

How Effective Are Indian Rooftop-Solar Subsidies in Increasing Household Adoption?

A mixed-method research paper based on evidence available up to December 2024

Abstract

This paper examines the effectiveness of Indian rooftop-solar subsidies in increasing household adoption. It focuses on Central Financial Assistance (CFA) under the Grid Connected Rooftop Solar Programme Phase II and PM-Surya Ghar: Muft Bijli Yojana, using evidence available up to December 2024. The study proposes a mixed-method approach combining state-wise administrative data with interviews of households and solar installers.

Available evidence indicates that subsidies accelerated adoption, but effects were highly uneven across states. By 31 October 2024, 3,138.94 MW of residential rooftop capacity had been installed with CFA. By December 2024, PM-Surya Ghar had produced approximately 6.3 lakh installations. Gujarat accounted for a particularly large share of subsidised capacity. Thus, subsidies reduce the financial barrier but do not alone overcome differences in regulation, administrative efficiency, installer availability, income, roof suitability and DISCOM performance.

Keywords: rooftop solar; household adoption; subsidy; Central Financial Assistance; PM-Surya Ghar; India; DISCOMs; renewable-energy policy

1. Introduction

India promotes rooftop solar to expand renewable electricity, reduce household electricity expenditure and improve energy security. Compared with utility-scale plants, rooftop systems generate power near consumption and can reduce transmission losses.

Yet household adoption remains below technical potential. High upfront cost, uncertain payback, weak access to credit, limited information, unsuitable roofs and grid-connection delays all constrain adoption.

This paper asks: How effective have Indian rooftop-solar subsidies been in increasing household adoption? It also examines whether adoption rose under subsidised programmes and why outcomes were concentrated in certain states.

2. Policy and Institutional Background

Grid Connected Rooftop Solar Programme Phase II was launched in March 2019 with a 4,000 MW residential target supported by CFA. As of 31 October 2024, 3,138.94 MW had been installed under the residential CFA component—about 78.5% of the target.

For residential systems up to 3 kW, CFA was 40% of benchmark cost. For systems above 3 kW up to 10 kW, assistance was 40% for the first 3 kW and 20% for the remaining capacity.

PM-Surya Ghar: Muft Bijli Yojana began in February 2024 and aims to support one crore household rooftop systems by FY 2026–27. It introduced a national portal for registration, vendor selection, installation and subsidy delivery. About 6.3 lakh installations had been completed by December 2024.

3. Literature Review

Subsidies can increase adoption by lowering upfront price, shortening payback and reducing perceived investment risk. However, their behavioural effect depends on the ease of claiming assistance and the ability to finance the unsubsidised balance.

Research also identifies informational, technical, regulatory, social and psychological barriers. These include uncertain performance, approval delays, difficulty selecting vendors, maintenance concerns and unclear net-metering rules.

States vary in tariffs, regulations, DISCOM performance, installer networks, income, urbanisation and roof ownership. A uniform central subsidy can therefore produce very different state outcomes.

4. Research Methodology

The proposed research design combines quantitative state-wise analysis with interviews of adopting households, non-adopting households and installers. Data should be restricted to observations available on or before 31 December 2024.

The main outcome is adoption rate: installations divided by eligible households. A complementary measure is subsidised residential capacity per household. Explanatory variables include subsidy exposure, income, electricity tariff, urbanisation, roof suitability, net-metering rules, approval time, installer availability and finance.

A panel specification can estimate association between adoption and subsidy exposure while including state and time fixed effects. Interviews should examine awareness, total cost, financing, approval time, subsidy receipt, vendor trust, roof constraints and observed bill savings.

5. Findings

Subsidised programmes were associated with substantial uptake. The government reported 3,138.94 MW of residential rooftop capacity installed with CFA by October 2024. PM-Surya Ghar recorded about 6.3 lakh installations by December 2024.

Adoption was highly concentrated. Gujarat had 2,109.82 MW of residential CFA capacity as of October 2024, approximately 67.2% of the reported national total. Kerala had 293.67 MW and Maharashtra 231.80 MW.

The new programme expanded installations but did not eliminate geographic concentration. As of 9 December 2024, Gujarat had 231,917 residential installations, Maharashtra 91,248 and Uttar Pradesh 54,135.

Subsidies did not eliminate affordability or institutional barriers. Many households must still pay a substantial initial amount, while unclear procedures, slow approvals, weak vendor trust and technical constraints can prevent completion.

6. Discussion

The evidence supports a qualified conclusion: subsidies have worked as adoption accelerators, but their effect is conditional, geographically concentrated and potentially unequal across income groups.

Gujarat's leading position could reflect implementation quality, consumer awareness, installer networks, tariff conditions, roof suitability and accumulated market experience. The available evidence cannot isolate the relative importance of these factors.

A policy can increase installation counts while remaining inequitable if lower-income households cannot finance the residual upfront cost. Evaluation should therefore track beneficiary income, location, system size, loan access, approval times and actual bill savings.

7. Policy Recommendations

Present a transparent net-price schedule showing total cost, eligible subsidy, household contribution, expected generation and estimated bill savings.

Pair CFA with low-cost loans, instalment plans and regulated consumer-finance products.

Link DISCOM incentives to consumer-service outcomes, including approval times, grid-connection time, complaints and satisfaction.

Strengthen vendor accountability through disclosure of total prices, specifications, warranties, expected generation and maintenance obligations.

Use state-specific diagnostics and local-language outreach in low-adoption regions.

8. Limitations

The evidence is primarily descriptive and does not supply a complete counterfactual for causal estimation. State data may differ in reporting practices and definitions.

Installation counts do not establish system performance, continuing grid connection or realised bill savings. The interview portion is a proposed design, not original interview evidence.

PM-Surya Ghar was still in an early stage at the end of 2024, preventing a long-term assessment of welfare, electricity-bill and DISCOM effects.

9. Conclusion

Indian rooftop-solar subsidies have increased household adoption, especially after PM-Surya Ghar began in 2024. However, adoption is highly concentrated, and Gujarat accounted for about two-thirds of Phase II subsidised residential capacity.

Subsidies are necessary but insufficient. Effective household adoption also requires affordable finance, trusted installers, suitable roofs, clear consumer information, predictable net-metering and responsive DISCOMs. Future evaluation should focus on additionality, equity, delays, satisfaction, system performance and bill savings.

State-wise Residential Capacity under CFA

State/region	Capacity (MW)
Gujarat	2,109.82
Kerala	293.67
Maharashtra	231.80
Uttar Pradesh	93.66
Rajasthan	84.88
Madhya Pradesh	62.34
Haryana	52.51
Telangana	47.08
Punjab	45.63

Uttarakhand	26.76
West Bengal	0.04
Meghalaya	0
Sikkim	0

Source: Ministry of New and Renewable Energy data reported to the Lok Sabha, as of 31 October 2024.

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