

DIFFUSION AND ADOPTION OF SOLAR ENERGY FOR DOMESTIC USE WITH SPECIAL REFERENCE TO BANGALORE REGION

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ABSTRACT

Renewable source of energy is broadly classified into hydro power, wind power, thermal power and solar power. Solar energy is one of the cleanest sources of energy, and a very good resource for the usage of mankind. With the change in technology, mankind kept on inventing products that can run on solar energy and trying to make maximum use of it. Application of solar energy can be seen in many instances in day-to-day activities of life. For example, the water heaters (powered by solar energy), street lights and traffic signals which use solar energy for electricity input, and lot more. Solar panels can generate and store the energy for future usage. For the last decade, solar energy, as a new source of energy, found difficulty to emerge, because of the technology restrictions. But, with the passage of time, the electricity generated by the solar energy can be stabilized more and can fulfil the daily needs of the households. The objective of the study is to identify the factors affecting the use of solar energy by households and to analyze the factors affecting the acceptance of solar energy by households. Hypothesis test was conducted using statistical tool correlation to test if there is significant relationship between the influencing factors and acceptance of solar energy by domestic households. The main purpose of this study was to understand the adoption and diffusion of solar energy by households for domestic purpose with special reference to Bangalore region. This study will help to understand the perception of households regarding the usage of solar power system for their domestic purposes. A survey was conducted to understand the relationship between the influencing factors and acceptance of solar energy by individual households. From the study it was found that there is a significant relationship between the influencing factors and acceptance of solar energy by the households for their domestic purpose. Therefore, it can be concluded that there is greater influence of factors such as availability, affordability and acceptance of solar energy by the households.

Keywords: Renewable Energy, Solar Energy, Solar Power System

INTRODUCTION

Solar energy existed for a quite long time and it is said that it's one of the abundant resources on the earth. The mankind has been using solar energy for thousands of years. Solar energy is one of the cleanest sources of energy, and a very good resource for the usage of mankind. With the change in technology, mankind kept on inventing products that can run on solar energy and trying to make maximum use of it. Application of solar energy can be seen in many instances in day-to-day activities of life. For example, the water heaters (powered by solar energy), street lights and traffic signals which use solar energy for electricity input, and lot more. Basically, solar energy can be classified into two types viz., active solar energy and passive solar energy. The direct consumption of solar rays to generate energy is called active solar energy while the indirect consumption is called passive solar energy. For example, allowing sunlight through windows to heat a place is passive solar energy while generating electricity through sunrays is active form of solar energy. This study, focuses on the applications of solar energy in homes. Today, every home has nearly 10-12 electrical appliances. If the electricity for these appliances is generated by solar energy, we can reduce the carbon emissions from the other forms of generating electricity like hydro power, thermal power etc., which makes world a better place. Solar panels can generate and store the energy for future usage. For the last decade, solar energy, as a new source of energy, found difficulty to emerge, because of the technology restrictions. But, with the passage of time, the electricity generated by the solar energy can be stabilized more and can fulfil the daily needs of the households. Today, the number of users of solar energy and the appliances run by solar energy are very few in number. So, this paper aims to determine the factors affecting the acceptance of the solar energy which is a very potential source of energy for the mankind, in this era of high pollution and extreme climatic conditions.

REVIEW OF LITERATURE

A study conducted by **A. K. Pathania, B. Goyal, and J. R. Saini (2017)** shows the relationship between diffusion and adoption of solar technology. This research is confined to the Punjab area located in India. The data collected in this research is evaluated using a research model named Rogers's Diffusion Model. This model contains five components viz., relative advantage, trial ability, observability, complexity, and compatibility. The data for this study was collected from the residents of Punjab, both users and non-users of the solar technology and its products. The results of survey indicated that most of the solar product users have a basic understanding of the renewable and non-renewable sources of energy. The authors claim that out of the five components of the Roger's model mentioned earlier, trial ability and relative advantage are the significant factors for the adoption of the solar technology by individuals. The authors state that effective trials and demos of solar products will help in selling the solar technology.

A study conducted by **S. Ahmad, R. M. Tahar, J. K. Cheng, Liu Yao (2017)** focused on the problem of increasing pollution due to fossil fuels, which in turn, is leading to unpredictable climate changes. This study states to avoid these unpredictable climate changes, usage of renewable energy is highly recommended. One of the highly potential renewable technologies is solar photovoltaic (PV), yet the amount of people who use solar photovoltaic (PV) are very minimal in number. This study used technology acceptance model (TAM) as a reference framework. The sample size for the study is 663, where data is collected with the help of questionnaires. This whole study is confined to the Malaysian region. This research determines that attitude to ease, perceived usefulness and perceived ease of use are the significant factors which affected the adoption of solar photovoltaic (PV) technology. The research concludes that public focus is mainly on the ease of use when compared to the usefulness of the technology.

A study by **Jarmilla Z., Adam P., and Petr C. (2017)** explained the differences between off grid households and on grid households and also the impact of solar electricity on the households – prosumers. The paper aimed at developing a model of household – prosumer projects (systems). A micro level agent model is developed which represents one household-prosumer. The model contains its own electricity generation with the support of photovoltaic panels, battery and in case of on grid household also connection to the grid. The findings of the study turned out to be that subsidy has significant impact on the economic indicators of various scenarios.

A study conducted by **Dr. SubratSahu (2017)** focused on the sustainable business and marketing approach of the solar technology in selected national and international companies on the basis of their technology-based offerings to the market. The findings of this study are that the incentives and policies undertaken by the government of India are effective in increasing the solar photovoltaic capacity at the country level which has a negative effect on the private market as well. Considering the diversified climatic conditions and cultural behavior in India, the findings of study holds true for all the nations, i.e., it is true that the policies and incentives taken by government of India has a significant impact on the increasing the solar PV capacity.

A study by **M. A. H. Talpur, F. Baig (2017)** focused on the energy crisis and the perception of households at Hyderabad District, Pakistan. The countrymen discovered the rapid growth of population and the lower penetration of the solar energy in the households. This study focused on the empirical data about the acceptance of the clean renewable source of energy, solar energy in the above-mentioned area. The study found out that the affordability of the solar energy is a major factor which is hindering the growth of usage of solar energy in Hyderabad, Pakistan. There are few more factors viz., lack of government interest, deficiency of awareness about solar energy panels etc.

A study conducted by **E. Kabir, K. Kim, and Jan E. Szulejko (2017)** focused on the social impacts of solar home systems in rural areas of Bangladesh. There were both good and bad impacts of SHS on the rural areas of the Bangladesh. On one hand, it made it easy for the households to have a global transparency, while the adverse impact was a toll on the students' grades, etc. According to the authors, basic energy needs can be satisfied with the help of SHS. There is a need for skilled technicians who can provide quality after-sales service. So, unless and until a nation has skilled technicians, there won't be proper growth of solar energy users.

A study conducted by **G. R. Mukami (2016)** examines the extent of the solar technology adoption at household level. This research is limited to the Kiambu County located in Kenya. A stratified random sampling method was followed by the author to derive the sample out of the whole population. The sample size is 500 households who are residents of the Kiambu County. The design of the research is a descriptive survey design. Author performed qualitative and quantitative analysis on the data collected and examined the factors influencing the adoption of solar energy at household level. The author claims that the reason for the non-adoption of solar technology by Kiambu residents is lack of awareness and knowledge about the solar energy and its relative advantage. Also, the study says that the availability of cheaper substitute sources of power is a reason for the descent in the solar energy adoption. The study also states that there was poor support from the government bodies of that respective region with respect to the solar energy technology adoption. The research concludes that, if the government intervenes and plays its part in the adoption of the solar energy, the Kiambu residents will benefit for the long-run.

A study conducted by **J. Sommerfeld (2016)** focuses on understanding the customer perspective and the nature of the consumers who are the users of solar photovoltaic (PV). The study is confined to the area of south-east Queensland, a state in Australia. The author used both qualitative and quantitative methods of analysis to determine the factors affecting the usage of solar photovoltaic (PV). Roger's Diffusion of Innovation model is used in this study to classify the customers into various categories viz., early adopters, early majority, late majority and laggards. This research findings depict the variation of the solar photovoltaic (PV) consumer profile over the period.

A study conducted by **K. H. Solangi, A. Badarudin, S. N. Kazi, T. N. W. Lwin, and M. M. Aman (2013)** focused on the public acceptance of solar energy. This study is primarily based on the area of Peninsular Malaysia. The authors found that there is a huge need for solar energy in the Peninsular Malaysia to achieve the goal set by their government before 2020. The study says that the public support and target achievement is highly necessary for balanced production and consumption of the renewable energies such as solar energy. A strong emphasis on this ground has to be taken by the government in order to attain the balanced production and consumption of the renewable energies.

A study conducted by **Keriri (2003)** focused on the access of solar energy facilities to the Kenyan citizens especially in the location of Lakipia's north constituency. The objective of the study was to determine the status of literacy of the solar technology, and the availability of the alternate source of powers, also, the benefits of solar technology in the region of north constituency of Lakipia. The author used a descriptive study design, and stratified sampling technique where she collected data using questionnaires and interviews. A total of 365 households are considered as a sample out of the whole population of 6733 households. Out of the sample which amounts to 365 heads, only an 82.2% are the heads, i.e., only 300 are the heads for that specific house. The findings of this study says that only 32% of the northern constituency of the Kenyan county, Lakipia, are using solar technology as a power source. These findings are useful to the Ministry of Energy and at the same time, to most of the energy solution companies like Kenya Power and Lighting Company. Also, the author had "Vision 2030" of Kenya in her mind while she was working on this research. So, the findings were in same line with the Vision 2030 of Kenya.

STATEMENT OF THE PROBLEM

Earlier researches focused entirely on the renewable source of energy altogether. Since, many papers concentrated only on the photovoltaic appliances (PV) and their usage, there is a scope to conduct a research on the solar energy for domestic use by households. Most of the papers conducted study in areas other than Bangalore region viz., Punjab of India, Laikipia & Kiambu regions of Kenya and Queensland of Australia focused on the literacy of the solar energy and the photovoltaic appliances. As these researches do not focus on diffusion and adoption of solar energy for domestic use with special reference to Bangalore region, my study focuses on the factors affecting the use of the solar energy by individual households in the Bangalore region.

OBJECTIVES OF THE STUDY

1. To identify the factors affecting the use of solar energy by households
2. To analyse the factors affecting the acceptance of solar energy by households

SCOPE OF THE STUDY

This study will help to understand the perception of households regarding the usage of solar power system for their domestic purposes. A survey was conducted to understand the relationship between the influencing factors and acceptance of solar energy by individual households

HYPOTHESES

Ho: There is no significant relationship between the identified factors and acceptance of solar energy.

H1: There is a significant relationship between the identified factors and acceptance of solar energy.

METHODOLOGY

The Research Method used is Applies Research and the data was collected from Primary and Secondary Sources, where the tool of collection used was questionnaire.

PLAN OF ANALYSIS

The Tool for analysis which has been used is correlation.

HYPOTHESES TESTING

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
Factors influencing use of solar energy * Solar energy is fully compatible with household needs	27	100.0%	0	0.0%	27	100.0%

Factors influencing use of solar energy * Solar energy is fully compatible with my household needs Crosstabulation

Count		Solar energy is fully compatible with my household needs			Total
		Agree	Strongly agree	Neutral	
Factors influencing use of solar energy	"Affordability"	10	0	1	11
	"Acceptability"	6	7	0	13
	"Availability"	2	0	1	3
Total		18	7	2	27

Symmetric Measures

		Value	Approximate Significance
Nominal by	Phi	.695	.011
Nominal	Cramer's V	.492	.011
N of Valid Cases		27	

INTERPRETATION:

Since, the 'P' value (0.011) is less than the significant value (0.05), we reject the null hypothesis that there is no significant relationship between the influencing factors and acceptance of solar energy, and accept the alternative hypothesis i.e. there is significant relationship between the influencing factors and acceptance of solar energy.

INFERENCE:

There is a significant relationship between the influencing factors and acceptance of solar energy as these factors affects the adoption and diffusion of solar energy by the households for the domestic purpose.

FINDINGS

Majority of the respondents are either self-employed or workers, belonging to low and middle-income levels.

- Majority of the respondents are aware of the benefits of solar energy and believe that solar energy is environment-friendly.
- Majority of the respondents believe that solar energy reduces electricity bills.

- Majority of the respondents believe that the reason for lack of awareness of solar energy is because the initiatives taken by the governments of India and Karnataka are not effective.
- Majority of the respondents are of opinion that acceptability is the main factor influencing the use of solar energy.
- Majority of the respondents believe that the installation of solar energy is very expensive.
- Majority of the respondents are willing to spend INR5000-6000 on solar energy.
- Majority of the respondents believe that usage of solar energy is convenient., eco-friendly and very useful for domestic purpose.
- Majority of the respondents are of the opinion that solar energy is cost-effective.
- Majority of the respondents believe that government is ineffective in promoting the solar energy.
- Majority of the respondents are willing to recommend the usage of solar energy to others as it is convenient.

CONCLUSION

The above study conducted, mainly focused on adoption and diffusion of solar energy by households for domestic purpose of Bangalore region. From the above data analysis and interpretation, it is evident that the various identified factors such as acceptability, affordability and availability influence the adoption and diffusion of solar energy by households for their domestic purpose. Finally, the study concluded that high installation expenses, less availability of solar products and no government intervention in promoting solar energy might have deterred them from adoption of solar energy.

RECOMMENDATIONS

Government should take good initiatives to promote awareness about solar energy and its benefits.

- Government can provide subsidies on installation of solar energy in order to encourage people to use solar energy for household purpose.
- Availability of solar power systems should be increased in order to enhance the adoption of solar energy by the households for domestic purpose.

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