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Enablers and Barriers for Adoption of Roof Top Solar System: A Case Study of Pusad City

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Abstract: ***The increasing demand for electricity and the environmental problems caused by conventional fossil-fuel-based energy generation have created a strong need for renewable and sustainable energy sources. Among the various renewable energy technologies, rooftop solar photovoltaic (PV) systems have emerged as an effective solution for clean and decentralized electricity generation. India receives abundant sunlight throughout the year, making solar energy a highly suitable option for meeting growing energy demands. Although the Government of India has introduced several initiatives, subsidy schemes, and policies to promote rooftop solar systems, the adoption rate in small and medium-sized cities like Pusad remains comparatively low. This study focuses on identifying the major enablers and barriers influencing the adoption of rooftop solar systems in Pusad city, Maharashtra. A descriptive research methodology was adopted, and primary data was collected through a structured questionnaire survey conducted among residents, homeowners, and small business owners, while secondary data was collected from research papers, government reports, and renewable energy publications. The study analyzed factors such as awareness, willingness to adopt solar technology, financial considerations, environmental concerns, government support, and technical challenges. The findings reveal that reduction in electricity bills, environmental benefits, increasing electricity tariffs, and government incentives act as important enablers for rooftop solar adoption. However, barriers such as high initial installation costs, lack of technical knowledge, maintenance concerns, insufficient awareness about subsidy schemes, and limited financial support significantly hinder the adoption process. The study concludes that increasing public awareness, simplifying subsidy procedures, improving technical guidance, and providing better financial assistance can help accelerate rooftop solar adoption in small urban areas like Pusad and contribute towards sustainable energy development and environmental protection.***

I. INTRODUCTION

Energy is essential for the economic growth and development of any country. Due to rapid population growth, urbanization, and industrialization, electricity demand is increasing continuously. Conventional energy sources such as coal, oil, and natural gas are limited and cause environmental pollution and climate change. Therefore, renewable and sustainable energy sources are becoming increasingly important. Among them, solar energy is one of the most promising and widely available clean energy sources, especially in India, which receives abundant sunlight throughout the year. Rooftop solar photovoltaic (PV) systems allow households, commercial buildings, and institutions to generate electricity through solar panels installed on rooftops, helping reduce electricity costs and dependence on fossil fuels.

The Government of India has introduced several initiatives and subsidy schemes to promote rooftop solar adoption under programs such as the National Solar Mission. However, the adoption of rooftop solar systems in small cities like Pusad remains comparatively low despite favorable climatic conditions and growing awareness about clean energy. Factors such as government incentives, environmental awareness, and rising electricity tariffs encourage solar adoption, while high installation costs, lack of technical knowledge, maintenance concerns, and limited financial support act as major barriers. This study focuses on identifying the key enablers and barriers influencing rooftop solar adoption in Pusad city, Maharashtra, through survey-based research and analysis of residents' awareness, perception, and willingness to adopt rooftop solar technology.

II. LITERATUREREVIEW

The literature review shows that rooftop solar adoption is influenced by a mix of financial, technical, regulatory, and awareness-related factors. Studies from different countries and sectors consistently report that high initial investment cost, long payback periods, complex administrative procedures, limited financial incentives, and grid connection issues are major barriers to rooftop solar growth. For example, research from Chile highlighted regulatory and economic obstacles, while studies from India, Oman, Pakistan, and Sweden also found that lack of awareness, technical knowledge, and financing support strongly affect adoption decisions.

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At the same time, government subsidies, rising electricity costs, environmental concern, and long-term bill savings act as important enablers. Some studies also showed that consumers and businesses with higher electricity consumption, ownership of their property, and stronger environmental awareness are more likely to adopt rooftop solar systems. Overall, the reviewed literature confirms that rooftop solar has strong potential, but its adoption depends on local policy support, financial accessibility, and user awareness.

III. METHODOLOGY

The present study adopted a descriptive research methodology to identify the major enablers and barriers influencing the adoption of rooftop solar photovoltaic (PV) systems in Pusad city, Maharashtra. The study area was selected because Pusad receives sufficient solar radiation throughout the year and has good potential for rooftop solar installations. Both primary and secondary data collection methods were used for the research. Primary data was collected through a structured questionnaire survey conducted among residents, homeowners, tenants, and small business owners using Google Forms and direct interaction. The questionnaire included sections related to demographic information, awareness about rooftop solar systems, willingness to adopt solar technology, government subsidy awareness, enablers such as reduction in electricity bills and environmental benefits, and barriers such as high installation cost, maintenance concerns, and lack of technical knowledge. Secondary data was collected from research papers, government reports, renewable energy publications, and policy documents related to rooftop solar adoption. The collected responses were organized and analyzed using descriptive statistical methods such as percentage analysis and graphical representation through pie charts and bar graphs to identify the key factors affecting rooftop solar adoption in Pusad

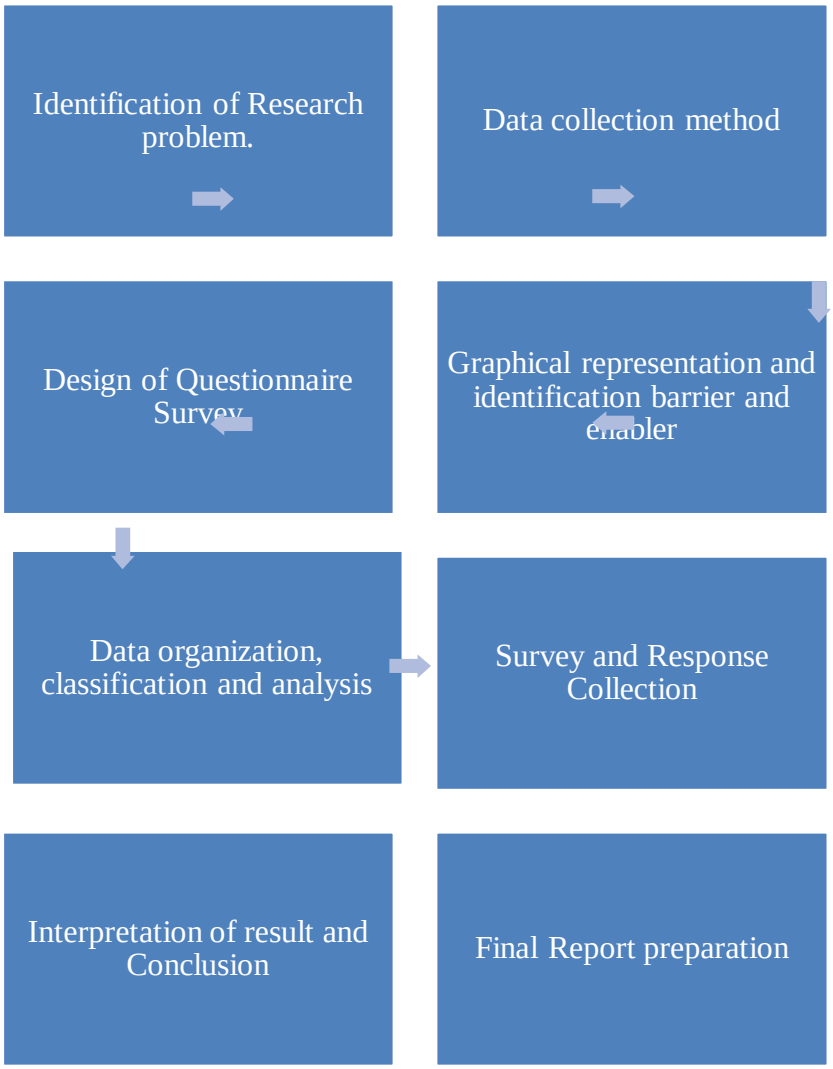


Table 1: Flow Of Work

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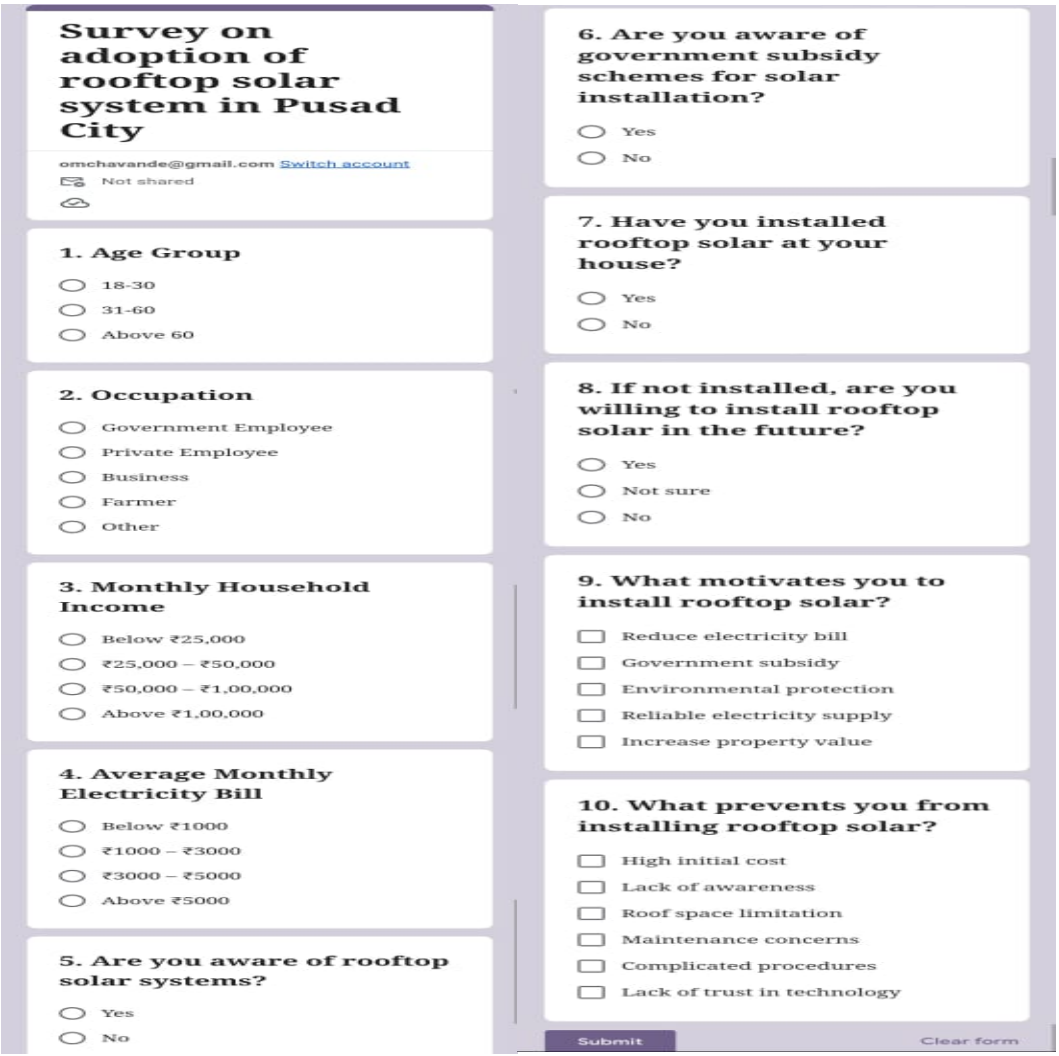


Figure 1: Data Collection Survey Form

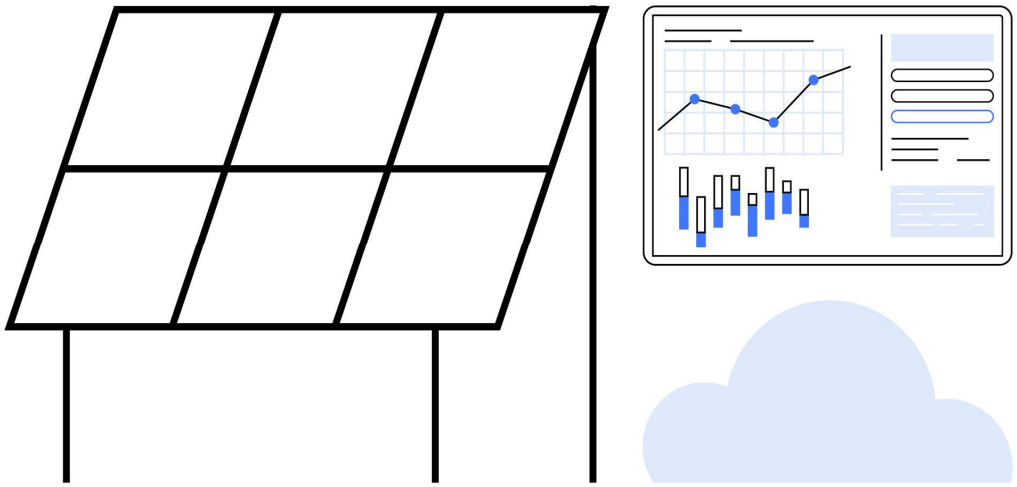


Figure 2: Analysis of Survey Data on Rooftop Solar Adoption

IV. RESULTSANDDISCUSSION

The survey conducted in Pusad city helped in understanding the awareness, perception, and willingness of residents toward rooftop solar photovoltaic (PV) systems. The collected responses were analyzed using percentage analysis and graphical representation methods. The analysis identified the major factors encouraging rooftop solar adoption as well as the challenges preventing its wider implementation in the study area.

1) Demographic Analysis of Respondents; The demographic analysis showed that the majority of respondents belonged to the 18–30 and 31–60 age groups, indicating higher awareness and interest in renewable energy technologies among younger and middle-aged individuals. Salaried employees and private-sector workers formed a major portion of the respondents and showed greater interest in rooftop solar systems due to increasing electricity expenses and long-term financial savings.

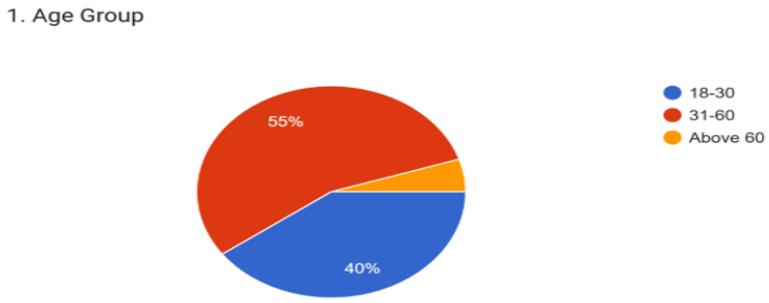


Figure 4: Age Group Distribution of Respondents

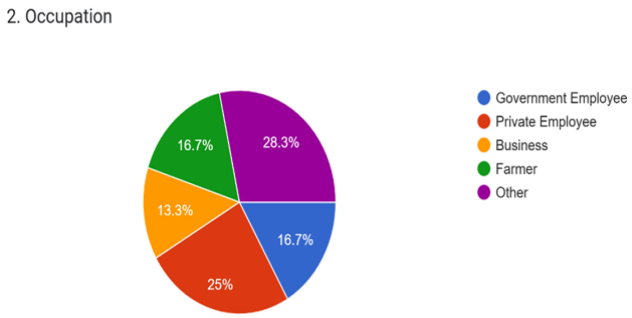


Figure 5: Occupation-wise Distribution of Survey Respondents

2) The income-wise analysis revealed that most respondents belonged to the ₹25,000–₹50,000 monthly income category. Households with higher income levels and higher monthly electricity bills showed greater willingness to adopt rooftop solar systems because of the potential reduction in electricity expenses and long-term economic benefits.

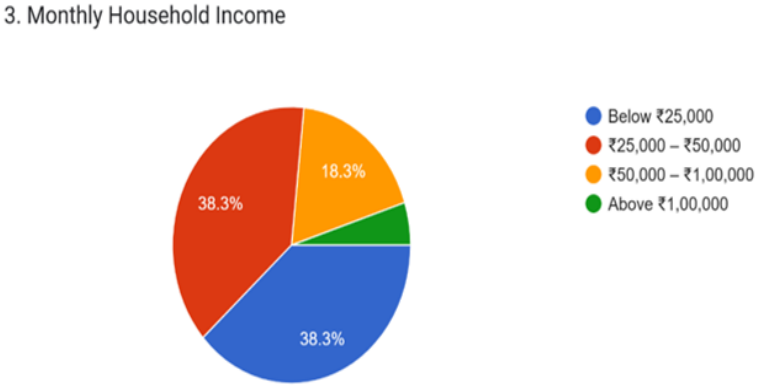


Figure 6:Income-wise Distribution of Survey Respondents

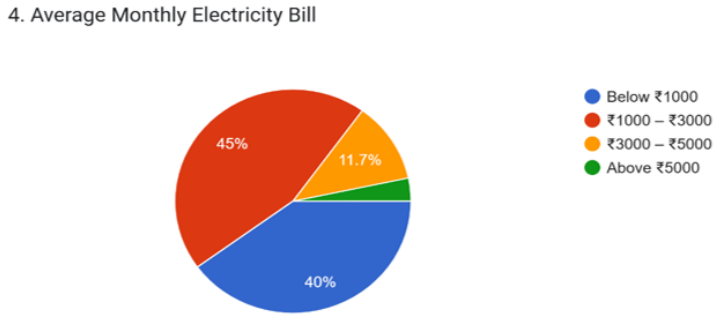


Figure 7: Electricity Bill-wise Distribution of Respondents

3) Enablers for Rooftop Solar Adoption: The study identified several important enablers encouraging rooftop solar adoption in Pusad city. Reduction in electricity bills, environmental benefits, government subsidy schemes, and increasing electricity tariffs were found to be the major motivating factors influencing residents to consider rooftop solar installation. Respondents recognized solar energy as a clean and sustainable energy source capable of reducing dependence on conventional electricity generation.

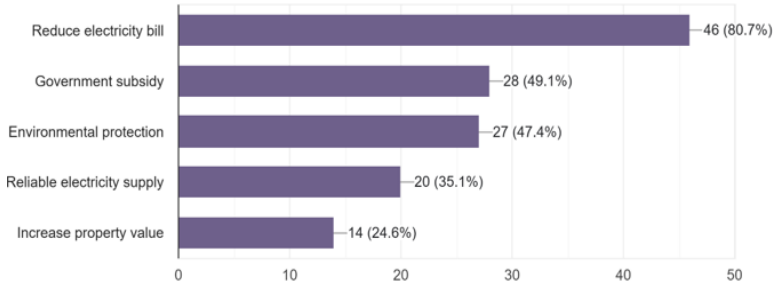


Figure 8: Factors Motivating Adoption of Rooftop Solar Systems

4) The analysis also identified significant barriers limiting rooftop solar adoption in the study area. High initial installation cost was found to be the most critical barrier faced by respondents. Other major challenges included lack of technical knowledge, maintenance concerns, insufficient awareness regarding subsidy schemes, and limited financial support. Although many respondents showed interest in adopting rooftop solar systems, financial and technical difficulties prevented them from installing solar panels.

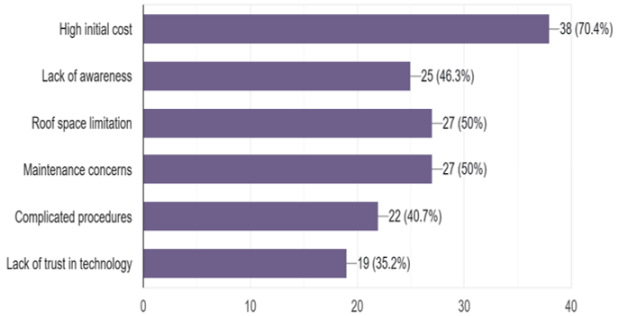


Figure 9: Factors Preventing Installation of Rooftop Solar

Overall, the results indicate that rooftop solar systems have strong potential in Pusad city if proper awareness programs, financial assistance, technical guidance, and simplified policy support are provided to consumers.

V. CONCLUSIONS

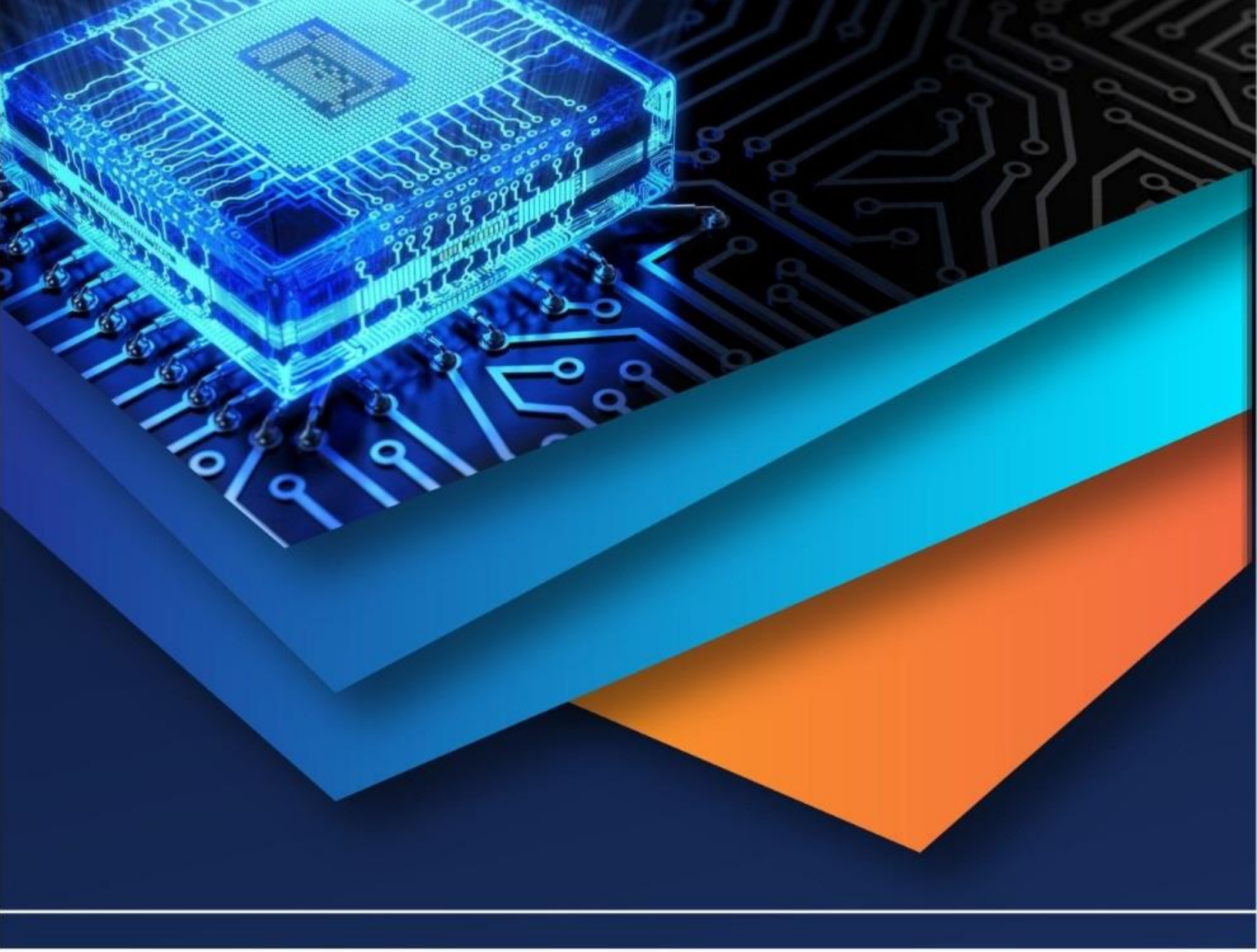
The present study analyzed the major enablers and barriers influencing the adoption of rooftop solar photovoltaic (PV) systems in Pusad city, Maharashtra. The findings revealed that factors such as reduction in electricity bills, environmental awareness, government subsidies, and increasing electricity tariffs encourage people to adopt rooftop solar systems. At the same time, high initial installation cost, lack of technical knowledge, maintenance concerns, insufficient awareness about subsidy schemes, and limited financial support were identified as the major barriers restricting wider adoption. The study also showed that households with higher income and higher electricity consumption are more interested in rooftop solar installation due to the long-term economic benefits.

Overall, the research concludes that rooftop solar systems have strong potential for sustainable energy generation in small urban areas like Pusad. Increasing public awareness, improving access to financial assistance and subsidies, simplifying installation procedures, and providing proper technical guidance can significantly improve rooftop solar adoption. The study can help policymakers, local authorities, and energy stakeholders develop effective strategies to promote renewable energy utilization and support sustainable development.

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