Determinants of Residential Adoption of Solar Energy System: A Survey of Rural India

Ganesh P. Sahu, Asheesh K. Singh, Somya Gupta, Vikas Tiwari
Professor, Motilal Nehru National Institute of Technology Allahabad
gsahu@mnnit.ac.in, asheesh@mnnit.ac.in, 15somyagupta@gmail.com,
contact@vikastiwari.in

Abstract

In the year 20-21, globally India stands fifth in solar power capacity. The Indian government is eager to promote solar energy as one of the country's major energy sources. The objective of this research is to examine the Behavioral aspects which result towards the adoption of solar energy systems among household in India, which will further allow policymakers to increase the implementation of this exciting innovative eco-friendly technology. The framework of UTAUT2 with role of awareness, government policies, perceived functional benefit and risk-taking ability is used in this study to recognise and develop a quantitative approach and analyse their impact on the Behavioral intention of the rural households to adopt solar energy systems. The structural equation modelling (SEM) approach was used to examine the data of 516 collected from the field survey questionnaire. The outcomes mainly showed that Behavioral intention is largely predicted by government policies followed by facilitating conditions.

Keywords
Renewable Energy, Solar Energy System, Behavioral Intention, Households and Structural Equation Modelling (SEM)

1. Introduction
Energy is considered as a crucial component of the economic growth of any nation. It has been claimed that without energy, sustainable development is almost unattainable. According to Abdullah, 2013 Increase in energy use results in growth and improved overall economic development of the nation's economy. The electricity sector is ultimately responsible for ensuring that sufficient power is provided to the users. The energy generation, efficiency, and reach of the distribution network are crucial elements that form the ability of the power sector to meet the demand of energy (Amewornu and Nwulu, 2020). In 2006, The International Energy Agency forecasted that by 2030 there would be an increase of sixty per cent from the current scenario in respect of the energy requirement of the whole world. A two-thirds rise will be due to China, India and their rapidly growing industries, which account for close to half the aggregate worldwide demand of energy by 2030 (International Energy Agency, 2010; Kumar et. al., 2019).

Despite widespread policy agreement, we are falling short of meeting international promises to deliver sustainable energy for all (World Bank, 2017). As reported by IEA in its SDG7 tracking progress report of 2020, during 2018, twenty countries with the greatest access deficits accounted for seventy-eight percent of the entire inhabitants lacking access to electricity. By addressing different technological, economical and institutional restrictions a transition toward greener energy can be achieved. Apart from all those, human resistance to change and its acceptance of solar power technology will be the final frontier (Aggarwal et al., 2019). This is especially noticeable in locations where good sunshine and farming conditions are favourable (Neira et al., 2013).

India has a potential for large amounts of energy generated by solar light as it has between 300 and 330 sun days a year (MNRE, 2018; Kumar et al., 2019). This potential has been referred in various studies in India context(International Energy Agency, IEA, 2010; Gevorg, 2011; Zarnikau, 2003). The absence of electrical availability by almost four hundred million in distant locations has intensified the need to use solar energy as an energy source (International Energy Agency, 2013; Kumar et al., 2019; Kumar et al., 2020). The Indian Government, through the MNRE, is pushing this effort to achieve 100GW of solar photovoltaic energy by the year 2022, which contains 40 GW target out of the solar rooftop (MNRE, GoI, 2013; 2020; Aggarwal et al., 2019). Despite established numerous benefits from solar power and its widespread global reach, private domestic investment on the solar rooftop is largely uncommon (Masini and Menichetti, 2013; Parsad et al., 2020). The solar mission's long-standing success is when it develops without governmental assistance as a revolutionary social movement that considers societal acceptability and the application of solar technology (Aggarwal et al., 2019). Solar energy, deemed "the single biggest source of further development prospect", is a vital element in this inescapable renewable energy transformation (Alipour, et al., 2019).

The study aimed at a better understanding of elements which might assist forecast the Behavioral intention of households towards adoption solar energy in rural areas of India. This study attempted to study the influence of the factors such as 'Awareness', 'Effort Expectancy', 'Government Policies', 'Performance Expectancy', 'Social influence', 'Price value', 'Perceived Functional benefits', 'Facilitating Conditions' and 'Risk-Taking Ability' on the 'Behavioral Intention to adopt' solar energy system in the Indian context.

This paper is organized as follows: section 2 synthesize theoretical background, proposed research model and hypothesis for this study. Section 3 presents research methodology of the study. Section 4 summarises the demographic and SEM results in various subsections. Sections 5 deliver the discussion of the statistical results. Section 6 discuss regarding Research Implications. Finally, section 7 concludes this article with future research scope.

2. Theoretical Background

Various studies have investigated why and how individuals, households, and industries embrace and adopt such new technologies in energy research. Research was performed by Apergis and Danuletiu in the year 2014 among data of 80 nations on the association between renewable energy and economic advancement. They identified a favorable cause of economic growth from renewable energy. Various studies have examined the gaps in early research, focusing on non-consumption behaviour, such as energy conservation, and post-usage behaviour, such as residual recycling Joshi and Rahman, 2015.

In the Indian Context, minimal literature is available regarding the adoption of solar technologies by households. To fulfil energy requirements, according to Harish and Raghavan, 2011, countries such as India must focus additionally on localised energy generation and focus government policy on improvements in finance, affordability, timeliness and product uniformity. It was reported by Van et al., 2013, that rural electrification in India has long-term benefits such as enhanced earning and girl education and solve other societal issues. Similar outcomes have been observed in Dinkelman, 2011; Khandker et al., 2013 in South Asia and sub-Saharan Africa Context. In India, MNRE support and promote the solar energy system adoption by assisting in subsidies, aids, and incentives (MNRE, 2013; MNRE, 2020). Awareness level and Geographical differences have also been found as differential influences while adopting solar energy systems. (Dutta and Das, 2020).

Perceived cost of the technology was found to negatively impact the adoption level in Korea by adopting solar energy technology (Kim et al., 2014) but in Indian context, Cost-effectiveness was relevant in the study of solar water pumping systems (Kumar et al., 2019). While reviewing the actual behavioral intention of consumers of the solar energy system, a study in Finland's context found a gap between rationality and intention and the behavior of adopters and non-adopters, whereas they also found that individuals have massive interest in a clean and inexhaustible source of energy (Hai et. al., 2017). While the 'environmental consciousness', 'monetary benefit', 'social factors' along with 'new technology adoption' are found to be factors those are considered before adopting to solar energy (Sharma and Bhattarchaya, 2018).
Based on the literature review and context of the study, we used the UTAUT2 model, by Venkatesh et al. in the year 2012, to study the factors influencing solar energy adoption in rural India context, with the literature review, expert opinion and conceptual validity using ISM, we reached to the conclusion that 'hedonic motivation' and 'habit and experience' does not have relevance to this study context. But as initially, most of such theories, for example, TAM and UTAUT; were proposed in organisational context (Venkatesh et al., 2012). This leads to concerns about the use of customer-oriented contexts. Therefore, because of the diversity in context of what and how factors affect organisational behavior and how people's technology intentions and behavior might emerge.

2.1 Hypothesis Development

As per the existing research and behavioral decision theories in IS/IT context, The theoretical framework suitable for the individual customer setting should be selected (Venkatesh et al., 2012). So, for suitability of model framework in the context of Solar Energy adoption by the households in rural India, we have also incorporated few external factors, such as 'Awareness', 'Risk-Taking Ability' and 'Government Policy'; to the UTAUT2 model, while lead to the model being more relevant to the study context.

Effort Expectancy: Effort Expectancy is conceptualized as “the degree of ease associated with the use of the system” (Venkatesh et al., 2003). It explains the easiness and effortless approach to use solar energy systems.

The easier it is to use any technology or harder to use the technology affect the usages level of the technology. Thus, it is important to take this construct in account for the current study.
H1: Effort expectancy positively influence behavioral intention to adopt solar energy systems.

Perceived Functional Benefits: Perceived Functional Benefits is conceptualized as "perceived benefits of any product can be examined through the benefits, performance and quality derived its usage" (Bright et al., 2017; Akehurst et al., 2012). In the area of solar energy products the benefits are viewed as cost-effective, dependable and environmentally benign, and eventually improve the adoption of products based on solar energy technology.
H2: Perceived functional benefits positively influence behavioral intention to adopt solar energy systems

Awareness: Awareness is conceptualized as "awareness is the initial step to begin with the adoption process. It generally means to have an understanding and information of solar energy systems. Awareness about solar energy systems means knowing about its advantages and disadvantages" (Rebaneand Barham, 2011).
H3: Awareness positively influence behavioral intention to adopt solar energy systems.

Facilitating Conditions: Facilitating Conditions is conceptualized as "the degree to which an individual believes that an organizational and technical infrastructure exists to support use of the system." (Venkatesh et al., 2003) In literature, numerous studies show a relation between the facilitating conditions individuals' behavioral intention to adopt. Hence, taken as a factor of study.
H4: Facilitating conditions positively influence behavioral intention to adopt solar energy systems.

Risk Taking Ability: Risk Taking Ability is conceptualized as "risk taking ability is the degree of uncertainty related to the use of any new technology" (Burgucu et al., 2010). In other words, risk taking can be explained as an ability of tackle with the perceived adverse effect those may incur or not by using of any goods or technology.
H5: Risk taking ability positively influence behavioral intention to adopt solar energy systems.

Government policies: The government Policies in any country are outlined regarding government support, grants and financial aid (Pathania et al., 2017). In the context of energy area, government have formed various promotional schemes, policies etc. So, it been crucial to consider this factor as the factor of the study.
H6: Government policies positively influence behavioral intention to adopt solar energy systems.

Performance expectancy: Performance expectancy is conceptualized as "the degree to which an individual believes that applying the technology will help him or her to attain gains in job performance" (Venkatesh et al., 2003). In other words, performance expectancy can be defined as the perceived additional functional benefits derived by an individual while applying the concerned technology in the task perform.
H7: Performance expectancy positively influence behavioral intention to adopt solar energy systems.

Social influence: It is conceptualized as "the extent to which an individual perceives that important other believe he or she should apply the new system" (Venkatesh et al., 2003). In other words, social influences can be defined as the change in persons prospective due to others prospective about the same thing in question. A study of the link between societal impact and solar photovoltaic use is very crucial. Hence, taken for the study.
H8: Social influence positively influence behavioral intention to adopt solar energy systems.

Price value: Price value is conceptualized as "the consumers' cognitive trade-off between the perceived benefits of the applications and the monetary cost for using them" (Venkatesh et al., 2012). In research in the energy area, the ever-increasing power price has been proven to function as a persuasive drive to switch into solar energy technology. (Pathania et al., 2017). Price value might be suitable while assessing each technology that emphasizes more on their utilitarian value (Tamilmani et al., 2018). This factor has also found relevant in other studies in the area and hence taken for further examination.
H9: Price value positively influence behavioral intention to adopt solar energy systems.

3. Methodology

3.1. Survey design and pre-testing

The questionnaire was created to reflect our consumers acceptance model. One section was dedicated to the demographic section consisting of questions of socio-economic context and other questions relating to attitude towards solar energy. Part second of the questionnaire consist of behavioral questions grounded on the constructs analysed from previous studies. The five-point Likert scale with anchors ranging from strongly agree to strongly disagree was used in this study.

Primarily questionnaire was designed in the English language. As we followed adopted scale to design the questionnaire so there was no restriction placed on the no. of questions for each construct. Further survey was also tested with local interviewers of the Allahabad district by the research staff employed in the project. Interviewers were bilingual (Hindi and English), so while collecting data they made sure that respondents could be able to cope with it. How well respondents could be able to understand survey gave us insight about the reliability and validity of the questionnaire.

3.2 Sampling

Firstly, the questionnaire was administered to the respondents of the Prayagraj district; interviewers walked from building to building in the sample villages looking for responders. 175 questionnaires were filled in various respondents in various villages of Prayagraj district, whereas out of them, 168 questionnaires were selected for final study. Later we moved to the next batch of data collection and visited other districts. A total of 516 Questionnaires were considered for the final survey.

4. Results

4.1 Sample Profile/Structure

To better comprehend the sample's structure, descriptive statistics were calculated. Results of all the demographic data is discussed in Table 1.

Table 1. Table of Sample Profile

Demographic Variable	Classification	No. of Responses	Percentage (%)
Gender	Male	382	74.03%
	Female	134	25.97%
Age	18-30 year	187	36.24%
	31-45 year	198	38.37%
	Above 45 year	131	25.39%
Marital Status	Married	435	84.30%
	Unmarried	81	15.70%
Education	Illiterate	51	9.88%
	Primary School(5^{th})	69	13.37%
	Upper Primary school (8^{th})	61	11.82%
	High school (10^{th})	64	12.40%
	Intermediate (12^{th})	138	26.74%
	Graduation	104	20.155%
	Above graduation	29	5.62%
Family Size	1-5 Members	263	50.97%
	6-10 Members	224	43.41%
	More than 10 members	29	5.62%
Income	Up to Rs. 1,00,000	277	53.68%
	Rs.1,00,000-3,00,000	133	25.76%
	Above Rs. 3,00,000	106	20.54%
Do you have electricity connection?	Yes	507	98.26%
	No.	9	1.74%
Monthly electricity Bill	Up to Rs. 200	97	18.80%
	Rs.200-500	282	54.65%
	Rs. 500-1,000	110	21.32%
	Above Rs. 1,000	27	5.23%
Do you know about solar Energy System	Yes	363	70.35%
	No	153	29.65%
Have you ever used solar Energy Systems	Yes	107	20.74%
	No	409	79.26%

4.2 Normality

A skewness-kurtosis technique was employed to assess univariate normality for each variable. (Kline, 2005; Hair et al., 2010; Byrne, 2010). The statistical values of skewness and kurtosis were evaluated using AMOS 21.0 and determined to be within acceptable bounds. All of the findings support the normality of the univariate distribution because all skewness values were found to be less than their cut-off point of ‘3′, and all kurtosis values were found to be less than ‘8′.

4.3 Structural Equation Modelling (SEM) Analysis

For additional examination, structural equation modelling (SEM) was used to analysed the gathered data. Evidently, the two-stage SEM methodology was used, firstly measurement model was evaluated first and then the structural model being estimated. It was necessary to go through this process in order to see the model's predictive power.

4.3.1 Measurement Model: Confirmatory Factor analysis (CFA)

Model fitness: To evaluate the model fitness, the main fit indices such as CMIN/DF, NFI, TLI, CFI, and RMSEA were all tested. The model fitness with initial measurement model of solar energy adoption is realised as follows: CMIN/DF=2.669, NFI=.889, TLI=.918, CFI=.927, RMSEA=.057. As some of the items were not able to reach their threshold values (e.g., NFI) (Hair et al., 2010), In order to increase model fitness, further purifications and revaluations were carried out. (Anderson and Gerbing, 1988; Bagozzi and Yi, 1988; Byrne, 2010). A refinement method was utilised to improve the model's fitness by looking at standardised regression weights (factor loading), modification indices, and the standardised covariance matrix. (Byrne, 2010; Hair et al., 2006; Cunningham et al., 2006).

One of the items (SI2) from social influence, (PV24) from perceived value, and (FC1) from facilitating conditions was found to be below its cut-off value of 0.50 when standardised regression weights (factor loading) were examined. Hair et al., 2010. As a result, these three items were dropped and CFA was evaluated again without them, and the model's fitness improved significantly, as expected. The chi-square value was still significant (CMIN=1383.98, DF= 580, P=0.000), while the other fit indices, as shown in Table 2, are within their cut-off values. All of the items that were kept were exposed to construct reliability and validity tests. In this case, composite reliability (CR), Cronbach alpha (α), and average variance extracted (AVE) were used (Anderson and Gerbing, 1988). The CR values for all constructs were found to be over 0.70 (Fornell and Larcker, 1981), as shown in the Table 3. The risk taking ability (RT) had the highest CR value, whereas the facilitating condition had the lowest CR value. The AVE readings are all more than 0.50 (Hair et al., 2010; Fornell and Larcker, 1981). The perceived benefit (PB) received the highest AVE score, whereas government policy obtained the lowest (GP). All of the Cronbach alpha (α) values were found to be under their cut-off limits. The construct validity was assessed using both convergent and discriminant validities as shown in Table 3.

All non-removable items had a significant standardised regression weight with their latent components, demonstrating convergent validity, according to the statistical findings. Furthermore, the factor loading of all undeleted items was below 0.54, which was greater than the cut-off point of 0.50, as the p-value is less than 0.000 and all the constructs were statistically significant. As established by assessing correlation values among latent constructs, the highest value of inter-correlation estimations was less than 0.72, which is below its highest possible level of 0.85 (Kline, 2005). For all latent constructs, the square root of AVE was greater than their inter-correlation estimations with other related constructs.

Table 2. Table of Measurement Model

Fit Indices	Cut-off point	Initial Measurement Model	Modified Measurement Model
CMIN/DF	≤ 3.000	2.669	2.386
NFI	≥ 0.90	0.889	0.911
TLI	≥ 0.90	0.918	0.938
CFI	≥ 0.90	0.927	0.946
RMSEA	≤0.08	0.057	0.052

Table 3. Table of Construct Reliability and Discriminant Validity

	CR	AVE	α	PE	EE	GP	SI	RT	PB	AW	FC	PV	BI
PE	0.871	0.693	0.870	0.833									
EE	0.902	0.697	0.901	0.530	0.835								
GP	0.889	0.667	0.887	0.755	0.566	0.817							
SI	0.866	0.684	0.859	0.507	0.375	0.371	0.827						

RT	0.923	0.706	0.925	0.346	0.210	0.283	0.421	0.840					
PB	0.919	0.739	0.916	0.719	0.542	0.714	0.563	0.396	0.860				
AW	0.886	0.724	0.897	0.329	0.498	0.567	0.319	0.222	0.495	0.830			
FC	0.837	0.720	0.837	0.652	0.461	0.594	0.555	0.420	0.765	0.544	0.849		
PV	0.911	0.718	0.741	0.473	0.320	0.439	0.595	0.476	0.552	0.329	0.574	0.848	
BI	0.900	0.693	0.886	0.709	0.592	0.696	0.561	0.370	0.695	0.571	0.689	0.549	0.832

4.3.2 Structural Model

Following the evaluation and approval of the measurement model in the preceding section, the structural model was investigated further. The yield of fit indicators for the structural model suggests that it was good enough to fit the observed data. Even with the fact that the chi-square was significant (CMIN = 1440.298, DF = 581, P = 0.000), All other goodness of fit were found to be within their respective thresholds: CMIN/DF = 2.479, NFI = 0.907, TLI =.934, CFI = 0.942, and RMSEA = 0.054. The hypothesis was tested using beta values for hypothesised pathways with a significance level of 5%. In Path coefficient analysis, most of the paths were found to be significant except perceived benefits and risk-taking behaviour. In statistical analysis behavioral intention was found to be affected by UTAUT 2 factors performance expectancy (β=0.164, p<0.008), effort expectancy (β=0.160, p<0.000), social influence (β=0.128, p<0.006), facilitating conditions (β =0.176, p<0.006), price value (β=0.108, p<0.015). whereas other variables which also found to have a significant impact on the behavioral intention to adopt solar energy systems are awareness (β =0.101, p<0.016), government policy (β=0.207, p<0.000). Whereas perceived benefit and risk taking ability were found to have insignificant effect on behavioral intention to adopt solar energy systems. The results of hypotheses testing are summarised in Table 4. Accordingly, all hypotheses H1, H3-H4, H6-H9 were confirmed, except two hypotheses H2 and H5 which were rejected. The R^2 values extracted for the endogenous factor, i.e., behavioral intention was found as 68%. The current factors predict that all the UTAUT 2 factors, awareness and government policy play a vital role in framing the intention of the user to adopt and install solar energy systems in their buildings (Figure 1). Variance inflation factors (VIF) was examined to confirm that there was no multicollinearity between the primary dependent and independent constructs, and all of the results received in this regard were judged to be below the acceptable range (<10) as shown in Table 4. (Diamantopoulos andSiguaw, 2000).

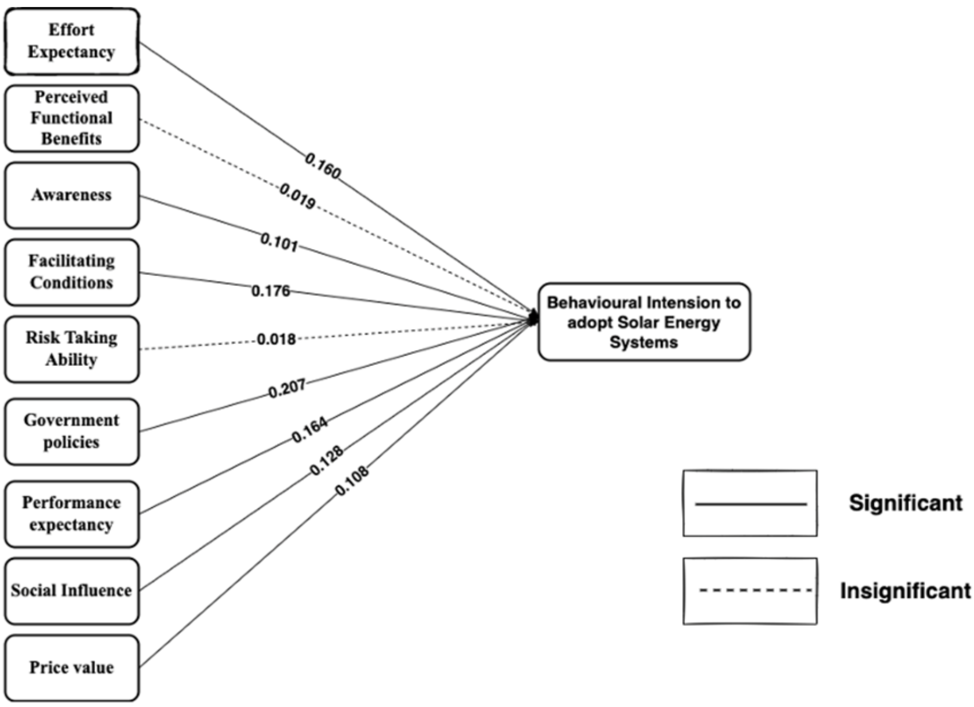

Figure 1. Validated Research Model

Table 4. Result of Structural Model

Hypothesis Path		Standardised Estimates	P- value	Significance	VIF
H1	EE→BI	0.160	***	Yes	1.570
H2	PB→BI	0.019	0.784	No	3.127

H3	AW→BI	0.101	0.016	Yes	1.581
H4	FC→BI	0.176	0.006	Yes	2.072
H5	RT→BI	0.018	0.626	No	1.302
H6	GP→BI	0.207	***	Yes	2.378
H7	PE→BI	0.164	0.008	Yes	2.279
H8	SI→BI	0.128	0.006	Yes	1.693
H9	PV→BI	0.108	0.015	Yes	1.625

5. Discussion

As per the findings presented in the preceding sections, the proposed research model investigated in this study was able to produce sufficient predictive power derived by the dependent construct behavioral intention to adopt solar energy adoption (68 per cent). Apart from these good results, construct reliability and validity and fit indices were also within acceptable limits. The R2 value derived in the desire to adopt was well within acceptable bounds and much beyond the required range, as according to the experts.

The R2 value for BI was also determined to be quite very acceptable, exceeding all of the required values. Furthermore, this variance value is similar to those accounted for by other UTAUT research on solar energy adoption (Roy and Mohapatra, 2021; Kapoor and Dwivedi, 2020; Aggarwal et al., 2019).

According to the path coefficient analysis government policy was among the most substantial factors predicting behavioral intention to adopt solar energy systems in rural India. By aggressively pursuing efficiency improvements and sharing "best practises" of energy generation and delivery, effective and coordinated government policy might fulfil the rising demand (Zhang et al., 2012; Chimres and Wongwises, 2016). Apart from the subsidies, government should also invest in the RandD of solar energy systems for efficient generation, for reducing the cost of solar panels, for storing electricity etc., so, as to reduce the price of use for end consumers (Lee and Shepley, 2020). From the demographic questions, it's clear that actual adoption of solar energy is still 20.74%, but the population will adopt 70.35%. In statistical path analysis, government policies are found to be one of the essential factors to predict behavioral intention. So, the government should frame specific policies to make adoption more wider.

Customers of solar energy systems have also become conscious of facilitating conditions. Solar energy generation and consumption necessitate specific resources, and survey respondents believe that the existence of those resource base for setting up and maintaining rooftop Solar is a significant element in its popularity. (Lau et al., 2020; Aggarwal et al., 2019). Respondents have tended to assume that if they have problems operating the solar PV system, they would be able to get help from others quickly. The respondents want to adopt solar PV systems in the near future, according to their behavioral intentions.

Performance expectancy was found to positively and significantly impact the behavioral intention to adopt solar energy systems. People using it believes that solar power generation systems are safe and easy-to-operate for household and well as for irrigation This has led to a lower reliance on grid or DG power, greater operational comfort with less involvement, and increased electrical safety, as grid or DG power are all factors to consider.
With a regression weight of 0.160, the empirical findings confirmed the substantial connection between effort expectancy and behavioral intention to use solar energy systems. This indicates that Indian consumers are worried about the degree of ease or difficulty with which solar energy equipment may be used.

Social influence was also found to significantly impact behavioral intention to adopt solar energy systems with a regression weight of 0.128 in the findings reported above. The social structure of a developing nation with few resources, such as India, is highly interconnected, and the behaviours of friends, family, neighbours, peers, and society have a significant impact on decision-making. Positive and favourable word-of-mouth of solar energy use by people will positively impact the purchase intention. A bad interaction with technology, on the other hand, has a negative effect on the customer's intention. These findings signifies that social influence play a significant role on the behavioural intension to adopt solar energy systems.

Price value significantly predicts behavioral intention to adopt solar energy systems with regression weight of 0.108, because consumers are affected by price-cost decisions individually. This infers that consumer calculate the cost estimates and perceived economic utility derived from that cost (Kim et al., 2014). Solar panel installation is costly, and the customer's return on the investment (ROI) depends on attaining the targeted electricity generation and financial savings over time Zulu et al., 2021.

Awareness among people about the solar energy systems directly impacts the consumers' behavioral intention. According to the respondents in this study, solar PV knowledge is a crucial influencing factor in their use of this technology. As asked in the demographic questions in part1 of the questionnaire, it is evident that 70.35% of the population are only aware of solar power systems. Lack of awareness about the technology, prices, advantages, operation and maintenance, financing sources, and potential of the solar energy systems will severely impact their growth and implementation.

Perceived functional benefit has an insignificant effect on the behavioral intention to adopt solar energy systems compared to other studies. Solar energy's prospective benefits: it not only lowers prices for the fuel poor, but it also improves energy protection and sustainable benefits in moderate and long-term energy planning. Individuals may lack an adequate understanding of solar energy systems' advantages, which is a significant drawback for its adoption. The second reason demonstrated from the demographic data is that the electricity bill paid by more than 60% of consumers is below 500 Rs, so their electricity consumption is much low. At the same time, charges in rural India vary between 3-5 Rs per unit of electricity consumption. Hence, consumers prefer to stay on the regular grid connection rather than investing a huge sum on solar energy installation.

Risk-taking ability was found to be insignificant while predicting behavioral intention to adopt solar energy systems. Solar energy adoption is not a decision under uncertainty. With solar technology adoption, no substantial risk is associated as for financial risk. The government has framed various policies to provide subsidies to cover up their financial expenses, later moving towards maintenance and performance risk. All equipment manufacturers provide assurance regarding most of the solar equipment installed. So, it is evident that no substantial risk is associated with the adoption of solar energy systems.

6. Research Implications

The statistical findings support the critical function of the following aspects from a practical standpoint: awareness, effort expectancy, government policy, price value, performance expectancy and facilitating conditions. As a result, aspects linked to these characteristics must be the government's primary priority in its efforts to encourage customers to use solar energy systems. India has abundant source of solar energy, whereas India stands 5th in solar power generation capacity MNRE, 2020-21. Before framing policies, government can investigate the barriers and reasons for the non-adoption of the solar energy systems. Indian government along with all state government might frame policies for reducing installation and product cost by enhancing subsidies. Whereas continuous monitoring and updating of policies is crucial part of adoption process. If the government wants to encourage more consumers to apply for subsidised loans, the process for obtaining loans from banks for the purchase of solar energy systems should be simple. Government can also provide financial incentive in form of tax relief to individuals who are willing to install solar PV at their premises.

To facilitate the adoption of solar power plant installation, consumers can explore the OPEX model or the operating expense model where the solar installation is owned by the developer and the customers just pays for the energy generated this model also known as Renewable Energy Service Company model (RESCO). Although these contracts are long term legally binding contracts for the roof on which the solar panels are installed but it covers all the installation, maintenance and risk for lifetime. Apart from this government can setup few consultation and demonstration offices in every rural area, so consumers facing difficulty can have free guidance from experts which in turn will enhance their confident in using the technology.

To enhance the awareness of rural consumers about solar energy systems policymakers should consider incorporating concept of solar energy systems and its benefits in elementary school education and university curriculum. So that benefits of adopting solar energy systems would reach to every rural Indian household. Government can also make use of mass media, especially social media to elevate the general public's knowledge about solar power generation.

As from the results about 70% of the people are aware about the energy generation through solar power, and out of the total sample only 20% are found to use these systems, so government and private companies operating in this sector can make use of the existing customers and influential figures of society in their promotional campaigns, to share their experiences among the public. Whereas current customers can also be motivated to share their experiences among with their peer members, relatives and friends, so that it become easier for others to get reliable and authentic information from existing users.

Because the majority of solar energy facilities are out of reach for the average person, industrial engineers, academics, and government officials should work to minimise the cost of the components, processing, installation, and assembly. Consumers with a positive environmental concern keep a close eye on their energy usage and are optimistic about RETs, so rural Indian customers should also be made aware about the environmental benefits that solar energy consumption creates. Apart from the environmental benefits of solar energy, consumers should also be made aware about black side of non-renewal source of energy generation and impact it creates on the environment.

7. Conclusion

As stated at the outset, the purpose of this study was to determine the main factors that could influence the adoption of solar energy systems in India. The renewal source of solar energy generation is an appealing subject of interest to be investigated and assessed, especially in light of the significant problems that such technology entails. Due to the low adoption rate by customers in rural areas, this study examined the factors that could mould the intention to adopt solar energy systems. This study also framed a theoretical base, which captured the critical aspects of adopting solar energy systems by Indian rural customers. Factors from UTAUT 2 with other external factors such as awareness, government policy, perceived functional benefit, and risk-taking ability were selected to propose the study's conceptual model. Apart from perceived functional benefit and risk-taking ability, all other factors considered for this study had positive and significant impacts on the behavioral intention to adopt solar energy systems.

This study has certain limits as the study results are difficult to generalise to the whole of India, as this study was conducted in the northern part of India. Further studies on solar studies can extend their geographic boundaries. Whereas this study was only conducted in rural areas, other studies can enhance frontiers to semi-rural, semi-urban, urban and metro cities. As the data was collected from each participant only once, so this study was cross-sectional in nature. Whereas further studies can be conducted on the longitudinal approach, as solar energy systems are aggressively enhancing their edges, consumers can have different perceptions with time.

As this study is only conducted in India, further studies can also conduct cross-cultural studies with other Asian countries, developing countries, or developed countries. So that they can also have relevant clues on the impact of culture/region on solar energy adoption. As a model of this study explains 68% of the variance in behavioral intention, there could be other behavioral factors that determine the consumers' intention to adopt solar energy systems. Apart from UTAUT2 other IS/IT studies models can be used for further studies. Integration of UTAUT with other pre-established models can also be used in further studies; this will enhance the efficiency of the behavioral factors considered for the study.

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Biographies

Ganesh P. Sahu: is Professor in School of Management Studies at Motilal Nehru National Institute of Technology Allahabad, India. He has more than 23 years of teaching and research experience. His research interests are in the areas of MIS, E-governance, Green Information Systems, Digital Marketing etc. He has published more than 100 research papers in international journals and conferences. He has also edited nine books in the area of MIS and E-governance. He has acted as a reviewer for international journals and has served as Guest Editor of International Journal of Electronic Governance.

Asheesh K. Singh: is Professor in Department of Electrical Engineering at Motilal Nehru National Institute of Technology Allahabad, India. He has more than 28 years of teaching and research experience. His research interests are in the areas of Power System, Power quality, E-mobility, Renewable energy integration, Microgrids, Smart Grid, etc. He has published more than 100 research papers in international journals and conferences.

Somya Gupta: is a Doctoral Scholar in School of Management Studies at Motilal Nehru National Institute of Technology Allahabad. She has presented his research in IFIP conference. Her area of interest includes Education Research, Financial Technology (FinTech), Technology Management.

Vikas Tiwari: is a Doctoral Scholar in School of Management Studies at Motilal Nehru National Institute of Technology Allahabad. His area of interest includes Blockchain, Financial Systems, Financial Technology and Auditing.