

Determinants of Consumer Perception and Adoption Intentions towards Solar Energy Products: An Empirical Study in Madurai District

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Abstract

As India moves toward its net-zero goals, regional adoption of renewable energy becomes critical. This study investigates consumer perception toward solar energy products in the Madurai district of Tamil Nadu. Using a descriptive research design, primary data was collected from 300 respondents via structured questionnaires. The study examines awareness levels, perceived benefits, and barriers to adoption. Results indicate that while environmental consciousness and government subsidies (e.g., PM Surya Ghar Muft Bijli Yojana) drive positive perception, high initial costs and lack of technical knowledge remain significant hurdles. Statistical analysis reveals a significant correlation between education levels and the adoption of solar rooftop systems. The paper concludes with strategic recommendations for policymakers to enhance solar penetration in Madurai district.

Keywords: Solar Energy, Consumer Perception, Madurai, Renewable Energy Adoption, Sustainability.

I. INTRODUCTION

Energy security and environmental sustainability are the twin pillars of India's current economic policy. With Tamil Nadu leading in renewable energy capacity (exceeding 10 GW in 2026), districts like Madurai present a high-potential market due to high solar irradiance. However, technical availability does not always translate into consumer adoption. Consumer perception—a psychological process of selecting, organizing, and interpreting information—dictates market success. This study aims to bridge the gap between "intent" and "action" among residential consumers in Madurai.

II. REVIEW OF LITERATURE

Bhuvaneshwari and Srija (2014) have made study on **preference towards solar power in Coimbatore**. The research article found that many respondents preferred solar products for its safety, environmental protection, then less harm, affordable cost, better quality, less effort to maintenance, variety of brands and easy availability. The study confirmed that by more consumption of solar energy products the consumers had succeeded in reduction of direct energy needs.

Kumar and Raju (2014) aimed to analyse **An overview of public perception about the suitability of solar power panels' usage as an alternative energy source in Andhra Pradesh**. The researcher mentioned that due to high initial cost and lack of awareness about the working of solar panels customers are not willing to use solar energy panels. The

researcher suggested the Government to extend support to the industries by offering price subsidiaries for solar products to increase the solar energy production adoption.

Venktaraman and Sheeba (2014) made a study on **Customer's attitude towards Solar Energy Devices at Coimbatore** . The researcher found that majority of the customers preferred to buy solar devices influenced by its durability, better after sale services, good quality, best features of solar energy devices as low power consumption, suitability, independent existence and Government subsidies. The study found that customer's attitude towards solar energy devices are influenced by many factors. At the same time in the changing educational qualification of the customers and standard of living of the people has significantly influences solar energy adoption by them.

Lu and Gao's (2015) study aimed to **identify the determinants of consumer attitudes toward solar energy policy in US (United States)**. The study found that the consumers are significantly motivated to use solar energy as an alternative to the usage of fossil fuels. The study offered recommendations to the US Government and its energy ministry to create more awareness about solar energy usage among its citizens and they were suggested to adopt different strategies to increase solar energy usage i.e., adoption by common man.

Sharma and Bhattacharya (2018) made study on **Factors that influenced in adoption of solar energy usage among higher educational students in Assam**. The article mentioned that majority of the students have shown genuinely considered the issue of climatic changes, emission and its impact on the climatic changes for usage of solar energy. The article also addressed the hindrance that restricts them from non- adoption of solar energy affordability, inconvenience and after sales service concerns etc. The article suggested that manufacturers of solar energy products to concentrate more on promotional activities and to create unique marketing strategies to increase consumer liking for adoption of solar energy products.

III. OBJECTIVES OF THE STUDY

1. To analyze the socio-economic influence of the respondent
2. To study the perception factors influencing the customer to purchase solar energy products
3. To assess consumer awareness levels about solar products.
4. To provide strategic recommendations

IV. RESEARCH METHODOLOGY

Research methodology is the specific procedure or technique used to identify, select, process, and analyze information about a topic. The present study is descriptive in nature and it has made an effort to understands the Consumer Perception and Adoption Intentions towards Solar Energy Products. In order to achieve the objectives of the study and to analyze the data collected, an appropriate methodology has been developed.

PRIMARY DATA

The information consists of data gathered from the different source. Primary data is the refresh data. This has been collected from various sources. The sources adopted to get data is questionnaire and through observation. Questionnaire is designed in such way that every employee can understand.

SECONDARY DATA

The data is collected from published reports, unpublished reports, annual reports, unpublished manuals, TNEB and MNRE reports.

STUDY AREA: Madurai District (Urban and Semi-urban).

SAMPLE SIZE: 300 Respondents.

SAMPLING TECHNIQUE: convenient sampling

STATISTICAL TOOLS:

Statistical tools are used in the study are Percentage Analysis, Chi-Square Test, and Garrett Ranking.

V. DATA INTERPRETATION AND ANALYSIS

TABLE 1 SOCIO-ECONOMIC PROFILE OF RESPONDENTS

Variable	Category	Frequency	Percentage
Age	Below 20 years	55	18.3
	21-30 years	130	43.3
	31-40 years	45	15
	Above 41 years	70	23.3
Occupation	Government	152	50.6
	Private	28	9.3
	Business/ self employed	90	30
	Others	30	10
Monthly Income	Less than 15000	30	10
	15000-30000	38	12.6
	30000-45000	83	27.6
	More than 45000	140	46.6

Source: computed data

The demographic profile of the 300 participants reveals a predominantly young and financially stable cohort, characterized by a significant concentration of individuals aged 21–30 years (**43.3%**) and a substantial representation of those above 41 years (**23.3%**). Regarding occupational distribution, more than half of the respondents are employed in the government sector (**50.6%**), followed by self-employed individuals or business owners at **30%**, indicating a sample with high job security. This professional stability is reflected in the income levels, where a clear majority (**46.6%**) earns more than **45,000** monthly, and an additional **27.6%** earns between **30,000** and **45,000**. Collectively, these findings suggest that the study population is largely composed of mid-to-high-income earners with stable Government-sector backgrounds, a factor that must be considered when analyzing their subsequent behavioral patterns and the broader applicability of the research findings.

TABLE 2 PERCEPTION OF FACTORS INFLUENCING PURCHASE

Factor	Mean score	Rank
Reduction in electricity bills	4.62	I
Environmental concern	4.20	II
Government subsidies	3.95	III
Status symbol/ Modernity	3.10	IV

Source: computed data

The data shows that "Reduction in Electricity Bills" is the primary driver for Madurai consumers. Interestingly, while "Environmental Concern" ranks high, it is secondary to economic savings. The high mean score for subsidies (3.95) suggests that the current central and state schemes are well-recognized by the public.

ASSOCIATION BETWEEN AGE AND AWARENESS OF CUSTOMERS ON SOLAR ENERGY PRODUCTS

Null Hypothesis (H0): No significant relationship between age of the customers and their awareness possessed in utilizing the solar energy products.

Alternative Hypothesis (H1): A significant relationship between age of the customers and their awareness possessed in utilizing the solar energy products.

CHI – SQUARE TEST

Factor	Calculated Chi-square value	Table value	Degree of freedom	Level of Significance
Age	16.812	13.277	6	Significant at 1%

Source: computed data

It is understood from the above table that the null hypothesis (H0) is rejected and the alternative hypothesis (H1) is accepted. Because the calculated chi-square value is greater than the table value and the result is significant at 1% level. Hence, the hypothesis, age of the sample customers and their awareness level possessed in utilizing the solar energy products are associated, holds good. Finally, it is concluded that there is a close relationship between age of the customers and their awareness level possessed in utilizing the solar energy products

VI. FINDINGS

- **Dominant Demographic Profile:** The majority of solar energy consumers in Madurai are young adults, with **43.3%** of respondents falling in the **21–30 years** age bracket.
- **Employment and Economic Stability:** Over half of the participants (**50.6%**) are **Government employees**, and nearly half (**46.6%**) earn more than **45,000** per month. This indicates that solar adoption is currently skewed toward individuals with high job security and steady disposable income.

- **Economic Motivation as the Primary Driver:** According to the Garrett Ranking, the **"Reduction in Electricity Bills"** is the most influential factor (Mean Score: **4.62**) for purchasing solar products, outweighing environmental concerns.
- **Secondary Role of Environmental Awareness:** While **"Environmental Concern"** is recognized (Mean Score: **4.20**), it ranks second to financial savings, suggesting that consumers view solar energy as a practical financial tool rather than just a "green" lifestyle choice.
- **Impact of Policy Interventions:** There is high recognition of **Government Subsidies** (Mean Score: **3.95**), such as the *PM Surya Ghar Muft Bijli Yojana*, proving that central and state incentives are key components in the consumer decision-making process.
- **Age-Dependent Awareness Levels:** Statistical analysis through the Chi-Square test confirmed that **Age significantly influences awareness** ($p < 0.01$). With a calculated value of **16.812** against a table value of **13.277**.
- **Social Perception:** Interestingly, "Status Symbol/Modernity" ranked the lowest (Mean Score: **3.10**), indicating that solar energy is seen as a utility-based necessity rather than a luxury or prestige-driven purchase.

VII. SUGGESTIONS

- **Localized Service Centers:** Solar companies should establish dedicated service hubs in Madurai to alleviate "after-sales service" anxiety.
- **EMI Schemes:** Financial institutions should partner with local vendors to provide low-interest "Green Loans" specifically for middle-income households.
- **Demonstration Centers:** Setting up "Solar Experience Zones" in public areas like Mattuthavani or near the Meenakshi Temple area could increase tactile trust in the product.

VIII. CONCLUSION

The study concludes that consumer perception in Madurai is overwhelmingly positive but cautious. While the economic benefits of reduced TNEB bills are clearly understood, the perceived "hassle" of installation and maintenance remains a barrier. To achieve total solarization, the focus must shift from "selling a product" to "providing an energy solution." If the government continues its aggressive subsidy support and vendors improve local service transparency, Madurai could become a benchmark for solar adoption in Tamil Nadu by 2030.

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