

A Study of Motivational Factors and Barriers About Solar Electricity Generation System

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ABSTRACT

India, an emerging economy, needs renewable energy to sustain its economic growth. The solar energy market in India is being driven by growing economy, more and more infrastructure projects and increasing urban dwelling with a huge increase in middle class' paying ability, rising import bills of diesel and coal, higher power demand during day and the heavy losses in the electricity network. Indian Govt needs to accelerate the installation of solar energy sources by clearly defining renewable energy policies and addressing regulatory issues. Purpose of this paper is to find out the factors that motivate potential customers for installation of Solar Electricity Generation System (SEGS) and to identify barriers that need to be reduced or neutralized. In Research Design / methodology the detailed literature reviews was done to identify the factors that increase installation of Solar Electricity Generation System across India. A questionnaire was designed to find out the motivational factors and barriers for installation of Solar Electricity Generation System. The responses from 504 potential customers were recorded using online survey method and further analyzed using SPSS. Findings reveal that awareness about Solar Electricity Generation System among potential customers is low. The Govt of India needs to focus on the advertisements in TV and Radio and publish articles in newspapers on the benefits of Solar Electricity Generation System. The primary motivation of customers is to reduce the electricity bill, avail govt subsidy and reduce pollution by using Solar (green) energy. The primary barriers like high initial cost and cheap and affordable loans need to be addressed through innovative lease models.

Practical Implications: Factors identified, if implemented, will boost installation of Solar Electricity Generation System and will thus facilitate lowering of overall cost of the system. The SEGS will reduce pollution thus improve the quality of life of a common man.

Opportunity: The primary data collected online across India will give better picture of the expectations of potential customers and help modify solar energy policies being promulgated from Ministry of New and Renewable Energy, to be implementation across India.

Research is Exploratory research.

Key words – Solar Electricity Generation System, Awareness, Motivational factors, Barriers.

INTRODUCTION

It is clearly evident that renewable energy is going to emerge as a mainstream energy source globally over the next decade. The future electricity generation system will have large amounts of variable renewables that will integrate different technologies of renewable energy. The solar industry has seen dynamic changes in the last few years with steep fall in module prices encouraging early adoption, while at the same time, this has raised concern about the health of manufacturing sector and its sustainability. In India, the solar power can help meet the twin objective of long term energy security and climate change considerably. According to KPMG report,

the primary factors driving solar market in India are increasing energy demand, rising import bills of diesel and coal, power from diesel is costlier than solar and higher power demand during day.

The National Solar Mission of India has triggered the development of solar- electric capacity with target increased from 20 GW to 100 GW by 2022. The Indian govt needs to keep the momentum going by providing sufficient clarity to the market, clarifying next phase of National Solar Mission and addressing regulatory issues.

Financial viability will be the main driver for adoption of solar energy by various customers. An innovative lease model can further improve the market attractiveness by avoiding high upfront cost and reducing monthly power bills. Keeping in mind the research conducted in previous studies, this study aims at finding out the level of awareness, motivational factors and barriers related to installation of Solar Electricity Generation System. The issues related to high initial cost, availability of affordable loans, Govt subsidies, rate of return on investment, confidence in solar technologies, availability of suppliers and retailers etc were asked through a questionnaire having a five points Likert scale. The solar policies are framed by the Ministry of New and Renewable Energy and implemented across India through state govt agencies, hence the canvas of study has been kept at Pan India level. The data collected from the respondents has been analyzed using SPSS software and discussed in subsequent paras.

REVIEW OF LITERATURE

Palvi and Uday (2010) segmented consumers as users and nonusers in Satara dist, Maharashtra, observed that although the awareness about the solar products was 65% however the usage of solar products was a little lower i.e 49% for solar lantern, 22% for solar cooker and 10% for solar home lighting system. The attitude survey showed that 100% consumers agreed on usefulness of the solar equipment while 94% users opined high prices of products, while 94.8% users felt that they had high savings on using solar products. About 70 to 75% users were aware of the govt schemes and availability of soft loans provided by banks. Study suggests to continue subsidies and low interest loans as these have been the major motivator for purchase of solar products. The study also suggests to increase awareness through advertisements.

Thamizchelvan and N.Jayanthi (2013) while studying the marketing strategies to expand the potential markets for renewable energy products recommended promotional measures to boost the use of renewable energy. The study revealed that 26% of awareness is through newspapers and magazines while 22.3% got awareness through conferences and seminars. Study also revealed that only 55% users were willing to switch over to renewable energy. Majority of users were willing to pay more for renewable energy system being green energy and environment friendly. The factors influencing the investment in renewable energy products are lower energy bills, inadequate power supply, environment friendly energy, frequent advertisements, tax exemptions and govt subsidies. The study revealed various barriers such as high investment, non-availability of finances, maintenance difficulties, municipal approvals & permits, lack of awareness due to limited advertisement, non-familiarity with innovative technology and lack of govt subsidies. Consumers attitude revealed that majority (71%) responded lack of financing being the major problem. Study recommends increasing awareness among general public and potential users through conduct of workshops, business meets, seminars and encourage publicity through newspapers, TV, radio, emails and social media. The study recommends tax concessions and govt subsidies on renewable energy products to continue.

Dr. NILESH and NARENDRA (2014) in the study 'Consumer buying behavior and responses towards use of solar energy equipment's' divided individual consumers in users and nonuser groups. More than 85% users are having income above Rs 2 lakhs, of which 78.2 % user are highly dissatisfied about high prices of solar

products. Despite knowing the benefits of using solar energy equipment 90.2 % respondents were not ready to buy solar systems due to high initial cost. The study revealed that the effective marketing communication of the organization has impact on buying behavior of the customers of solar equipment. Most of the respondents (30.2%) came to know about the solar equipment after seeing the system installed in their area, followed by 26.9% of respondents who came to know about the solar equipment and its uses through their friends / social circle. Some of the respondent (18.2%) came to know about the solar equipment and its uses through advertisement in media while only 05% came to know through articles in newspapers / books. In the non-user group 70.1% were aware of the benefits of solar-equipment but most of the respondents (92.2%) had not thought of installing solar system in near future and only 7.8% had thought of installing solar system in future.

Anupamaa S. Chavan (2014) while finding out the 'Significant factors affecting the use of Solar Energy Products' commented that the utility of solar energy products has emerged to be a significant factor for all the four products viz. Solar Water Heaters, Solar Street Lights, Solar LED Lights and Solar Inverters. Study recommends that there is a strong need to convince people about the utility of Solar Energy products because only convinced people will think of using it. Cost has been identified as another significant factor for private residential owners. People need to be made aware of the fact that though initial cost is high, the utility bills will go down drastically. When more and more people start using these products, the cost will come down due to increase in demand. The after sales service has not been identified as significant factor for Individual and Institutional buyers. Product availability has been significant only for institutional buyers using solar water heaters. Social and environment concern have not been significant for all the products but it has influence on buying / use.

Mohammed Yaqoot (2015) in the study on 'Assessment of the barriers faced by Decentralized Renewable Energy Systems (DRES)' separated adopters and non-adopters in Uttarakhand . It revealed that high capital cost and lack of access to capital (loan) are the barriers that are considered most critical by all categories of responders. Lack of awareness is a critical barrier to the non-adopters whereas the adopters consider unavailability of spares and trained manpower as more critical. A satisfied DRES adopter is more likely to recommend it to others resulting in more adoptions. Thus effective maintenance services will increase adoption of renewable energy systems. Study recommends that DRESs may be promoted initially for community usage by demonstrating its usage and benefits. The improved distribution and after sales services will motivate households to adopt them. Financial analysis indicates that under unsubsidized fuel scenario, almost all DRES considered in the study are found to be viable even without capital subsidy. Thus subsidies on conventional energy sources are found to be a major barrier to the diffusion of DRESs. Removal of such subsidies would minimize the need to provide capital subsidy on DRESs and would also promote DRESs adoption leading to sustainable development.

Bruce N. Stram (2016) in study on the “Key challenges to expanding renewable energy” highlights integration of intermittent renewable with existing power grids, renewable ramping and over production issues, energy poverty circumstances and consequences .The study shows that energy efficiency could be the most important method to reduce greenhouse gas emissions while maintaining energy services. There are several causes of energy poverty, the most obvious of which is living in a

community having no or very limited access to electricity. Energy poverty can also exist in geographical regions that have inadequate electricity supplies, especially urban areas in less-developed countries. In these circumstances, the inability to afford electricity and associated end-use equipment are among the many consequences of poverty that cause suffering to hundreds of millions of people including malnutrition and preventable disease.

Komali Yenneti (2016) studied “The grid-connected solar energy in India: Structures and challenges”. This paper critically reviews the political economy of grid-connected solar energy in India. Findings of the study indicate that the implementation of a range of policies, programs and institutions, especially since the initiation of the Jawaharlal Nehru National Solar Mission (JNNSM), have been playing a prominent role in India's solar energy portfolio building up the sector from less than 10 MW installed capacity in the year 2000 to about 3000 MW in 2014. Solar energy is still not the most popular source of renewable energy in India. The findings of this study also indicate that issues surrounding policy, financial and social aspects are increasingly becoming impediments to bringing a paradigm shift in the solar sector.

RESEARCH PROBLEM

Purchase decision begins with 'need recognition and information search' because if a customer does not perceive a problem or need, he will not move forward towards purchasing a product. Since awareness is the ability to directly know and perceive about a product, by raising awareness, we change his behavior and influence his decision making process. Hence this study is to know the level of awareness of potential customers about 'Solar-Electricity Generation System' and recommend ways to increase awareness thus directly influences his purchasing decision. By identifying and boosting the motivational factors we can increase installation of Solar Electricity Generation System. Similarly after identifying the barriers we can reduce or neutralize their impact thus again boosting installation of SE System. Thus, the aim of this paper is to identify the level of awareness of customers, motivational factors and barriers for installation of Solar Electricity Generation System.

RESEARCH OBJECTIVES

1. To analyze the awareness level about Solar Electricity Generation System in potential customers.
2. To analyze the motivational factors for purchase of Solar Electricity Generation System in potential customers.
3. To analyze the barriers for purchase of Solar Electricity Generation System.

METHODOLOGY

The study investigates the level of awareness, motivational factors and barriers faced by customers for installation of Solar Electricity Generation System across India. Potential customers were approached to respond to the questionnaire where purposive sampling of non-probability sampling were used for the study. Out of total 514 responses collected from potential customers across various states of India, 504 were found to be usable responses. The objective of the current study is to test the 20 items instrument based on awareness, motivation and barriers about Solar Electricity Generation System. The response has been recorded using five point Likert scale ranging from (5) strongly agrees to (1) strongly disagree and Yes and No responses for other questions.

Validity and Reliability Analysis

Content validity: The content of the questionnaire regarding motivational factors and barriers about Solar Electricity Generation System were identified through literature and exploratory investigations and were thoroughly reviewed by professionals and academicians. Refined questionnaire based on 20-items was put through pilot test from 60 customers. The respondents were distributed across various states of India based on convenient sampling technique. The questionnaire collected two sets of information, one was the demographic information and the other was to collect awareness, motivational and barriers information. A five point Likert scale ranging from Strongly Agree (5) to Strongly Disagree (1) was used. Reliability was defined with Cronbach's alpha, which was 0.906 and standard value was 0.904 for 17 items.

Hypotheses

H1: There is awareness about Solar Electricity Generation System in potential customers.

H2: There are barriers about installation of Solar Electricity Generation System in potential customers.

DATA COLLECTION AND ANALYSIS

The study being exploratory in nature, the sample was non-probabilistic convenience sample comprising of 504 responses from nine geographical regions of India namely Rajasthan, Madhya Pradesh, Uttar Pradesh, Maharashtra, Gujrat, Jharkhand, Andhra Pradesh, Chandigarh and New Delhi. The demographic profile of the sample is as given in Table 1.

Table 1: Demographic Profile of Sample

<u>Characteristic</u>	<u>Frequency</u>	<u>Percentage</u>
<u>Age (In Years)</u>		
20 to 25	65	12.9%
26 to 40	254	50.4%
41 to 50	115	22.81%
51 to 60	50	9.92%
More than 60	20	3.97%
<u>Occupation</u>		
Govt Service	105	20.83%
Pvt Factories	90	17.86%
Business	106	21.03%
Private Job	203	40.28
<u>Gender</u>		
Male	400	79.36%
Female	104	20.64%
<u>Income (Yearly)</u>		
Up to 5 Lakhs	309	61.3%
6-12 Lakhs	177	35.13%
12-20 Lakhs	10	1.98%
More than 20 Lakhs	08	1.58%

Demographic information has been categorized into four groups namely age, occupation, gender and income. Maximum respondents are in the age group of 26 to 40 years, in occupation maximum respondents are in private job, males responded higher than females and maximum respondents are in 'Up to 5 lakhs' income category.

DATA ANALYSIS AND RESULT

Part 1

The first research objective i.e 'Analysis of awareness level of Solar Electricity Generation System' calculated with second part of the questionnaire inquires as to how respondents came to know about Solar

Electricity Generation System. The response has been recorded in two parts, one is based on how respondents came to know about the system and second was based on impact of awareness on customers.

Table 2 :- Awareness about Solar Electricity Generation System through

<u>S.no</u>	<u>Statements</u>	<u>Respondents</u>	<u>Percentage</u>
1.	Newspapers.	19	3.7%
2	Advertisements on T.V, Internet or radio.	80	15%
3	Demonstrations during exhibitions and seminars	105	20.8%
4	Personal selling, solar dealers and retailers.	300	59.5%
Total		504	100%

Maximum (60%) respondents got awareness about Solar Electricity Generation System from personal selling, followed by demonstrations during exhibitions and seminars. Only 15 % respondents came to know through advertisements on TV or other media while through newspaper only 3.7 % got awareness. After taking basic information about Solar Electricity Generation System, one sample t test was applied for hypothesis analysis.

H1: There is awareness in customers about Solar Electricity Generation System.

Table 3 : T test on Awareness

<u>S. No</u>	<u>Statements</u>	<u>Mean</u>	<u>S.D</u>	<u>T value</u>	<u>Sig</u>
1	How a solar to electrical energy system works	3.5952	1.28257	33.446	000
2	Government provides subsidy and incentives on Solar Electrical system	3.5952	1.28257	27.923	000
3	Installation of Solar – Electrical system	3.2956	1.37353	21.177	000
4	Awareness about Solar energy being pollution free (green) energy	4.4345	1.03405	52.855	000
5	Awareness about companies that install Solar – Electrical system at homes	2.9147	1.36072	15.091	000
6	Govt runs training programs on installation and maintenance of solar systems	2.7857	1.41341	12.480	000
7	Through ‘Net metering’ you can transfer surplus energy generated during day to the national electric grid	3.0476	1.52309	15.442	000
8	National electricity grid (Govt) buys (pays you for) surplus energy transferred through ‘Net metering’.	2.9484	1.50589	14.139	000

The highest mean of 4.43 out of 5 is for awareness about solar energy being pollution free (green) energy, which is followed by how solar energy works with mean of 3.592. Least mean of 2.785 is for govt run training programs on installation and maintenance of solar systems. Standard deviation is varying from 1.523 to 1.282. The overall t value of each items is varying from 52.855 to 12.480. The p value of all parameters being less than 0.05 proves that awareness about Solar Electricity Generation System in customers is moderate.

Part 2:

Analysis of second research objective 'Motivational factors for purchase of Solar Electricity Generation System' was done using six parameters based on power cut, independent power source, reduce electricity bill, govt subsidy, tax concessions and reduce pollution. Data analysis with percentage is as given below.

Table 4 : Motivation to purchase 'Solar Electricity Generation System'

S. No	Statements	Number		Percentage	
		Yes	No	Yes	No
1	Power cut is a problem issue	364	140	72.22%	27.7%
2	Will have independent power source at home	435	69	86.3%	13.6%
3	Will reduce electricity bill.	471	33	93.45%	06.5%
4	Government provides subsidy on installation	406	98	80.55%	19.4%
5	Avail Tax concessions.	338	166	67.06%	33%
6	It reduce pollution being green energy	66	438	13.09%	86.9%

Primary motive 'To reduce electricity bill' was responded by 93.45% of 504 respondents, followed by 86.3% responding for independent power source at home, Government subsidy was responded by 80.55%, Power cut is a problem was responded by 72.22%, tax concessions was responded by 67.06% and reduce pollution is motivation to only 13.09%.

Table 5 : Factors Encouraging installation of 'Solar Electricity Generation System'

S. No	Statements	Number		Percentage	
		Yes	No	Yes	No
1	Benefits of solar to electric system.	462	42	91.66%	08.34%
2	Easy availability of sellers and retailers	329	175	65.27%	34.73%
3	Positive Influence by existing users.	379	125	75.19 %	24.81%
4	Cheap and affordable loans.	358	146	71.03 %	28.97%
5	Government subsidies and Tax concessions.	412	92	81.74 %	18.26%
6	Demonstrations during Exhibitions & Conferences.	322	182	63.88 %	36.12%

Six parameters encouraging installation of Solar Electricity Generation System were studied. 91.66% respondents were encouraged by benefits of Solar Electricity Generation system while 81.74% customers got motivated because of tax concessions. 75.19% consumer were encouraged positively from existing users, while 71.03% were encouraged by affordable loans. 65.27% were motivated by easy availability of sellers and retailers while 63.88% got encouraged by demonstrations during exhibitions.

Part 3

Analysis of 'Barriers for installation of Solar Electricity Generation System' was done on 504 samples using one sample t test. The focus during analysis was on barriers like high cost, difficulty to install and many other parameters.

H2: There are barrier about installation of Solar Electricity Generation System.

Table 6 : T test on Barriers

S. No	Statements	Mean	S.D	T value	Sig
1	I feel Solar to electrical system is difficult to install and maintain.	2.9940	1.37500	16.230	000
2	I lack confidence in solar to electrical energy technology as it is not yet matured.	2.9702	1.38334	15.746	000
3	Non affordable due to high initial cost.	3.3948	1.30637	23.970	000
4	I feel solar electricity is expensive than existing domestic electricity	2.5774	1.38795	9.339	000
5	Lack of availability of cheap and affordable loans.	3.1096	1.31092	18.964	000
6	Tedious process to claim govt subsidy.	3.4930	1.22371	27.364	000
7	I don't see too much benefit or advantage on installing 'Solar to Electrical system.	2.4223	1.38026	6.855	000
8	Retailers and suppliers are not easily available.	3.2994	1.27678	22.780	000
9	It has low 'Rate of Return' on investment and long payback period.	3.2718	1.22577	23.294	000
10	Existing domestic electricity is more convenient than solar electricity.	3.1052	1.35786	18.272	000
11	I feel space required for installation of Solar to Electricity Generation System is very large	3.1865	1.38471	19.236	000
12	I would like to utilize my space for other gainful purpose than installation of Solar panels.	2.6210	1.39341	10.006	000

The barriers for installation of were evaluated using 12 parameters. The highest mean 3.4930 and lowest mean of 2.4223 indicate moderate level of barriers. Highest mean is for 'Tedious process to claim govt subsidy' and lowest mean is for 'I don't see too much benefit on installing Solar Electrical system'. Standard deviation varied from 1.39341 to 1.22371. The overall t value of each item varied from 27.364 to 6.855. The p value of all parameters being less than 0.05, the hypothesis has been accepted and which proves moderate impact of barrier on customers for installation of Solar Electricity Generation System.

FINDINGS AND RECOMMENDATIONS

Max (60%) respondents got awareness through personal selling while 15% got awareness through advertisements on TV & Radio and only 3.7% got awareness through newspaper. There is thus a need to increase awareness through advertisement in TV and Radio and also to publish articles in newspapers regarding benefits of Solar Electricity Generation system. The mean of 4.43 out of 5 clearly indicates that the people are aware about solar energy being pollution free (green) energy. The mean of 2.785 out of 5 indicates that there is a need to increase awareness about availability of companies that install Solar Electricity Generation System and also about training programs run by govt. Regarding motivational factors, 93.45% persons got motivated because of reduction in electricity bill with 86.3% persons got motivated because of independent power source, for 80.55% people the motivator has been govt subsidy and for 67% persons tax concessions motivated installations. Indian govt therefore needs to continue the subsidy and tax concessions. The primary barriers still remain to be high initial cost, lack of affordable loans, tedious process to claim subsidy, non-availability of retailers & suppliers. Indian govt therefore needs to work on innovative lease model to make finances easily available to boost installation of Solar Electricity Generation System.

CONCLUSION

The study has shown that the growth of Solar Electricity Generation System is moderate in India because of low awareness and other barriers. The Indian govt therefore needs to provide extra push to increase awareness and reduce barriers. Govt subsidy and tax concessions being the primary motivators needs to be continued till power from solar becomes comparable with conventional sources and affordable to a common man. Once the system becomes affordable to the common man, it will improve his quality of life. The power from solar will save large amount of foreign exchange used for import of diesel and coal. These savings of foreign exchange can be used for other developmental projects and contribute for economic growth of the country. Reduced burning of diesel and coal will also reduce air pollution and reduce other Global warming gases thereby improving environment of the country.

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