

CONSUMER ATTITUDE FOR SOLAR ENERGY AND FACTORS OF ADOPTION; AN EMPIRICAL STUDY IN HIGHER STUDIES EDUCATIONAL INSTITUTIONS IN KAMRUP DISTRICT, ASSAM.

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Abstract

Solar has been globally accepted as one of the best source of sustainable and clean energy. A lot of advancement has happened on the technical front of developing solar energy systems with higher efficiency and better durability. However the presence of solar remains a big concern as adoption levels has not reached to sufficient levels. Solar being a relatively new technology innovation has been perceived as one of the most promising renewable energy sources. Probably technical aspects of solar energy reached a myopic levels for innovators and this has somewhere avoided understanding the demand side of the solar story. Focus has been majorly in developing the technology to higher efficiency levels. Attention has now shifted to understand the demand side of solar energy. A lot of studies has been conducted across to understand the consumer buying behavior related to solar energy. This paper gives an extensive insight on the attitude and purchase behavior of consumers taking educational institutions as the consideration set. A set of educational institutions having a capacity exceeding 20Kw of electricity has been selected as the sample set of study. The study aims to understand the attitude and awareness of people towards solar energy and the decision making parameters for solar energy products purchase.

Keywords: Consumer attitude towards solar; Green Marketing programs; Consumer behavior towards green energy.

Introduction:

This paper studies the consumer attitude and perception towards solar energy and the parameters that consumers take into consideration while making a decision to purchase a renewable energy product.

Our objectives in this study is twofold:

- (1) To analyze the attitude of respondents towards environmental changes and perception towards solar energy.
- (2) To study the factors that influences the decision for adoption of solar energy over conventional electricity

The importance of solar energy has increased with constant rising concerns of global warming and depleting sources of fossil fuel in limited supply on earth. Solar energy has emerged as one of the most viable form of renewable energy adopted across the globe. The problems from existing source of energy such as generation of greenhouse gases and having limited reserves on earth have made people to look for alternative source of energy. However even though solar has been accepted as one of the most viable form of alternate energy source, the actual adoption levels has not being satisfactory. Product manufacturers and marketers must overcome the challenge that consumers' stated behavior does not always manifest itself in actual consumption behavior.(Faiers & Neame, 2006). Understanding consumers' attitudes towards an innovative product provides two key benefits. First, strengths and weaknesses in the innovation attributes can be identified and managed effectively (Sharyn Rundle, Paladino, 2003) . Second, more control can be imposed on the marketing strategy in order that the innovation is made attractive to the most receptive audience (Auty and Elliott 1998). Perceptions and attitudes have been shown to impact behaviors and innovation adoption. The study of perceptions has been used in marketing research to form the basis for studying motivations and attitudes (Lusk 1973; Auty and Elliott 1998; Hsu et al 2000). Perceptions and attitudes can affect consumer behaviour and innovation adoption. Elkington (1994: 93) defines green consumer as one who avoids products that are likely to endanger the health of the consumer or others; cause significant damage to the environment during manufacture, use or disposal; consume a disproportionate amount of energy; cause unnecessary waste; use materials derived from threatened species or environments; involve unnecessary use of, or cruelty to animals; adversely affect other countries. Thus, a firm must be perceived to be helping the environment through its products, services, and through its very operation and existence to attract green consumers (Ottman, 1998). Consumer perceptions of the effectiveness and greenness of a renewable electricity source will determine the premium that a green consumer is willing to pay (Rowlands & Parker, 2002). By 1991, environmentally conscious individuals were willing to pay between 15-20 percent more for green products (Suchard and Polonsky, 1991). Research suggests that electricity aware consumers are more likely to respond to marketing efforts (e.g. Batley, Colbourne, Fleming & Urwin, 2001). It is well established that an absence of knowledge will lead to consumer uncertainty and confusion, which inadvertently increases the risk attributed to a purchase (Foxall & Goldsmith, 1985). Research suggests that electricity aware consumers are more likely to respond to marketing efforts (e.g. Batley, Colbourne, Fleming & Urwin, 2001). It is well established that an absence of knowledge will lead to consumer uncertainty and confusion, which inadvertently increases the risk attributed to a purchase (Foxall & Goldsmith, 1985). When a product such as electricity fulfils only functional or instrumental needs it is not likely to be interesting to customers (Gabbott & Hogg, 1999)

Consciousness over solar energy:

Over the time, consumers have become more concerned with the natural environment and are realizing that their production and consumption purchasing behavior will have direct impact on the environment (Laroche, Bergeron, and Barbaro-Forleo, 2001). This awareness is congruent with the belief that the world's supply of natural resources is finite and the ecological balance of

the environment may be at a critical disruption stage (Hayes, 1990). In addition to functional goals, renewable electricity can fulfil non-functional goals, such as altruism, paternalism and moral satisfaction, where a consumer feels a sense of achievement when helping the environment (Wohlgemuth & Getzner, 1999). By 1991, environmentally conscious individuals were willing to pay between 15-20 percent more for green products (Suchard and Polonsky, 1991). According to Hallin (1995) and McCarty and Shrum (2001), people engage in environmental behavior as a result of their desire to solve environmental problem, to become role models and a belief that they

can help to preserve the environment. However, consumers' indications of positive attitude towards environmental issues do not necessarily lead to actual environmentally friendly purchasing behavior (Laroche et al., 2002). Majority of consumers do not purchase products based on the environmental concern alone and they will not trade-off other product attributes for a better environment (Yam-Tang and Chan, 1998). While the results are ambiguous, the environmentally conscious consumer tends to be better educated, higher income, and higher socio-economic status, and politically liberal people who are concerned about the environment (Balderjahn, 1988). Furthermore, Antil (1984) discovered a positive relationship between environmental knowledge and pro-environmental attitudes. In other words, socially responsible consumers have more knowledge about environmental related issues and are likely to demonstrate positive attitudes toward the environment. This result is largely in line with the findings of earlier studies which emphasized consumers' skepticism toward the technology and the decisive role of others' behavior (Faiers and Neame, 2006; Faiers et al., 2007). Consumers may only claim to be green as a result of social acceptance and peers pressure (Kalafatis et al., 1999). Solar systems can raise a householder's awareness of energy consumption by means of a monitoring facility provided with the installation. This enhanced awareness of energy use could encourage further energy efficiency. Truffer et al (2001) define this type of efficiency as using

_'negawatts'; units of energy never used, perhaps due to intervention by an energy efficient product or more efficient behaviour arising from changing attitudes towards energy use.

Barriers to adoption

According to the findings of consumer surveys, the high initial capital costs, the long amortization time, low public subsidies as well as a lack of trust in the functionality and effectiveness of the technology impair the adoption of this product (Faiers and Neame, 2006; Foster, 1993; Watson et al., 2006). Among the top influential barriers is the investment of purchasing these products (Steg, 2008). For example, evidence from a study of consumer attitudes towards solar power systems in the United Kingdom demonstrated that high purchase prices are a major obstacle to solar panels adoption (Faiers and Neame, 2006). The perception about possibility of drops in utility price may lower the estimated potential savings associated with the usage of EERE products, and hence decreases the chance of purchase (Hirst and Brown, 1990). The underestimate of saving potentials through using EERE products, plus the time and effort needed for researching these new products, may have also discouraged purchases (Attari et

al., 2010; Dietz, 2010). Issues such as long simple payback periods, high capital costs and a lack of confidence in the long-term performance of the systems are limiting widespread adoption (ETSU 2001; Timilsina 2000). Cabraal (1998) proposes that quality service, products and support should help overcome the high initial costs. Oliver and Jackson (1999) state that installed costs are being reduced, however, in later research Luque (2001) concludes that there is very little potential for reducing costs in the future. Previous studies suggest that consumers would purchase and are willing to pay more for green labeled products (see Bigsby and Ozanne, 2002; Vlosky et al., 1999; Ottman, 1992). Although consumers are in general concerned about the environment, the previous literature found that consumers are extremely price sensitive towards green products (Massachusetts Department of Environmental Protection, 2002) and are unwilling to pay higher prices for green products (Ottman, 2000). In the context of PV, for example, the

—value of PV_I is a characteristic of the individual adopter and includes not only the monetary cost of the technology, which includes both equipment and installation costs, but also non-monetary costs, such as information search costs and uncertainty about the future performance, operations and maintenance requirements, and perceptions of quality, sacrifice, and opportunity cost (Zeimthaml, 1988; Faiers & Neame, 2006).

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Diffusion of Innovations Theory (Rogers 1995) sets out a practical innovation adoption process. The speed at which an adopter passes along this process is influenced by the attributes of particular innovations, and the propensity of the adopter to accept innovation. The theory has been utilised to model the diffusion of a range of products, for example agricultural products and techniques (Rogers 1995), medical treatment protocols and emergency contraception (Heimburger et al. 2002), and the use of solar power systems (Kaplan 1999; Labay and Kinnear 1981; Velayudhan 2002). Drawing upon Rogers' account of the diffusion of innovations (Rogers, 1995) and related literature from social psychology, further explanatory factors can be identified: environmental attitude, knowledge of the applicability of solar thermal systems to satisfy consumer needs, and the presence of this technology among peer consumers (peer group behavior). A consumer decision to purchase green product is hypothesized to be a function of price consciousness, quality consciousness, environmental consciousness, and brand

consciousness.(Christopher Gan 2008). When a product such as electricity fulfils only functional or instrumental needs it is not likely to be interesting to customers (Gabbott & Hogg, 1999)

1.3 Rationale of this study

This study is conducted to understand the consumer attitudes towards solar electrification system, and identification of the factors that motivate people in adopting solar technology. With growing awareness about global warming and its impacts and successive changes in lifestyle, consciousness of people towards contributing to the reduction of greenhouse gas emission has significantly increased. The famous —Diffusion of Innovations theoryl by Roger is used in our study to understand the adaptation cycle of consumers towards a new technology product. This would give a good insight to the transition of solar electrification systems from only an experimental setup to a large scale commonly used source of energy by masses. The results would help manufacturers to predict and forecast the demand of market and thus formulate suitable strategies in terms of marketing and supply chain to address the demand. This study in conducted in selected educational institutions in the state of Assam, considering the large amount of energy consumption in public establishments exceeding 20KW. Replacement of conventional energy source by solar will also have the bigger social impact, with such pilot projects increasing the visibility of solar installations and knowledge of the importance of renewable energy among masses.

This study is conducted in some of the educational institutions of Guwahati to understand the feasibility of replacement of the power source from conventional energy source to solar.

Educational institutions are selected for the case study since it will be less challenging to seek funds for these non-profitable organizations since solar installation will have a high initial cost. Another important factor for carrying out this study in educational institutions is to raise the interests and awareness of the students towards renewable energy domain. Renewable energy still remains as a very small contributor to our energy requirements. A huge amount of research needs to be carried out if we envision making the nation self-sufficient for our ever increasing energy requirements and shifting to renewable energy sources as the major source of our energy requirements. Solar installations and successive works and research by students of those institutions is expected to increase the visibility of solar systems to many folds and will increase the overall awareness of the solar energy generating systems to the common people. A combined effect will ultimately increase the share of electricity generation with solar energy as a major source, reducing consumption and dependency on fossil fuel.

Another major reason to choose this segment is considering the economic behavior of consumers in case of renewable energy products. Renewable energy installations are more beneficial in terms of long term views. So in case of Individual customer, it is very difficult to propagate this value proposition since majority of individuals do not think of long term benefit more than 2 3 years. However institutions are more beneficial to long term investments which will be a good return to their investments within a span of time. Also the amount of power consumption for

individual customer is very less as compared to that of an Institution. So the amount of power savings in terms of usage will increase with increasing amount of power usage.

The study of perceptions has been used in marketing research to form the basis for studying motivations and attitudes (Lusk 1973; Auty and Elliott 1998; Hsu et al 2000). Perceptions and attitudes can affect consumer behaviour and innovation adoption. Perception is the process by which individuals make sense of sensations utilising their sensory receptors, whereas attitude is the way that an individual views, or behaves towards an object, often in an evaluative way (Kotler 2003).

2. Research design

Research questions

Questionnaire and survey with a good mix of open end and close ended questions are administered. Focused interview is to be conducted with decision makers and key individuals having a strong understanding of the subject matter. Once data collection is done, correlation study is done to understand the perception of the people in regards to solar energy considering the preference of renewable energy against the demographic and socio economic characteristics **of the respondents.**

Following parameters mentioned below are an integral part of our study.

- a. Total population of the institution.
- b. Age group of the respondents
- c. Education background of the respondents
- d. Nature of funding for the Institution (Govt. funded or private)
- e. Age of the institution
- f. Type of courses offered

List of selected respondents;

- i. Decisions makers in universities (DEAN, VC, Director, Registrar, HOD technical and 3 professors with technical background) - No's 10 each university.
- ii. Technical persons related to academics- No's 10.
- iii. ASTEC and other regulatory authority- No's 10.
- iv. Existing manufacturers and vendors- No's 10.
- v. Selected individual consumers-No's 10.

Selection of sample

It is estimated that there are around total of 38 Educational institutions of higher studies (Graduation Colleges) in Kamrup district. We have selected a few institutions on the basis of maximum usage of power, exceeding capacity of more than 20kW. Geographical segmentation is done and one institution is selected in each area of East, West, North, South and Central of metro Guwahati.

Sr. No.	University	Location	Type	Established
1	Gauhati University	Guwahati	State	1948
2	Assam Don Bosco University	Guwahati	Private	2008
3	Assam Engineering College	Guwahati	State	1955
4	Girijananda Chowdhury Institute of Management and technology	Guwahati	Private	2006
5	Krishna Kanta Handique State Open University	Guwahati	State	2007
6	Assam Down Town University	Guwahati	Private	2010
7	Cotton College State University	Guwahati	State	2011
8	Guwahati Medical College	Guwahati	State	1960
9	North Eastern Regional Institute of Management	Guwahati	Private	1992
10	Guwahati Commerce College	Guwahati	State	1962
11	Guwahati College of Architecture	Guwahati	Private	2006
12	IIT Guwahati	Guwahati	State	1994

Data and Methodology

This study is a descriptive research and is conducted to understand the consumer attitudes towards solar electrification system, and identification of the factors that motivate people in adopting solar technology. Since the quantum of electricity consumption is much higher in public institutions, Gov. Office, schools & colleges, it makes more sense to conduct the study in such institutions first. Kamrup is a district which experiences the highest rate of urbanization among all districts in the state of Assam and it also houses the capital of the state. Also Guwahati is

considered the gate way for the North East of India, hence the visibility of solar in this city would give a strong boost to solar energy awareness to this part of the country. The samples selected are educational institutions in Guwahati city. The research is basically an exploratory one which is based on both primary and secondary data. The primary data will be collected by the technique of field survey, Personal Interview and questionnaire. Secondary data collected from different books, journals, Journals, websites etc. A detailed source of secondary data is mentioned in the appendix section.

Location and Limitation

This study is concentrated in Kamrup district for the fact that Kamrup district is the central place of North East India where consumption of power is the highest. Further it is observed that a majority portion of power is used by the educational institutions in Kamrup district. We have considered the high energy consumption entities of these educational institutions where the sample size is restricted to 12 highest power consuming institutions among the total count of higher educational institutions in Kamrup district. Regarding the limitation of the study it is to be mentioned that the study mainly concentrates on selected number of educational institutions which used the highest amount of power. In a further course of study and future research scope, more numbers of institutions and different establishments can be considered under the study to get a further insight about the subject.

3.Results and Discussions:

Factory Analysis

This research used factor analysis to identify factors affecting consumers' purchasing behavior towards green products. The most frequently used approach is principal components analysis (Cooper and Emory, 1995). This method transforms a set of variables into a new set of composite variables or principal components that are not correlated with each other.

The varimax rotation is performed and items are selected where the factor loadings are greater than 0.50 and loaded on a single factor, and a total of 88.1% of the variance explaining four constructs. The four constructs are clearly visible in the Rotated Component matrix table analyzed in SPSS as below. On further detailed observation, we can relate the constructs to a specific genre of a respondent's attraction towards solar energy. We can put four nomenclature of the constructs as **Environmental friendly, Saves Money, Techno-savvy group, and social consciousness**. In a way, we can form a statement as —these four factors play a critical role in making an impact on a consumers mind as why he should adopt solar energy over conventional energy. This gives a very distinct output of our factor analysis study conducted to understand the factors that influence consumer for decision to adopt solar energy over conventional electricity.

Rotated Component Matrix

	Component			
	1	2	3	4
Makes us energy independent			0.803	
Saves the environment			0.704	
Saves money	0.630			
Prepares India for future				0.789
Recommendation by others		0.861		
Good ROI	0.808			
Social peer pressure		0.705		
Space requirement				0.606
Maintenance for solar	0.205			
Reduces use of fossil fuel			0.805	
Role of regulatory authority	0.844			
Leads to better Social Status		0.803		
Feasible technology				0.707
Customer service	0.244			

Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalization

Reliability Test

The reliability test of each construct was then conducted, Cronbach’s Alpha for Social factor (0.712), Saves money (0.723), and Environmentally Consciousness (0.742) are above 0.60, and therefore, these constructs are considered to be reliable. Cronbach’s Alpha for techno-savvy group (0.573) failed to meet the recommended criteria. However, the value is close to 0.60 as recommended and previous literature suggests that modest reliability in the range between 0.50 and 0.60 is acceptable (Shamdasani et al., 1993). Therefore, this construct was retained for the data analysis. Factor analyses were also conducted to evaluate the ability of the items to measure each construct. These analyses were performed using the maximum likelihood method to extract the factors and the oblimin rotation to enable a better interpretation of these factors. Results of these reliability tests are presented in Table I.

Reliability Statistics for Social Factors

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
0.712	0.501	3

Item-total statistics for Social Factors

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item- Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
Recommendation by others	13.42	.652	.603	.643	.752
Social Status	13.55	.256	.610	.488	.707
Social peer pressure	13.35	.503	.549	.522	.739

Reliability Statistics for Saving Money

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
0.723	0.355	3

Reliability Statistics for Techno-savvy group

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
0.573	0.355	3

Attitude towards environment change and Perception towards Solar:

Attitude towards environment changes and current perception towards solar energy forms an integral part of our study. We had taken response from our respondents about their views about environment changes and the intensity of the impact of changes in environment in our daily lives. The response shows that people in general are conscious about the harmful effects of environment changes and show an interest in further understanding the background. Probably visible changes in temperature over past few years have brought the matter of climate change in notice of public and people show genuine concern for the same. A seven point rating scale to find out about the level of understanding of respondents is used in the questionnaire. High rate of industrialization (73%) and more usage of fossil (65%) were considered the biggest contributor for increase in Greenhouse gas leading to climate change. More than 77% of respondents were aware of the relationship between greenhouse gas emission and climatic changes. Close to 92% of respondents agree that climate change is a highly concerning issue faced currently and immediate remedial actions are necessary to sustain healthy life on earth.

The second aspect of perception towards solar has given us very valuable insights as to why solar till now has not been able to grow exponentially, despite of the huge potentiality. The very first check point is that people perceive solar technology as unaffordable and inconvenient. Close to 80% of the respondents have answered solar as being unaffordable and 66% feel that adoption solar energy would be inconvenient as a lot of homework and technical study needs to be done prior to purchase of such a system. Lack of knowledge and unawareness of the existing schemes by the regulatory authorities is distinctly the pain areas because of which people perceive solar as

costly and inconvenient. This stands true despite of the huge benefits solar offers, with a relatively lower cost considering the various promotional schemers and Govt. initiatives. Lack of trust in the technology, insecurity of after sales support and absence of a known Big name in this field proves to be the second set of hindrance for solar adoption. Close to 68% of respondents feel that solar can be a substitution to existing conventional fossil fuel utilization. A very critical factor to note is that this response is taken after the respondent has answered questions about his awareness about environmental changes. The responses are captured in SPSS and findings are shared in the table.

4. Conclusion and Recommendations

The output results show us a very distinct picture that people look to adopt solar considering four major value pillars. These are the monetary benefit, Environmental consciousness, Social factors and New Technology adoption. These four constructs encompass majorly all factors which people may consider while making a decision to purchase solar energy. Attitude towards environment has given vary positive indications from our study that people in general are aware about environmental changes and its negative impact. Majority of the respondents have shown genuine concern for the issue of climatic changes, also many were able to relate greenhouse gas emission and its impact on the climatic changes. Perception of people towards Solar is studied by taking up the factors which people may feel as a hindrance to adopt solar. We had taken out

subjective data first on what factors can add up to low level of acceptability of solar on our sample respondents. Based on the response to our questionnaires and analysis results from SPSS, we have identified two major factors which people consider as a hindrance to adopt solar and switch from conventional source of electricity. These are (a) Affordability (b) Inconvenience. Other than this, lack of awareness/knowledge and lack of trust in technology are the second highest contributor which stops people from adopting solar energy.

4.2 Recommendation:

Based on the results we derived from the attitude of people towards solar and the factors which people look at while making their purchase decisions, we have to develop an effective marketing strategy. Firstly, the attitude of people towards solar gives us a theme line of what a promotional strategy needs to be designed around. Once this matter is established, we need to showcase which product attribute will give them maximum benefit. In our case, —good financial investmentll emerged as the top selected factor. Hence the feature of maximum output at lowest cost is shows highest significance among factors which people will value, based on the sample data. The third pointer should proactively address the highest hindrance which people may feel for solar. In our case, affordability, inconvenience and after sales service concerns gets rated as the biggest concern, as there is not clarity and visibility of solar energy service providers. Hence our promotion should revolve around these three variables.

Take away from this set of information is that, while designing the marketing strategy, the factor of adoption which shows the highest response should be projected most highly. In this particular study output, the features of solar energy system as, —Monetary benefitsll and —Future source of energyll emerged as the biggest motivator for people to adopt solar energy. These factors have received the highest amount of ratings from the respondents when asked about the reasons why they may choose solar over conventional source of energy. While designing the marketing and promotional strategies, —Futuristic source of energyll should formulate the baseline of our

promotions which is expected to hit the maximum number of people high on their emotions about solar energy, based on the information gathered from our sample data.

The layout of promotional activity has to include the layout of these three content. The bingeing foundation and theme of the promotion has to project solar as a futuristic source of energy. This needs to follow throughout the entire flow of events. The second portion has to reflect the product attribute which should come of the product as —a good financial investmentll. Preempting that fact that we are trying to promote a new technology, the most critical hindrance which people feel for this new technology adoption needs to be addressed. In our case, —after sales service supportll, has been rated as the biggest factor which stops people from adopting solar. Hence, before the conclusion, this needs to be highlighted in our promotion. Based on the observation of various feedbacks from stake holders and existing countries where solar power has been a success, actions by the regulatory authority is a critical step to be taken in order to increase the presence level of solar energy. Based on interviews and our data analysis and interpretation, findings show that effective differentiation for renewable energy is required to

increase consumer involvement levels and the likelihood of consideration. It is apparent that success of green marketing programs depends on the integration of education into a carefully targeted marketing program emphasizing functional and emotional values to differentiate renewable energy and simplify consumer decision-making processes (Quote). NGO and awareness spread by activities are very critical to spread the awareness level of people about the advantages of solar energy. The critical aspect of the effects of global warming and its major negative impacts on our planet needs to be communicated to common masses. The combined effect of awareness of the benefits of solar energy and its role in reducing global warming would increase the morale of people towards solar power. Technical expertise and reliability is another important reason why people take a step back. Since there is a low visibility of this technology, people are not yet confident of this technology and the existing suppliers have not been able to build up the confidence levels. Hence few of such pilot projects funded by govt. would give a strong boost to scale up the visibility.

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