PRADHAN MANTRI SURYA GHAR MUFT BIJLI YOJANA: EVALUATING INDIA'S ROOFTOP SOLAR GROWTH AND ACHIEVEMENTS

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Abstract

The Pradhan Mantri Surya Ghar Muft Bijli Yojana, launched in 2024, is a flagship initiative promoting rooftop solar adoption by providing households up to 300 units of free electricity monthly. It supports India's target of achieving 500 GW of non-fossil fuel capacity by 2030 through decentralized renewable generation. The scheme uses subsidies, concessional loans, and simplified approvals to boost participation, with DISCOMs, private partners, and government agencies playing key roles.

Despite progress, challenges remain, including high installation costs, low awareness, administrative delays, and uneven regional adoption. Early success is evident in urban and semi-urban areas, alongside job creation in solar panel production, installation, and maintenance. The program also contributes to reducing carbon emissions, enhancing energy security, and advancing India's green economy. To maximize its impact, continued policy support, awareness efforts, and capacity building are essential.

Keywords: Pradhan Mantri Surya Ghar Muft Bijli Yojana, Rooftop Solar, Renewable Energy, Sustainable Development, Energy Transition, India, Clean Energy Policy

JEL Classification: Q42, Q48, Q56, O13, O38

Introduction

The most ambitious home rooftop solar program in the world, the PM Surya Ghar Muft Bijli Yojana, was introduced by Prime Minister Narendra Modi on February 13, 2024. By March 2027, it aims to provide up to 300 units of free electricity per home every month by solar-powering one crore (10 million) dwellings. Supported by a substantial ₹75,021 crore investment, the program is essential to India's shift to renewable energy. The program easily fits in with India's larger green energy goals, which include reaching net-zero by 2070 IBEF, supplying 50% of energy from renewable sources, and generating 500 GW of renewable energy by 2030. It seeks to lower electricity costs and give homes energy independence; encourage the development of jobs in the solar manufacturing, installation, O&M, and related industries; and reduce carbon emissions and further climate objectives

The scheme follows a subsidy-based implementation strategy. It provides subsidy in the manner as namely, 1. 60% cost assistance for up to 2 kW systems, 2. 40% subsidized for capacity between 2–3 kW, 3. Equates to subsidies: ₹30,000 (1kW), ₹60,000 (2kW), ₹78,000 (3kW or above)

The Scheme has two innovative deployment models viz.

1. *RESCO Model:* Solar companies install and own systems for 5 years; households pay for generated power.

2. *Utility Led Asset (ULA):* DISCOMs own systems temporarily before transferring ownership to beneficiaries. Streamlined digital portal for easy registration, vendor choice, subsidy disbursal (ideally within 15 days).
3. *Model Solar Village initiative:* Every district pilots a solar village, promoting rural adoption and energy literacy.

Literature Review

The Literature pertaining to the study is limited in number and only those studies which totally align with the title of study has been reviewed. P.M Surya Ghar Muft Bijli Yojana is a recent development and Literature is not entirely available.

Wei S., Temitope E. (2024) in their paper "Adoption of solar grid-tied PV-system adopted in a residential building," Wei S. and Temitope E. (2024) proposed that the installation of a solar grid-tied system in a three-bedroom house in Auckland, New Zealand, would have both economic and environmental benefits. In order to reduce its need on conventional energy sources, the property installed a 4.5 kW photovoltaic panel. Energy-efficient material integration further increased cost savings, demonstrating the viability and sustainability of solar systems when combined with contemporary technologies.

Dixit S. (2018) in their study "Role of solar energy and issues in its implementation in the Indian context," evaluated how the solar industry in India faces challenges due to high costs and a lack of subsidies. Adoption rates could be increased by broadening eligibility requirements and simplifying regulations. Practical steps for stakeholders are the main emphasis of the recommendations.

Shaughnessy E. (2023) in their study "Impacts of non-residential solar on residential adoption decisions," examined how solar systems on commercial sites can promote residential adoption in the surrounding area. This strategy emphasizes the cumulative effect of non-residential solar installations and encourages community-wide adoption.

Sahu G. (2022) in their study "Determinants of residential adoption of solar energy system: A survey of rural India," looked at how government policies, awareness, and supporting infrastructure influence the adoption of solar energy systems in rural India. Perceived advantages and behavioral elements are important in determining people's intentions to use solar technology.

Dalal R. (2021) proposed that a 3-kWp solar PV system enhances energy ratings for Indian homes with a 3–7-year payback period in their paper "Bridging the energy gap of India’s residential buildings by using rooftop solar PV systems for higher energy stars." The results highlight the economic and environmental benefits, which promote the use of rooftop solar.

Kant K (2020) in their study, "Renewable energy policies and their effectiveness in promoting solar energy adoption in India" proposed that solar energy is effectively promoted by India's renewable energy laws. Although there are still implementation issues, state-level initiatives are crucial in promoting acceptance.

Gande Acosta G. (2020), in their study “Boosting Energy Efficiency and Solar Energy in the Residential, Commercial, and Public Services Sectors in Mexico,” posited that the adoption of solar energy in Mexico could substantially reduce emissions and generate cost savings, albeit

necessitating considerable investments. The report advocates for the investigation of additional efficiency measures.

Kiray V. (2019), in the paper "Feasibility Study for Utilization of Solar Energy in Arctic Areas," concluded that a photovoltaic system featuring a dual-axis tracker and gazebo design improves both aesthetics and energy efficiency. It exemplifies cost-effectiveness and attracts residential consumers.

Jain M. (2022), in their study "Solar Energy for the Commercial Buildings Sector: Recommendations for the Indian Scenario," examined the policy-related obstacles confronting off-grid solar systems in commercial buildings. Streamlined procedures and enhanced subsidy initiatives can facilitate adoption in the Indian market.

Rathod. S. and et.al. (2024) in their study presented a descriptive view and highlighted the positive outcomes and shortcomings of the scheme.

Shah. N (2024) in his study highlighted the impact of sustainable renewable energy practices which significantly lowers the electricity cost. He further highlighted that this type of efforts will increase the employment opportunities for the skilled workers. He concluded that there are few challenges such as higher upfront cost, difficulty in obtaining subsidies etc.

Amin. U (2025) highlighted the positive outcomes of adoption of Roof top solar installations such as financial savings, environmental benefits, government initiative and also pointed out few grey areas such as limited knowledge, high installation cost.

Research Gap

The studies reviewed above provide descriptive insights into the outcomes of rooftop solar adoption but lack empirical evaluations of scheme effectiveness, financial assistance distribution, and inter-state variations. Consequently, there is a distinct research deficiency in evaluating the quantitative impact, state-level advancement, correlation among registrations, installations, and benefits, as well as the overall performance assessment of the PM Surya Ghar Muft Bijli Yojana. This study seeks to fill this gap through a descriptive and analytical methodology utilizing recent government data.

Objective of the Study

The Present study aims to assess the Current Status and Progress of Pradhan Mantri Surya Ghar Muft Bijli Yojana, India's Roof Top Solar Initiative.

Rationale of the Study

The Pradhan Mantri Surya Ghar Muft Bijli Yojana is a first-of-its-kind national effort that started in 2024 to speed up the use of solar panels on roofs by providing up to 300 units of solar-generated electricity per household per month and using large-scale subsidies, low-interest loans, and easier delivery models. A systematic evaluation of the program's initial progress, regional disparities, implementation challenges, and socio-economic effects is imperative, considering its magnitude, financial commitment, and direct correlation to India's 2030 renewable energy objectives. This study addresses a significant empirical deficiency: the existing literature is predominantly descriptive or context-specific, with a scarcity of rigorous nationwide analyses concerning registration-to-installation conversion, subsidy disbursement, and the scheme's distributional

outcomes across states and urban/rural divides. This research analyzes government data (registrations, applications, installations, households benefited, and central financial assistance) for 2024–25 and examines correlations among these indicators. It offers evidence regarding the scheme's effectiveness, areas of deficiency, and the implementation factors (awareness, administrative efficiency, DISCOM participation, state policy environments) that necessitate policy intervention. The study thus provides policymakers, DISCOMs, industry partners, and researchers with actionable insights derived from early program metrics, aimed at enhancing targeting, equity, cost-effectiveness, and the scheme's role in India's energy transition.

Research Methodology

The present study is both Descriptive and Analytical. The Study tries to examine the status and Progress of Pradhan Mantri Surya Ghar Muft Bijli Yojana.

Sources of Data

Data has been mainly procured through secondary sources, such as the Reports of the government Agencies and data is extracted from the government Databases.

Tools and Techniques Used

For analysis of data, Percentage and Correlation has been used. The Dependence on M.S. Excel Office 365 and PSPP 2.0.1 is necessary for data analysis.

Period of Study

The period between 2024 to 2025 i.e. 1(One) Financial Year has been used for the present study data.

Analysis and Discussion

Table 1: Installation of Solar Roof Top in different states of India in Nos.

SL. No.	State/UT	Installation (Nos.)	Change	% Change
1	Andhra Pradesh	6725	0	0
2	Arunachal Pradesh	0	(-6725)	0
3	Assam	2858	2858	100
4	Bihar	2291	(-567)	(-25)
5	Chhattisgarh	774	(-1517)	(-196)
6	Goa	335	(-439)	(-131)
7	Gujarat	286545	286210	100
8	Haryana	14198	(-272347)	(-1918)
9	Himachal Pradesh	423	(-13775)	(-3257)
10	Jharkhand	72	(-351)	(-488)
11	Karnataka	5099	5027	99
12	Kerala	52693	47594	90
13	Madhya Pradesh	18464	(-34229)	(-185)

14	Maharashtra	126344	107880	85
15	Manipur	63	(-126281)	(-200446)
16	Meghalaya	14	(-49)	(-350)
17	Mizoram	51	37	73
18	Nagaland	6	(-45)	(-750)
19	Odisha	1039	1033	99
20	Punjab	3572	2533	71
21	Rajasthan	18697	15125	81
22	Sikkim	1	(-18696)	(-1869600)
23	Tamil Nadu	20151	20150	100
24	Telangana	7511	(-12640)	(-168)
25	Tripura	77	(-7434)	-9655
26	Uttar Pradesh	53423	53346	100
27	Uttarakhand	9500	(-43923)	(-462)
28	West Bengal	248	(-9252)	(-3731)
29	Andaman and Nicobar Islands	1	(-247)	(-24700)
30	Chandigarh	312	311	100
31	Dadra and Nagar Haveli and Daman and Diu	33	(-279)	(-845)
32	Jammu and Kashmir	327	294	90
33	Ladakh	139	(-188)	(-135)
34	Lakshadweep	85	(-54)	(-64)
35	NCT of Delhi	1931	1846	96
36	Puducherry	440	(-1491)	(-339)
Total		634442		

N.B: Figures in Bracket Indicates Negative

Source: *Self Compilation of data from GoI reports and Analysis after that*

Table 1 depicts the number of solar Roop top that has been installed nationwide we see a healthy growth in the installation in the past one year since the scheme is launched. The states like Gujrat and Maharashtra are leading in the Table in the number of installations. This may be due to dry and sunny regions where average rainfall is low and these areas could immensely harness the solar energy.

Table 2: Table Showing No. of Registration in the Portal and Applications made and Households Benefitted in Nos.

Sl. No.	State/UT	Registration (Nos.)	Application (Nos.)	Households benefitted (Nos.)
1	Andhra Pradesh	1770413	1107234	12036
2	Arunachal Pradesh	1289	91	0
3	Assam	1749651	289307	6485
4	Bihar	951809	66157	4013
5	Chhattisgarh	243071	35475	1840
6	Goa	10708	4400	544
7	Gujarat	1740135	366097	362907
8	Haryana	449153	159218	19069
9	Himachal Pradesh	154318	5217	1111
10	Jammu and Kashmir	315332	21082	1124
11	Jharkhand	252540	6667	160
12	Karnataka	610332	208545	8181
13	Kerala	271011	111065	68938
14	Madhya Pradesh	542465	55065	26233
15	Maharashtra	1661676	546307	203742
16	Manipur	2712	671	165
17	Meghalaya	8327	1819	17
18	Mizoram	3037	604	87
19	Nagaland	1204	236	7
20	Odisha	1280205	88514	2199
21	Punjab	122004	11908	4682
22	Rajasthan	522299	225993	28064
23	Sikkim	469	51	4
24	Tamil Nadu	971032	80014	26213
25	Telangana	142085	40561	10839
26	Tripura	11766	2377	121
27	Uttar Pradesh	2822194	1004105	77937
28	Uttarakhand	159281	38024	15445
29	West Bengal	359669	26245	388

30	Andaman and Nicobar Islands	1132	125	5
31	Chandigarh	5168	1293	605
32	Dadra and Nagar Haveli and Daman and Diu	5251	1025	56
33	Ladakh	3257	611	285
34	Lakshadweep	1142	596	208
35	NCT of Delhi	24613	7578	2594
36	Puducherry	19739	1226	601
Total		17190489	4515503	886905

Source: *Self Compilation of data from GoI reports and Analysis after that*

Table 2 depicts the number of Registrations and applications and number of households that are benefited from the scheme. from the table it is pertinent that Gujrat and Maharashtra are the leading states it is due to the public awareness about the scheme and the potential to harness the renewable source of energy like solar is more.

Table 3: Table Showing Correlation Between No. of Registration, Application, Installation and Household Benefitted

		Registration (Nos.)	**Application (Nos.)**	**Installation (Nos.)**	**Households benefitted (Nos.)**
Registration (Nos.)	Pearson Correlation	1	.852**	.294	.538**
	Sig. (2-tailed)		.000	.082	.001
	N	36	36	36	36
Application (Nos.)	Pearson Correlation	.852**	1	.143	.402*
	Sig. (2-tailed)	.000		.407	.015
	N	36	36	36	36
Installation (Nos.)	Pearson Correlation	.294	.143	1	.760**
	Sig. (2-tailed)	.082	.407		.000
	N	36	36	36	36
Households benefitted (Nos.)	Pearson Correlation	.538**	.402*	.760**	1
	Sig. (2-tailed)	.001	.015	.000	
	N	36	36	36	36
**. Correlation is significant at the 0.01 level (2-tailed).					
*. Correlation is significant at the 0.05 level (2-tailed).					

Source: *Self Compilation of data from GoI reports and Analysis after that*

Table 3 shows the Bi variate correlation between the factors like No. of registrations, Applications, Installations and households benefitted we see that there is a positive Correlation between these factors at 1% and 5% level of significance.

Table 4: Table Showing Applications made and Households Benefitted and central Financial Assistance Received

Sl. No.	State/UT-wise	Applications (In Number)	Households Benefitted (In Number)	CFA Released (In Crore)
1	Andhra Pradesh	1156693	14086	65.11
2	Arunachal Pradesh	94	NA	NA
3	Assam	298666	8748	41.76
4	Bihar	69757	4537	20.83
5	Chhattisgarh	36344	2101	6.38
6	Goa	4458	801	2.59
7	Gujarat	384013	385820	1920.3
8	Haryana	163517	20225	88.42
9	Himachal Pradesh	5949	1409	6.85
10	Jharkhand	6947	225	0.93
11	Karnataka	214640	9316	38.29
12	Kerala	119947	75371	444.11
13	Madhya Pradesh	59147	29191	169.95
14	Maharashtra	566937	226863	804.16
15	Manipur	728	189	1.1
16	Meghalaya	2003	17	0.08
17	Mizoram	620	101	0.62
18	Nagaland	243	8	0.05
19	Odisha	91689	2680	12.86
20	Punjab	13879	5015	29.58
21	Rajasthan	235924	31687	187.2
22	Sikkim	58	4	0.01
23	Tamil Nadu	82029	27660	128.33
24	Telangana	44994	12155	49.39
25	Tripura	3008	153	0.75

26	Uttar Pradesh	1034729	87208	487.47
27	Uttarakhand	43194	17702	110.69
28	West Bengal	26540	419	NA
29	Andaman and Nicobar Islands	158	15	0.01
30	Chandigarh	1342	625	1.56
31	Dadra and Nagar Haveli and Daman and Diu	1578	105	0.26
32	Jammu and Kashmir	25324	1811	6.65
33	Ladakh	655	320	2.15
34	Lakshadweep	672	229	1.56
35	NCT of Delhi	8196	3014	6.39
36	Puducherry	1351	690	3.87
Total		4706023	970500	4640.28

Source: *Self Compilation of data from GoI reports and Analysis after that*

Table 4 depicts the Central financial assistance released from the government it is evident from the table that the two states Gujrat and Maharashtra have received the maximum amount of Central Financial Assistance this is due to number of installations are more this is the reason why CFA in these two states is immense.

Table 5: Table Showing Correlation Between No. of Registration, Application, Installation and Household Benefitted

		Applications (In Number)	**Households Benefitted (In Number)**	**CFA Released (In Crore)**
Applications (In Number)	Pearson Correlation	1	.410*	.399*
	Sig. (2-tailed)		.014	.020
	N	36	35	34
Households Benefitted (In Number)	Pearson Correlation	.410*	1	.988**
	Sig. (2-tailed)	.014		.000
	N	35	35	34
CFA Released (In Crore)	Pearson Correlation	.399*	.988**	1
	Sig. (2-tailed)	.020	.000	
	N	34	34	34
*. Correlation is significant at the 0.05 level (2-tailed).				
**. Correlation is significant at the 0.01 level (2-tailed).				

Source: *Self Compilation of data from GoI reports and Analysis after that*

Table 5 depicts the correlation between the three factors Applications (In Number) Households Benefitted (In Number) CFA Released (In Crore) the table above shows there is a positive correlation between these three factors between these factors at 1% and 5% level of significance.

Findings

The study shows that the Pradhan Mantri Surya Ghar Muft Bijli Yojana has made measurable early progress but also has clear gaps in how it is being carried out. Nationwide data for 2024–25 show strong participation (registrations >17 million) with applications in the range of ~4.5–4.7 million and roughly 0.9–1.0 million households benefitting; total rooftop installations reported are 634,442 and central financial assistance disbursed is about ₹4,640 crore. Gujarat and Maharashtra are clearly the leaders in installations and subsidy absorption. Urban and semi-urban areas have also seen faster uptake than many rural areas. Statistical analysis shows that there are strong, positive links between registrations, applications, installations, and households that benefited. This means that outreach and application conversion have a direct impact on implementation outcomes. The program has already created jobs in manufacturing, installation, and O&M. It has also helped India reach its decentralized renewable energy goals, reduced its reliance on the grid, and cut emissions. The remaining barriers are high upfront costs, uneven awareness, delays in administration, and differences between regions. The paper suggests that policy support should continue, subsidies should be given out faster, awareness campaigns should be stepped up, and capacity should be built to have a bigger impact.

Conclusion

The empirical analysis for 2024–25 shows that the PM Surya Ghar Muft Bijli Yojana has had some important early successes, but it also shows that there are clear geographic and operational imbalances. States with strong solar ecosystems, more awareness, and better administration (like Gujarat, Maharashtra, and Kerala) have a lot more registrations, installations, and households that have benefited. They have also received the most central government money. The strong and positive links between registrations, applications, installations, and households that benefited show that demand-side interest (registrations) is a good predictor of actual deployment. However, conversion rates differ widely from state to state, which suggests that implementation friction, not lack of demand, is a major problem in some areas. Central financial assistance closely follows the number of households that benefited, which shows that subsidy flows are generally in line with installations. However, some states have a lot of registrations but not many conversions or benefits, which could mean that vendors aren't available, approval times are too long, or beneficiaries aren't getting enough help. The program helps save money on energy, create jobs in the solar value chain, and lower emissions in the early stages. However, to reach its full potential toward national renewable energy goals and fair access, it needs to cut down on administrative delays, lower the costs for vulnerable households, improve monitoring, and expand targeted awareness and capacity-building efforts in areas that are falling behind.

Recommendations

To get the most out of the Pradhan Mantri Surya Ghar Muft Bijli Yojana, policymakers should streamline and speed up the processes for giving out subsidies and concessional loans (for example, by reducing approval delays and automating reimbursements). They should also focus on giving more help to low-income and rural households to fix regional imbalances. Put money into big, long-term campaigns to raise awareness and change behavior (in local languages, at gram

sabhas, and in schools). Also, expand the Solar Village pilots so that rural people learn more about energy and want more of it as it becomes available. Encourage different ways to get money, like scaling up RESCOs where the upfront cost is a problem and expanding DISCOM-led ULA rollouts with clear deadlines for when the money will be transferred. At the same time, make private investment less risky by offering guarantees or payments based on results. To keep beneficiaries safe and make sure systems last, set standard technical and quality standards, require accredited vendors, and enforce warranties and O&M plans after installation. Use targeted training programs and incentives to build local manufacturing and installation capacity. This will create long-term jobs and lower the cost of equipment. Require open, timely monitoring and public dashboards (registrations → installations → CFA released → households benefitted) to find problems and distribute resources based on performance. Finally, encourage learning forums between states so that high-performing states like Gujarat and Maharashtra can share best practices. Also, give states with low uptake incentives to make process and outreach improvements that are specific to their needs.

Limitations of the Study

The study has a number of important flaws. It depends completely on secondary data from the government and portal records, which may have reporting lags, missing information, or inconsistencies. This means that the data may not be accurate at the household level. The analysis is limited to a single financial year (2024–2025), which means that it is not possible to see longer-term trends, seasonal changes, or the scheme's lasting effects. The study employs descriptive statistics, percentages, and bivariate correlations—methods that discern associations without determining causality or addressing confounding variables. The literature review is constrained due to the scheme's recency, which diminishes theoretical depth and comparative context. Significant aspects, including actual energy generation (kWh), system performance, household-level socioeconomic factors, user satisfaction, and qualitative implementation challenges, were not analyzed. State-level aggregation obscures intra-state and urban-rural heterogeneity, constraining the generalizability of the findings. Lastly, if policies, markets, or technologies change quickly after the study period, some conclusions may only be true for that time and not for future phases of the program.

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