Solar Energy Users and Customer Satisfaction

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Abstract

This paper considers the relationship between solar energy users and customer satisfaction. It investigates the role and importance of price and promotion on customer satisfaction. Most of the reviewed papers are from 1979 to 2018. Majority of the data are primary and have been collected through questionnaires and interviews by the researchers. Out of 68 papers have been reviewed for this study. We conclude that households are satisfied with solar home system because of energy saving, low dependence on kerosene and increase study time at night and improving in standard of living.

KEYWORDS: solar energy user, price, promotion, customer satisfaction

1. Introduction

Solar energy in the form of sunlight is a source of energy that has existed since the advent of the earth. This energy can be obtained directly from the sun and even in cloudy weather. Solar energy is used globally and extensively to generate electricity and heat water. This paper considers the role of price and promotion on satisfaction of solar users in different areas. It explains that solar energy as a green energy is environment friendly and prevent greenhouse gas emissions. The most important point in this paper is that different groups of people prefer to use solar energy for water heating and electricity. So, price and promotion have a significant role for encouraging people towards using solar energy system. Adequate financial support, awareness about the quality and operation of the system and skilled technician are important points for promoting solar energy. A detailed analysis show that solar energy has a positive impact on the lifestyle of people and also increase standard of living.

2. Theatrical Framework

It shows that consumers are conscious about the limitation of natural resources of energy, so they want to save energy by using renewable sources of energy (**Prasad and Rajeshkumar 2018)**.
The results of the study indicate that local government plays an important role in the development of residential solar energy systems. Moreover, local solar approval processes in cities enhance size, capacity and quantity of residential solar PV installation (**Hsu 2018).**
It shows that Life Cycle Costing Assessment is a strong tool for acquiring trustworthy life cycle sustainability of solar energy technologies and solar energy projects (**Naves et al 2018).**

The results indicate that BiPVT system operates better in warm weather and PV cells are better overheated because of high solar radiation. Also, it can produce more electricity and supply a part of hot water (**Gautam and Andresen 2017).**

It determines that Demand Response program has an important benefit for Load Saving Entities and saving in customer's electricity payment. Demand Response also causes a reduction in average and standard deviation of the Locational Marginal Price (**Asadinejad and Tomsovic 2017).**

It demonstrates that consumers are satisfied with solar home systems, because it provides enough light and more entertainment during night (**Jacobson 2007).**

It indicates that solar home lighting system has positive effects on the duration of study, reducing kerosene consumption and improving standard of living (**Barman et al 2017).**

The article attempts to show that an open source program is an optimized and strong tool, which is used for designing solar home system. The open source program specifies the best combination and volume of components (**Campana et al 2016).**

The paper represents that SHS plays an important role on the living of rural people in South Africa. Solar home system has developed the productivity of small businesses. There is no sustainability for Energy Service Companies (ESCOs) because of irregularities in payment of subsidy funds and energy bills, high operation cost, non-optimal use of SHS, grid encroachment and lack of customer satisfaction (**Azimoh et al 2015).**

It shows that education is an important factor for reducing energy consumption, thus professionals and designers must try to bring changes in user's energy consumption (**Kos and de Souza 2014).**

The results show that solar lighting services have the benefits for children. They can study more during night, watch TV and listen to radios compare to children without solar services (**Akhi and Islam 2014).**

The results show that renewable energy in small scale household has an important role in perceived ease of use, perceived behavioral control, knowledge and awareness, cost reduction and relative profit (**Alam et al 2014).**

It shows some important factors that have influence on consumers to go towards solar energy. These are: An active energy market, Security of supply, energy prices and environment and climate situations (**Lavrijssen 2014).**

It demonstrates that households are satisfied with solar home systems because of: equipment quality, energy savings, low dependence on kerosene, and increase in study time at night and improvement in standard of living (**Komatsu et al 2013).**

The study shows the most important benefits of solar home system; 1. it increases standard of living for a long-term. 2. It reduces the risk of using kerosene. 3. It is energy efficient. 4. It increases study time. 5. It provides better indoor air quality (**Rahman and Ahmad 2013).**

It indicates that energy of the sun is abundant and there is no source limitation for this energy. So, solar energy systems are workable choice in rural areas (**Harish et al 2013).**

It shows that solar electricity provides an opportunity for rural people to watch television, so advertiser can obtain a larger number of audiences. Solar electricity provides opportunity for students to study at night. Also, people in rural Kenyawith solar energy system can use cellular phone (**Pode 2013).**

It demonstrates that there is less direct evidence on the capitalization for residential solar home market. Some households are proud that they are producing green energy by using solar home systems (**Hoque and Das 2013).**

The results demonstrate that most of users prefer to keep solar home systems although they have electricity grid. Solar home system is good in performance and it is good for solving pollution problems**(Bond et al 2012).**

The finding of the study shows that solar energy is a clean and sufficient energy in nature and provides a sustainable development to the environment so we can use it in accordance with nature (**Dastrup et al 2012)**
It shows that successful strategies for development of solar in Ethiopia are: communicating the information about end-user's need to manufacturer, training of solar experts, local solar businesses. Development of solar can attain by local solar production, adapted appliances and financing plans**(Wahi 2012).**
It reveals that installing of solar home systems enable household to have clean, environmentally friendly, high quality and reliable energy services. Solar home system improves education, recreation, and communication in rural areas. It also increases standard of living in rural Bangladesh**(Buragohain 2012).**

The results show that solar energy is a clean, plentiful and environment-friendly energy source while conventional or non-renewable energy sources like natural gases, coal and oil are limited in nature and lead to emission of greenhouse gases and environmental damage**(Sharma et al 2012)**.
It shows that users are not satisfied with service quality variables such as: convenient use of the system, sustainability of solar home systems, longevity of solar home systems, availability of loan from system providers, friendly behavior of the personnel, the leaflet and catalog of the system and easy access to parts of solar in local market. So, service providers should enhance the service quality of the solar home systems in Bangladesh (**Momotaz and Karim 2012).**

The results reveal that solar water heater is accepted and used by consumers and they have more awareness about solar water heater than solar photovoltaic (**Yuan et al 2011).**

The finding of the study determines that SHS programs are successful in Bangladesh, because the executors have the ability to control the cost of solar home system, ensure the quality of solar panels and also, they have loan recovery rates. In addition, they intend to achieve household with low income that are ready to pay by micro-credit loan (**Urmee and Harries 2011).**
The results of the study reveal that solar energy has a great impact for development of rural area in India. The use of kerosene has reduced in all income groups; because of solar home lighting systems. It is also very beneficial for women and children, because they can do their activities at night. Due to availability of lighting system during night, crime rate also has been declining (**Iemsomboon 2011).**
It identifies the link between extension of rural electric grid and solar home systems.Demand is a key factor for developing solar energy system programs. So, sensible and practical policies for rural electrification help to create a stable market (**Mondal et al 2010).**
The results show that users prefer solar home lighting systems to solar lanterns because of: 1. better light quality 2.the house will be lighted up completely 3. possibility to study at night**(Urmee and Harries 2009).**
The results show that user-centered improvement has an important effect on functionality, ergonomics, symbolic value and interconnectedness with other systems. It reduces cost and payback. User-centered improvement support designing and developing of new product or system design for increasing rapid adaption and carbon-saving use of energy (**Caird and Roy 2008).**
The study reveals major disadvantages of the system as follow: i. Law capacity of the battery ii. during rainy season solar doesn't work properly iii. companies don't provide any services for the maintenance of panels (**Gustavsson 2007).**

The results show that combination of demand and supply motivation is necessary for expanding solar water heating network (**Balmer et al 2007).**
It reveals that the standard of living is improved because of solar services. Solar energy system has a major impact on lifestyle of Zambian people. The major impacts of solar systems are: reading and writing for longer period of time at night, watching TV or video and listening to music is improved (Djamin **et al 2002).**
It shows that availability of suitable service infrastructure and distribution channels are important for solar home systems. But yet, there are weaknesses in distribution channels (**Nieuwenhout et al 2001).**

2.1 Price and Customer Satisfaction

It shows that subsidies for photovoltaic solar can change and also enlarge the price distribution (**Dobrotkova et al 2018).**

It found that planned auctions are great opportunity to extend solar photovoltaic capacity in a cost-effective way. Low prices for PV are a way for the sustainable development of photovoltaic in future (**Dobrotkova et al 2018).**

It found that hydro-technology has the benefit of cost-covering compare to thermal technology. Hydro-technology set a higher cost for consumers of electricity in short term while in long run it provides considerably less cost to the end users of electricity (**Adom et al 2018).**

The finding of the study reveals that consumers in Tamil Nadu are satisfied with solar home system and believe there is only installation cost of solar and no other cost during the life time of the system (**Mohanasundari and Devi 2018).**

It shows that consumers prefer good-looking solar panels and panels that match with the color of roof, so they pay a higher price for these kinds of panels(**Bao et al 2017).**
It considers that consumers have accepted solar as a viable energy system. Solar is a source of energy that causes reduction in electricity bill, increase safety, increase study time during night and receiving information from radio (**Gayathri and Abitha 2017).**
It found that the operating cost of solar home system and income level of users are dependent on each other in rural areas**(Lay et al Stoever 2013).**
The results show that photovoltaic is very cost-effective for diminishing CO2 emissions compare to products that reduce consumer's operating cost (**Yamaguchi et al 2013).**

The results show that consumers tend to choose fee-for-services compare to other factors such as: donation, cash sales model and full subsidy for rural electrification in developing countries. Consumers prefer fee-for-services because there is no need for high initial cost **(Wlokas 2010).**

It indicates that installing solar home system is a good opportunity for household to make possible the income-generating activities. The income-generating activities may lead to positive attitudes for solar home systems**(Breyer et al 2009).**
It considers that residents in Zambia are not able to pay high cost for installing solar home system. So, fee for service companies are the most suitable way for providing reliable energy service (**Lemaire 2009).**
It shows that price policies play a very important role for government in developing countries. Price policies -subsidy for sources of energy, clean energy and taxes on carbon

intensive fuels- are the strongest tools that form the evolution of energy system (**Ahammed and Taufiq 2008).**
The results show that significant change in incentive will occur, if the price of energy enhances remarkably. Substantial increase in pool prices of Australian electricity might occur, if the generating capacity does not increase with the growth in demand (**Maine and Chapman 2007).**
It found that income level is one of the most important elements in demanding for solar home systemsbut doesn't determine the amount of energy consumption by itself. Energy demand is also related to economic, social, cultural and also family structure in Sao Paulo (**Gustavsson 2007).**
The results demonstrate that although income is a major factor in purchase decision of solar home systems, but non-income factors such as: kerosene consumption, lighting, indoor pollution have a great role in choosing the size of solar home system in rural Bangladesh (**Gustavsson 2004).**
It indicates that solar energy systems as a renewable energy reduces cost of electricity, emission of CO2 and dependency on fossil fuels**(Morante and Zilles 2001).**
It found that consumers prefer to buy passive solar home, because they want thermal at low cost (**Yakubu 1996).**

2.2 Promotion and Customer Satisfaction

The results reveal that lower income groups prefer non-branded solar products compare to branded one in Burkina Faso. So, prices must be financially manageable for poor family and it is not necessary to be cost covering in short and medium terms. Promotion programs, consumer education and harmonized quality standards are required for market development**(Bensch et al 2018).**
It shows that the most important factors for establishing solar in rural areas are: payment by installment, service fee, subsidy and technical support (**Rahman and Kholilullah 2017).**
The finding of the study reveals that companies should provide information to consumers at the time of installation and teach consumers about performance and operation of the system (**Mannes 2017).**
It reveals that investors of solar PV with adequate motivation are ready to continue the installation of solar rooftop (**Comello and Reichelstein 2017).**
It shows that government's notice is necessary for installation of solar water heating system. Some factors that prevent solar water heating promotion are as follows: inadequate financial support and regulation, low awareness about the quality and operation of the system and deficiency of skilled technicians (**He, G et al 2015).**
The results show that significant factors for successful implementation of rural electrification are local technician training and also capable users. Time and financial resources are special goals for system technicians and end users in solar technology transfer projects (**Brooks and Urmee 2014).**
It reveals a basis for execution of renewable energy technologies as follow: i. creating opportunities for local income generation and local demand ii. including service and maintenance organization, private sector and end-users for promotion and management of renewable energy technologies**(Borah et al 2014).**
The results demonstrate that three main incentives for promoting of solar thermal energy are: i. tax incentive ii. non-refundable grants and iii. desirable line of finance (**Pablo-Romero et al 2013).**
The results show that users of PV in Texas believe that important reasons for installing PV are: reduction of greenhouse gases on the environment and it is a prudent financially

investment and investors consider risk and time horizon. Users have enough information about PV and the time of installation is certain from the date of ordering. So, there is no uncertainty and there are sufficient information at the time of decision making (**Rai and McAndrews 2012).**

It reveals that integrated solar home system has the following benefits: 1. Installation process is easy. 2. There is a considerable reduction in the cost of the system. 3. There is increase in efficiency by means of low cell-temperature operation. 4. There is increase in reliability by means of pre-manufactured and pre-tested units. 5. Standard AC output 6. Discretionary use of hot water as a by-product (**Kamalapur and Udaykumar 2011).**

The results show that fee for services and micro-credit system are two important factors for obtaining solar home systems. High installment cost and non-availability of flexible payment are barriers for lower income family to purchase solar home system**(Komatsu et al 2011).**

It found that implementers of solar PV believe that maintenance and monitoring of solar panels are very important. So, technicians and consumers should learn how to maintain and monitor solar panels (**Linguet and Hidair 2010).**

The results demonstrate that the most important financial arrangements for solar PV on rural Bangladesh are: i. Fee for services and payment in installment ii. User's training about maintenance and operation of solar is a good way that enables consumers to solve the problems such as: adding distilled water and replacing fuses. iii. Women's training as main users of solar panels also is a way for developing panels in rural Bangladesh. iv. Availability of different variety of solar panels enables consumers to choose panels according to their needs and financial capacity**(Bond and Fuller 2010).**

It found that factors such as: professional service, systematic and efficient technology and balanced supply chain might increase customer value. Moreover, sharing of certain and enough information help the customers to know better about renewable energy and this may increase demand for renewable energy systems (**Tapaninen et al 2009).**

The results show that consumers of solar home systems are satisfied with using of solar and they want to recommend the solar systems to other potential customers in spite of increase in price and decrease in subsidy. In Bangladesh, users of solar home systems are satisfied with technical performance, adequate financing infrastructure andafter sale services (**Aziz et al 2009).**

The results indicate that household prefers solar lighting to grid system because supplying power from grid is not reliable. Solar lighting causes reduction in kerosene usage and decrease in electricity cost. Banks play an important role in the viability of solar home systems. Banks act as an intermediary among consumers and solar system firms for ensuring good quality services and maintenance processes (**Anisuzzaman and Urmee 2006).**

The results reveal that people have accepted the solar energy in rural areas. The PV-ESCOs project shows that people are willing to use solar energy compare to kerosene and dry cells they were using before. But providing credit because of very high interest rate is not possible (**Ellegård et al 2004).**

It demonstrates that market in Kenya encourage customer to buy credit-based solar home system via ensuring the quality of the system**(Duke et al 2002).**

The results signify that the most important elements for enhancing the operational sustainability of photovoltaic solar systems are: 1. training and preparing of stakeholders 2. financial support 3. Technical innovation for local 4. building and improving local technical skills 5. beneficiary ownership (**Mapako and Afrane-Okese 2002).**

It found that customers can acquire solar panels on credit. There is customer satisfaction on the performance of SHS. Solar Home System has improved lighting, day time execution and saving on energy bills (**Nieuwenhou et al 2001).**

The results show that: i. The fee for service is a favorable mechanism for sustainability in Solar Home System. In developing countries, monitoring and evaluating of fee for service system is an important factor for a successful Solar Home System. ii. Experiences show that credit schemes are very useful for middle-income householdbecause they are financially manageable. Monitoring and evaluating of SHS provide information about designing of products and also market. iii. There is limited information about the experiences of end-users from different sources and gathering this information is very difficult because they are in different places. This information is very valuable for improvingsolar Home system **(Nieuwenhout et al 2000).**

It demonstrates that solar users are strongly satisfied with solar energy and because of their high commitment for solar they are ready to pay for the problems that may occur in solar **(Unseld and Crews 1979).**

3. Data and Methods

Most of the reviewed papers are from 1979 to 2018. Majority of the data are primary and have been collected through questionnaire and interview by the researchers. Out of 68 papers have been reviewed for this study. We have used inductive method for review the papers and concluding the results.

4. Source of the Study

Year	Authors	Keywords	Journal
2018	Dobrotkova et al	auctions, capital, cost effectiveness, developing countries, markets, prices, solar collectors, solar energy	*Energy Policy*
2018	Hsu	Solar PV, Permitting, Local policies, Policy adoption, Policy impact	*Energy Policy*
2018	Naves et al	Life Cycle Cost, LCC, Whole Life Cost, WLC Solar energy	*Solar Energy*
2018	Bensch et al	Energy access, Energy poverty, Technology adoption, Branded products, cost-effectiveness, Rural Africa	*Renewable and Sustainable Energy Reviews*
2018	Adom et al	Electricity price, Hydro energy, Macroeconomic indices, Thermal energy	*Energy strategy reviews*
2018	Prasad and Rajeshkumar	Solar energy product, consumer satisfaction	*BANGLADESH UNIVERSITY JOURNAL*
2018	Mohanasundari and Devi	Solar, Solar energy, Solar products and Energy conservation, Consumer awareness and preferences	*International Journal of Engineering and Management*

			Research (IJEMR),
2017	Gautam and Andresen	Economics comparison of flat-plate solar technologies, Building-integrated solar collector, TRNSYS simulation	*Solar Energy*
2017	Asadinejad and Tomsovic	Customertariff, Incentive-basedDR, Incentivepayment, Peakandoff-peaktariff, Price-basedDR, Pricevolatility	*Electric Power Systems Research*
2017	Bao et al	Residential Solar Panels, Solar System Adoption, Product Appearance, User Preference Modeling	*Renewable Energy*
2017	Rahman and Kholilullah	Solar Panel, Financial Viability, Future Prospects, Bangladesh	*International Journal of Science and Research (IJSR)*
2017	Mannes	Solar home system, End user, Rural development	Norwegian University of Life Sciences
2017	Jacobson		
2017	Barman et al	Solar home lighting system, performance evaluation, Livelihood, Rural electrification	*Energy for Sustainable Development*
2017	Comello and Reichelstein	Solar PV, Net Metering, levelized Cost, Time of Use Pricing	*Renewable and Sustainable Energy Reviews*
2016	Campana et al	open-source optimization tool, solar home systems	*Energy Conversion and Management*
2015	He, G et al	Solar water heater, building integrated, Urban, Barriers, Policy	*Renewable and Sustainable Energy Reviews*
2015	Azimoh et al	Off-grid electrification,Solar Home System, Sustainability,User education,Socio-economic development,Energy burde	*Applied energy*
2014	Kos and de Souza	Ekó House, Solar Decathlon, Home automation and information system, User habits, Weather data, Energy savings	*Energy and Buildings*
2014	Brooks and Urmee	Capacity building, Training, Solar, PV, Philippines, Users	*Renewable Energy*
2014	Lavrijssen	energy consumers, behavioural economics	*Journal of Competition Law and*

			Economics
2014	Borah et al	Photovoltaic, Photovoltaic lighting, Home lighting systems, Rural electrification, Energy access	*Energy Procedia*
2014	Akhi and Islam	Tariff, Solar home system, Rural electrification, IDCOL, Bangladesh	*International Journal of Innovation and Applied Studies*
2014	Alam et al	Small-scale renewable energy Usage	*Renewable Energy*
2013	Pablo-Romero et al	Solar thermal energy, Tax incentives, Spain	*Renewable and Sustainable Energy Reviews*
2013	Komatsu et al	Solar home systems, Rural electrification, Satisfaction, Bangladesh	*Energy*
2013	Rahman and Ahmad	Solar Home System (SHS) Rural development Bangladesh	*Energy Policy*
2013	Lay et al Stoever	Renewable energy, Household fuel choice, Solar power use, Solar home system, Technology diffusion	*Energy Economics*
2013	Harish et al	Rural electrification, Solar lighting systems, Technology diffusion	*Energy policy*
2013	Yamaguchi et al	Photovoltaic, solar water heater, promotion policies	*Applied energy*
2013	Pode	Solar home system, Financing, Free for service, Micro-credit system	*Renewable and Sustainable Energy Reviews*
2013	Hoque and Das	Solar home system, Cost, Energy, Emission	*International Journal of Renewable Energy Research*
2012	Bond et al	SHS, Developmentimpact, East Timor	*Energy policy*
2012	Dastrup et al	Solar panels, Real estate prices, Environmentalism	*European Economic Review*
2012	Rai and McAndrews	Solar PV adoption, Rooftop PV, Diffusion of innovations, Energy use behavior change, Renewable	In *Proceedings of the World Renewable Energy Forum*
2012	Wahi	Solar home system, Rural areas, Prospect, Progress, Challenges	In *Proceedings of the*

			Global Engineering, Science and Technology Conference
2012	Buragohain	Development, energy, Odisha, solar	*International journal of environmental science and development*
2012	Sharma et al	Solar Energy, Renewable policy in India, Solar photovoltaic systems, Decentralized energy system	*Renewable and Sustainable Energy Reviews*
2012	Momotaz and Karim	service, customer satisfaction, solar home system, SERVQUAL	*World*
2011	Yuan et al	solar energy technologies, End users' perspective	*Energy policy*
2011	Urmee and Harries	Solar PV,SHS, Bangladesh, Micro-credit, Successfulness	*Renewable Energy*
2011	Kamalapur and Udaykumar	Rural electrification, Photovoltaic Solar Home System, Grid extension	*International Journal of Electrical Power & Energy Systems*
2011	Iemsomboon	Quality of Life, Solar Home System, Analysis Hierarchy Process	*Energy Procedia*
2011	Komatsu et al	Solar Home Systems (SHS),Nonincome factors, Ruralelectrification, BangladeshDiscrete Choice Models	*Energy for Sustainable Development*
2010	Mondal et al	Renewable energy technologies, Drivers and barriers, Strategies	*Energy Policy*
2010	Wlokas	Solar home system, sun, vision, energy	University of Cape Town
2010	Linguet and Hidair	Rural photovoltaic electrification, Solar home system, French Guiana	*Renewable and Sustainable Energy Reviews*
2010	Bond and Fuller	SHS, Solar lantern, East Timor	*Renewable energy*
2009	Urmee and Harries	Solar home system, Success factors, Program implementers, Barriers, Success indicators	*Energy for Sustainable Development*
2009	Breyer et al	Rural Electrification, Dissemination, Education and Training, Developing Countries, Sustainable Development	In *Proceedings 24th European*

			Photovoltaic Solar Energy Conference, Hamburg
2009	Lemaire	Rural electrification concession, Photovoltaic fee-for-service model, Energy service companies, Solar home systems, Zambia	*Energy for sustainable development*
2009	Tapaninen et al	Barrier, basis of competition, perceived characteristic,renewable energy, wood pellet heating	*International Journal of Agile Systems and Management*
2009	Aziz et al	Solar Home System (SHS), technical performance, Micro financing, After sales service	In *Developments in Renewable Energy Technology*
2008	Caird and Roy	efficiency, energy renewable energy, consumer surveys, user-centred design and marketing.	*International Journal of Innovation Management*
2008	Ahammed and Taufiq	Rural Development, Solar PV, Solar Home System, Micro utility, Tariff Collection	*Journal of Rural and Community Development*
2007	Maine and Chapman	Value of Solar, price, photovoltaic generation	*Energy Policy*
2007	Gustavsson	Solar home system, Rural electrification, ESCO, Energy use, Zambia	*Energy Policy*
2007	Balmer et al	Solar water heating system, promotion, price comparisons	*Energy for Sustainable Development*
2006	Anisuzzaman and Urmee	Solar Home Systems, Rural Electrification, Financing Mechanism	
2004	Ellegård et al	solar photovoltaic (PV), solar energy services	*Renewable energy*
2004	Gustavsson	Solar home system, Solar electric services, Energy service companies, Pre payment	*J. Energy South. Afr*
2002	Duke et al	Product quality, Product standards, Solar home systems, Kenya	*Energy Policy*
2002	Mapako and Afrane-Okese	Solar home system, Income, Reliability, maintenance	*DUEE, Cape Technicon, Cape Town, South Africa*
2002	Djamin et al	solar home system, social impact,	In *World Renewable Energy Congress VII*
200	Morante and	Solar home system, Energy demand	*Research and*

1	Zilles		*Applications,*
2001	Nieuwenhout et al	Solar home system; rural electrification; households	*Research and Applications*
2000	Nieuwenhout et al	Solar energy, PV systems, experiences,applications	Netherlands Energy Research Foundation ECN
1996	Yakubu	Passive Solar Design, User-Experience Survey, Building Performance, Energy Efficiency	*Renewable energy*
1979	Unseld and Crews	Solar Water Heaters, Protection, performance, Solar space heating	Solar Energy Research Inst., Golden, CO (USA)

5. Conclusion

This paper considers a review on solar home users and customer satisfaction. It also investigates a relation between price andpromotion. We found that most articles focus on the following points: i. Households are satisfied with solar home system because of: energy saving, low dependence on kerosene and increase study time at night and improving in standard of living. ii. Local government plays an important role in the development of residential solar home system. iii. Three main incentives for promoting solar thermal energy are: a. tax incentive b. non-refundable grants c. desirable line of finance. iv. Renewable energy reduces cost of electricity, emission of CO2 and dependency on fossil fuels. v. Main problem for expansion of solar home systems are: high initial cost, installation cost, implementation and maintenance.

References

Balmer, M., Beall, J., Bergler, H., &Grupp, M. (2007). An overview of international experience in manufacturing and promotion of solar water heating systems with price comparisons and lessons for South Africa. Energy for Sustainable Development, 11(3), 11-16.

He, G., Zheng, Y., Wu, Y., Cui, Z., & Qian, K. (2015). Promotion of building-integrated solar water heaters in urbanized areas in China: experience, potential, and recommendations. Renewable and Sustainable Energy Reviews, 42, 643-656.

Bensch, G., Grimm, M., Huppertz, M., Langbein, J., & Peters, J. (2018). Are promotion programs needed to establish off-grid solar energy markets? Evidence from rural Burkina Faso. Renewable and Sustainable Energy Reviews, 90, 1060-1068.

Yamaguchi, Y., Akai, K., Shen, J., Fujimura, N., Shimoda, Y., &Saijo, T. (2013). Prediction of photovoltaic and solar water heater diffusion and evaluation of promotion policies on the basis of consumers' choices. Applied energy, 102, 1148-1159.

Yakubu, G. S. (1996). The reality of living in passive solar homes: a user-experience study. Renewable energy, 8(1-4), 177-181.

Gautam, K. R., & Andresen, G. B. (2017). Performance comparison of building-integrated combined photovoltaic thermal solar collectors (BiPVT) with other building-integrated solar technologies. Solar Energy, 155, 93-102.

Adom, P. K., Minlah, M. K., & Adams, S. (2018). Impact of renewable energy (hydro) on electricity prices in Ghana: A tale of the short-and long-run. Energy strategy reviews, 20, 163-178.

Naves, A. X., Barreneche, C., Fernández, A. I., Cabeza, L. F., Haddad, A. N., & Boer, D. (2018). Life cycle costing as a bottom line for the life cycle sustainability assessment in the solar energy sector: A review. Solar Energy.

Asadinejad, A., &Tomsovic, K. (2017). Optimal use of incentive and price based demand response to reduce costs and price volatility. Electric Power Systems Research, 144, 215-223.

Bao, Q., Honda, T., El Ferik, S., Shaukat, M. M., & Yang, M. C. (2017). Understanding the role of visual appeal in consumer preference for residential solar panels. Renewable Energy, 113, 1569-1579.

Barman, M., Mahapatra, S., Palit, D., & Chaudhury, M. K. (2017). Performance and impact evaluation of solar home lighting systems on the rural livelihood in Assam, India. Energy for Sustainable Development, 38, 10-20.

Comello, S., &Reichelstein, S. (2017). Cost competitiveness of residential solar PV: The impact of net metering restrictions. Renewable and Sustainable Energy Reviews, 75, 46-57.

Campana, P. E., Holmberg, A., Pettersson, O., Klintenberg, P., Hangula, A., Araoz, F. B., ... & Yan, J. (2016). An open-source optimization tool for solar home systems: A case study in Namibia. Energy Conversion and Management, 130, 106-118.

Maine, T., & Chapman, P. (2007). The value of solar: Prices and output from distributed photovoltaic generation in South Australia. Energy Policy, 35(1), 461-466.

Yuan, X., Zuo, J., & Ma, C. (2011). Social acceptance of solar energy technologies in China—End users' perspective. Energy policy, 39(3), 1031-1036.

Hsu, J. H. Y. (2018). Predictors for adoption of local solar approval processes and impact on residential solar installations in California cities. Energy Policy, 117, 463-472.

Dobrotkova, Z., Surana, K., &Audinet, P. (2018). The price of solar energy: Comparing competitive auctions for utility-scale solar PV in developing countries. Energy Policy, 118, 133-148.

Komatsu, S., Kaneko, S., Ghosh, P. P., & Morinaga, A. (2013). Determinants of user satisfaction with solar home systems in rural Bangladesh. Energy, 61, 52-58.

Kos, J. R., & de Souza, B. M. (2014). Educating home users through a solar house: the Ekó House experience. Energy and Buildings, 83, 181-185.

Brooks, C., &Urmee, T. (2014). Importance of individual capacity building for successful solar program implementation: A case study in the Philippines. Renewable Energy, 71, 176-184.

Momotaz, S. N., & Karim, A. M. (2012). Customer satisfaction of the solar home system service in Bangladesh. World, 2(7), 193-210.

Unseld, C. T., & Crews, R. (1979). Residential solar energy users: a review of empirical research and related literature(No. SERI/TR-354-245). Solar Energy Research Inst., Golden, CO (USA).

Lavrijssen, S. A. C. M. (2014). The different faces of energy consumers: toward a behavioral economics approach. Journal of Competition Law and Economics, 10(2), 257-291.

Aziz, S., Chowdhury, S. A., & Al-Hammad, H. (2009, December). Marketing and financing of solar home systems in Bangladesh: Assessment of success. In Developments in Renewable Energy Technology (ICDRET), 2009 1st International Conference on the (pp. 1-4). IEEE.

Nieuwenhout, F. D. J., Van Dijk, A., Lasschuit, P. E., Van Roekel, G., Van Dijk, V. A. P., Hirsch, D., ... & Wade, H. (2001). Experience with solar home systems in developing countries: a review. Progress in Photovoltaics: Research and Applications, 9(6), 455-474.

Alam, S. S., Hashim, N. H. N., Rashid, M., Omar, N. A., Ahsan, N., & Ismail, M. D. (2014). Small-scale households renewable energy usage intention: Theoretical development and empirical settings. Renewable Energy, 68, 255-263.

Rai, V., & McAndrews, K. (2012, May). Decision-making and behavior change in residential adopters of solar PV. In Proceedings of the World Renewable Energy Forum.

Tapaninen, A., Seppanen, M., &Makinen, S. (2009). Characteristics of innovation: a customer-centric view of barriers to the adoption of a renewable energy system. International Journal of Agile Systems and Management, 4(1-2), 98-113.

Caird, S., & Roy, R. (2008). User-centred improvements to energy efficiency products and renewable energy systems: research on household adoption and use. International Journal of Innovation Management, 12(03), 327-355.

Pablo-Romero, M. P., Sánchez-Braza, A., & Pérez, M. (2013). Incentives to promote solar thermal energy in Spain. Renewable and Sustainable Energy Reviews, 22, 198-208.

Duke, R. D., Jacobson, A., &Kammen, D. M. (2002). Photovoltaic module quality in the Kenyan solar home systems market. Energy Policy, 30(6), 477-499.

Azimoh, C. L., Klintenberg, P., Wallin, F., & Karlsson, B. (2015). Illuminated but not electrified: An assessment of the impact of Solar Home System on rural households in South Africa. Applied energy, 155, 354-364.

Urmee, T., & Harries, D. (2011). Determinants of the success and sustainability of Bangladesh's SHS program. Renewable Energy, 36(11), 2822-fu2830.

Lemaire, X. (2009). Fee-for-service companies for rural electrification with photovoltaic systems: The case of Zambia. Energy for sustainable development, 13(1), 18-23.

Ellegård, A., Arvidson, A., Nordström, M., Kalumiana, O. S., & Mwanza, C. (2004). Rural people pay for solar: experiences from the Zambia PV-ESCO project. Renewable energy, 29(8), 1251-1263.

Rahman, S. M., & Ahmad, M. M. (2013). Solar Home System (SHS) in rural Bangladesh: Ornamentation or fact of development?. Energy Policy, 63, 348-354.

Nieuwenhout, F. D. J., Van Dijk, A., Van Dijk, V. A. P., Hirsch, D., Lasschuit, P. E., Van Roekel, G., ... & Wade, H. (2000). Monitoring and evaluation of Solar Home Systems.

Experiences with applications of solar PV for households in developing countries (No. ECN-C--00-089). Netherlands Energy Research Foundation ECN.

Nieuwenhout, F., Martens, J., Lasschuit, P. E., Lafleur, M. C. C., &Cloin, J. (2001). Life-cycle analysis and optimization of solar home systems.

Rahman, M. A., &Kholilullah, M. I. (2017). Use of Solar Panel at Rural Areas in Bangladesh: Impacts, Financial Viability and Future Prospects. International Journal of Science and Research (IJSR), 6(10), 398-404.

Mohanasundari, R., & Devi, N. (2018). Consumer Awareness of Solar Energy Products A Study with Special Reference to Tirupur District Abstract. International Journal of Engineering and Management Research (IJEMR), 8(1), 139-145.

Prasad, C. R., &Rajeshkumar, K. (2018). AN EMPIRICAL STUDY ON CONSUMER SATISFACTION TOWARDS SOLAR ENERGY PRODUCTS IN CHENNAI CITY. INDIAN JOUR. Solar Home Systems in Bangladesh: Progress and Impending Marketing Issues. BANGLADESH UNIVERSITY JOURNAL, 12.

Gayathri, S. B., &Abitha,(2017) A. SATISFACTION TOWARDS SOLAR WATER HEATER AT HOUSEHOLDS–A STUDY WITH SPECIAL REFERENCE TO POLLACHI TALUK.

Mannes, M. (2017). End-user evaluation of Solar Home System as a viable energy system for rural development in South Africa (Master's thesis, Norwegian University of Life Sciences, Ås).

Gustavsson, M. (2007). With time comes increased loads—An analysis of solar home system use in Lundazi, Zambia. Renewable Energy, 32(5), 796-813.

Linguet, L., &Hidair, I. (2010). A detailed analysis of the productivity of solar home system in an Amazonian environment. Renewable and Sustainable Energy Reviews, 14(2), 745-753.

Urmee, T., & Harries, D. (2009). A survey of solar PV program implementers in Asia and the Pacific regions. Energy for Sustainable Development, 13(1), 24-32.

Bond, M., Aye, L., & Fuller, R. J. (2010). Solar lanterns or solar home lighting systems–Community preferences in East Timor. Renewable energy, 35(5), 1076-1082.

Ahammed, F., & Taufiq, D. A. (2008). Applications of solar PV on rural development in Bangladesh. Journal of Rural and Community Development, 3(1).

Lay, J., Ondraczek, J., &Stoever, J. (2013). Renewables in the energy transition: Evidence on solar home systems and lighting fuel choice in Kenya. Energy Economics, 40, 350-359.

Bond, M., Fuller, R. J., & Aye, L. (2012). Sizing solar home systems for optimal development impact. Energy policy, 42, 699-709.

Djamin, M., Lubis, A. Y., Alyuswar, F., &Nieuwenhout, F. D. J. (2002). Social impact of solar home system implementation: the case study of Indonesia (Kolaka, South East Sulawesi). In World Renewable Energy Congress VII.

Gustavsson, M. (2004). The impact of solar electric services on lifestyles- experiences from Zambia. J. Energy South. Afr., 15(1), 10-15.

Komatsu, S., Kaneko, S., Shrestha, R. M., & Ghosh, P. P. (2011). Nonincome factors behind the purchase decisions of solar home systems in rural Bangladesh. Energy for Sustainable Development, 15(3), 284-292.

Pode, R. (2013). Financing LED solar home systems in developing countries. Renewable and Sustainable Energy Reviews, 25, 596-629.

Jacobson, A. (2007). Connective power: solar electrification and social change in Kenya. World Development, 35(1), 144-162.

Iemsomboon, P., Tangtham, N., Kanjanasuntorn, S., &Bualert, S. (2011). Modeling community quality of life indicators for developing solar home system in remote areas. Energy Procedia, 9, 44-55.

Buragohain, T. (2012). Impact of solar energy in rural development in India. International journal of environmental science and development, 3(4), 334.

Wahi, R. R. H., & Ahsan, N. U. (2012, December). Feasibility study of solar home system in rural areas of Bangladesh: Prospect, progress and challenges. In Proceedings of the Global Engineering, Science and Technology Conference.

Breyer, C., Gerlach, A., Hlusiak, M., Peters, C., Adelmann, P., Winiecki, J., ... &Gashie, W. (2009, September). Electrifing the Poor: Highly economic off-grid PV Systems in Ethiopia–A Basis for sustainable rural Development. In Proceedings 24th European Photovoltaic Solar Energy Conference, Hamburg(pp. 21-25).

Mapako, M. C., &Afrane-Okese, Y. (2002, April). Experiences and lessons in the implementation of solar home systems from Zimbabwe. In Conference Proceedings, DUEE, Cape Technicon, Cape Town, South Africa.

Borah, R. R., Palit, D., & Mahapatra, S. (2014). Comparative analysis of solar photovoltaic lighting systems in India. Energy Procedia, 54, 680-689.

Mondal, M. A. H., Kamp, L. M., &Pachova, N. I. (2010). Drivers, barriers, and strategies for implementation of renewable energy technologies in rural areas in Bangladesh—An innovation system analysis. Energy Policy, 38(8), 4626-4634.

Wlokas, H. L. (2010). A review of the solar home system concession programme in South Africa.

Anisuzzaman, M., &Urmee, T. P. (2006). Financing mechanisms of solar home systems for rural electrification in developing countries.

Harish, S. M., Iychettira, K. K., Raghavan, S. V., &Kandlikar, M. (2013). Adoption of solar home lighting systems in India: What might we learn from Karnataka?. Energy policy, 62, 697-706.

Akhi, R. A., & Islam, M. (2014). Prospects of Solar home system in Bangladesh and a case study for tariff calculation. International Journal of Innovation and Applied Studies, 7(1), 273.

Gustavsson, M. (2007). Educational benefits from solar technology—Access to solar electric services and changes in children's study routines, experiences from eastern province Zambia. Energy Policy, 35(2), 1292-1299.

Morante, F., & Zilles, R. (2001). Energy demand in solar home systems: the case of the communities in Ribeira Valley in the state of São Paulo, Brazil. Progress in Photovoltaics: Research and Applications, 9(5), 379-388.

Hoque, S. M. N., & Das, B. K. Analysis of Cost, Energy and CO2 Emission of Solar Home Systems in Bangladesh" 2013, Volume 3, Issue 2, 2013. International Journal of Renewable Energy Research.

Dastrup, S. R., Zivin, J. G., Costa, D. L., & Kahn, M. E. (2012). Understanding the Solar Home price premium: Electricity generation and "Green" social status. European Economic Review, 56(5), 961-973.

Kamalapur, G. D., &Udaykumar, R. Y. (2011). Rural electrification in India and feasibility of photovoltaic solar home systems. International Journal of Electrical Power & Energy Systems, 33(3), 594-599.

Krauter, S. C. (2004). Development of an integrated solar home system. Solar energy materials and solar cells, 82(1-2), 119-130.

Sharma, N. K., Tiwari, P. K., &Sood, Y. R. (2012). Solar energy in India: Strategies, policies, perspectives and future potential. Renewable and Sustainable Energy Reviews, 16(1), 933-941.