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A Study on Consumer Attitude Towards Solar Rooftop PV Panel Adoption

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Abstract

This research explores consumer attitudes regarding the adoption of solar rooftop photovoltaic (PV) panels in Coimbatore, a region where demand for sustainable energy solutions is high. Solar rooftop systems offer a practical way for residences to meet their energy needs. We surveyed 250 households using a questionnaire to investigate socio-economic drivers, key motivators, and significant adoption barriers. Factor analysis identified three primary influences: environmental concern, financial appeal, and technological confidence. The findings suggest that a combination of proactive government policies and targeted awareness campaigns could significantly boost adoption rates. We provide specific recommendations aimed at policymakers and solar providers to improve consumer engagement and overcome current resistance.

Keywords: Solar Rooftop PV, Consumer Attitude, Renewable Energy, Factor Analysis, Coimbatore

1. Introduction

The solar power plays a crucial role in the transition to clean and sustainable power in the world. In India, the central and state governments are creating incentives to encourage the use of rooftop solar PV panels in the state by means of subsidies and policy programs. However, these incentives have not succeeded in the adoption in urban and semi-urban areas like Coimbatore. The socio-economic factors and the perceptions of the consumers towards solar technology determine the attitudes which are essential in the process of adoption.

The Ministry of New and Renewable Energy (MNRE) has given a target of 40 GW of rooftop solar capacity to India. To achieve this objective, one needs a better insight into consumer mindset. This paper will look at the variables that determine how willing consumers are to install rooftop solar systems in Coimbatore.

2. Review of Literature

Numerous studies have consistently shown that environmental concern, economic benefits, social influence, and general awareness significantly impact solar adoption (Rai & Beck, 2015; Balcombe et al., 2014). For instance, Claudy et al. (2013) argued that an individual's perceived behavioral control and attitude are stronger predictors of adopting green technology than mere demographic information.

Conversely, research also highlights significant roadblocks. Bhattacharyya (2018) revealed that a lack of public awareness and low trust in the technology impede adoption, even when favorable policies exist. Similarly, Mahapatra and Dasappa (2012) underscored the necessity of reliable service and installation support for ensuring consumer satisfaction. Clearly, closing the gap between consumer perception and the actual decision to adopt is vital for policy success. The impact of public education is evident in studies like Zhao et al. (2012), which found a strong correlation between awareness campaigns and PV system uptake in China. Furthermore, long-term policy consistency and media communication have been shown to significantly affect home energy behavior (Sastresa et al., 2010).

On a personal level, Jager (2006) observed that personal innovativeness and traits associated with being an early adopter predicted solar panel installation in European markets. In the Indian context, Sharma et al. (2021) highlighted the critical role of state electricity boards and utility-level support in shaping rooftop solar demand. Conceptually, Rogers' (2003) work on the diffusion of innovations provides a foundational theory, explaining that an individual's decision to adopt a technology moves through distinct stages: awareness, interest, evaluation, trial, and, finally, adoption.

Collectively, these studies confirm that the successful adoption of rooftop PV systems hinges not only on policy and cost but also on the cognitive and behavioral variables that fundamentally shape consumer attitudes.

3. Research Gap

Even though there is extensive literature on solar adoption in general, little literature has been done on household attitudes in Coimbatore. An analysis by factor and systematic study should be conducted to identify the psychological and financial motivation in this semi-urban location. Additionally, empirical studies that document consumer response on the implementation of the policy are scant.

4. Statement of the Problem

Even with the financial incentives and the high awareness about the environmental issue, a large number of Coimbatore households have not accomplished the move to install solar rooftop PV panels as anticipated. The cost of solar panels is not the only factor that would affect the decision to install them. These factors involve the attitude of the people in regard to the technology, attitude toward installers, and views of friends and family. It is therefore imperative to know these attitudes in order to make the understanding of awareness and incentive programmes to become more effective and focused.

5. Objectives of the Study

To examine the Consumer attitude towards Solar Rooftop PV panel adoption.

6. Scope of the Study

In this study, the researcher will only look at households within the Coimbatore district. It seeks to test the level of consumer awareness on rooftop solar, its attitude and readiness to own it. The research will uncover impediments on the demand side, which will aid in developing specific outreach plans

Its name is A Study of Consumer Attitudes Towards Solar Rooftop PV Panel Adoption, and the purpose of the research is to determine the effect of economic, social, environmental, and technological determinants on consumer acceptance. Such variables as cost-effectiveness, payback period, availed subsidies, perceived trustworthiness, consciousness towards the environment, and peer pressure are key variables.

The paper will also discuss the influence of the demographics on consumer responses in relation to age, income, education, occupation, and the type of residence. It will determine the role of government policies, promotional campaigns and institutional support in assisting or hindering adoption. The gathered primary data will be in the form of structured questionnaires and interviews, whereas secondary will be gathered with the help of the official reports, scholarly literature, and industrial publications.

Even though the study will be restricted to a particular city centre to be possible, the results will be applicable to other contexts of the same socio-economic and cultural backgrounds. The study provides a more detailed examination of behaviour and attitudes, without considering the technical effectiveness of solar panels. This should aim at offering meaningful information to policy makers, industry players and stakeholders interested in enhancing penetration of solar rooftops.

7. Research Methodology

Data Collection

The given research is a mixed-methods one, which combines quantitative and qualitative methods to investigate the perception of the people towards the implementation of solar rooftop PV panels.

Primary data will be collected through questionnaires in the form of structured questionnaires. The questions are set in such a way that they attract self-reported awareness, perception and intention to implement the technology by the respondents basing on cost, government incentives, environmental issues and trust to the technology. The questionnaire will be composed of close and open ended questions to have a detailed and reliable information.

Besides the surveys, we will also carry out personal interviews and in-depth conversations with the sampled consumers in order to collect more qualitative data on their perceived benefits and barriers. We will also conduct a review of secondary data which includes government reports, policy documents, industry publications, and recent scholarly studies to enhance the validity of the study. These sources will assist in situating the consumer reactions and indicate the trends that are arising in the adoption of solar energy.

Sampling Method:

Purposive sampling was our kind of sampling method because we wanted to find the participants who either could or already used solar rooftop PV panels. The sample finally consisted of 299 respondents, including household decision-makers and residents with different interest in renewable energy.

The sample was stratified to obtain more insight and capture various opinions using the demographic variables, namely age, income, education, occupation and type of residence. This stratification assists the study to identify the differences in attitudes of consumers in different socio-economic segments. The research pays particular attention to households that are the most pertinent to rooftop solar penetration to guarantee that the information gathered covers a broad spectrum of willingness and resistance variables to give in-depth information on the influence of consumer attitudes on the issue of demographic, financial, and environmental forces.

8. Framework of Analysis

This paper provides an accurate model to investigate the effect of consumer attitudes (independent variable) and the willingness to install solar rooftop systems (dependent variable). Questionnaires will be used to give us quantitative data which will be processed using statistical techniques to measure the correlations, the trends of adoptions, and the noticeable differences between groups.

Thematic analysis shall be used in the analysis of the interpretive data gathered in the course of the interviews and focused discussions to define the key motivators, the perceived barriers and the current trends in terms of consumer

decision making. A combination of the qualitative and quantitative findings will also provide feasible solutions to the policymakers, energy suppliers, and stakeholders, and, eventually, help to plan successful interventions to improve the solar and sustainable use of the rooftop.

9. Significance of the study

Green energy and sustainable living is gaining significance. This study is relevant to the academia and the industry. To enhance energy efficiency, reduce carbon footprints and sustainability of the environment, it is very important to understand the consumer perception towards solar rooftop PV panels.

The research provides information about the perception of costs, environment, government incentives, and technology trust. The findings can be used by the policymakers, energy suppliers, and urban planners to design the specific strategies that can stimulate the adoption of solar energy.

The research contributes to the existing literature on consumer behaviour in renewable energy as it evaluates behavioural and attitudinal theories in a regional context. It considers the demographic and socio-economic variables, incentives, and impediments with a holistic approach to creating a complete view of the decision-making process of households regarding energy. Such findings are needed so as to design effective campaigns on awareness, subsidy schemes, and incentive schemes which will help in a smooth transition to cleaner and more sustainable energy.

Analysis and Interpretation

Simple Percentage Analysis

Table No.:1

Gender	Number Of Respondents	Percentage %
Male	121	57
Female	82	43
Total	229	100
Age	Number Of Respondents	Percentage %
Below25	32	14
26-35	57	24.9
36-50	113	49.3
Above50	27	11.8
Total	229	100
Education	Number Of Respondents	Percentage %
No: Formal Education	103	45
High School	60	26.2
Degree/Diploma	39	17
Professional	27	11.8
Total	229	100
Occupation	Number Of Respondents	Percentage %
Salaried Employee	127	55.5
Business/Self-Employed	58	25.4
Professional	25	10.9
Agriculture	19	8.2
Total	229	100
Type of Residence	Number Of Respondents	Percentage %
Own House	111	48.5
Rented House	53	23.1
Apartment	65	28.4
Total	229	100

Household Monthly Income	Number Of Respondents	Percentage %
Below 20,000	44	19.2
20,001-30,000	85	37.1
30,001-50,000	65	28.4
Above 50,000	35	15.3
Total	229	100

Both genders were represented because of the survey consisting of 57 percent men and 43 percent women. On age, almost half of the respondents were aged 36 to 50 years, that is, 49.3%. The second most significant group was 26.35-year to 25-year at 24.9 per cent., then under 25, 50 and above at 14 and 11.8 per cent. respectively. In this way, the sample was composed of the largest middle age population.

As far as education is concerned, 45 percent of the participants claimed to have no formal schooling. Twenty six point two percent had completed high school, 17% had a degree or diploma and 11.8% a professional qualification. All in all, there was a diverse educational background, where the upper levels of the education were more concentrated.

A majority of the respondents were employed as salaried workers (55.5 3). An individual of the business or self-employed was 25.4, professionals 10.9, and 8.2 were occupied with agriculture.

On residential status, 48.5 percent occupied their own houses, 23.1 percent occupied houses under rent and 28.4 percent occupied apartments, which showed that they had a combination of housing structure.

The household income analysis showed that 37.1 per cent of the respondents had monthly incomes between 20, 001 and 30,000. Twenty-eight point four percent (30,001 to 50,000), nineteen point two percent (less than 20,000) and fifteen point three percent (more than 50,000) were the earnings. As a result, most of the participants are in the lower and middle-income bracket.

On the whole, the demographic variables reveal that the sample of the participants is heterogeneous in terms of gender, age, education, occupation, residence, and income, which gives a full socio-economic picture of respondents.

Factor Analysis

Table No.:2

CONSUMER ATTITUDE TOWARDS SOLAR ROOFTOP PV PANEL

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.790
Bartlett's Test of Sphericity	Approx. Chi-Square	776.529
	df	171
	Sig.	.000

Both Kaiser-Meyer-Olkin (KMO) test and Bartletts Test of Sphericity indicate that the data is prepared to be analyzed by factor analysis. The KMO value is 0.790 which is acceptable and it means that the sample size and inter-variables correlations are adequate to be analyzed. The test by Bartlett resulted in a chi-square of 776.529 and 171 degrees of freedom with a p -value of 0.000. Since the p-value is less than 0.05 we reject the null hypothesis that the correlation matrix is an identity matrix thus asserting that the correlation between the variables is sufficient.

The combination of these tests is a good indication that the data can be used in additional factor analytic processes.

Table No3

Factor	Statements	Rotated Factor Loadings
Willingness and Optimism Toward Solar Rooftop Installation (9.566 of variance explained)	I am interested in installing a solar rooftop PV panel in the near future	.937
	I believe solar energy is a reliable source of power for homes.	.970
	I feel positive about contributing to clean energy by using solar panels	.943
Supportive and Promotional Attitude Toward Solar Energy (19.111of variance explained)	I support the idea of reducing dependency on conventional electricity through solar energy.	.833
	I would recommend solar rooftop PV panels to friends or family.	.882
	I think adopting solar energy is a smart lifestyle decision.	.733
	I feel proud to be associated with the use of renewable energy like solar power	.593
Positive Perception and Willingness Toward Solar Energy Adoption. (24.829 of variance explained)	I consider solar panels to be a symbol of environmental responsibility.	.512
	I am willing to make lifestyle changes to accommodate the use of solar energy	.826
	I am confident that solar panels will meet my household's electricity needs.	.965
	I am more likely to trust homes or communities that promote renewable energy.	.937
	I believe the benefits of solar energy outweigh the costs.	.970
Technological Adaptability and Support for Energy Independence (29.481 of variance explained)	I am comfortable with the idea of learning new technologies associated with solar energy.	.943
	I am enthusiastic about contributing to national energy security through personal solar usage.	.965
Solar Energy as a Symbol of Progressive and Sustainable Living (33.338 of variance	I think people who adopt solar panels set a good example for society.	.937
	I see rooftop solar systems as a smart addition to modern urban homes.	.970

explained)	I believe using solar panels enhances the image of a tech- savvy, sustainable lifestyle in urban settings	.943
Support for Policy Initiatives and Environmental Responsibility (35.871 of variance explained)	I support city-level initiatives that promote widespread rooftop solar adoption.	.833
	I believe installing rooftop solar panels is a responsible step toward reducing environmental impact."	.882

The consumer attitudes to solar rooftop PV panel adoption were placed into a factor analysis that retrieved six factors.significant differences that can be considered to be explaining the variance of the data. The first factor,Both desire and hopefulness toward having solar installed on the roof, 9.566 percent is explained by this accounts.variance and underlines the high interest and positive emotions of the respondents towards the adoption of solar.panels, which is manifested in their solar energy faith in it as a stable power source, and their readiness.to provide donations to clean energy. The second reason is Supportive and Promotional Attitude.

Towards Solar Energy, which is an explanation of 19.111 percent of the variance, is the reflection of respondents. Predilection to support and encourage solar acceptance, such as prescribing it to others and considering it to be a clever way of life. The third one, Positive Perception and Willingness. Towards Solar Energy Bradption, describes 24.829% of the variation and highlights the focus on consumers. Trust in the efficiency of solar panels, their willingness to change their lifestyles, and their perception of the benefits and environmental friendliness of the solar energy. The fourth factor, Technological Adaptability and Support to Energy Independence with 29.481 percentage the variance, indicates the responsiveness of the respondents to acquiring new technologies and their indicators interest in supplying the country with energy by using solar. The fifth factor, The explanation of 33.338% of the goes under Solar Energy as a Symbol of Progressive and Sustainable Living variance, gathers impressions of solar energy as a futuristic, forward-thinking practice that increases environmental consciousness and represents a high-tech life. Finally, the sixth factor, Support of Policy Initiatives and Environmental Responsibility, which takes 35.871% of the firm of the variance, indicates that there was backing of city-level solar policies and acceptance of solar adoption as accountable environmental practice. These aspects combine to show a holistic and multi-dimensional knowledge about consumer attitudes, which includes willingness, optimism flexibility, encouragement, symbolic value, and state-level incentives on the adoption of solar rooftop PV panels.

10. SUGGESTIONS

It will take extra effort to increase the take-up of solar PV panels on roofs among the consumers. Government incentives, environmental benefits and concise technical information should be highlighted through awareness programs, namely, workshops, local events, and social media. Partnering with local influencers and local groups of people creates credibility and engagement. Affordable through expansion of financial support by means of low-interest loans and easy EMI schemes by banks and microfinance institutions. Certified installers are another way of ensuring transparency and also quality , and clear post-installation services plans work to ensure reliability and maintenance of the equipment.

Social outreachs and activities -solar demo houses, word of mouth- are useful in making rooftop solar the new norm in communities. The long-term savings and environmental benefits of solar energy are the parts of solar energy education that need to be emphasized in the public. Customers can use digital tools and mobile applications to determine savings, estimate the possibility of installing a rooftop, and request subsidies. The school and college outreach creates awareness at an early age and influences decisions at the family level. The training programs impart skills in the solar technology to the youth, thus providing them with work locally, and guaranteeing them of ready employment. The enhancement of connections with electricity boards facilitates the process of net -metering, ensures the transparency of billing, and aids the transition process toward prosumer models. Common doubts are eradicated by myth-busting campaigns and actual stories of success. The adoption is relatable and practical due to targeted marketing to different income levels and house types. Lastly, consistent feedback, external audits, and partnerships between the public and the private create accountability, affordability, and success in the long term. Promote government-principal cooperation in order to harmonize practices and minimize costs.

11.CONCLUSION

It is revealed that the attitude of consumers in Coimbatore toward the adoption of the rooftop solar is rather positive, which demonstrates their willingness to adopt the solutions of sustainable energy. The environmental awareness level among the population is high, and most of them value the benefits of using solar energy in the long term. The adoption is still low due to the following practical issues: high initial cost, lack of awareness on the availability of financial aid and doubts about the technical reliability. The results demonstrate that consumers have a positive attitude toward solar PV technology, although the lack of information, financial affordability, and trust of the service is the barrier to mass adoption. The consumers are willing to install solar panels when they are assured of the government incentives, reliable services of installing the panels, and after sale services. The factor analysis demonstrated that not all incentives are monetary. The social influence and values of the environment also contribute to the critical role in decision making. Consumer confidence largely depends on technological trust and ease of use. Policy initiatives thus need a combination of raising the level of financial subsidies as well as fostering awareness, skill training as well as supporting networks locally The multi-stakeholder approach that includes, but not limited to, government agencies, receiving financial institutions, solar providers, and leaders of the community is necessary. The perception can be changed by encouraging peer influence by visible installations in the neighborhood and success stories. This paper confirms that enhancing consumer awareness, perceived risks, and establishment of an ecosystem of trust will hasten the adoption of rooftop solar PV systems. With Coimbatore and other cities striving to achieve a national objective of sustainability, a local and national agenda should be to instill a sense of consumer confidence in the uptake of solar.

12. SCOPE FOR FURTHER RESEARCH

Future research will be able to investigate the difference in adoption between urban and rural locations, compare rates of adoption among various districts, and quantify the post-installation satisfaction to resolve how long the adoption decisions will be maintained.

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