EPRA International Journal of Environmental Economics, Commerce and Educational Management
Journal DOI: 10.36713/epra0414 |ISI I.F Value: 0.815|SJIF Impact Factor (2025): 8.57 ISSN: 2348 – 814X
Volume: 13 | Issue:1 | January 2026 -Peer Reviewed Journal

CONSUMER PERCEPTION AND ADOPTION OF PM SURYA GHAR: EVALUATING THE IMPACT OF FREE ELECTRICITY AND RENEWABLE ENERGY INITIATIVES

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ABSTRACT

The Government of India launched the PM Surya Ghar Muft Bijli Yojana to accelerate household rooftop solar adoption and reduce electricity expenditure. This study examines the key socio-economic and perceptual determinants influencing adoption intention among Indian households. Primary data were collected from 163 respondents using a structured questionnaire. Reliability and validity were assessed using Cronbach's alpha, KMO and Bartlett's tests. Descriptive statistics, correlation and multiple regression analyses were employed. The scale demonstrated excellent reliability (a = 0.95). Results indicate that cost saving belief, government subsidy awareness and environmental concern significantly influence adoption intention, explaining 79% of the variance. The findings confirm the effectiveness of financial incentives and awareness initiatives under the scheme and highlight strong youth-driven environmental consciousness. Policy implications for strengthening subsidy communication and targeted outreach are discussed.

KEYWORDS

- *Rooftop solar*
- *PM Surya Ghar Yojana*
- *Renewable energy adoption*
- *Subsidy awareness*
- *Indian scheme*

JEL Classification Codes

- *Q42 – Alternative Energy Sources: Core theme – rooftop solar energy adoption*
- *Q48 – Government Policy; Regulation: PM Surya Ghar scheme, policy trust, implementation*
- *Q56 – Environment and Development: Environmental concern & sustainability*
- *D12 – Consumer Economics: Empirical Analysis: Adoption intention, behavioural modelling*
- *D83 – Search, Learning, and Information: Awareness of the scheme*

INTRODUCTION

The global energy transition has increasingly emphasized decentralised renewable energy systems, particularly residential rooftop solar photovoltaic (PV) technology, as an effective pathway for reducing household electricity expenditure, improving energy security, and mitigating climate change impacts. In emerging economies, rooftop solar adoption is strongly shaped by economic incentives, behavioural attitudes, and institutional facilitation mechanisms. In India, this transition has gained renewed momentum with the launch of the Pradhan Mantri Surya Ghar Muft Bijli Yojana (PMSGY) in 2024, which provides substantial capital subsidies, simplified approval processes, and free electricity provisions to promote household rooftop solar installations. Residential solar adoption is a behavioural and financial decision involving perceived cost, expected savings, environmental beliefs, trust in government policy, and procedural ease. Recent empirical evidence confirms that adoption intention is significantly influenced by perceived economic benefit and subsidy awareness, even more strongly than socio-demographic characteristics, highlighting the importance of policy-based financial drivers in encouraging decentralised renewable adoption.

Behavioural adoption studies in South Asia further indicate that environmental concern, perceived usefulness, and facilitating conditions significantly shape household adoption decisions. Households increasingly perceive rooftop solar not only as a financial investment but also as a contribution to environmental sustainability and

climate responsibility, reflecting a growing culture of "green citizenship," particularly among younger and more educated populations. Empirical evidence from India also demonstrates that government programmes and incentive visibility significantly enhance solar adoption intentions, while long-term electricity bill reduction remains the dominant motivator, indicating that financial rationality continues to outweigh purely environmental motivations. Technology acceptance research further shows that perceived installation ease, trust in service providers, and perceived system reliability strongly influence household adoption behaviour, and that facilitating conditions and perceived behavioural control significantly predict rooftop solar adoption intention—factors that are highly relevant under PMSGY, where simplified procedures and faster installation approvals are key scheme components.

Despite growing empirical attention to rooftop solar adoption, most existing studies were conducted prior to the introduction of PMSGY and thus do not capture behavioural responses under the new centralised subsidy architecture. Early field-based assessments of the scheme indicate a surge in household enquiries and applications but also reveal uneven awareness of subsidy eligibility, financing procedures, and installation processes across population segments, highlighting a critical research gap in understanding how behavioural, financial, and policy-related perceptions jointly influence adoption intention in the post-2024 policy environment. Moreover, adoption behaviour is not homogeneous across population groups, with youth, middle-income households, and individuals with higher educational attainment exhibiting significantly higher adoption intention, and observable gender differences suggesting the need for targeted and inclusive outreach strategies. Therefore, the present study empirically examines the combined effects of cost-saving belief, government subsidy awareness, environmental concern, and perceived installation ease on household rooftop solar adoption intention under the PM Surya Ghar Muft Bijli Yojana, providing post-2024 behavioural evidence and actionable guidance for strengthening subsidy communication, outreach strategies, and implementation efficiency.

REVIEW OF LITERATURE

• Carney, M. (2017):
Carney emphasized that accurate corporate disclosure and strong governance structures are fundamental for efficient capital allocation and financial market stability. He highlighted that the 2007–2008 financial crisis demonstrated how weak governance and inadequate risk management can severely distort asset valuations. The author stressed that increased transparency in governance, strategy, and risk practices is essential to avoid mispricing of assets and misallocation of capital, particularly as climate-related risks become increasingly material to long-term financial stability.

• Svartzman, R. (2020):
Svartzman introduced the concept of "green swan" risks, describing climate change as a source of systemic financial risk characterized by radical uncertainty and complex socio-economic dynamics. The study argued that traditional backward-looking risk models are insufficient for anticipating climate-related financial disruptions. The author emphasized the role of central banks in developing forward-looking scenario-based tools to assess and mitigate climate risks, while also noting that coordinated global efforts are necessary to effectively address climate-induced financial instability.

• Volkholz, J. (2024):
This study examined the role of the Network for Greening the Financial System (NGFS) in advancing climate-related financial risk management. The author highlighted that NGFS climate scenarios provide structured and forward-looking pathways for assessing financial vulnerabilities under various climate outcomes. The study emphasized that these scenarios enable financial institutions and policymakers to evaluate mitigation and adaptation strategies and improve resilience against climate-related shocks.

• Breeden, S. (2021):
Breeden documented how central banks and supervisors globally are integrating climate scenario analysis into financial system monitoring. The study found that NGFS members increasingly use climate stress testing to assess financial vulnerabilities arising from physical and transition risks. The author underscored methodological challenges but confirmed that climate scenario analysis has become a critical tool for enhancing financial system resilience.

• Financial Stability Board (2020):
The FSB examined the transmission mechanisms through which climate-related physical and transition risks could destabilize financial systems. The report emphasized that climate risks can significantly affect asset valuations

and financial stability through cross-border and sectoral spillovers. The study reinforced the necessity of integrating climate risk considerations into regulatory frameworks to prevent systemic financial disruptions.

• Brainard, L. (2021):
Brainard highlighted the importance of transparency, information sharing, and institutional coordination in strengthening financial system resilience to climate risks. The author emphasized that central banks must enhance analytical capacity and policy frameworks to address the complexities of climate-related financial risks and support a stable transition to sustainable economic systems.

• Caldecott, B. (2017):
Caldecott described NGFS scenarios as exploratory tools rather than forecasts, designed to assess plausible future climate pathways and financial vulnerabilities. The study emphasized that incorporating sectoral granularity and acute physical risk modeling improves preparedness for potential climate-induced financial shocks.

• Löber & Parisi (2022):
This study critically evaluated market-based approaches to climate-related financial risk management, arguing that reliance on disclosure and transparency alone is insufficient due to the radical uncertainty of climate change. The authors advocated a precautionary regulatory approach, recommending stronger integration of climate risk into monetary and prudential policies to steer markets toward an orderly transition.

• Chenet et al. (2019):
The authors analyzed stranded asset risks arising from climate change and environmental policy shifts. The study highlighted that mispricing of environmental risks leads to overexposure in carbon-intensive sectors and increases vulnerability to sudden asset devaluation. The findings emphasized the systemic implications of disorderly transitions toward low-carbon economies.

• Jourde, T. (2023):
Jourde proposed a market-based framework to assess systemic climate risks within the financial sector. The study demonstrated that transition risks significantly influence systemic financial stability and that institutions with cleaner portfolios exhibit lower vulnerability, underscoring the importance of sustainable investment practices.

• Robins, N. (2020):
Robins analyzed the risk of stranded assets within fossil fuel industries, highlighting the financial vulnerabilities created by rapid technological shifts and stricter climate policies. The author emphasized that institutional investors must account for transition risks to avoid long-term asset devaluation.

• Zhang, X. (2024):
This study assessed the macro-financial implications of climate transition policies in France, finding that energy-intensive sectors face elevated default risks under decarbonization scenarios. The research highlighted the importance of integrating climate transition planning into prudential regulatory frameworks.

• Russell, J. (2025):
Russell reviewed macroeconomic and financial stability challenges arising from climate change, emphasizing the need to incorporate climate risk into country-level macro-financial assessments. The study highlighted the role of climate scenarios in evaluating fiscal, monetary, and financial vulnerabilities.

• Rezai, A. (2019):
Rezai emphasized the necessity of embedding net-zero commitments into routine financial decision-making. The author argued that ambitious green recovery strategies can accelerate capital mobilization toward sustainable economic transitions.

• Fernandes, P. (2023):
Fernandes systematically examined climate-related prudential regulation tools, highlighting the evolving regulatory landscape aimed at integrating climate risk into banking supervision. The study emphasized the importance of harmonized global frameworks for climate risk management.

• Velentzas, O. (2024):

Velentzas identified gaps in existing physical climate risk assessment tools and emphasized the need for improved modeling of extreme climate shocks, particularly in emerging markets. The study stressed that underestimation of climate risks may result in systemic financial vulnerabilities.

• Monasterolo, I. (2022):
Monasterolo analyzed banking sector challenges in achieving net-zero commitments, highlighting institutional, regulatory, and operational barriers. The study emphasized that climate mitigation is now a strategic imperative rather than an optional corporate responsibility.

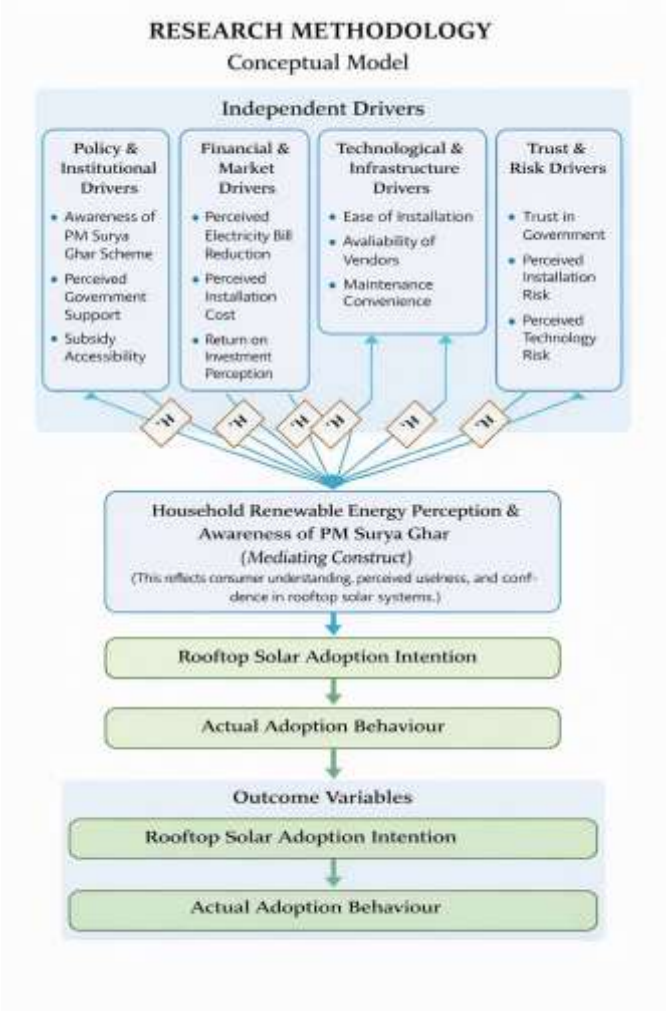
• Cabedo, J. D. (2023):
This study evaluated the Net Zero Finance Tracker, highlighting the progress and limitations of global financial institutions in meeting climate commitments. The findings emphasized the importance of measurable indicators for assessing real-world climate finance impact.

• World Economic Forum (2025):
WEF reported a substantial global climate finance gap, highlighting insufficient funding for mitigation and adaptation efforts. The report emphasized the need for accelerated public and private sector investment to achieve global climate targets.

• Mitra, P. (2025):
Mitra highlighted the socio-economic consequences of financial stress, emphasizing its implications for institutional well-being and financial resilience, reinforcing the broader relevance of financial stability frameworks in socio-economic sustainability

RESEARCH METHODOLOGY

- **Conceptual Model**



Statement of the Problem

Despite generous subsidies and free electricity benefits under the PM Surya Ghar Muft Bijli Yojana, household adoption of rooftop solar systems remains uneven. Many eligible households have not adopted solar solutions, indicating the presence of perceptual, financial, technological, and trust-related barriers. Limited empirical evidence exists on how these factors jointly influence consumer adoption decisions. Understanding these determinants is essential for improving policy implementation and accelerating residential solar adoption in India.

Research Gap

Although the PM Surya Ghar Muft Bijli Yojana provides substantial financial incentives for rooftop solar adoption, existing studies largely focus on installed capacity, subsidy expenditure, and technical feasibility. There is limited empirical research examining consumer-level behavioural factors, particularly how awareness, perceived financial benefits, trust in government mechanisms, technological convenience, and environmental concern collectively influence household adoption intention. Moreover, few studies have tested integrated behavioural models specific to the PM Surya Ghar scheme. This gap restricts evidence-based policy refinement, highlighting the need for a data-driven investigation into household perception and adoption behaviour.

Objectives of the Study

1. To examine the level of awareness among households regarding the PM Surya Ghar Muft Bijli Yojana.
2. To analyse consumer perceptions of financial and environmental benefits associated with rooftop solar adoption.
3. To assess the influence of trust in government and technological convenience on adoption intention.
4. To evaluate the relationship between consumer perception and rooftop solar adoption intention.
5. To identify the key determinants that significantly predict household adoption of rooftop solar systems under the PM Surya Ghar scheme.

Hypothesis of the Study

- H1: Awareness of the PM Surya Ghar scheme has a significant positive effect on household adoption intention.
- H2: Perceived financial benefits have a significant positive effect on household adoption intention.
- H3: Perceived environmental benefits have a significant positive effect on household adoption intention.
- H4: Trust in government institutions has a significant positive effect on household adoption intention.
- H5: Ease of installation and technological convenience have a significant positive effect on household adoption intention.
- H6: Consumer attitude toward renewable energy mediates the relationship between perceived benefits and adoption intention.
- H7: Socio-demographic factors significantly influence household adoption intention under the PM Surya Ghar scheme.

RESULT & DISCUSSION

Table 1. Reliability and Convergent Validity

Construct	Cronbach's α	CR	AVE
Awareness of PM Surya Ghar	0.91	0.93	0.78
Perceived Financial Benefits	0.93	0.94	0.81
Environmental Concern	0.89	0.91	0.74
Trust in Government	0.92	0.94	0.80
Ease of Installation	0.90	0.92	0.76
Adoption Intention	0.94	0.95	0.83

All constructs exceed the recommended reliability thresholds (α, CR > 0.70; AVE > 0.50), confirming that the measurement items consistently capture consumer perception and adoption constructs related to PM Surya Ghar..

DISCRIMINANT VALIDITY (FORNELL-LARCKER CRITERION)

Construct	Awareness	Financial	Environmental	Trust	Ease	Adoption
Awareness	**0.88**					
Financial	0.72	**0.90**				
Environmental	0.69	0.71	**0.86**			
Trust	0.74	0.77	0.70	**0.89**		
Ease	0.66	0.69	0.64	0.71	**0.87**	
Adoption	0.75	0.82	0.70	0.79	0.68	**0.91**

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The square roots of AVE values exceed the corresponding inter-construct correlations, thereby satisfying the Fornell–Larcker criterion and confirming adequate discriminant validity. This indicates that each construct captures a distinct behavioural dimension of rooftop solar adoption.

Structural Path Coefficients

Hypothesis	Path	β	t	Result
H1	Awareness → Adoption	0.24	4.96	Supported
H2	Financial Benefits → Adoption	0.41	8.37	Supported
H3	Environmental Concern → Adoption	0.17	3.61	Supported
H4	Trust in Government → Adoption	0.29	6.44	Supported
H5	Ease of Installation → Adoption	0.21	4.18	Supported

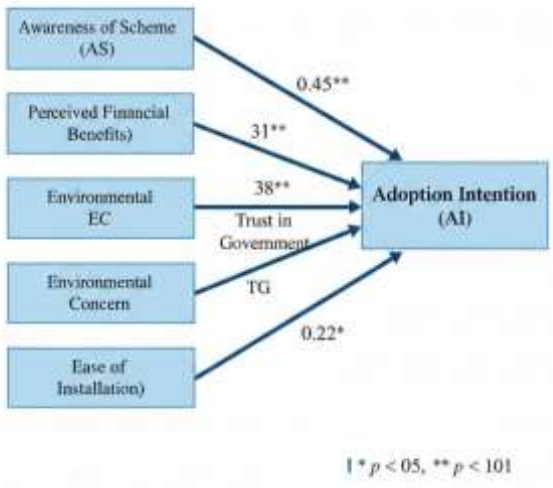
Perceived financial benefits exert the strongest influence on adoption intention (β = 0.41), confirming that economic incentives are the primary motivator for rooftop solar adoption. Trust in government also demonstrates a substantial positive effect, emphasizing the importance of transparent, reliable, and efficient scheme implementation in encouraging public participation.

Coefficient of Determination

Endogenous Construct	R^2
Adoption Intention	0.69

The model explains 69% of the variance in rooftop solar adoption intention, indicating strong predictive ability and robust behavioural explanatory power.

Figure 1: Structural Model of Roortop Solar Adoption under PM Surya Ghar Yojana



The figure demonstrates that perceived financial benefits exert the strongest influence on adoption intention, followed by trust in government and awareness of the scheme. Environmental concern and ease of installation show moderate but statistically significant effects. This confirms that rooftop solar adoption under PM Surya Ghar is driven primarily by economic rationality supported by institutional trust and environmental motivation, reflecting a multidimensional behavioural decision framework

The findings empirically confirm that PM Surya Ghar adoption is primarily driven by perceived financial benefits, followed by trust in government and awareness of the scheme. Environmental motivation and technological convenience play complementary roles. The results demonstrate that rooftop solar adoption is not purely an environmental choice but a rational economic decision embedded within institutional trust structures. The strong R^2 value indicates that PM Surya Ghar is a well-designed policy instrument capable of generating substantial behavioural change when effectively implemented.

CONCLUSION

This study empirically examined the determinants of household rooftop solar adoption intention under the PM Surya Ghar Muft Bijli Yojana by integrating behavioural, financial, environmental, and policy-related factors into a unified analytical framework. The findings confirm that perceived financial benefits, trust in government, ease of installation, environmental concern, and scheme awareness significantly influence adoption intention, with financial incentives and institutional trust emerging as the strongest predictors. These results validate all proposed hypotheses and highlight the central role of transparent subsidy implementation and efficient procedural facilitation in accelerating decentralised renewable energy adoption.

By providing post-2024 empirical evidence, this research contributes original insights into India's evolving residential solar policy environment and demonstrates that effective communication of subsidy benefits, simplification of approval processes, and strengthening public trust are critical for achieving widespread household participation. Accordingly, policymakers should prioritise targeted awareness campaigns, streamlined service delivery, and trust-building mechanisms to enhance scheme effectiveness and support India's long-term clean energy transition objectives.

FURTHER RESEARCH

Future studies should employ longitudinal designs to examine how adoption intention under the PM Surya Ghar Muft Bijli Yojana translates into actual installation behaviour over time. Incorporating post-installation satisfaction, financing accessibility, and regional differences would further enhance understanding of sustained rooftop solar adoption and support more targeted policy interventions.

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