International Research Journal of Multidisciplinary Scope (IRJMS), 2025; 6(3):1316-1332 IRJMS

Review Article | ISSN (O): 2582-631X DOI: 10.47857/irjms.2025.v06i03.05069

The Influence of Marketing and Awareness Campaigns on Solar Energy Adoption: A Review of Strategies and Effectiveness

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Abstract

The shift to renewable energy sources is picking up pace globally, with solar energy being one of the most significant sustainable solutions. However, with technological advancements and declining costs, solar adoption has been inconsistent among various consumer segments. This review critically examines marketing strategies, awareness campaigns, financial incentives, and socioeconomic factors as drivers of solar energy adoption. The study classifies findings into four key dimensions, namely: consumer awareness, effectiveness of traditional compared to digital marketing, socioeconomic influences, and psychological and behavioural impacts on decision making. Results show that high consumer awareness leads to highly significant increases in adoption rates, while traditional marketing finds relevance in low-digital penetration, but digital marketing is more effective all along. Policies and incentives for economic support also have an immense impact on adoption rates among the lower classes because high-class education and urbanization affect adoption rates strongly. Behavioural factors including consumer trust in providers, environmental causes, installation ease, and social influence further influence consumer adoption readiness. Recommendations emerging from this study point towards awareness campaigns targeted at specific groups, availability of financial incentives, and customized marketing strategies aimed at actual consumption at a scale. This literature review has informed policymakers and marketers on how to tailor their marketing and promotion approach towards solar energy as a mass adoption solution.

Keywords: Awareness, Campaigns, Consumer Behaviour, Marketing, Policy Makers, Psychology, Renewable Energy.

Introduction

The increasing global demand for sustainable energy solutions has led to positioning of solar energy at the heart of the transition to a low-carbon future. Adoption of solar energy has registered tremendous growth during the last ten years due to improvements in PV technology, lowering costs, and favourable government policies. However, despite these environmental and economic benefits, wide-scale adoption of solar energy remains a challenge: consumers lack knowledge about it, there is constraints on the available finances, and the marketing approach has an effect on consumer adoption behaviour. There is a need to understand how marketing and awareness campaigns shape consumer decisions to bridge this adoption gap. The primary role for marketing and advertising is to target consumer behaviour concerning the knowledge gaps and myths against the purchase of solar energy through a series of marketing and campaigns. Communication used includes traditional channels, such as television, radios, and press; digital campaigns like social networking and online publicity; and social and word of mouth. Although digital marketing has emerged as a very powerful tool for diversifying consumer segments, the effectiveness of strategies in comparison with one another is still debated. Additionally, financial incentives like subsidies, tax credits, and financing options play a critical role in promoting the adoption of solar energy, but this varies with the perception and fiscal background of consumers. Despite the increasingly vast literature about solar energy adoption, there remains a scarcity of holistic studies comparing systematically the efficiency of various marketing and awareness approaches. Most current studies focus on technological development and policy intervention without adequately considering the marketing efforts as direct influencers on consumer adoption.

(Received 18th April 2025; Accepted 02nd July 2025; Published 30th July 2025)

Additionally, even though financial incentives are highly advocated, their relationship with consumer levels of awareness and marketing strategies remains less explored. This review seeks to bridge this research gap by analyzing the influence of marketing campaigns, consumer awareness, and financial incentives on solar energy adoption. Specifically, this paper explores the following key research objectives are to examine the role of consumer awareness in shaping solar energy adoption decisions, Comparing the Efficacy of Traditional vs. Digital Marketing: Whether Traditional Advertising Strategy Influences Adoptive Behaviour, to evaluate the effect of financial incentives and willingness to pay on solar adoption, to assess factors of socioeconomic and psychological nature in consumer adoption behavior, In order to recognize the most impactful awareness campaign strategies through comparative analysis.

In so doing, this review addresses objectives to provide insight into strategies that could improve solar energy adoption and makes recommendations to policymakers, marketers, and industry stakeholders. Findings will add to the continued discourse on sustainable energy marketing and provide a basis for more focused and effective pro-motional efforts in the global shift to solar power.

Consumer Awareness and Solar Energy Adoption

Consumer awareness develops the behavior or pattern of adopting solar energy. Knowledge, perception, and availability of information reinforce decision-making about a technology. Findings are that there will be high adoption with increased awareness level, while lack of information is the most significant barrier to solar uptake. Consumer trust in the technology, social influence, and targeted knowledge communication campaigns impact willing-ness to invest in solar solutions.

Impact of Knowledge and Perception on Solar Adoption

Awareness of solar energy benefits influences both trust in technology and consumer decision-making. It is found that knowledge and trust are key drivers of solar energy consumption behavior (SECB), with social influence and gender playing a moderating role (1). The study, based on 8,500 Pakistani households, revealed that the higher the knowledge levels, the more it enhances trust in solar technology, leading to higher adoption. However, the study also noted that social influence could dilute the impact of awareness because external opinions sometimes overshadow factual knowledge. The question of how the cognitive preferences of residents impact the adoption of renewable energy, using education, income levels, and awareness of pollution as key factors that determine the trend in adoption are examined (2). The findings indicated that high incomes, better access to information, and highly polluted living conditions increased the likelihood of people adopting solar solutions. Another "herd effect," where people in neighbouring regions have similar adoption patterns due to sharing the same perceptions, was found in the study. The work extends the set of psychological consideration of solar acceptance by analyzing media sentiment and SLO through opinion mining using artificial intelligence (3). It has been observed that positive sentiment in media discourse enhances the acceptance of solar installations by consumers; thus, supporting the hypothesis about consumer knowledge's influence on buying decisions. Further-more, narratives of traditional media also influence consumer acceptance in the long term while determining public perceptions and investment opportunities.

Role of Awareness Campaigns in Overcoming Barriers

Unawareness is a dominant deterrent and is particularly seen in rural and underdeveloped areas. A study of decentralized solar PV adoption in rural India was developed, where TV, print, and even government advertisements were ineffective; however, word-of-mouth recommendations, experiential learning, and the work of community-driven awareness programs prompted more favourable responses from the households (4). Hence, this suggests that localized marketing approaches that target the individual level are more effective than mass media campaigns at driving an influence into solar adoption. Crowdfunding as an alternative funding source for African solar projects, showing those consumers' perceptions of financial security and trust in the investment mechanism will influence adoption (5). They pointed out that social proof and reputation signalling are critical elements in the facilitation of

community-based financing of solar energy solutions.

Hypothesis Addressed

The discussed studies are significant in providing ample evidence for the following hypotheses.

H1: Increased consumer awareness positively impacts adoption of solar power. Several studies show that increased knowledge and awareness significantly increase the adoption rate (1, 2, 4). However, the impact would be moderated by social influence and economic factors, thus necessitating finely tailored approaches.

H2: Knowledge of benefits from solar will enhance the chances of adoption. Studies reveal that favourable attitude and publicity in the media boost consumer confidence in solar technology (3). It is found that prior knowledge mainly drives adoptive trends in renewable energy by way of cognitive preferences (2).

All these studies indicate that consumer awareness is an important determinant of solar adoption; however, the effectiveness of this factor is highly dependent on how information is communicated, perceived, and reinforced through social and economic factors. Trust, financial security, and social influence thus either reinforce or antagonize awareness-driven adoption, but well-designed information campaigns are likely to overcome these barriers and increase adoption rates.

Effectiveness of Marketing Strategies

In addition, marketing strategies are a determinant of consumer decision-making on whether to adopt solar energy. Earlier, marketing solar technology was achieved through television and radio advertisements and print media; however, this has changed since the advent of digital media with social media, online advertisements, and AI-powered marketing strategies. The shift from traditional to digital marketing has had a profound effect on consumer involvement, message targeting, and the adoption process. This section compares the effectiveness of traditional versus digital marketing strategies in promoting the adoption of solar energy.

In addition to consumer behavior and marketing strategies, the effectiveness of solar adoption campaigns is significantly shaped by systemic factors such as grid integration initiatives, local government collaborations, regulatory frameworks, and subsidy schemes. Well-integrated solar infrastructure that allows easy connection to the grid enhances consumer confidence and improves the functional appeal of adoption. Similarly, local government partnerships can bolster campaign credibility, streamline administrative support, and increase outreach efficiency. Regulatory clarity, particularly concerning net metering, feed-in tariffs, and installation standards, reduces uncertainty and accelerates decision-making. Moreover, the availability, accessibility, and transparency of subsidies directly influence consumer willingness to invest. Campaigns launched in areas with strong policy alignment and institutional backing tend to show higher adoption success, while regions lacking coordinated policy efforts often face resistance, confusion, or apathy. Thus, integrating institutional and policy-level factors into campaign planning is crucial to improve both the reach and impact of solar adoption efforts.

Comparison of Traditional vs. Digital Marketing for Solar Energy Adoption

Traditional advertising, including tv, radio, and print ads, has traditionally been a primary driving force of renewable power campaigns. However, virtual advertising has caused a trend of more targeted and facts-pushed promotional efforts. Television remains a sturdy medium in international locations like Uganda because it is accessible and credible (6). However, it's miles restricted by lower interactivity and is more highly-priced than virtual options. Digital marketing, however, has emerged as a more distinguished platform as it permits for targeting precise patron demographics and measuring engagement in actual-time. Additionally, it was point out that there may be a exquisite shift toward social media and digital structures all through and after the COVID-19 pandemic as groups adapt to modifications in client behavior (7). The have a look at suggests how digital advertising helped businesses to have direct contact with purchasers, thereby growing engagement and recognition of solar solutions. This would further highlight that, if AI is going to change digital marketing and help in optimizing adverts and, concurrently, working for improving sustainability; AI-based targeting campaigns can better hold customers, eliminate unnecessary waste about adverts, and increase conversion concerning solar energy consumption (8). A similar study carried out on the effectiveness of AR in advertisement shows that interactive and

immersive experiences lead to greater interest in sustainable offerings, including the solutions of solar energy (9). The efficacy of digital marketing when they utilized a machine learning approach involving decision trees, random forests, and artificial neural net-works algorithms was further enhanced to predict prospective consumers based on their media consumption habits (10). This shows social networking sites hold the most power in influencing purchase decisions related to energy, specifically for tech-oriented and environmentally mindful consumers. Even though digital marketing has shown more targeted capabilities, one must acknowledge that media penetration and economic factors are significant influences on consumer response. A study was conducted, that analyzed the interplay between media infrastructure, consumer behavior, and economic conditions in 23 Asian economies, where they showed that advertising effectiveness is dependent on the accessibility of media, income, and educational backgrounds (11). These findings suggest that although digital marketing is more effective, traditional marketing still has value in regions where internet penetration is low.

Demographic and Regional Variations in Marketing Effectiveness

The effectiveness of marketing strategies—whether traditional or digital—is not uniform across all population segments. Consumer behavior is significantly influenced by demographic variables such as age, education level, income, and geographic region. For instance, younger, urban, and digitally literate consumers tend to respond better to AI-powered social media campaigns and influencer-driven content. In contrast, older or rural populations often exhibit higher trust in traditional media like radio and community outreach programs. Additionally, regional disparities in media infrastructure, internet penetration, and cultural values play a key role in shaping the success of solar marketing efforts. For example, while television may remain a reliable source of information in sub-Saharan Africa or rural India, mobile-based awareness through WhatsApp or SMS is more effective in digitally transitional regions. Therefore, a one-size-fits-all strategy may lead to suboptimal results. Solar adoption campaigns should be demographically segmented and regionally adapted to ensure maximum outreach, cultural resonance, and behavioral alignment with local communities.

Role of Personalized Marketing in Solar Adoption

Digital marketing can provide highly customized content in response to the preferences and behavior of consumers. Personalized marketing means that promotions for solar energy will be matched with individual needs, financial capacities, and environmental concerns, hence leading to an increase in adoption rates. The influence of smart marketing innovations in tourism shows that customized pro-motions influence consumer decision-making (12). The same approach may be adopted for marketing solar energy, where through targeted messaging; the financial incentives, ROI, and long-term advantages may be well communicated to the potential adopters. In emphasizing the personalization aspect, about online entertainment media and its influence on consumer perceptions and behavior extends further discussions on this topic (13). This study's findings even suggest that such individually tailored digital content augments not only engagement but also trust-a very important attribute in building awareness for solar energy.

Hypotheses Addressed

These findings of these studies offer great strength to the following hypotheses:

H3: The digital marketing campaigns are stronger influencers than the traditional media. It is found that the marketing techniques, using social media and AI, can influence targeted consumers better than conventional TV, radio, and print media (7, 10). It was also emphasized that AI and digital marketing contribute to environmental sustainability and customer engagement, thus validating its use against traditional approaches (8).

H4: Personalized marketing enhances solar energy usage. AR marketing substantially improves customer engagement and purchasing intent (9). It was revealed that personalized digital content aligned with the consumer demand will contribute to higher adoption rates (12, 13).

Socioeconomic Factors Affecting Solar Adoption

Use of solar energy is strongly affected by socio - economic factors, especially income levels,

education and geographical location (Urban vs. Rural). While sun technology has become more accessible in recent years, eco-nomic capacity, knowledge and inequalities in the regional infrastructure affect the adoption rate. These section ex-plains how these factors affect the adoption of solar energy and present a comparison of comparison of adoption trends between different socio -economic groups.

Influence of Income Levels on Solar Adoption

At high income levels, it is more likely that homes can install solar systems and can be designed to do so when the encouragement that will be low or no costs are available from the government. According to research, economic inequalities between urban and rural areas affect the consumption of renewable energy, especially where transport infrastructure is poor or limited (14). In their research on 227 Chinese cities, researchers revealed that stronger transport in cities will be better access to infrastructure and high -income solar solutions, while rural families must overcome high economic and practical obstacles. Targeted Poverty Alleviation (TPA) program in China and found that decreases in the rural-urban income gap led to a significant increase in solar adoption (15). The program overcame the financial constraint for low-income community rural house-holds and thus proved that targeted financial policies can encourage the use of solar among the poverty groups. The effect of digital financial inclusion on income inequality and solar adoption was also examined (16). Their results show that broader financial inclusion through digital finance tools helps lower-income households invest in solar technology, but the urban areas are more significant beneficiaries than the rural ones as these areas differ in terms of literacy regarding financial service and infrastructure. All these studies lend credence to the hypothesis that better-off consumers are more likely to adopt solar energy because they have better affordability and access to financial services.

Education Level and Solar Adoption

Education also has a bearing on awareness, decision-making, and the comprehension of financial incentives in solar energy. Higher education is linked to higher knowledge of the benefits of sun power, better financial literacy, and the likelihood of adoption increases. The influence of digital finance and financial literacy on household energy consumption (17). The authors came to the conclusion that higher financial literacy is associated with better adoption of clean energy technologies, including solar power. Households with educated heads of households better understood government incentives and calculated ROI, leading to increased adoption rates. Likewise, in assessing water conservation behavior in rural Tanzania, their work indicated that educational level was important for influencing households to take sustainability practices (18). Here, while focused on water, the pattern continues for the installation of solar power—the better an educated consumer understands long-term financial and environmental gain, the greater the potential they have for the installation of a solar product. These findings support the hypothesis that higher education levels positively influence solar energy adoption by increasing awareness and financial confidence.

Geographic Disparities: Urban vs. Rural Solar Adoption

Geographic location becomes one of the factors critical for solar energy adoption, where more urban consumers than rural consumers use solar energy. In fact, in general, the infrastructures and financial services, and above all, proper marketing campaigns to encourage its utilization are relatively available in the cities. It was further stated that the adoption rate of solar energy is negatively affected due to limited access of financial resources and to infrastructure and awareness programs by rural households (14, 15). Overall, urban households benefit more from higher access to financing, incentives from the government, and stronger presence of the solar energy providers. The other part considered a "digital divide" between city and countryside settings, concluding rural households lack many financial instruments needed to back such solar in-vestments; thus, efforts in enhancing literacy in financial activities and developing electronic finance might solve the disparity across cities and townships regarding increased adoption of sun-based electricity (17).

Cross-Country Comparisons of Socioeconomic Influences on Solar Adoption

Global trends in solar adoption can be compared with different regions and socioeconomic groups. analyzed housing prices for South Australia and

found that higher-income urban groups are more likely to invest in sustainable infrastructure, such as solar power (19). Consistent with this, global trends report that financial stability, government incentives, and digital finance tools in developed nations lead to higher solar adoption rates. Employment barriers for individuals with disabilities across 20 countries were analyzed, asserting that socioeconomic status affects how technology is adopted (20). Income inequality would pose a major barrier to sustain-able investment in any form of technology, which may also be applied when discussing solar adoption. Another such study iswho analyzed African small-scale farming households and established that access to financial services, as well as government support, significantly increases technology adoption rates. Their study establishes the need for region-specific strategies to promote the adoption of solar energy among low-income groups. Cross-country comparison confirms that these factors are affecting the solar adoption trends in other countries as well.

Hypotheses Addressed

The reviewed literature strongly supports the following hypotheses:

H7: High-income consumers are more likely to adopt solar. It is confirmed that income disparities affect the adoption of solar, and better financial access favours higher-income households (17-19). Also it was mentioned that financial inclusion strategies may enhance technological adoption for lower-income groups (21).

H8: Education is a determinant in the adoption of solar. How education increases people's awareness, financial literacy and, therefore the adoption of the solar technology (17, 18). "Financial education programs are important in enhancing the rate of technology adoption." (21).

H9: Urban consumers adopt solar energy at higher rates than rural consumers. Urban areas have better infrastructure, financial access, and marketing exposure, leading to higher solar adoption rates (14, 15). The urban-rural digital divide, which affects access to financial tools necessary for solar investments were also found (17).

Socio -economic factors such as income levels, education and geographical rooms are the most important determinants for solar option patterns. Home with high incomes has more flexibility in its financial resources, making it easier for them to invest in solar solutions. Education affects consumers' consciousness; with better education, consumers' financial literacy increases and as a result, the adoption rate increases. In addition, urban areas have a higher sunshine due to better infrastructure, awareness campaigns and financial access, while in rural areas more obstacles are met. To address these differences, decision makers must focus on increasing financial incentive extension, better access to digital finance and more awareness campaigns targeting rural and lower income. Future research should detect innovative funding models and government programs around the world to reduce socio -economic obstacles for solar cell adoption.

Psychological and Behavioural Factors

It is clear that using solar energy is not just a decision made by financial incentive and technical viability, but at the same time a psychological and behavioral reason. Such factors include the environmental impact of consuming solar energy, alleged insurance policy providers, facilities for use and social influences. Establishment affects consumers' prerequisites for complexity, long -term reliability and social acceptance of solar option. This section examines these psychological and behavioral dimensions regarding consumer decisions.

The Role of Environmental Concerns, Trust in Technology, and Ease of Use

Environmental awareness has become a comprehensive driver for individuals who choose solar cell adoption process. Consumers with high environmental awareness are ready to invest in permanent technologies including solar panels. To work on this inspiration, it was showed whether technological innovation and renewable energy is to reduce simultaneous emissions in BRICS land, which drives environmental considerations drives adoption behavior (22). The study focuses on the development of green technology without giving up environ-mental quality, which corresponds to the hypothesis that environmental awareness affects solar options positively (H10).

The next is trust in the solar technology and providers. Customers are unlikely to embrace the technology if it lacks reliability and reliability or entails monetary risk. Consumer confidence is improved with aspects such as privacy, security, and user friendliness for the digital banking system

(23). Similarly, it was examined how trust in crypto currencies influences adoption, highlighting that consumers need clarity, transparency, and security assurances before embracing new financial technologies (24). Applying this insight to solar energy, trust in providers, warranties, and proven technology performance plays a significant role in encouraging adoption (H11).

Ease of use also determines the investment in solar technology. When the installation process is perceived to be complicated, expensive, or involves a lot of alterations, the consumer will not invest. Tested the Technology Acceptance Model (TAM) for the adoption of electric vehicles, which found that perceived risk and ease of use were the significant determinants of adoption decisions. These results validate H12: The fear that installation complexity has will deter the adoption of solar.

Impact of Social Influence and Peer Recommendations on Adoption Rates

Social influence, in the form of peer recommendations and community adoption trends, is significant in solar energy adoption. They are also likely to adopt solar technology once they notice other members, relatives, or leaders in their community adopting the technology. A discrete choice experiment in Wuhan, China, assessing preference of community photovoltaic (PV) adoption. The study found out that 65% of those surveyed would take up PV installations if their immediate neighbours had adopted them (25).

Therefore, peer effect and visibility created a ripple effect that enhanced confidence and willingness by consumer to make investments. ICT adoption by SMEs and conclude that, even though the adoption decision was dominant, social influence dominated it (26). If used in the solar energy industry, such findings recommend marketing strategy efforts to be peer advocacy as well as evidence of success in real life to sustain increases in rates of adoption. The adoption of telemedicine in China, with trust and subjective norms (collective expectations) impacting adoption behavior greatly. This finding is consistent with research in the renewable energy space; people install solar panels more when their friends, local influencers, or community leaders advocate for these installations (27).

Solar Adoption Campaigns

Successful solar adoption campaigns often result from effective multi-level coordination involving national policies, local governance, private sector engagement, and grassroots participation. For example, India's Saubhagya Scheme combined central government funding, state-level implementation, and village-level awareness drives to electrify remote areas with solar-based microgrids, leading to notable increases in adoption in rural regions. Similarly, Germany's Energiewende program demonstrates how coordinated policy at the federal level—supported by municipal utilities and citizen cooperatives—can drive widespread residential solar uptake. In Bangladesh, the Infrastructure Development Company Limited (IDCOL) model successfully brought together international donors, national regulators, and local NGOs to install over 6 million solar home systems, largely due to synchronized financial mechanisms, marketing education, and micro financing. These examples show that when technical infrastructure, fiscal incentives, regulatory clarity, and consumer outreach are coordinated across administrative layers, campaigns are significantly more effective in overcoming both structural and behavioural adoption barriers. Multi-level governance, therefore, serves as a key enabler of scalable and inclusive solar diffusion.

Hypotheses Addressed

From the reviewed literature, good evidence can be seen in support of the following hypotheses:

H10: Awareness of the environment enhances the adoption of solar. It established that environmental concerns influence the adoption of green technology, such as solar energy, sustainability-driven consumers is more likely to adopt photovoltaic systems (22, 25).

H11: Trust in solar providers increases adoption. It was considered that trust in the technology and service providers would enhance adoption decisions (23, 24). Customer confidence in the service provider affects their willingness to adopt new technology (27).

H12: The fear of installation complexity negatively affects the adoption. It is said that the alleged complexity reduces the adoption rate for permanent technologies (26, 28). Whether one of

the study motivated to use ease of use in the installation process and easy clarity (24).

The consumer's attitudes to solar cell adoption are strongly influenced by psychological and practical factors. Environmental issues are a major motivator for consumers that give more significance for stability and reduction in carbon footprints. The opposition to adoption of trust in the supplier of sun technology overcomes resistance, while concern about the complexity of installation and purpose serves as obstacles in the adoption process. In addition, consumer behavior is affected by adoption trends and colleagues in society, which strengthens the argument that social verification plays a role in the sun extension. Political decision makers and abstractor should push for environmental benefits, establish confidence in sun suppliers, streamlined installation process and drain social influence strategies to better use the frequency of solar option. Future studies should focus on social consequences to promote long -term behaviour the consequences of trust -based measures and renewable energy.

Search Strategy

The systematic analysis followed for an in-depth scrutiny of marketing and awareness campaigns driving solar energy consumption shall include adoption research conducted, ensuring thorough studies. Structured methodologies ensure overall incorporation of credible studies within these limits-peer-reviewed literatures and the papers on proceedings presented from respective conferences-industry reports of particular industry bodies that form key in-puts into methodology consisting of the selection criteria along with an analytical framework as given in Figure 1.

Data Collection

Data sources used in the compilation of this review are diversified across several authentic sources, allowing for a more holistic and research-based approach toward analysing the pattern of solar adoption. The key sources used for gathering information were academic databases, peer-reviewed journals, conference proceedings, and government & industry reports. Access to scientific research into renewable energy adoption, marketing strategy, and consumer behavior was sought from academic databases like Scopus, Web of Science, IEEE Xplore, Google Scholar, and ScienceDirect. The databases selected provide adequate coverage of the empirical and theoretical studies for this topic.

In-depth marketing effectiveness, financial incentives, and socio-economic drivers of solar uptake were some key contributions through studies in peer-reviewed journals. Journal articles related to energy policy and environ-mental economics besides behavioral sciences contributed to ensuring qualitative research inclusion in the analysis. Conference proceedings for IEEE, ACM, and some energy policy events were scanned through to absorb novel developments in the field of digital marketing, contemporary policy deliberation, and promising technologies related to solar promotion. Besides that, reports from government and industry organizations, such as the International Energy Agency (IEA), World Bank, and national energy agencies, were included to analyze real-world policy im-pacts, financial models, and large-scale awareness campaigns for the promotion of solar adoption.

Selection Criteria

A comprehensive filtering and selection process was utilized to ensure the review is relevant to research in key themes in marketing and awareness strategies in the adoption of solar. The criteria for inclusion have been set with the aim of ensuring that studies selected are both relevant and reliable. Only publications between 2015 and 2024 are considered, considering recent developments in marketing and changes in policy. Studies were reviewed if they aimed at consumer awareness, marketing efficiency, financial inducements, and socioeconomics that lead to the solar adoption. There was an inclusive approach of qualitative, quantitative, or mixed methodology research. Most importantly, it was ensured to review studies, which compared both traditional and online marketing strategies in addition to having cross-country differences in adoption pattern.

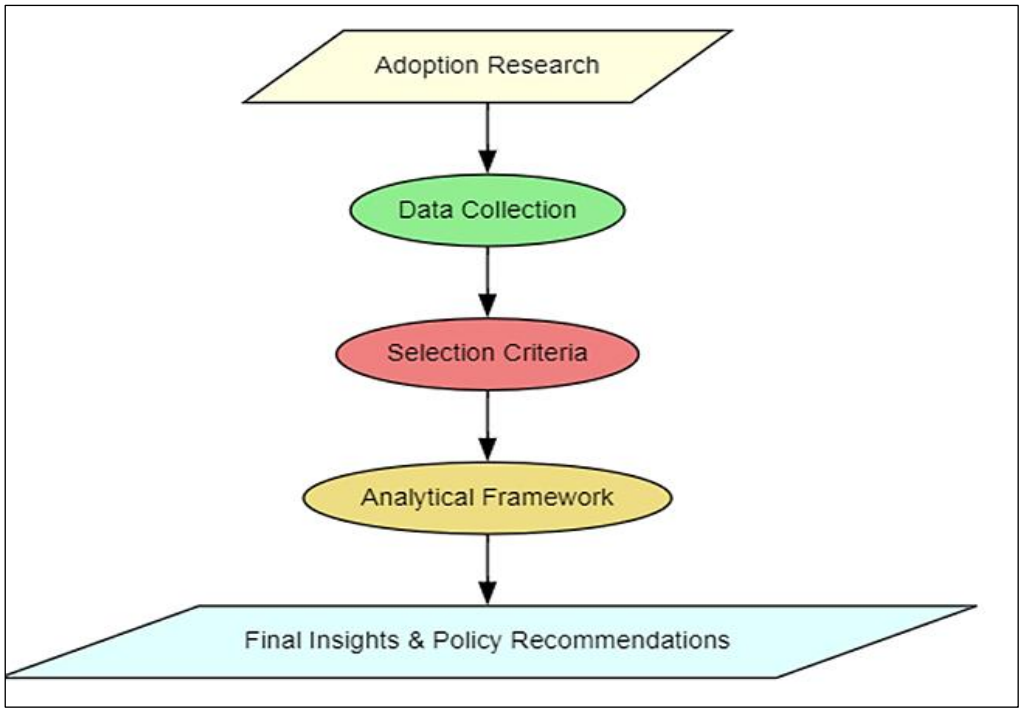

Figure 1: Methodological Approach

Studies were excluded when they were on technological advancement on solar energy, without mentioning factors related to consumer adoption. Those papers that didn't give empirical data, conceptual frameworks, or statistical insights regarding marketing strategies were also omitted. Research without a clear statistical or theoretical contribution towards the understanding of solar energy awareness and adoption were not considered for inclusion.

Analytical Framework

A comparative synthesis and meta-analysis were applied to assess the selected studies in a manner that ensured there was a well-structured investigation of how both marketing strategies and socioeconomic factors interact to influence adoption. First, the literature is categorized thematically according to their key variables-including consumer awareness, marketing strategy, financial incentive, and social and economic effects. This method helps in uncovering patterns across several studies.

All the hypotheses (H1-H12) were assessed based on a comprehensive synthesis of literature from several papers, where there were findings to support and refute the hypothesis. Quantitative research with statistical correlation was meta-analyzed, whereas qualitative research was analyzed using thematic synthesis. In addition, the cross-country comparisons were made for the regions so that regional variation in the patterns of adoption may be understood with the help of economic, cultural, and policy-driven factors leading to adoption.

Thus, by using structured and systematic methods, this literature review will encompass the entire thought pro-cess regarding marketing and awareness schemes and their adoption of solar energy. The main findings are drawn to provide practical insights for decision-makers, scientists, and others in the related industries to use in developing stronger marketing strategies or policy interventions so that solar energy solutions can become more widely available.

Discussion

This review draws on studies from diverse regional contexts—including South Asia, East Asia, Sub-Saharan Africa, Europe, and Oceania—to strengthen the global generalizability of findings and to reflect context-sensitive solar adoption dynamics.

Understanding Consumer Awareness and Adoption Trends in Solar Energy

Consumer awareness has the greatest influence on the adoption of solar energy solutions. It's the knowledge regarding solar technology, its benefits, and incentives that drives consumer decisions and shapes their attitudes. In fact, more awareness tends to be positively related to a greater

likelihood of adoption, but less information is a major barrier to adoption.

The Figure 2 plots the awareness of different levels on the x-axis and solar adoption rates on the y-axis. Consumers with higher awareness have around 80% adoption, but those with mid-level awareness adopt at a lesser rate of approximately 60%. The adoption falls drastically below 30% among consumers with less awareness, establishing that lack of knowledge is the most significant hurdle in the solar adoption process.

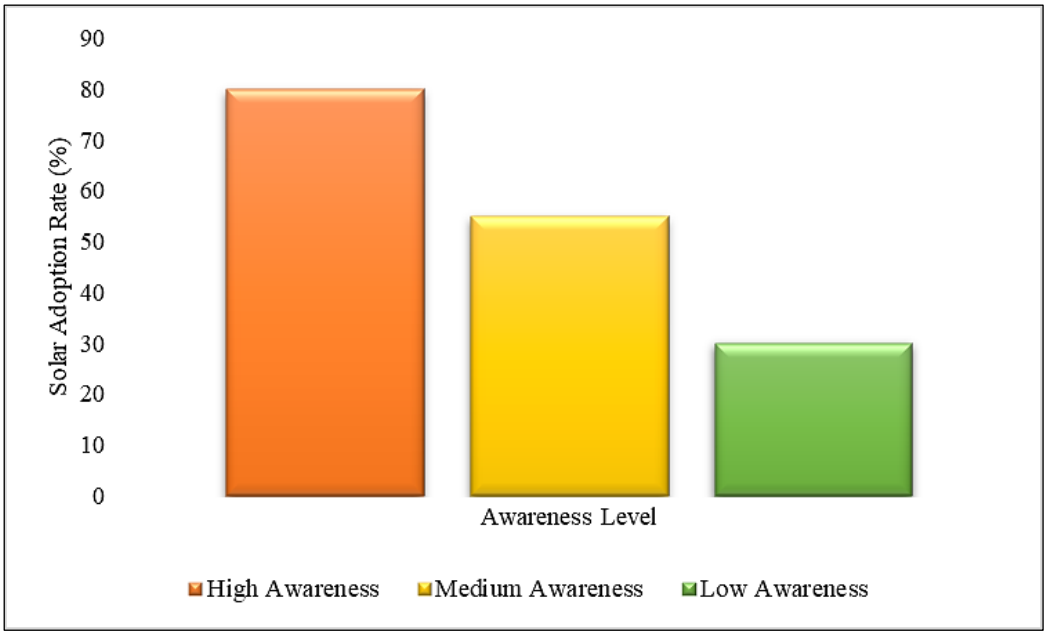

Figure 2: Impact of Consumer Awareness on Solar Adoption

The results show that targeted awareness campaign efforts towards individual consumer groups lead to more efficacious general market efforts. This is due to localized experiential learning - community workshops, peer-to-peer recommendations - pushing adoption in these areas. This will be added to trust being built through a transparent financial incentive and media engagement.

Effectiveness of Marketing Strategies in Solar Energy Adoption

Marketing strategies are significant in influencing the decision of the consumer to use solar energy. Consumer engagement and decision-making processes have changed over time from the traditional marketing modes such as television, radio, and print media to digital platforms like social media and AI-driven advertisements.

The Figure 3 confirms that digital marketing influences solar adoption significantly more than traditional marketing, with 78% in comparison to 45%. Digital platforms allow for real-time engagement, targeted consumer messaging, and interactive content, which explains the higher adoption rates. However, traditional marketing still plays a role in regions with limited internet penetration, making a hybrid approach effective in promoting solar solutions. Personalized marketing uses customer data to deliver the right messages for a person based on financial capability, consumption of energy, and environmental considerations. According to Figure 4, it ascertains that tailored marketing communications directed to consumer preference, financial ability, and green issues raise the adoption levels.

The advantage of digital marketing over traditional marketing in promoting solar energy is that it allows re-al-time engagement, targeted content, and data-driven decision-making. AI-driven and AR-based advertisements increase consumer confidence and interest in solar solutions.

The most impactful driver for consumer adoption is personalized marketing, with the increase in engagement translating to increased solar uptake.

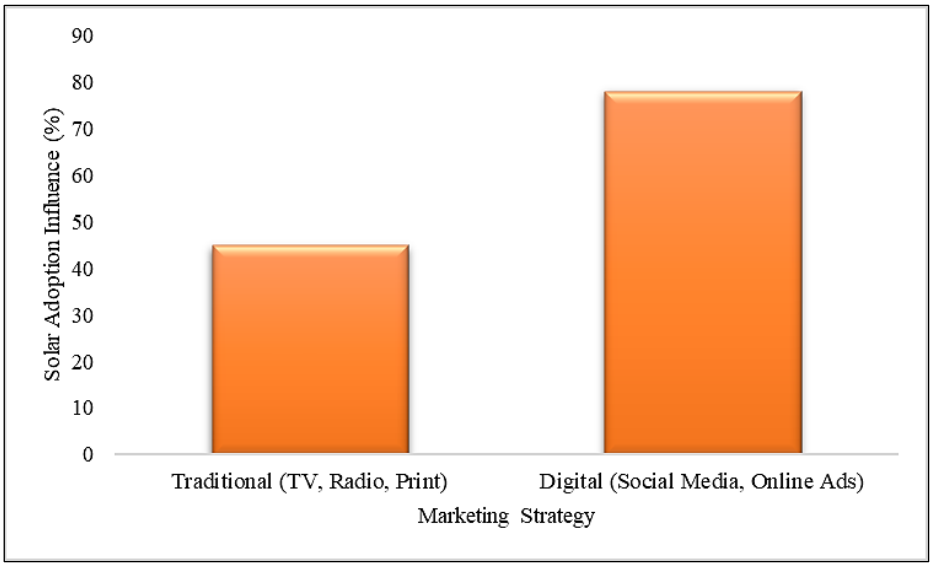

Figure 3: Effect of Traditional vs. Digital Marketing

The study indicates that more digital and personal marketing should be adopted by the solar energy companies to increase the reach and conversion rates. Further studies may investigate the application of AI and consumer behaviour analytics for further improvements in solar adoption trends.

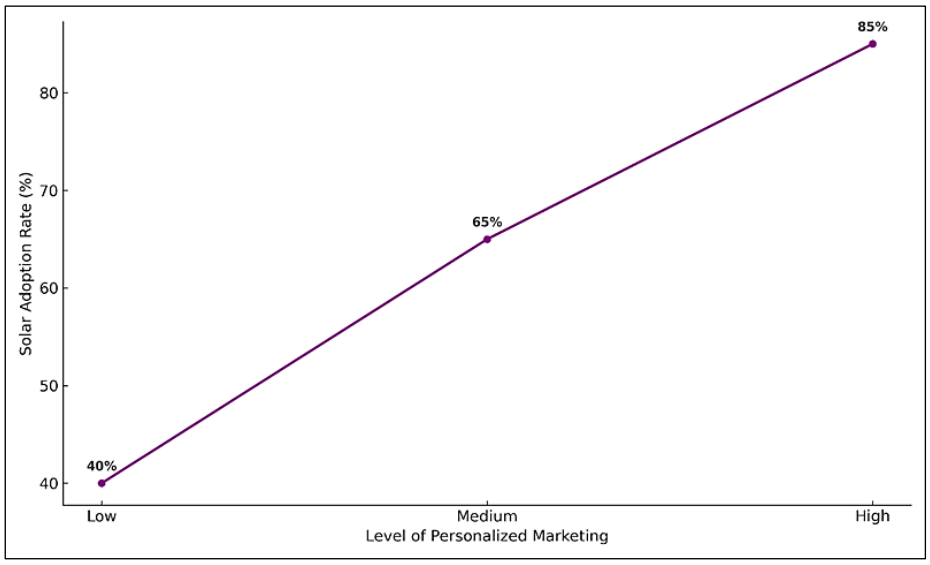

Figure 4: Solar Energy Adoption using Personalized Marketing Strategy

Socioeconomic Factors Affecting Solar Adoption

The socioeconomic factors are most sensitively analyzed by indicating an increased probability of investment in solar technology by higher-income groups and educated consumers. This phenomenon is because of the availability of greater financial flexibility, better perception of return on investment, and a higher level of exposure to renewable energy benefits. In contrast to this, the low-income group faces significant barriers in the form of extremely high initial costs, limited financing options, and low awareness levels, which restrict their abilities to adopt solar energy solutions. Geographic location also plays a significant role in adoption rates as shown in Table 1. Urban areas have much higher solar adoption than rural regions due to better access to financing, infrastructure, and aggressive marketing efforts. Urban consumers benefit from stronger government incentives, wider availability of solar providers, and increased social influence in favour of renewable energy solutions. In contrast, the adoption rate for rural households is relatively

low, attributed to lack of access to financing, trained installers, and exposure to marketing campaigns.

Moreover, developed countries have higher adoption rates than developing nations mainly because of well-established policy frameworks and financial support mechanisms. More developed economies have stronger subsidies, tax incentives, and financing options that encourage even more consumers to switch to solar energy. Developing countries remain problematically structurally challenged due to weak or even absence of certain essentials of electricity supply grids and financial difficulties.

Table 1: Socioeconomic Factors Affecting Solar Adoption

Factor	Category	Solar Adoption Rate (%)	Key Barriers	Supporting Studies
Income Level	High-Income Households	75-85%	Initial cost, bureaucratic procedures	(14, 15)
	Middle-Income Households	45-60%	Limited financial incentives, awareness	(16)
	Low-Income Households	20-35%	High upfront costs, lack of financing	(21)
Education Level	Higher Education	70-80%	Cost-benefit analysis barriers	(17, 18)
	Secondary Education	40-55%	Limited technical understanding	(21)
	Primary or No Education	15-30%	Lack of awareness, misinformation	(14)
Geographic Location	Urban Areas	65-80%	Bureaucracy in subsidy access	(17, 19)
	Semi-Urban Areas	40-60%	Grid dependency, infrastructure	(15)
	Rural Areas	20-35%	Limited access to providers, financing	(20, 21)

Conceptual Framework Connecting Awareness to Behavioural Adoption

The pathway from marketing input to actual adoption of solar energy can be conceptualized through a four-stage behavioral framework: awareness, perception, attitude modification, and behavioral adoption. First, awareness represents the informational stage, where consumers become exposed to solar solutions through campaigns or peer influence. This progresses to perception, in which consumers interpret and evaluate the reliability, benefits, and risks of the technology based on their cognitive and social context. As perceptions crystallize, they influence attitude modification—shaping the consumer's favorable or unfavorable stance toward adoption. Finally, when attitudes are positively reinforced—by trust, financial clarity, and social validation—they culminate in behavioral adoption of solar technologies. This framework is informed by the Theory of Planned Behavior and Social Cognitive Theory, and it helps explain why some marketing efforts lead to sustained adoption while others fail. Recognizing this sequence is crucial for designing campaigns that do not just raise awareness but also foster internalized belief change and action.

Policy Implications for Improving Solar Adoption

Adopter gaps will bridge in with relevant policies and policies will implement pertinent intervention measures; besides, giving further subsidies with a tax rebate as well as a microloan, it decreases upfront costs quite effectively for such low-income solar installation. Incorporation of education related to fiscal issues will allow a boost towards building confidence related to the installation, mainly during middle and the lowest stratum sections.

In addition, there is a significant policy thrust that should focus on the improvement of rural infrastructure and marketing efforts. This could be through effective region-specific education

campaigns, incentives for local solar providers, and simplifying the financing processes in rural communities. There is also a wide range of digital finance options that can be effectively utilized, such as mobile banking for enabling payments towards solar investments, thus promoting investments in underserved communities.

In general, these results indicate that a combination of financial support, education, and easy access increases the adoption rate for solar energy. A strategic design addressing the needs of different socioeconomic groups will help drive the more widespread and inclusive transition to renewable energy solutions. Targeted Recommendations for Local Governments, NGOs, and Campaign Organizers. To accelerate solar adoption through coordinated action, the following practical strategies are recommended:

Local Governments should develop simplified approval procedures for solar installations, promote region-specific subsidy awareness through municipal offices, and invest in localized grid integration to ensure technical feasibility for residential users.

NGOs should prioritize grassroots engagement through peer-led workshops, solar demonstrations, and mobile-based information dissemination in rural and underserved communities. They can act as intermediaries between policy and people, improving trust and reducing knowledge asymmetry.

Campaign Organizers should leverage behavioral science by incorporating social proof (testimonials, influencer advocacy), localized content, and default-nudge mechanisms (e.g., pre-filled subsidy forms or opt-out installation models). They should also segment campaigns by digital access and socioeconomic profile to optimize targeting and reduce marketing fatigue.

Adoption of solar energy extends beyond financial and technical considerations and is deeply influenced by behavioral science principles. Theories such as the Theory of Planned Behavior (TPB), Social Cognitive Theory (SCT), and Nudge Theory provide valuable insight into why some awareness campaigns succeed while others do not. TPB highlights how attitudes, perceived social norms, and confidence in one's ability to act shape consumer intent—individuals with strong environmental values, supportive peer influence, and confidence in handling installations are more likely to adopt solar solutions. SCT emphasizes the power of observational learning and self-efficacy; campaigns featuring peer installations, testimonials, or community-driven case studies increase the likelihood of adoption through social modeling. Meanwhile, Nudge Theory shows that small behavioral cues—like simplified processes, social proof messages, or default solar options—can significantly influence decisions. Campaigns that incorporate these behavioral elements tend to outperform those focused solely on financial incentives or technical features, especially in low-trust or underserved areas. Therefore, behaviorally informed strategies are essential for maximizing the effectiveness of solar marketing and awareness efforts.

Psychological and Behavioural Factors Affecting Solar Adoption

The choice to go with solar energy is not solely dependent on financial incentives and technological feasibility but rather significantly influenced by psychological and behavioral factors. Some of the key aspects that shape consumer attitudes toward adopting solar energy include environmental awareness, trust in solar providers, ease of use, and social influence. This is important in designing the effectiveness of marketing strategies and policy interventions aimed at spreading out the use of solar energy.

Environmental consciousness is one of the biggest motivators for solar adoption. Consumers who are highly conscious of the environmental impact of fossil fuels and the benefits of renewable energy are more likely to invest in solar solutions also shown in Figure 5 and 6. In addition, studies have shown that people who are sustainability-focused are more likely to invest in solar energy, aligning their choices with their environmental values in Figure 5. Consumer's trust in the solar technology and service providers is a critical determinant of adoption decisions. Consumers also require the solar industry to provide clear information, warranties, and proofs of performance before investing in solar. The perceived complexity of installation and usability concerns can prevent potential adopters from entering the solar market. When consumers perceive the installation of solar panels as difficult to put up, expensive, or that it changes the status quo significantly, they will not invest as per Figure 6. Social dynamics are vital in the spread of solar technology. Word-of-mouth

advocacy through peer recommendations, as well as visible installations of solar technology within communities, helps increase consumer readiness to invest in solar solutions.

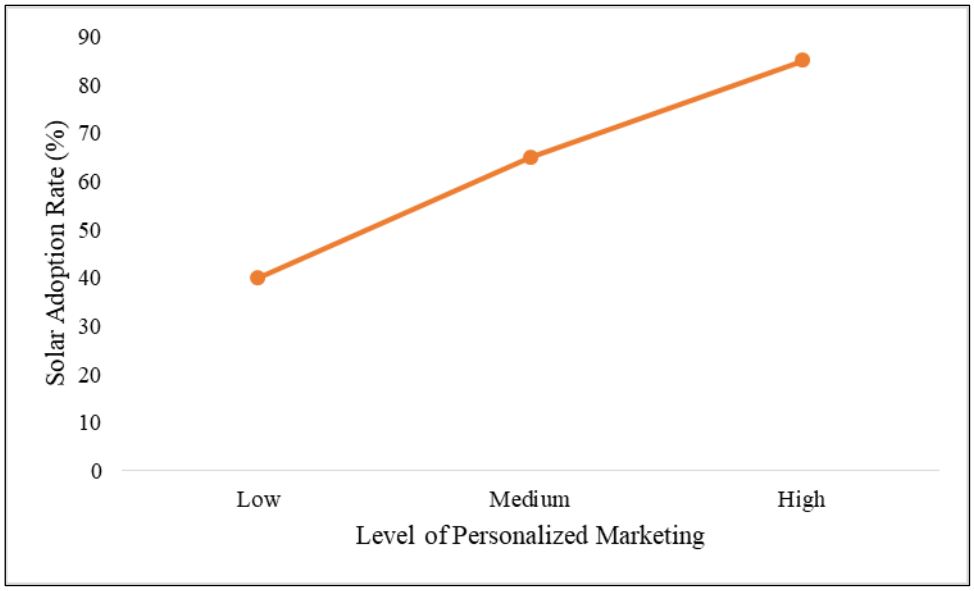

Figure 5: Increasing Solar Adoption Rates with Respect to Environmental Awareness

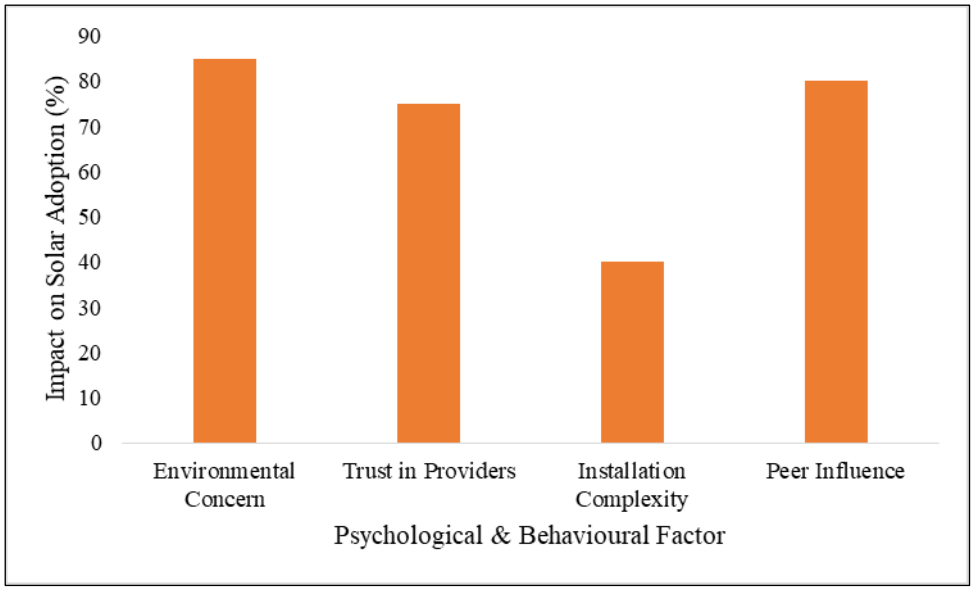

Figure 6: Psychological and Behavioral Factors

The most significant psychological and behavioral factors in solar adoption decisions include environmental awareness, trust, ease of use, and social influence. Those consumers who have sustainability at the top of their priority list are more likely to invest. Installation complexity, however, acts as a deterrent for consumers. In addition, social influence is one of the most major influences; community adoption patterns and peer recommendations reinforce investment decisions shown in Figure 7. With such educational campaigns, efforts at trust building, and ease of installation, policymakers and solar providers will find that it can enhance the rate of adoption while paving a sustainable energy future.

Targeted interventions in form of policies and marketing are required to be implemented to remove such behavioral barriers and drivers of solar adoption. Environment-awareness initiatives should educate the customers on carbon reduction benefits and long-term cost savings through sustainable behavior. Consumer confidence in solar investments may be improved by establishing trust with transparent policies, certification schemes, and warranties on solar solutions.

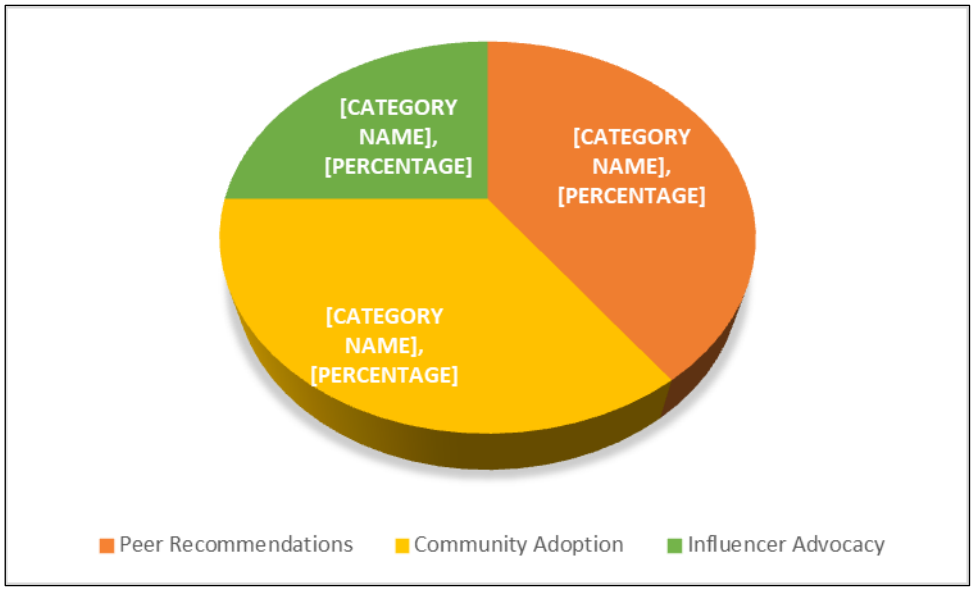

Figure 7: Social Influence on Adopting Products based on Solar Energy

This factor can be added by simplifying the installation processes, reducing bureaucratic hurdles, streamlining procedures, and clearly guiding others. Social influence based on community-based solar projects, influencer endorsement, or peer referral can create a ripple effect that accelerates adoption rates and normalizes solar technology in society.

Research Gap and Future Directions

While this review consolidates a wide range of literature on marketing effectiveness and solar adoption, there are still critical research gaps that warrant attention. First, there is a notable lack of randomized field trials that measure the causal impact of specific marketing strategies (e.g., influencer-led campaigns or AR-based promotion) on solar adoption. Second, longitudinal studies tracking the effects of sustained awareness efforts over time are limited, making it difficult to assess how enduring behavioral changes are formed. Third, little empirical work exists on the long-term behavioral outcomes of marketing exposure—particularly whether initial interest leads to permanent adoption or merely temporary intent. Future research should thus prioritize experimental and longitudinal designs, integrate behavioral metrics into campaign evaluations, and explore the decay or reinforcement of consumer commitment over time. These avenues would enhance both the academic rigor and practical utility of solar marketing interventions.

Conclusion

This review comprehensively analyzed the impact of marketing and awareness campaigns on the adoption of solar energy. It assessed whether traditional or digital marketing is effective, socioeconomic disparities, and behavioral factors that impact consumer decisions. The findings showed that consumer awareness is the strongest determinant of the adoption of solar energy, whereby higher levels of awareness translate into higher adoption levels. This implies that digital marketing strategies, especially AI-powered targeted campaigns and social media outreach, are more effective than traditional means in terms of consumer engagement and conversion rates. However, hybrid approaches are more necessary in less digitally penetrated regions. Socioeconomic disparities are still a major obstacle, as high-income and well-educated consumers are more likely to adopt solar solutions. Urban households enjoy stronger financial support and better infrastructure, while rural communities face higher financial and logistical barriers. To bridge these gaps, there is a need to expand financial incentives, increase financial literacy, and enhance rural infrastructure to ensure equitable access to solar solutions. Psychological and practical factors, such as environmental considerations, confidence in suppliers, experienced installation complexity and social impact, are important factors in consumer

decisions. Confidence -building measures, openness in service distribution and community -controlled marketing initiatives can increase the adoption rate. For decision makers and solar suppliers, this review has few key points:

- Consumer training should be expanded through located awareness campaigns and experienced learning initiatives.
- Follow a hybrid marketing approach that will benefit from digital platforms while maintaining traditional marketing, where needed.
- Expand financial incentives for the following classes and increase access to other financial equipment such as microloan and tax exemption.
- Encourage social consequences strategies including collaborators recommendations and community -based solar projects to use solar energy.
- Simple installation processes to reduce alleged complexity and improve consumer confidence.

Abbreviations

AGFI: Adjusted Goodness of Fit Index, AI: Artificial Intelligence, CFI: Comparative Fit Index , GDP: Gross domestic product, GFI: Goodness of Fit Index, ICT: Information and Communications Technology, IDT: Innovation Diffusion Theory, IFI: Incremental Fit Index , IoT: Internet of Things, IPRs: Indian Performing Right Society, NFI: Normed Fit Index , PGFI: Parsimony Goodness of Fit Index, PNFI: Parsimony Normed Fixed Index, R&D: Research and Development, RFI: Relative Fit Index, RMR: Root Mean Square Residual, SEM: Structural Equation Modelling, TCA: Technology Acquisition as a Catalyst, TOE: Technology-Organization-Environment.

Acknowledgement

None.

Author Contributions

Ankur Gupta: Conceptualization, Formal analysis, Methodology, Validation, Sanjeev Saaraswat, Kamal Upreti: Draft manuscript preparation.

Conflict of Interest

The authors declare that they have no known financial or non-financial competing interests in any material discussed in this paper.

Ethics Approval

Ethical approval was not required for this research as it does not involve human subjects, animal experiments, or sensitive data.

Funding

No funding was received from any financial organization to conduct this research.

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