



CONSUMER BUYING BEHAVIOR TOWARDS SOLAR ENERGY PANELS IN ALIGARH DISTRICT: A SOCIO-ECONOMIC ANALYSIS

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Abstract

The research endeavour seeks to investigate consumer purchasing behaviour concerning solar energy panels within the Aligarh district. As awareness regarding sustainable energy resources intensifies, solar energy has become a pivotal component in the shift towards greener energy alternatives. Grasping the determinants that shape consumer choices is critical for both market evolution and the formulation of effective policies. This investigation delves into demographic factors, economic influences, social consciousness, environmental apprehensions, and technological perceptions that either facilitate or impede the adoption of solar panels in the specified region. It assesses the impact of consumers' socio-economic backgrounds on their decisions to procure solar energy panels within the Aligarh district. Key socio-economic variables are scrutinized to ascertain their effect on the acceptance of solar energy solutions, encompassing household size, age, occupation, income, and educational attainment. Data were collected from a sample of district consumers utilizing a standardized questionnaire, followed by statistical methods employed for analysis. The findings indicate a significant correlation between socio-economic factors and purchasing decisions, with wealth and educational level emerging as prominent determinants. The research paper offers insights aimed at assisting businesses and policymakers in devising targeted strategies to promote the adoption of solar energy in rural and semi-urban settings.

Keywords: Consumer Behaviour, Environmental Awareness, Financial Incentives, Solar Energy Panels, Solar Energy Adoption, Socio-economic Factors.

INTRODUCTION

This research paper aims to explore how socio-economic factors influence consumer buying behaviour towards solar energy panels in Aligarh district, Uttar Pradesh, India by

understanding these factors, policymakers and businesses can develop targeted strategies to promote the adoption of solar energy. The increasing awareness of climate change and the rising energy costs have made solar energy an attractive alternative for many. Solar energy panels have gained significant popularity due to their ability to harness renewable energy from the sun. However, the adoption of solar energy panels varies across different socio-economic groups. This study seeks to investigate the factors that influence consumer decisions regarding the purchase of solar energy panels in Aligarh district, a region in India with diverse socio-economic conditions. By examining the relationship between socio-economic factors and consumer buying behaviour, this research will provide valuable insights for policymakers, businesses, and individuals interested in promoting the adoption of solar energy. Understanding the factors that influence consumer decisions can help to identify target

This research paper aims to explore how socio-economic factors influence consumer buying behaviour towards solar energy panels in Aligarh district, Uttar Pradesh, India by understanding these factors, policymakers and businesses can develop targeted strategies to promote the adoption of solar energy. The increasing awareness of climate change and the rising energy costs have made solar energy an attractive alternative for many. Solar energy panels have gained significant popularity due to their ability to harness renewable energy from the sun. However, the adoption of solar energy panels varies across different socio-economic groups. This study seeks to investigate the factors that influence consumer decisions regarding the purchase of solar energy panels in Aligarh district, a region in India with diverse socio-economic conditions. By examining the relationship between socio-economic factors and consumer buying behaviour, this research will provide valuable insights for policymakers, businesses, and individuals interested in promoting the adoption of solar energy. Understanding the factors that influence consumer decisions can help to identify target markets, develop effective marketing strategies, and address barriers to adoption. The increasing global focus on renewable energy sources has made solar energy a pivotal solution to addressing both energy demands and environmental challenges. Solar energy, being abundant, clean, and sustainable, offers immense potential for reducing reliance on fossil fuels and mitigating climate change. In India, where energy consumption is growing exponentially, the adoption of solar energy panels has become a significant step toward achieving energy independence and environmental sustainability.

The Aligarh district, a prominent region in Uttar Pradesh, reflects a microcosm of rural and urban dynamics, making it an ideal case study to examine consumer behaviour towards solar

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energy adoption. The socio-economic profile of consumers—comprising factors such as income, education level, occupation, age, and awareness—plays a critical role in shaping their purchasing decisions. Understanding these dynamics is essential for promoting solar energy solutions and designing policies that cater to diverse consumer segments.

This study explores how socio-economic factors influence consumer behaviour in Aligarh district, focusing on key elements such as awareness levels, affordability, perceived benefits, and barriers to adoption. By analysing the impact of socio-economic profiles, this research aims to provide actionable insights for stakeholders, including policymakers, solar energy companies, and local governments, to accelerate the adoption of solar energy panels in the region

LITERATURE REVIEW

The review covers previous research on renewable energy adoption, with a focus on consumer behaviour towards solar energy. The factors influencing the adoption of solar energy vary across different regions and communities. Studies suggest that financial incentives, awareness campaigns, environmental consciousness, and social influence play crucial roles in consumer decision-making. In India, government policies, subsidies, and incentives also significantly impact the solar energy market.

Fathima MS, et al. (2024). This study identifies the key authors, institutions, and sources in solar energy consumer research by analysing factors such as publication volume, citation counts, and H-index scores. It highlights relevant research clusters through methods like author clustering, co-citation analysis, and keyword exploration, mapping both basic and motor themes in the field. Additionally, a historical citation analysis reveals direct connections to prior studies. Overall, the study presents the most significant bibliometric indicators related to this area of research.

Sarangi,et al. (2023). It highlights the challenges of managing urban bio-waste and the importance of converting it into renewable energy to minimize environmental impact. Vaporization methods like anaerobic digestion and pyrolysis can produce clean fuels, such as biogas and green hydrogen, reducing carbon emissions while addressing urban energy demands. This approach promotes waste management, economic growth, and sustainability, as seen in regions like Madhya Pradesh, India. Ultimately, transforming waste into energy leads to cleaner, smarter cities.

Srivastava, et al. (2023). This study shows Energy demand in India can be managed by improving energy efficiency and implementing targeted policies. Buildings are the largest

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consumers of energy, with usage driven by factors like income, family size, and appliance use. The slight growth in electricity demand in India, as reported by the IEA, reflects broader global trends. By considering socio-economic characteristics and focusing on energy-efficient practices in residential sectors, reductions in consumption can be achieved through effective policies and planning interventions.

Sarangi, et al. (2023). This review highlights the challenges of waste management in cities and its role in maintaining clean and smart urban environments. It explores various waste sources, sustainable technologies for collection and processing, and the potential of anaerobic digestion (AD) for converting bio-waste into biogas, bio fertilizers, and value-added products. Addressing fast-degrading wastes like food and vegetable scraps through AD and microbial fermentation can mitigate health and environmental issues. Advancing waste management technologies can support bio refineries and smart city development.

Nazir, et al. (2022). Low market adoption hinders Pakistan's renewable energy growth. This study examined factors influencing purchase intention, including social media exposure, relative advantage, ease of use, awareness, cost, and attitude, using a framework based on the theory of planned behavior. A survey of 497 respondents analysed through structural equation modelling revealed that attitude significantly mediates the relationship between these factors and purchase intention. Findings highlight the importance of marketing strategies and government support to boost renewable energy adoption.

Aggarwal et al. (2019). This study reveals that socio-economic factors such as income, education, and awareness significantly influence the adoption of Roof Top (RT) solar systems in Aligarh district. While affordability and lack of awareness remain key barriers, declining solar prices and improved technology offer immense growth potential. Financial incentives, awareness campaigns, and simplified installation processes are crucial to overcoming barriers and boosting adoption. By addressing these challenges, policymakers can enhance the penetration of RT solar, fostering sustainable energy growth and environmental benefits.

Quraishi, et al (2019). This review highlights the challenges of waste management in cities and its role in maintaining clean and smart urban environments. It explores various waste sources, sustainable technologies for collection and processing, and the potential of anaerobic digestion (AD) for converting bio-waste into biogas, bio fertilizers, and value-added products.

Uddin, et al (2018). The study confirms that altruism, interpersonal influence, and environmental knowledge shape young Indian consumers' environmental attitudes, which

significantly drive their green purchasing behaviour. It highlights key insights for advancing environmental psychology research and practice.

OBJECTIVE OF THE STUDY

1. To identify socio-economic needs related to solar energy adoption.
2. To analyse how socio-economic factors affect consumers' likelihood of buying solar panels.
3. To identify socio-economic barriers to solar energy adoption.
4. To understand the resolution to the adoption of solar energy solutions.

HYPOTHESIS OF THE STUDY

H1: Socio-economic needs related to cost savings, energy reliability, and environmental benefits significantly influence the consideration of solar energy adoption.

H2: Higher socio-economic status is positively correlated with a greater likelihood of purchasing solar panels.

H3: High upfront costs and a lack of awareness regarding solar energy benefits and available incentives are significant barriers to adoption, particularly for lower socio-economic groups.

H4: The availability of government subsidies, financial incentives, and targeted awareness campaigns significantly increases the likelihood of solar energy adoption across all socio-economic groups.

RESEARCH METHODOLOGY

1. **Research Design:** Descriptive research design will be employed to study consumer behaviour and factors influencing solar panel adoption.
2. **Sampling:** A stratified random sampling method will be used. The target population includes households, businesses, and institutions in the Aligarh district.
3. **Sample Size:** 100 respondents (households, small business owners, and institutions).
4. **Data Collection:**
 - **Primary Data:** Surveys and structured questionnaires.
 - **Secondary Data:** Government reports, industry publications, and academic research.
5. **Data Analysis:** Statistical methods such as frequency distribution and cross-tabulation is used to identify relationships between variables.
6. **Key Variables:**
 - **Dependent Variable:** Purchase decision for solar energy panels.
 - **Independent Variables:** Awareness, financial incentives, environmental concerns, demographic factors (age, income, education), and technological perception.

DATA ANALYSIS AND INTERPRETATION

The collected data will be analysed to determine the significance of various factors in influencing consumer behaviour. Trends in awareness, adoption rates, and key motivators/barriers is discussed in relation to demographic profiles and socio-economic status.

OBJECTIVE 1: Socio-economic Needs Related to Solar Energy Adoption

This section focuses on identifying the socio-economic needs that drive consumer interest in adopting solar energy systems and the following needs were identified:

Cost Savings (40%): Most respondents prioritize cost savings, viewing solar energy as a long-term investment to reduce electricity bills. While recent price reductions have improved affordability, upfront costs remain a barrier, highlighting the need for financing options.

Environmental Benefits (30%): Environmental concerns drive adoption for many, particularly educated individuals. Solar energy is seen as a clean alternative to fossil fuels, with respondents emphasizing its role in combating climate change and securing a sustainable future.

Reliable Energy Access (20%): Rural and semi-urban households value solar for providing stable energy amid frequent outages. Increased energy demand due to extreme weather further underscores this need.

Government Subsidies (10%): Subsidies are crucial for affordability, especially for low-income groups. Awareness campaigns about existing programs could improve adoption rates significantly.

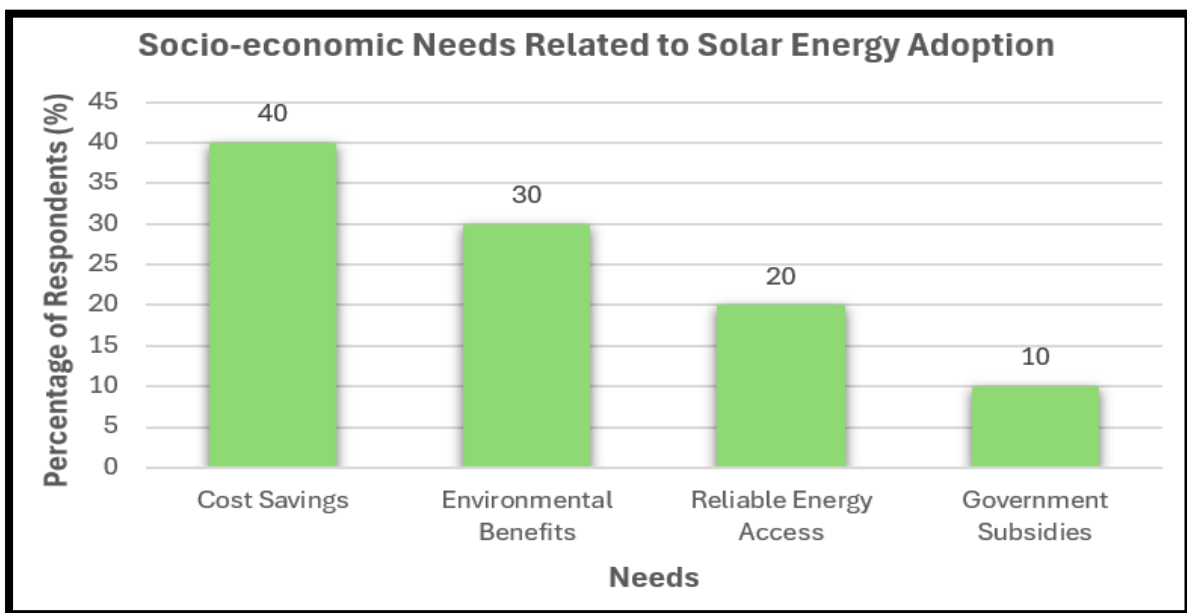


Figure 1: Socio-economic Needs Related to Solar Energy Adoption

H1 is accepted, since socio-economic needs related to cost savings, environmental benefits, and energy reliability significantly influence the consideration of solar energy adoption.

OBJECTIVE 2: How Socio-economic Factors Affect Purchase Likelihood

This section examines how socio-economic factors, such as income and education levels, influence consumers' likelihood of purchasing Roof Top (RT) solar systems and the following trends are observed:

Graphical Representation

1. Income Levels and Purchase Likelihood
2. Education Levels and Purchase Likelihood

Insights from Data

- **Income:** As income increases, financial barriers decrease, leading to a higher likelihood of purchasing Roof Top solar systems. Subsidies and financing options are critical for lower-income groups.
- **Education:** Higher education levels strongly correlate with higher adoption rates, reflecting the role of awareness and understanding in driving sustainable energy adoption.

1. Income Levels and Purchase Likelihood

Low Income (20%): Households in the low-income bracket are less likely to adopt solar energy due to the high upfront costs and lack of financing options. Despite recognizing potential long-term savings, affordability remains a major barrier.

Medium Income (50%): Medium-income households exhibit moderate interest in RT solar systems, primarily driven by the balance between affordability and energy cost savings. They are more likely to consider adoption if subsidies or financing options are available.

High Income (80%): High-income households show the highest likelihood of adoption, as they are financially capable of absorbing the initial installation costs and prioritize sustainability and energy independence.

2. Education Levels and Purchase Likelihood

High School (30%): Individuals with high school education have limited awareness of the environmental and financial benefits of RT solar systems, reducing their likelihood of purchase.

Graduate (60%): Graduates demonstrate a higher likelihood of adoption due to greater awareness of energy savings and environmental benefits, as well as the ability to evaluate the long-term cost-effectiveness of solar energy.

Postgraduate (90%): Postgraduates are the most likely to adopt solar energy, driven by a combination of higher awareness, environmental consciousness, and the financial resources to invest in sustainable technologies.

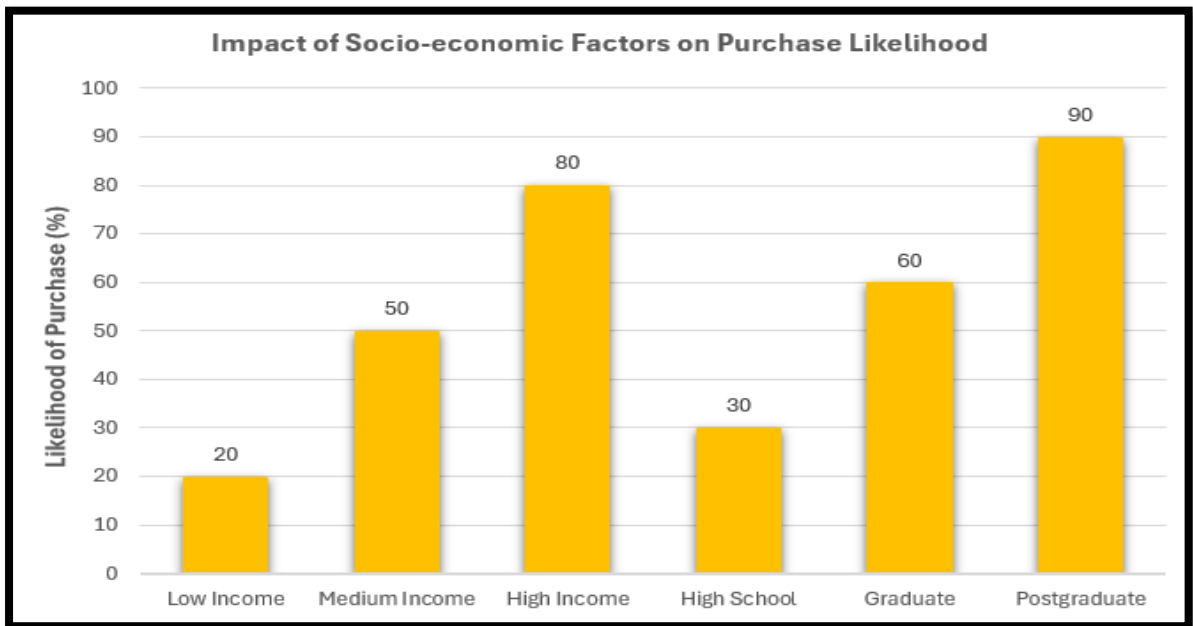


Figure 2: How Socio-economic Factors Affect Purchase Likelihood

Higher socio-economic status (income and education) is positively correlated with a greater likelihood of purchasing solar panels hence, **H2** is accepted.

OBJECTIVE 3: Socio-economic Barriers to Solar Energy Adoption

This section of the research serves to identify and analyse the obstacles that prevent people from adopting solar energy systems, specifically focusing on socio-economic factors. It provides the necessary background for developing effective strategies to promote solar energy adoption.

High Upfront Cost (40%) The most significant barrier is the high initial investment required for solar panel installation. This includes the cost of equipment, installation, and maintenance. Many households, particularly in lower- and middle-income groups, find it difficult to afford this without financial support or subsidies.

Lack of Awareness (25%) A considerable portion of respondents is unaware of the benefits, subsidies, or financing options available for solar energy systems. This lack of information leads to hesitation in adoption, particularly in rural and semi-urban areas.

Financing Issues (20%) Difficulty in accessing affordable loans or financing schemes prevents many consumers from adopting solar energy. Financial institutions often lack tailored products to cater to this market, further complicating adoption for potential buyers.

Installation Challenges (10%) Concerns about space availability, structural modifications, and lack of skilled professionals for installation pose additional challenges, especially in urban areas with limited Roof Top space.

Lack of Government Support (5%) Some respondents cited insufficient government involvement in promoting solar energy adoption through subsidies, incentives, or policy support as a barrier. Better communication about available programs is needed.

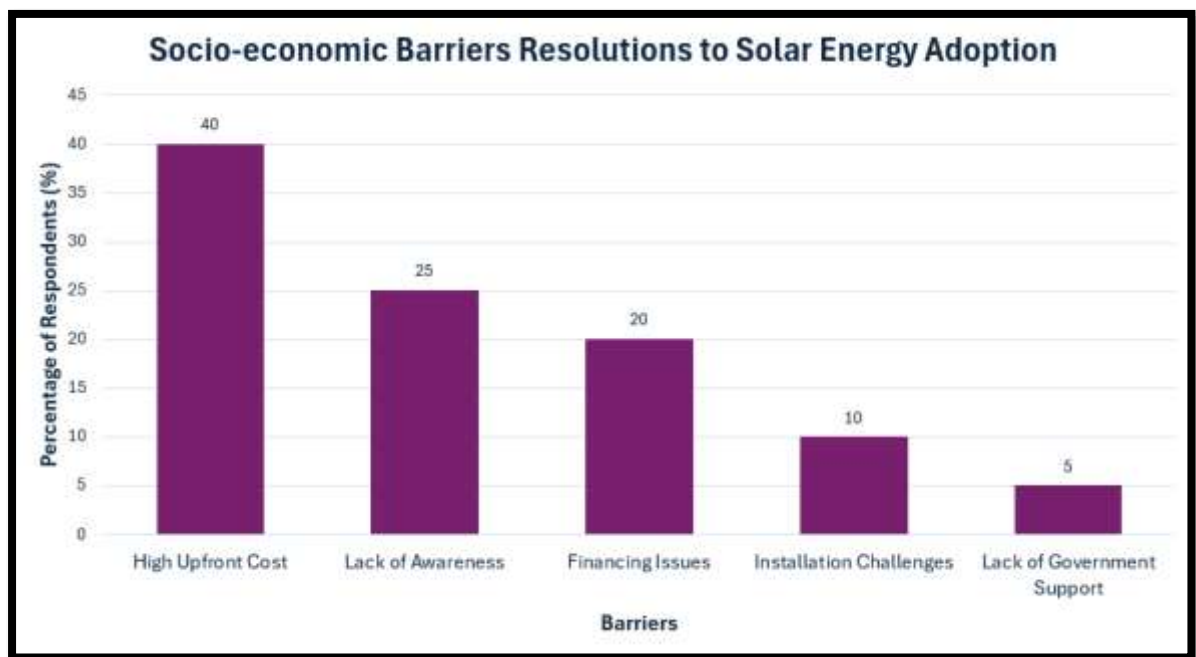


Figure 3: Socio-economic Barriers to Solar Energy Adoption

High upfront costs and a lack of awareness regarding solar energy benefits and available incentives are significant barriers to adoption, particularly for lower socio-economic groups therefore **H3** hypothesis stands correct.

OBJECTIVE 4: Resolutions for Solar Energy Adoption

These findings emphasize the need for targeted subsidies, financing programs for lower-income households, and awareness campaigns tailored to less educated groups to boost adoption rates across diverse socio-economic segments.

Increased Subsidies (35%) The most frequently cited resolution is the need for increased government subsidies. Subsidies can significantly reduce the high upfront costs of solar systems, making them more accessible, especially for low- and middle-income households.

Awareness Campaigns (25%) Raising awareness about the benefits of solar energy—such as cost savings, environmental advantages, and available government support—can encourage adoption. Effective campaigns targeting less educated and rural populations are critical.

Affordable Financing (20%) Many respondents suggested the need for affordable financing options, such as low-interest loans or instalment-based payment schemes, to ease the financial burden of adopting solar technology.

Streamlined Installation (10%) Simplifying the installation process, reducing associated complexities, and ensuring the availability of skilled professionals can address logistical challenges and increase consumer confidence.

Community-Based Programs (10%) Collaborative efforts, such as community solar projects, can make adoption more affordable and accessible. These programs allow multiple households to share the benefits and costs of solar energy systems, particularly in rural or low-income areas.

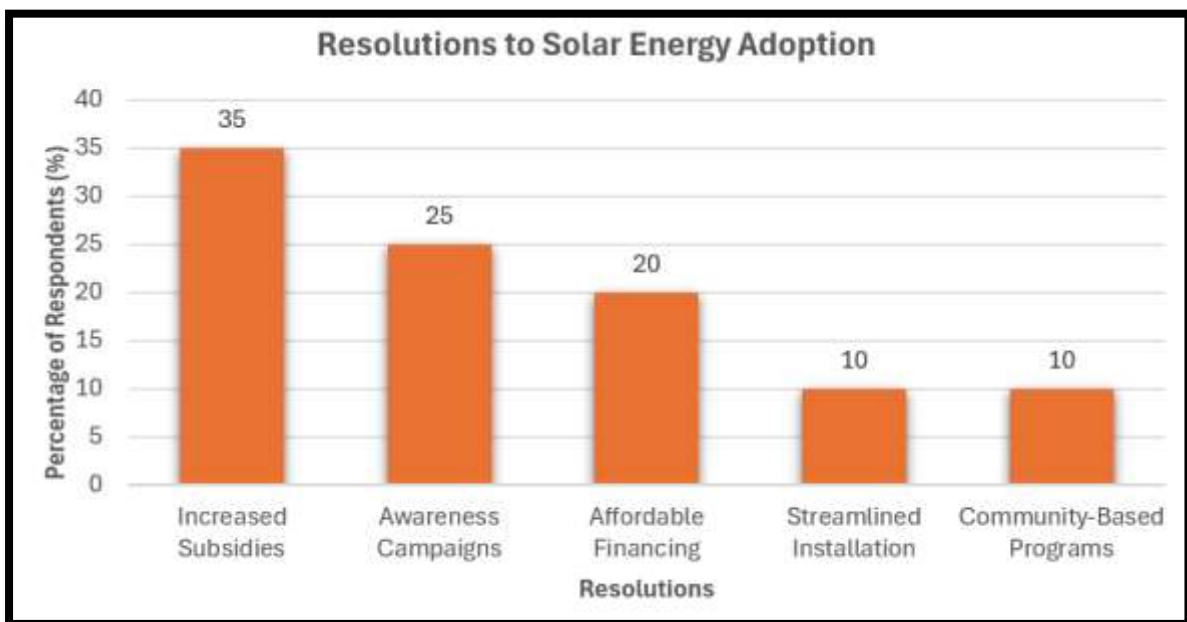


Figure 4: Resolutions for Solar Energy Adoption

H4 is accepted since the availability of government subsidies, financial incentives, and targeted awareness campaigns significantly increases the likelihood of solar energy adoption across all socio-economic groups.

FINDING AND RECOMMENDATIONS

The study is outlining the current adoption rates of solar energy panels in the Aligarh district, highlight consumer attitudes, and identify the most influential factors behind purchasing decisions. It is also addressing the common barriers that prevent consumers from adopting solar energy solutions, such as cost, lack of information, or distrust in technology.

1. **Increased Awareness Campaigns:** Governments and NGOs should conduct workshops to educate consumers on the benefits and financial aspects of solar energy.
2. **Financial Incentives and Subsidies:** Strengthening financial schemes and reducing the upfront cost of solar installations would encourage adoption.
3. **Local Community Involvement:** Engaging local leaders and influencers to promote solar energy adoption could help overcome social and informational barriers.
4. **Improved Access to Technology:** Collaborating with manufacturers and retailers to make solar technology more accessible and affordable in remote areas.

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