Manufactured Solar Modules:

Rooftop solar developers have raised concerns about the quality inconsistencies in domestically manufactured solar modules. Many modules available in the domestic market are of lower quality compared to export-grade products, impacting long-term performance. The market is flooded with substandard modules suffering from critical defects such as cold soldering, grid breaks, micro-cracks, and cell scratches, resulting in efficiency losses and reduced lifespan. These issues affect project viability and erode consumer confidence in rooftop solar adoption.

💡 Delays in Subsidy Disbursement Slowing Rooftop Solar Adoption:

Frequent policy updates and slow implementation of subsidy disbursements create uncertainty among consumers and vendors. Faster processing and timely updates from regulatory bodies can ensure smoother adoption of rooftop solar.

💡 Unavailability of Testing Beds for Net-Metering Causing Project Delays:

The lack of sufficient certified testing facilities for net meters results in extended wait times for system approvals and commissioning. Establishing more accredited testing centres across states can speed up the process and prevent unnecessary delays in project execution.

💡 Deployment of Sub-Par Solar Systems:

Despite technical guidelines issued by MNRE, many vendors are unaware of critical aspects such as shadow analysis, proper surge protection devices (SPDs) optimisation, and other essential system components. This results in inefficient and underperforming solar installations, affecting system reliability and consumer satisfaction.

💡 Lack of Consumer Awareness:

The sector suffers from limited public awareness, with regard to the system cost, subsidies available and the monetary benefits they may reap from the system in the long run. In-depth discussions with various stakeholders of the ecosystem also gave us an understanding that although many states in India have a payment mechanism for the surplus energy generation via RTPV systems, consumers are hardly aware of the same.

💡 Consumer Difficulty in Selecting Local Vendors:

On the national portal, consumers are shown the entire list of empanelled vendors for their state, regardless of the vendor's actual operational base. As a result, consumers often select vendors who do not have physical presence in their city or region, leading to logistical challenges, service delays, and poor after-sales support.

💡 Limited Clarity on Balcony Solar:

While MNRE has approved balcony solar systems for CFA under the PM Surya Ghar Yojna, state-level policies remain unclear, slowing adoption. RWAs, which have high paying capacity and significant potential for solar deployment, lack clear guidelines, leading to untapped growth in this segment

💡 Lack of Clarity Around Warranty of Rooftop Solar Components:

Consumers often assume their entire rooftop solar system is covered under a 25-year warranty, when in reality, only the solar modules are covered under such warranty, given the modules have a

manufacturing defect. Inverters typically have 8–10 years of coverage, and in cases where vendors shut down, consumers face difficulties in claiming warranties directly from manufacturers. This uncertainty reduces consumer confidence and needs better communication.

💡 DRE-Based Solutions Limited to Grid Feeding:

Currently, DRE systems primarily feed energy into the grid, missing opportunities to provide ancillary services such as reactive power injection, voltage control, and frequency regulation. There are OEMs exploring these services, but regulatory frameworks do not yet accommodate their integration into the grid effectively.

4.2 Recommended Solutions

- 💡 Expanding the single-window portal beyond the residential segment to include commercial and industrial consumers, simplifying approvals and accelerating implementation.
- 💡 Adopting best practices from states such as Rajasthan, which has removed the No Objection Certificate (NOC) requirement for projects under 10 kW, waived application charges, and exempted net meter testing charges. It will help reduce bureaucratic hurdles and accelerate project deployment.
- 💡 Introducing a structured rating system for vendors based on technical expertise and service quality will help consumers choose reliable vendors and encourage better industry standards. Moreover, restricting vendor listings on the national portal based on their operational presence will simplify consumer selection and improve service accessibility.
- 💡 Increasing local manufacturing capacity and temporarily easing DCR restrictions will help bridge supply gaps and ensure affordability without compromising efficiency.
- 💡 Strengthening regulatory oversight to prevent artificial price inflation by solar module dealers and promoting a transparent and competitive solar market. Establish a dedicated working group to ensure transparent price monitoring and benchmarking, avoiding significant disparity between factory gate prices and dealer-provided rates.
- 💡 Stringent quality control measures should be enforced on module manufacturers to ensure consistent product standards. Manufacturers supplying subpar modules should be subjected to penalties and stricter regulations to maintain quality assurance across the market. A robust quality certification and monitoring framework will help safeguard consumer investments and ensure the long-term reliability of rooftop solar systems.
- 💡 States should issue specific implementation guidelines and incentives for balcony solar to encourage adoption. These should include the maximum deployable capacity, orientation and structural requirements. Clear policies for Resident Welfare Associations (RWAs) and multi-storey residential complexes will help unlock this market segment and drive installations.
- 💡 State Nodal Agencies (SNAs) for rooftop solar should initiate consumer education campaigns to raise awareness of warranty coverage across different components of rooftop solar systems. Vendors should also be mandated to provide transparent warranty documentation and contingency plans for warranty claims in case they cease operations.
- 💡 Regulatory frameworks should be developed to support the aggregation of distributed solar and storage resources into virtual power plants (VPPs). These aggregated assets could then provide ancillary services to the grid, making rooftop solar more valuable beyond simple energy generation.
- 💡 Policies and regulations should be introduced to incentivise OEMs and DRE system owners to provide reactive power support, voltage regulation, and other ancillary services. Corresponding tariff mechanisms should be designed to compensate these services, encouraging their integration into grid management strategies.



Annexure-1

State Authorities Stakeholder Mapping

State	State Nodal Agency
Andhra Pradesh	New & Renewable Energy Development Corporation of Andhra Pradesh Ltd
Gujarat	Gujarat Energy Development Agency
Karnataka	Karnataka Renewable Energy Development Limited
Madhya Pradesh	Madhya Pradesh Urja Vikas Nigam Ltd
Maharashtra	Maharashtra Energy Development Agency
Odisha	Orissa Renewable Energy Development Agency
Rajasthan	Rajasthan Renewable Energy Corporation Limited
Tamil Nadu	Tamil Nadu Green Energy Corporation Ltd
Telangana	Telangana Renewable Energy Development Corporation
Uttar Pradesh	Uttar Pradesh New and Renewable Energy Development Agency

Annexure-2

State Distribution Utility Stakeholder Mapping

State Distribution Utility Stakeholder Mapping		
State	Organisation Type	Organisation Name
Andhra Pradesh	State Distribution Utility	Andhra Pradesh Southern Power Distribution Company Limited
Gujarat	State Distribution Utility	Gujarat Urja Vikas Nigam Limited
Karnataka	State Distribution Utility	Chamundeshwari Electricity Supply Corporation Limited
Madhya Pradesh	State Distribution Utility	MP Paschim Kshetra Vidyut Vitran Company Limited
Maharashtra	State Distribution Utility	Tata Power Corporation Limited
Odisha	State Distribution Utility	TP Central Odisha Distribution Limited
Rajasthan	State Distribution Utility	Jaipur Vidyut Vitran Nigam Limited
Tamil Nadu	State Distribution Utility	Tamil Nadu Power Distribution Corporation Ltd
Telangana	State Distribution Utility	Telangana State Northern Power Distribution Company Ltd
Uttar Pradesh	State Distribution Utility	Noida Power Company Limited



Annexure-3

RTPV Enablers Stakeholder Mapping

Rooftop Solar PV	
Skilling Agencies	Skill Council on Green Jobs
	National Institute of Solar Energy
Standards & Testing Agencies	TUV SUD
Research and Development & Academia	National Institute of Solar Energy

Annexure-4

RTPV Implementers Stakeholder Mapping

RTPV Developer	
NRG Solar Systems	Amira Solar
Smart Solar	
Solar PV Module Manufacturer	
Goldi Solar	ReNew
Premier Energies	Vikram Solar
Financial Institutions	
Asian Development Bank	World Bank



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