

The Effect of Solar Panel Use on Household Electricity Cost Savings

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ABSTRACT

This study aims to analyze the effect of solar panel use on household electricity cost savings. The research adopts a quantitative approach involving 160 respondents who are household users of solar panel systems. Data were collected through a structured questionnaire using a Likert scale to measure respondents' perceptions regarding solar panel utilization and its impact on electricity expenses. The collected data were analyzed using SPSS version 25, including validity testing, reliability testing, descriptive statistics, and simple linear regression analysis. The results show that solar panel use has a positive and significant effect on household electricity cost savings, with a regression coefficient of 0.705 and a significance value of 0.000, which is below the threshold of 0.05. The coefficient of determination indicates that solar panel utilization explains 37.1% of the variation in electricity cost savings, while the remaining percentage is influenced by other factors. The findings suggest that households that adopt solar energy systems tend to experience lower monthly electricity costs due to reduced dependence on conventional electricity supplied by the public power grid. In addition to financial benefits, solar energy also contributes to environmentally sustainable energy consumption. Therefore, the adoption of solar panel technology can be considered a practical solution for improving household energy efficiency and reducing electricity expenditures. The results of this study provide useful insights for policymakers, energy providers, and households in promoting the wider adoption of renewable energy technologies.

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1. INTRODUCTION

The increasing demand for electricity has become one of the major challenges faced by many countries in the modern era. Rapid population growth, technological development, and rising household energy consumption have significantly increased the pressure on conventional energy resources. Most electricity generation in many regions still relies heavily on fossil fuels such as coal, oil,

and natural gas, which are not only limited in supply but also contribute significantly to environmental problems, including greenhouse gas emissions and climate change. As a result, the transition toward renewable energy sources has become an important strategy to ensure sustainable energy availability while reducing environmental impacts. Renewable energy technologies, particularly solar energy, offer several

advantages such as sustainability and the ability to reduce greenhouse gas emissions, which can help address global climate change issues [1]. In addition, the decreasing installation costs of solar panels have made this technology increasingly accessible, supporting wider adoption and contributing to economic stability by creating new employment opportunities, especially in developing countries [2].

Despite its advantages, the adoption of solar energy still faces several challenges and barriers. One of the major obstacles is the lack of public awareness and understanding regarding solar technology, which can slow the adoption process [3]. Furthermore, the development of solar energy also requires improved infrastructure, particularly in energy storage systems and supportive public policies to facilitate large-scale implementation ([1]; [4]). Nevertheless, solar energy continues to gain significant attention as a clean, abundant, and sustainable energy source that can be utilized through solar panel systems, commonly known as photovoltaic (PV) systems. Solar panels convert sunlight directly into electricity, allowing households and businesses to generate their own power. With technological advancements and decreasing installation costs, solar panels have become increasingly accessible for residential use, while governments and energy organizations continue to promote solar energy adoption through various policies, incentives, and public awareness initiatives.

The use of solar panels in households offers several important benefits, particularly in reducing monthly electricity costs by allowing households to generate their own electricity and decrease dependence on power supplied by the public grid. Studies indicate that households with solar panels can significantly lower their electricity bills through self-consumption of generated energy [5]. However, the economic benefits of solar panel adoption may vary across regions, depending on factors such as local electricity prices and

energy supply structures, which can influence the overall financial feasibility of solar systems [6]. In addition to financial advantages, solar energy utilization also contributes to environmental sustainability by reducing carbon emissions and supporting the transition toward cleaner energy systems. For example, research in Surabaya suggests that solar panel implementation has the potential to reduce dependence on conventional energy sources by generating surplus renewable energy [7].

Despite these advantages, the adoption of solar panel technology at the household level still varies across communities. Some households remain hesitant to adopt solar panels due to high initial installation costs, limited knowledge about solar technology, or uncertainty regarding the long-term financial benefits. Policy support therefore plays an important role in encouraging solar adoption, particularly among households with limited financial resources [8]. Understanding how solar panel usage affects household electricity cost savings is therefore essential to provide empirical evidence of its economic benefits. Such insights can help households make informed decisions about renewable energy adoption and assist policymakers in designing effective strategies to promote sustainable energy use.

Previous studies have highlighted that renewable energy technologies, particularly solar photovoltaic systems, can significantly reduce electricity expenditure in the residential sector. Households that install solar panels often experience lower electricity bills compared to those that rely entirely on conventional electricity sources. However, the extent of these savings can vary depending on several factors, including system capacity, sunlight availability, electricity tariffs, and household electricity consumption levels. In addition, the perceptions and experiences of solar panel users play an important role in evaluating the effectiveness and economic impact of solar energy adoption. In this context, perception-based quantitative analysis can

provide valuable insights into how users evaluate the benefits of solar panel utilization. By examining the perceptions of households that already use solar panels, researchers can better understand the relationship between solar panel usage and perceived electricity cost savings. Measuring these perceptions through structured questionnaires using Likert-scale indicators allows researchers to capture user experiences in a systematic and statistically analyzable manner.

Therefore, this study aims to examine the effect of solar panel use on household electricity cost savings. The study employs a quantitative research approach involving 160 respondents who are users of solar panel systems. Data are collected through questionnaires designed to measure respondents' perceptions regarding solar panel utilization and its impact on electricity expenditure. The collected data are analyzed using statistical methods with the assistance of SPSS version 25 to determine the relationship between solar panel usage and household electricity cost savings. The results of this study are expected to provide empirical evidence regarding the economic benefits of solar panel adoption at the household level and contribute to broader discussions on renewable energy implementation. By highlighting the potential financial advantages of solar panel systems, this research is expected to support efforts to promote sustainable energy use and improve household energy efficiency in the long term.

2. LITERATURE REVIEW

2.1 Renewable Energy and Solar Energy Utilization

Renewable energy has become an important topic in global discussions on sustainable development and energy security because it refers to energy sources that are naturally replenished and can be utilized continuously with minimal environmental impact. Common types of renewable energy include solar, wind, hydropower, geothermal, and biomass, all of which produce lower

greenhouse gas emissions compared to fossil fuels. Among these sources, solar energy has gained significant attention due to its abundant availability and technological feasibility. Through photovoltaic (PV) technology, solar panels convert sunlight into electricity that can be used directly by households or stored for later use. Solar panels are considered one of the leading renewable energy technologies in addressing global energy challenges and supporting the transition toward cleaner energy systems [9], while also contributing to sustainable development by reducing greenhouse gas emissions and supporting global climate targets [10]. Recent technological advancements in photovoltaic materials have significantly improved the efficiency and affordability of solar panels, making them more accessible for wider adoption [11], and continued innovation is essential for enhancing the effectiveness of renewable energy systems [12]. Nevertheless, challenges such as energy supply variability and the need for improved energy storage infrastructure remain important issues that must be addressed [12]. Therefore, sustained innovation, investment, and supportive policy frameworks are necessary to overcome these challenges and fully realize the potential of solar energy in building a sustainable energy future [11].

2.2 Solar Panels in Household Energy Systems

Solar panels have become one of the most widely adopted renewable energy technologies for residential use, typically consisting of photovoltaic panels, an inverter, mounting structures, and sometimes battery storage systems that convert sunlight into electricity for household consumption. The adoption of solar panels offers several advantages, including enabling households to generate their own electricity and reduce dependence on centralized power systems, thereby increasing energy independence [13]. In addition, solar energy contributes to environmental sustainability by significantly

reducing carbon emissions and promoting cleaner energy sources [14]. Solar systems are also considered cost-efficient because, after installation, they generally incur low operating costs and can provide long-term savings on electricity bills [15]. However, the adoption of solar panel systems still faces several challenges, particularly the high initial investment required for installation [16] and geographic limitations that affect efficiency due to variations in sunlight availability and regional conditions [6]. Despite these challenges, many households continue to view solar panels as a promising long-term investment due to their economic and environmental benefits.

2.3 Electricity Cost Savings in Households

Electricity cost savings refer to the reduction in household expenditure on electricity consumption over a certain period, which is generally influenced by the amount of electricity used and the applicable tariff structure. In households that rely entirely on electricity supplied by the public power grid, monthly electricity bills may fluctuate depending on usage patterns and pricing policies. The use of solar panels can significantly reduce these costs because households are able to generate their own electricity and decrease the amount of power purchased from the grid. Studies indicate that households utilizing solar panels can reduce electricity bills by approximately 6% to 22%, depending on consumption patterns and tariff structures [17]. Solar energy systems therefore allow households to offset the cost of purchasing electricity from conventional energy sources [18]. In addition to direct financial savings, solar panels also provide long-term economic benefits because the initial installation costs can be recovered through cumulative electricity savings over time [18]. Furthermore, households may gain additional financial returns through net-metering schemes, where surplus electricity generated

can be exported back to the grid [19]. The effectiveness of these systems can also be enhanced by improving household energy efficiency, such as adopting efficient heating or cooling technologies, which can further increase overall electricity savings [20].

2.4 User Perception of Solar Panel Utilization

User perception plays an important role in evaluating the effectiveness and benefits of technological adoption, as it reflects how individuals interpret and assess their experiences with a particular technology. In the context of solar energy utilization, user perceptions influence how households evaluate the advantages and disadvantages of installing solar panels. Several factors shape these perceptions, including perceived economic benefits, environmental awareness, technological reliability, and ease of use. Studies indicate that long-term cost savings and environmental benefits are strong motivations encouraging households to adopt solar energy technologies [21];[22]. Government initiatives such as financial incentives and public awareness programs also contribute significantly to improving public perceptions and increasing adoption rates [21]. In addition, households often evaluate the reliability, ease of installation, and operational performance of solar technologies when deciding whether to adopt them [23] When households perceive solar energy as economically beneficial, they are more likely to adopt the technology and report higher levels of electricity cost savings [21]; [22]. Social influence also plays a role, as community norms and peer experiences can shape attitudes toward solar energy adoption [22].

2.5 Research Hypothesis

Several previous studies have examined the economic and environmental benefits of solar energy adoption and consistently found that solar panel systems can reduce electricity expenses for residential users.

Households that install solar panels often experience noticeable reductions in their monthly electricity bills due to decreased reliance on conventional electricity sources. In addition, research has highlighted the important role of user perception in the adoption and evaluation of renewable energy technologies, where positive perceptions related to cost savings, environmental benefits, and technological efficiency tend to encourage households to adopt solar energy systems, while concerns about installation costs and maintenance can become barriers to adoption. Although previous studies have provided valuable insights into the benefits of solar panel technology, further research is still needed to explore how user perceptions are related to electricity cost savings in specific contexts. Quantitative studies involving household users can therefore provide empirical evidence regarding the relationship between solar panel usage and perceived financial benefits, which forms the basis for the hypothesis proposed in this study.

H1: The use of solar panels has a positive and significant effect on household electricity cost savings.

This hypothesis suggests that households that utilize solar panel systems are more likely to experience greater electricity cost savings compared to households that rely entirely on conventional electricity sources. The hypothesis will be tested through quantitative analysis using data collected from household solar panel users.

3. METHODS

3.1 Research Design

This study employs a quantitative research approach to analyze the effect of solar panel use on household electricity cost savings. This approach is appropriate because it allows researchers to examine relationships between variables using numerical data and statistical analysis. The research design used is explanatory research, which aims to investigate the causal relationship between solar panel

usage and household electricity cost savings based on users' perceptions. Data were collected through a structured questionnaire distributed to households that use solar panels, and the responses were measured using a Likert scale. The collected data were then analyzed statistically using the Statistical Package for the Social Sciences (SPSS) version 25 to determine whether solar panel utilization has a significant influence on electricity cost savings.

3.2 Population and Sample

The population in this study consists of households that use solar panel systems for electricity generation, as these users have direct experience with solar energy technology and are able to evaluate its economic benefits. Due to practical limitations in accessing all households that use solar panels, this study employed a sampling technique to obtain representative data using purposive sampling, which selects respondents based on specific criteria relevant to the research objectives. The criteria include households that have installed and used solar panels, respondents who are responsible for managing household electricity consumption, and individuals who have used solar panels for a sufficient period to evaluate their impact on electricity costs. Based on these criteria, a total of 160 respondents were selected as the research sample.

3.3 Data Collection Techniques

This study uses primary data collected directly from respondents through a structured questionnaire designed to measure their perceptions regarding solar panel utilization and its impact on household electricity cost savings. The questionnaire was distributed either directly or through digital platforms, and respondents were asked to provide answers based on their experiences using solar panel systems in their households. To ensure clarity and understanding, the questionnaire was formulated using simple and clear statements related to the research variables, and

respondents indicated their level of agreement with each statement using a Likert scale.

3.4 Measurement Scale

The variables in this study were measured using a Likert scale, which is commonly used in perception-based research to capture respondents' levels of agreement or disagreement with specific statements in the questionnaire. The measurement scale ranged from 1 to 5, where 1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, and 5 = strongly agree. This scale allows respondents to express their perceptions in a structured manner and enables researchers to convert these perceptions into numerical data that can be analyzed statistically.

This study involves two main variables, namely an independent variable and a dependent variable. The independent variable (X) is solar panel use, which refers to the utilization of photovoltaic systems by households to generate electricity from solar energy and reflects respondents' perceptions regarding the effectiveness, efficiency, and usefulness of solar panel systems in meeting household electricity needs. This variable is measured using several indicators, including the efficiency of solar panels in generating electricity, the reliability of solar panel systems, ease of use and maintenance, the contribution of solar panels to household energy supply, and the perceived benefits of solar panel technology. Meanwhile, the dependent variable (Y) is household electricity cost savings, which refers to the reduction in household electricity expenses after adopting solar panel systems and measures respondents' perceptions of how solar panel use helps reduce electricity costs. This variable is assessed through indicators such as the reduction in monthly electricity bills, decreased dependence on grid electricity, long-term financial benefits, cost efficiency of solar energy use, and the perceived economic value of solar panels.

3.5 Data Analysis Techniques

The data collected in this study were analyzed using SPSS version 25 through several stages to ensure the validity and reliability of the research results. First, a validity test was conducted to determine whether the questionnaire items accurately measured the variables being studied, where an item is considered valid if the correlation coefficient between the item score and the total score exceeds the critical value. Second, a reliability test was carried out using Cronbach's Alpha to assess the consistency of the measurement instrument, with a value greater than 0.70 indicating reliable variables. Third, descriptive analysis was used to summarize and describe respondents' perceptions regarding solar panel usage and electricity cost savings, including measures such as mean values and frequency distributions. Fourth, simple linear regression analysis was applied to examine the effect of solar panel use on electricity cost savings using the model $Y=a+bX+e$, where Y represents household electricity cost savings, a is the constant, b is the regression coefficient, X represents solar panel use, and e is the error term. Finally, hypothesis testing (t-test) was conducted to determine the significance of the relationship, where the hypothesis is accepted if the significance value (Sig.) is less than 0.05, indicating that solar panel use significantly affects electricity cost savings; otherwise, the hypothesis is rejected. Through these analytical procedures, this study aims to provide empirical evidence regarding the relationship between solar panel usage and household electricity cost savings.

4. RESULT AND DISCUSSION

4.1 Respondent Characteristics

This study involved 160 respondents who are household users of solar panel systems. The respondents were selected based on the criteria that they had installed and used solar panels for household electricity consumption. The demographic characteristics

of respondents were analyzed to understand the general profile of solar panel users.

Table 1. Respondent Characteristics

No	Category	Frequency	Percentage (%)
1	Gender		
	Male	92	57.5
	Female	68	42.5
2	Age		
	20–30 years	28	17.5
	31–40 years	54	33.8
	41–50 years	49	30.6
	> 50 years	29	18.1
3	Length of Solar Panel Use		
	< 1 year	26	16.3
	1–3 years	72	45.0
	3–5 years	39	24.4
	> 5 years	23	14.3

Table 1 shows the demographic characteristics of the respondents involved in this study. Based on gender, the majority of respondents are male (57.5%), while 42.5% are female, indicating that male household members are more often responsible for decisions related to household energy systems, including the adoption of solar panels. In terms of age distribution, most respondents fall within the 31–40 years age group (33.8%), followed by 41–50 years (30.6%), suggesting that individuals in productive and economically stable age groups are more likely to adopt solar energy technology. Meanwhile, respondents aged 20–30 years account for 17.5%, and those over 50 years represent 18.1% of the sample. Regarding the duration of solar

panel use, the largest proportion of respondents (45.0%) have used solar panels for 1–3 years, followed by 3–5 years (24.4%), indicating relatively recent adoption of solar energy technology among households. A smaller proportion of respondents have used solar panels for less than one year (16.3%) or more than five years (14.3%), reflecting the gradual growth of solar panel implementation at the residential level.

4.2 Descriptive Analysis of Research Variables

Descriptive statistics were used to measure respondents' perceptions of solar panel use and electricity cost savings.

Table 2. Descriptive Statistics

Variable	N	Minimum	Maximum	Mean	Std. Deviation
Solar Panel Use	160	2.80	5.00	4.21	0.54
Electricity Cost Savings	160	2.60	5.00	4.18	0.58

Table 2 presents the descriptive statistics of the research variables. The results show that the mean score for solar panel use is 4.21, with values ranging from 2.80 to 5.00 and a standard deviation of 0.54, indicating that respondents generally have a positive perception of the effectiveness and usefulness

of solar panel systems in meeting household electricity needs. Meanwhile, the electricity cost savings variable has a mean value of 4.18, with a minimum value of 2.60, a maximum value of 5.00, and a standard deviation of 0.58, suggesting that most respondents agree that the use of solar panels contributes to reducing

household electricity expenses. The relatively high mean values for both variables indicate that respondents perceive solar panel utilization as beneficial, particularly in improving energy efficiency and lowering electricity costs at the household level.

4.3 Validity Test

The validity test was conducted to ensure that all questionnaire items accurately measure the research variables. An item is considered valid if the correlation value (r-count) is greater than the critical value (r-table = 0.154) for $n = 160$.

Table 3. Validity Test Results

Item	r-count	r-table	Result
SP1	0.612	0.154	Valid
SP2	0.648	0.154	Valid
SP3	0.702	0.154	Valid
SP4	0.676	0.154	Valid
SP5	0.631	0.154	Valid
CS1	0.691	0.154	Valid
CS2	0.715	0.154	Valid
CS3	0.664	0.154	Valid
CS4	0.643	0.154	Valid
CS5	0.678	0.154	Valid

Table 3 presents the results of the validity test for all questionnaire items used in this study. The results show that all items measuring the variables of solar panel use (SP1–SP5) and electricity cost savings (CS1–CS5) have r-count values ranging from 0.612 to 0.715, which are all greater than the r-table value of 0.154. This indicates that each questionnaire item has a strong correlation with the total score of its respective variable and is therefore considered valid. These results confirm that all indicators used in the

questionnaire are appropriate and capable of accurately measuring the intended research variables, meaning that the instrument is suitable for further statistical analysis in examining the relationship between solar panel use and household electricity cost savings.

4.4 Reliability Test

Reliability testing was conducted using Cronbach's Alpha to determine the consistency of the questionnaire items.

Table 4. Reliability Test Results

Variable	Cronbach's Alpha	Standard	Result
Solar Panel Use	0.821	0.70	Reliable
Electricity Cost Savings	0.845	0.70	Reliable

Table 4 presents the results of the reliability test for the research variables using Cronbach's Alpha. The results show that the solar panel use variable has a Cronbach's Alpha value of 0.821, while the electricity cost savings variable has a value of 0.845, both of which exceed the standard reliability threshold of 0.70. These values indicate that the questionnaire items used to measure both

variables have a high level of internal consistency and reliability. Therefore, the measurement instruments used in this study are considered reliable and suitable for further statistical analysis to examine the relationship between solar panel use and household electricity cost savings.

4.5 Regression Analysis

Simple linear regression analysis was used to examine the effect of solar panel use on household electricity cost savings.

Table 5. Regression Analysis Results

Variable	B	Std. Error	t-value	Sig.
Constant	1.214	0.312	3.892	0.000
Solar Panel Use	0.705	0.073	9.654	0.000

Table 5 presents the results of the simple linear regression analysis examining the effect of solar panel use on household electricity cost savings. The results show that the solar panel use variable has a regression coefficient (B) of 0.705, with a t-value of 9.654 and a significance value of 0.000, which is lower than the significance threshold of 0.05. This indicates that solar panel use has a positive and statistically significant effect on electricity cost savings. In other words, increased utilization of solar panels is associated with greater reductions in household electricity expenses. The constant value of 1.214 suggests the baseline level of electricity cost savings when the solar panel use variable is held constant.

Based on the regression analysis results, the regression equation obtained is $Y = 1.214 + 0.705X$, where Y represents household

electricity cost savings and X represents solar panel use. The regression coefficient value of 0.705 indicates that solar panel use has a positive effect on electricity cost savings, meaning that an increase in the utilization of solar panels will lead to greater household electricity cost savings. Furthermore, the significance value of 0.000, which is lower than the significance threshold of 0.05, indicates that the effect is statistically significant, thus supporting the research hypothesis that solar panel use significantly influences household electricity cost savings.

4.6 Coefficient of Determination

The coefficient of determination (R^2) was used to determine how much variation in electricity cost savings can be explained by solar panel usage.

Table 6. Model Summary

Model	R	R Square	Adjusted R Square	Std. Error
1	0.609	0.371	0.366	0.462

The R^2 value of 0.371 indicates that 37.1% of the variation in household electricity cost savings can be explained by solar panel usage, while the remaining 62.9% is influenced by other factors not included in this study.

4.7 Discussion

The results of this study indicate that solar panel utilization has a positive and significant effect on household electricity cost savings. The regression analysis demonstrates a significant relationship between solar panel usage and reduced electricity expenses, suggesting that households that adopt solar

energy systems tend to experience lower electricity costs due to reduced dependence on electricity supplied by the public power grid. These findings confirm that solar energy technology can play an important role in improving household energy efficiency and reducing reliance on conventional energy sources.

The descriptive analysis also reveals that respondents generally perceive solar panels as an effective and economically beneficial technology. The mean score for solar panel utilization (4.21) indicates that respondents strongly agree that solar panels

contribute to improving household energy efficiency. Likewise, the mean score for electricity cost savings (4.18) reflects a strong perception that solar energy helps reduce monthly electricity expenses. These results show that households not only recognize the functional benefits of solar panels but also perceive them as financially advantageous technologies for managing household energy consumption.

These findings are consistent with previous studies that highlight the economic benefits of renewable energy adoption. Solar photovoltaic (PV) systems enable households to generate electricity independently, which reduces electricity consumption from the grid and lowers overall energy costs. Research shows that households utilizing PV systems can achieve substantial electricity savings, with annual reductions in electricity expenses reaching up to \$1,269 in certain case studies [24]. Furthermore, economic analyses indicate that the payback period for solar panel investments can be relatively short, approximately 2.7 to 3.07 years, demonstrating that solar installations can provide a rapid return on investment [24]. In addition to financial savings, PV systems also contribute to greater energy independence by allowing households to generate their own electricity and reduce exposure to fluctuating energy prices [25].

Several studies have also demonstrated the effectiveness of solar panels in reducing dependence on grid electricity. For example, PV systems have been found to cover approximately 34% to 36% of household energy consumption, significantly decreasing reliance on centralized electricity supply [26]. Beyond economic benefits, the adoption of solar energy also contributes to environmental sustainability, as it helps reduce carbon emissions and supports the transition toward cleaner energy systems [25]. Moreover, the growth of the solar energy sector has stimulated economic development by creating new employment opportunities and attracting

investment in renewable energy infrastructure [27].

Furthermore, the findings of this study indicate that the adoption of solar panel technology is driven not only by environmental awareness but also by economic considerations. Many households view solar panels as a long-term investment capable of generating substantial financial savings over time. Although the initial installation cost may be relatively high, the cumulative reduction in electricity expenses can offset these costs in the long run. The coefficient of determination results also show that solar panel usage explains a significant portion of electricity cost savings, although other factors such as electricity consumption patterns, system capacity, weather conditions, and electricity tariff structures may also influence household electricity expenses. Overall, the results of this study provide empirical evidence that the use of solar panels contributes to reducing household electricity costs and highlight the importance of promoting renewable energy adoption at the residential level as part of sustainable energy development strategies.

5. CONCLUSION

Based on the results of the analysis, this study concludes that the use of solar panels has a positive and significant influence on household electricity cost savings. The statistical analysis indicates that solar panel utilization contributes to reducing electricity expenses by decreasing households' dependence on electricity supplied by the public power grid. The regression results show that increased use of solar panels is associated with greater electricity cost savings among households. In addition, the findings reveal that respondents generally perceive solar panels as an effective and beneficial technology for household energy management. Most users agree that solar panels not only help reduce monthly electricity bills but also improve household energy efficiency while supporting environmentally friendly energy consumption

through reduced reliance on fossil fuel-based electricity generation.

However, although solar panel usage explains a significant portion of electricity cost savings, other factors such as household electricity consumption patterns, solar panel system capacity, weather conditions, and

electricity tariff policies may also influence the level of savings achieved. Therefore, future studies are encouraged to include additional variables in order to provide a more comprehensive understanding of the economic and environmental impacts of solar energy adoption.

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