DOI: http://doi.org/10.4038/jbt.v4i1-2.43

ISSN 2738-2028 (Online) | Vol. 4 | No. 1 & 2 | 2020 January & July

JBT

Journal of Business and Technology

International peer-reviewed journal | Publish semi-annually

Use of Solar Electricity: Is it a matter of standard of living? Evidence from Sri Lanka

C. N. Wickramasinghe[1], R. M. S. D. Bandara[2], and R. S. L. B. Ranasinghe[3]

[1 2 3] Faculty of Commerce and Management Studies, University of Kelaniya, Sri Lanka.
[*] Corresponding author: nalakacw1@yahoo.com

Abstract

In the fast-moving technological world, innovations such as Renewable Energy Sources available in the form of Solar Electricity have started playing a significant role in people's day-to-day lives. The impact of changes or expected changes in a given population's Standard of living as a reason for such a dramatic shift in electricity consumption is a field of interest that has not been thoroughly examined in the existing literature. Thus, the purpose of this study was to examine and assess the relationship between the Household shift to solar electricity and the Standard of Living, in an attempt to conclude statistically whether such a shift would be a matter of Standard of Living with regard to a developing nation in the South Asian region, namely, Sri Lanka. The research design has taken into consideration the Household size, Economic Status and the Standard of Living in relation to the two-folded sources of electricity used in Sri Lanka, Solar and Grid electricity. The study has based its roots on the existing literature in relation to the Developed countries carried out by Schelly in 2014. Statistical Package for Social Sciences (SPSS) was used to carry out investigations related to the aforementioned relationship and Chi-square values and Mann-Whitney U Test Values were used as statistical measurements to arrive at conclusions, respectively.

Keywords: *Electricity, Energy, Solar Power, Sri Lanka, Standard of Living*

Introduction

Adapting to renewable energy sources has been encouraged by Governments all over the world. The present and future economic and environmental benefits of the shift from non-renewable energy to renewable energy has been discussed to a great extent in the literature (Ellabban, Abu-Rub, & Blaabjerg, 2014). When society becomes economically developed, citizens tend to use more and more electrical and energy-consuming equipment and devices to make their life easy. This creates the demand for more and more energy consuming products from the industrial sector. This causality is clearly visible in developed countries, where they have high energy-consumption and high economic indicators at both industrial and household levels (Walker & Day, 2016, Nasreen & Anwar, 2014). In literature, energy consumption has been identified as one of the indicators of economic growth and standard of living in industrial countries(Walker & Day, 2016). The existing limited studies in developing countries also have recognized the electricity consumption at households as an enabler of a higher standard of living of the citizens (Niu, Jia, Ye, Dai, & Li, 2016). However, since the non-renewable energy sources used for generating electricity are expensive, electrification of nations has been a costly task that has created a high price for electricity in many developing countries. High electricity cost has a significant influence on the "freedom" of using electricity at the domestic level and therefore, it has been said that technical and financial reformations are needed in developing countries to use more and more renewable energy sources for electricity generation (Niu et al., 2016).

During the last decade the significance of renewable energy sources has been taken off in developing countries. There are national and regional level discussions on assessing the economic and environmental benefits of using renewable energy sources (Tsoutsos, Frantzeskaki, & Gekas, 2005, Jamasb, 2006). There are published studies on the preferences and attitudes of local communities towards investments in renewable energy projects and their perception on the use of new energy technologies in their daily lives (Stigka, Paravantis, & Mihalakakou, 2014).

With the overwhelming growth of science and technology, a large number of household technological products were developed to make human life easier. Owing to the tempting nature of these new technologies, people are tempted to use them in the household, but the expensiveness of the electricity acts as one of the major barriers in developing countries that hinders the ability to go ahead with these technologies to improve the standard of living at the household level. Solar Power is one of the alternative energy sources that would reduce the household cost of electricity. However, there is hardly any study that has made an effort to investigate the association between solar PV electricity adaptation and standard of living in a developing country. Therefore, the existing knowledge on how solar power shift would associate with the standard of living in developing countries is not sufficient to understand the socio-psychological effects on solar power adaptation in developing countries. This paper aims to provide the results of a study conducted to identify the relationship between shift to renewable electricity and standard of living at household level in Sri Lanka, which is a lower middle income island nation located in South Asia and a country that has taken a proactive policy initiative called “Battle of Solar power” to encourage citizens to shift for solar power at household level.

Literature Review

Emergence of renewable energy dialog in developing countries

As per the evidence, economic development, industrialization and standard of living are inseparable elements of social development which are continuing to each other in a continuous cycle. Therefore, per capita electricity and energy consumption have been recognized as the appropriate indicators of the industrial development and standard of living of the western societies (Huenteler, Niebuhr, & Schmidt, 2016). Even though much attention has not been given, electricity and energy consumption have significantly influenced the recent economic growth and standard of living in developing countries as well (Kebede, Kagochi, & Jolly, 2010). As per the evidence, the current level of techno-industrial development achieved by the developing countries like China, India, Singapore or Vietnam is heavily crenelated with their energy consumption (Nasreen & Anwar, 2014).

In most developing countries, infrastructure development and operation of the electricity sector have become public service govern by the government institution. Hence, there are explicit inefficiencies, productivity issues and imbalance cost-benefit situations in the energy sector in these countries (Zhang, Parker, & Kirkpatrick, 2008). Apart from that, there are emerging threats where the fossil fuel would be depleted (Shafiee & Topal, 2009) and there are environmental concerns over other non-renewable sources of electricity (Sims, Rogner, & Gregory, 2003). Hence, there are ongoing discussions on findings the best alternative renewable and sustainable energy sources in both developed (Mai, Mulcahy, Hand, & Baldwin, 2014) and developing countries (Huenteler et al., 2016). Since there was a drastic increase in crude oil prices during the years 2008-2010, all the countries started to find alternative electricity sources, which are cost-effective and environmentally friendly. Especially the region like South Asia faced a serious threat from this oil crisis since they totally depend on imported fossil oil from other countries. Based on the research conducted on the rain, temperature and sunlight patterns throughout the year, solar photovoltaic (PV) and solar thermal technologies have been identified as a viable source of energy in South Asian (Huenteler et al., 2016) and sub-saran African regions (Huenteler et al., 2016). Considering the global prospect, technological progress, and environmental effects, solar photovoltaic power generation has been recognized as the most viable solution for electricity generation in developing countries (Hosenuzzaman et al., 2015).

Battle for Solar Energy in Sri Lanka

One of the major reasons for high electricity cost in developing countries is the source of energy they use for electricity generation. Mostly the source of electricity has been the power plants run by the coal, fuel extracted by the crude oil deposited beneath the earth surface or power plants runs by hydro power. Sri Lanka is an island nation situated in South Asia. Electricity generation, transmission and distribution in Sri Lanka are mainly done by the Ceylon Electricity Board (CEB), which is a government institution and Lanka Electricity Company (LECO), which is a government-owned company. CEB uses three main sources of energy for electricity generation in Sri Lanka: Hydropower, Coal Power, Fossil fuel. Owning to the increasing demand for electricity beyond the generation capacities, electricity board is forced to buy electricity generated by the private sector those who run mini-hydro and wind power plants at small and medium scale. However, the charges for privately generated electricity costs are generally higher than the rates CEB and LECO charged from the end users. However, CEB is not allowed to charge simple cost-plus margin prices from the consumers as per the social protection policy of the government. Therefore, in order to avoid the cost imbalance, CEB transfers that additional cost to moderate to high-end electricity consumers. Owing to this issue, moderate to high-end electricity charges in Sri Lanka are ranked to be the highest rates in the region. Owing to the limitations in power generation capacities, increase of imported fossil fuel prices and environmental concerns, citizens are always encouraged to save electricity rather than using it with “freedom”. Since the demand and cost of electricity generation continually increasing, CEB and LECO time to time, increase their tariff accordingly (Athukorala & Wilson, 2010). Hence the electricity bill has become a significant proportion from the monthly household income, public pressure on electricity bill was started to creeping in Sri Lanka. CEB and the government of Sri Lanka encourage the citizens to electrify their households and businesses using solar power as an alternative source; however, so far solar powered electricity has been utilized in Sri Lanka as small-scale household and business-a level projects on voluntarily basis. There is overwhelming political interest in renewable energy in Sri Lanka and the government encouraged the private sector business entities to bring solar power technology to the country. At present, the Government of Sri Lanka, CEB and LECO with the partnership with the private sector are encouraging the electricity consumers to use more solar power through giving concessions. This programme is called the “Battle for Solar Energy” and it promotes the setting up of small solar power plants on the rooftops of households, religious places, hotels, commercial establishments and industries in Sri Lanka. Because of the above program, there is a huge trend of shifting towards solar power by domestic electricity users. It is expected that through this intervention to add 200 MW of solar power to the national grid by the year 2020 and 1000 MW by the year 2025 (Ministry of Power and Renewable Energy, 2016). As per the statistics of the Ceylon Electricity Board (CEB), by the end of year 2014 there were only 1,688 solar power users, but by the end of year 2016 solar power consumers have been increased to 5,029 and that was 198% growth with respect to the year 2014.

Currently, there are more than 200 registered solar power service providers in Sri Lankan promoting solar energy targeting 5,264,282 households all over the country(Department of Census and Statistics, 2013). Since all the households would not get the return on investment by converting to solar power, actual market for solar power is significantly lower than this(De Silva, Attanayaka, Hapuarachchi, Wijekoon, & Sumudith, 2013). Hence there is severe competition among the solar power providers; there are large verity of marketing campaigns going on to encourage the public to install solar panels on their households and business entities. On the other hand, Sri Lankan government encourages citizens to install their own solar power plants at household and business premises by giving bank loans at low interest rates, buying back the generated power to the national grid at an attractive rate and educating the citizens on the benefits of green energy sources.

Why people use solar energy

As per the content analysis conducted by the researchers, it was observed that there are three (03) main themes in the solar power marketing campaigns: 1. solar power to reduce the electricity bill, 2. solar power as sustainable green energy, 3. solar power as investment option. With this awareness campaigns, electricity consumers purchase solar systems with several objectives. Many of them want to reduce their electricity bills and some of them expect to get additional income and environmental protection.

The cost of installation of solar panels has drastically declined in the last five years, but still, this initial investment is relatively very high for the majority of households. LECO and banks are providing low interest rate solar power bank loans for 5-7 years matching the current electricity bill of the household. In this approach, the household has to pay the loan installment equal to their current electricity bill for a period of 5-7 years. Therefore, in reality, until that period household would not get any monetary savings from that. Even the household install the solar system by their saved money, there is an opportunity cost similar to a bank loan. Since this cost of capital issue, most households are trying to install higher capacity than their existing electricity usage. By doing that they will be able to generate more units than they consume and get the net benefit each month. Hence at least 5-7 years of investment in solar power would not give substantial economic benefit for users.

As per the research conducted by Schelly (2014), that is to explore what motivates homeowners to adopt residential solar electric technology in the state of Wisconsin, it has been examined as to the relative of importance environmental motivations, economic considerations, and the demographic characteristics and network relations influencing the adoption and diffusion of innovations. According to the findings, environmental values have not been a concern on adoption. Economic benefits in the narrow sense of calculated return on investment or payback period is less important than the particular timing of economic events within a household. Interestingly, this study has found an interest in technical innovation and enjoyment of the technical aspects of energy systems as motives for solar power adoption. This study has indicated that there are some socio-psychological influences on solar power adaptation among households.

As per evidence available on the result of global warming, Sri Lanka is experiencing a climate shift where rain becomes heavy and lasts for shorted period and dry period become longer and much hotter throughout the country. Therefore, increased electricity consumption for cooling has become a necessity at the household level. However, owing to the energy saving mentality, households consume electricity at restricted economy mode without using fans, electrical items, and air conditioners even they are living in temperature at high 30 degrees in most parts of Sri Lanka throughout the year. Solar power would allow the households to generate more electricity than they are currently consuming and use the additional units to bringing in additional life technologies, which they have not been using before and improve their standard of living. This might be the major motivation for households to go for solar power, but this was not explicitly highlighted or promoted as a motivator. However, who are shifting for renewable electricity sources to improve their standard of living and how this shift would actually influence on standard of living at household level have not been comprehensively addressed in previous studies. Especially the present study aims to explain the differences in standard of living of households between those who are using national grid electricity and renewable source like solar powered electricity in Sri Lanka.

Methodology

Research Design

With the adaptation of solar power generation at the household level, the population of Sri Lankan household electricity users has been divided into two sectors: solar users and Grid electricity users. The aim of the study was to identify the differences in standard of living between solar power uses and grid electricity users. Therefore, the present study is mainly designed as a comparative research with two independent samples representing two segments of the electrified household in Sri Lanka. With the adaptation of solar power generation at the household level, the population of Sri Lankan household electricity users has been divided into two sectors: solar users and Grid electricity users.

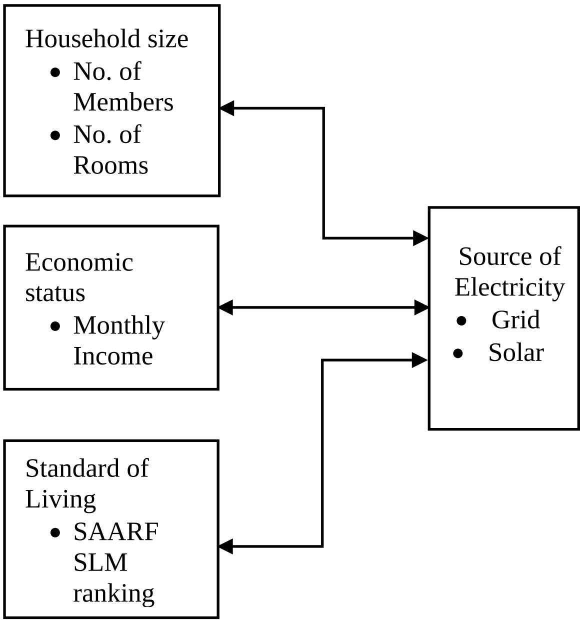


Figure 1: Conceptual Framework of the study

Operationalization

Household size

Household size has a positive impact on electricity consumption. When there are more rooms and members in the household, they tend to consume more electrical equipment and devices in their day-to-day life. Therefore, the number of members in a household and the number of rooms available in the household considered as indicators of the household size. As per the previous research findings, the researchers hypothesized positive associations between household size indicators and source of electricity.

Economic Status

Economic status often explains in relation to energy consumption. In the present study, the level of income has been used as the indicator of the economic status of the households (Rao & Pachauri, 2017). As per the findings of previous studies, high-income earners tend to consume more electricity than low-income earners. However, the conclusive evidence on the impact of income on shifting to solar power in developing countries are rare. Therefore, in the present study, the researchers hypothesized that there would be a significant association between level of income and source of electricity within the sample.

Standard of Living

The concept of Standard of Living has a long history in mankind and there are different definitions to define it. As per Sen (1984), there are at least three general approaches to the notion of the standard of living of a person. The first is to see the living standard as some notion of the welfare utility of a person, which describes the basic material things that person consumes in his/her normal life to satisfy their needs and wants (Sen, 1984). The second is some notion of opulence, wealth or income. The modern literature on real income indicators and the indexing of commodity bundles are stemming from this tradition of evaluating opulence. The third is to see the standard of living as one type of freedom; what is valued is the capability to live well, and in the specific economic context of standard of living, it values the capabilities associated with economic matters. The present study focuses on identifying the differences in standard of living between grid electricity users and solar power users. Therefore, the concern is recognizing the differences in their consumption of devices and equipment that make satisfactory living at the household level. Therefore, the notion of standard of living in this study measured as the combination of first and second approaches described by Sen (1984).

Since the purpose of standard of living measurement is to segment the grid electricity users and solar power users with similar economic capacities on their standard of living, the Living Standard Measurement (LMS) developed by the South African Audience Research Foundation (SAAF) was adapted to measure standard of living. As per the latest LSM (2012), living standard has been identified through twenty-nine (29) objects used at households, all the objects in the scale were selected on logical grounds and it was developed through principle component analysis and stepwise regression analysis (SAARF, 2012). It categorized the households based on their standard of living into ten main categories from 1-10. Lower living standards have been divided into six categories and the next four higher living standard levels were categorized in to 3 subcategories (as 7, 7Low, 7High|8, 8Low, 8High|9, 9Low, 9high|and 10,10Low, 10High). In the present study, standard of living was measured by using the 29 indicators and weighting scale given by the SAARF LSM.

Electricity Consumption

In order to identify the changes in electricity consumption, they were asked to report their last three months' average electricity consumption levels based on the number of units reported in their electricity bills.

Population and Sample

With the latest statistics from CEB (by the end of the year 2016), there are 5,029 Solar Power consumers and 5,964,194 electricity consumers in Sri Lanka. Since the research was designed as comparative research, to apply inferential analysis, two random samples had to select with a sufficient number of households in each group. When deciding the sample size, G-Power sample size calculation tool was used and since the household size, Income and LSM were collected as ordinal variables, sample size required for non-parametric comparative analyses of Chi-Square (DF=4, Power=.80, CI=.05,ES=.3) and Mann Whitney U test (Two tail, Normal Parent distribution, ES=.5, Power -.80, N1:N2=1, CI=.05, were calculated (Faul, Erdfelder, Lang, & Buchner, 2007). For Chi-Square test, the required minimum sample size was 133 and for Mann Whitney U test it was 134 with 67 respondents for each group. Therefore, the researchers decided to use 140 (70 for each group) as the satisfactory sample size for this study.

When selecting the sample, first, the researchers stratified the grid users' population and solar users' population based on their electricity consumption as at the 1st January 2016. The researchers used this date, to avoid the influences of recent consumption changes into the sample selection process. Based on the CEB calculations, the number of units that can be generated by different solar plant sizes are available in the Sri Lankan market, where the majority of household users are Light users who consume 113-567 units per month and are using solar systems from 1KW-5KW. Since more than 90% of the households come under this category, the researchers identified that the light-usage strata as the target population of this study. Finally, among these two target populations, researchers randomly selected 70 solar power using households and 70 grid power using households from the CEB customer database in March 2017.

Data Collection

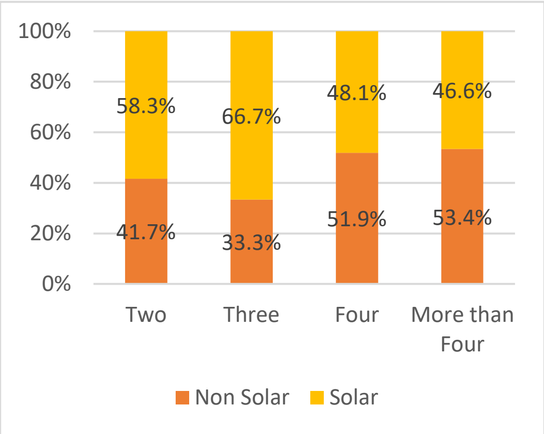
CEB is sending meter readers for each and every electrified household to get electricity meter readings every month. Irrespective of Solar power users or Grid power users, these meter readers are visiting each house. When selecting the sample, the researchers identified the exact households to be visited for data collection. The printed version of the questionnaire, including LSM and demographic information including Solar power usage (or not using) was given to selected meter readers and also provided them with comprehensive understanding about the research and what they have to get done.

During the first two weeks of March 2017, these enumerators visited selected households and gathered data required for the survey. Collected data were entered into SPSS software and verified for human errors and were verified by the researchers.

Findings

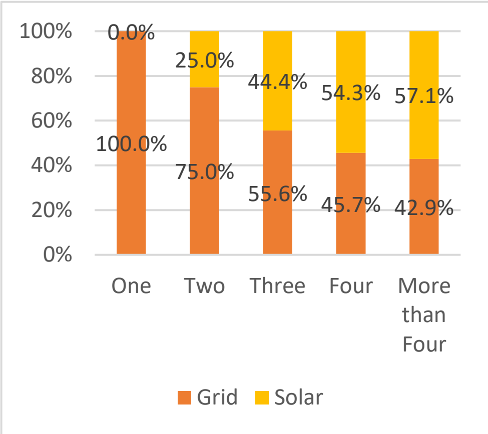
Solar Power Usage vs. Household size

In this study, household size was measured using two indicators: the number of permanent members in a household and the number of rooms available. According to the sample results, higher percentage of households with two to three members, have installed solar plants than the households with four or more than four members. However, the association between the number of members and source of electricity is not statistically significant. ($\chi2$=2.657, Df=3, P=.448) (Figure 2).



$\chi2$ =2.657, Df=3, P=.448

Figure 2: Percentage of Grid and Solar Electricity users by members of a household



FET=4.591,Df=4, P=.299

Figure 2: Percentage of Grid and Solar users by number of rooms in a household

Even though the Sample data has indicated households with more rooms tend to install solar power, the association between the number of rooms and source of electricity is not statistically significant (Fisher's Exact $\chi2$=4.591, Df=4, P=.299) (Figure 3). Therefore, the conclusion is household size, both the number of members and the number of rooms do not have association with the decision to go for solar power generation at the household level.

Economic Status and Solar Power Usage

First, the researchers tested the sample data to check whether the distribution of income is the same across the grid power users and solar power users by using the Mann Whitney U Test. According to the test results at a 95% confidence level (P=.053) distribution of income is the same across the grid power users and solar power users.

Second, the researchers tested the association between income and source of electricity by using the Chi-square test of association. According to the crosstabs results, 2/3 of the households with less than SLRs. 75000 (US $ 500 or less) monthly income are using solar power. However, in relation to the Income level up to SLRs. 150,000-225,000, the percentage of solar power users in each income level has declined, where SLRs. 150,000-225,000 level 82% of households are using grid electricity. However, among the households with higher income levels, higher percentages are using solar power. The chi-square analysis results are illustrated in Figure 3, and there is a significant association between monthly income and source of electricity (X2=25.290, Df=4, P=.000) and as per the Cramer' V statistics (CV=.425, P=.000) the strength of the association is lower. This result indicates that even though there is an association between income level and source of electricity, it might not be a linear association.

Standard of Living ratings of the households

The core aim of this study is to identify the association between standard of living and solar power usage. First, the researchers identify the categories of standard of living of the sample of all 140 households. Since they were selected from the target population identified based on the similar electricity consumption as at 1st January 2016, this analysis indicates the present level of standard of living of the households irrespective of their source of electricity. As per Figure 4, none of the households rate less than 6 ratings for the SLM scale. The minimum rating was 6 and only one household belongs to that rating. Highest percentage of households was in 10 Low categories and more than 17% of the households rated 10 Higher level. In general, more than 81% of the households rate 9 Low or above standard of living rating.

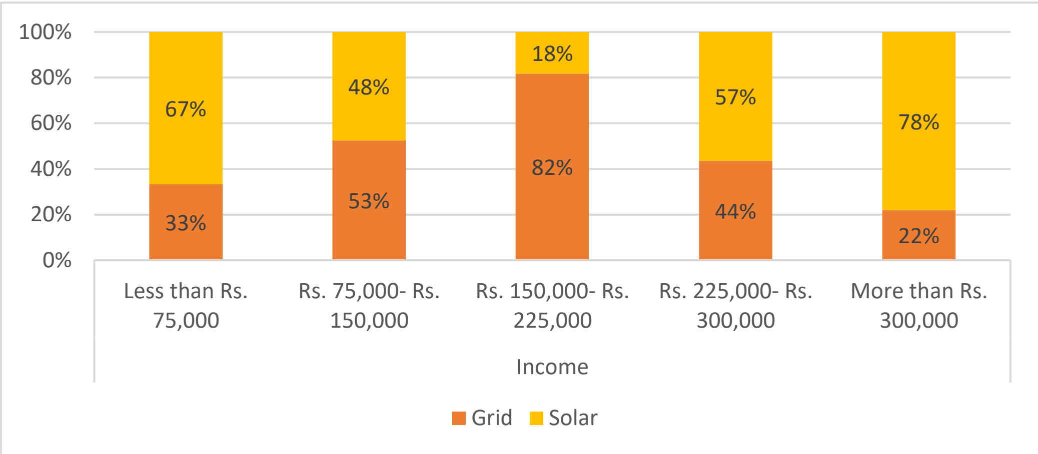


Figure 4: Percentage distribution of Source of Electricity by Income levels

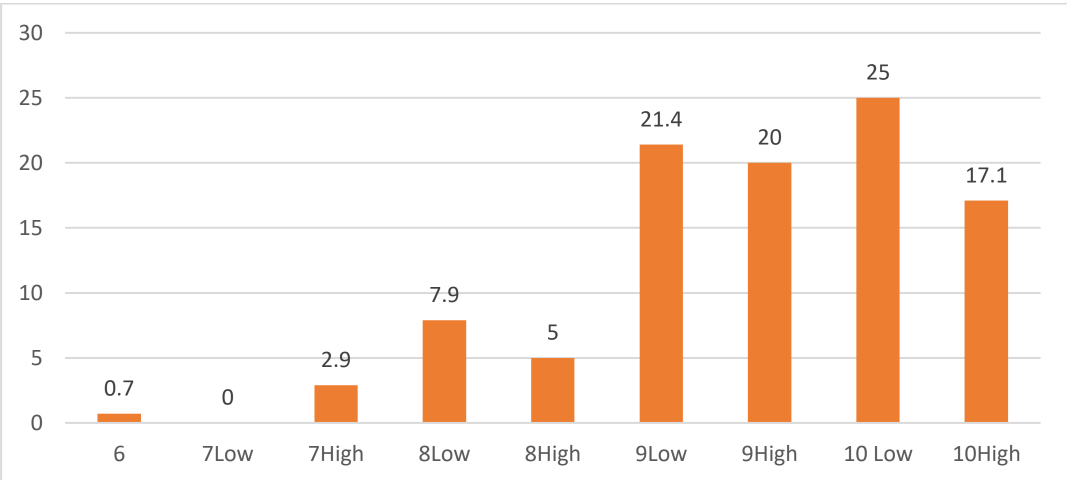


Figure 5: Ratings of the households in the sample by SAAF SLM levels

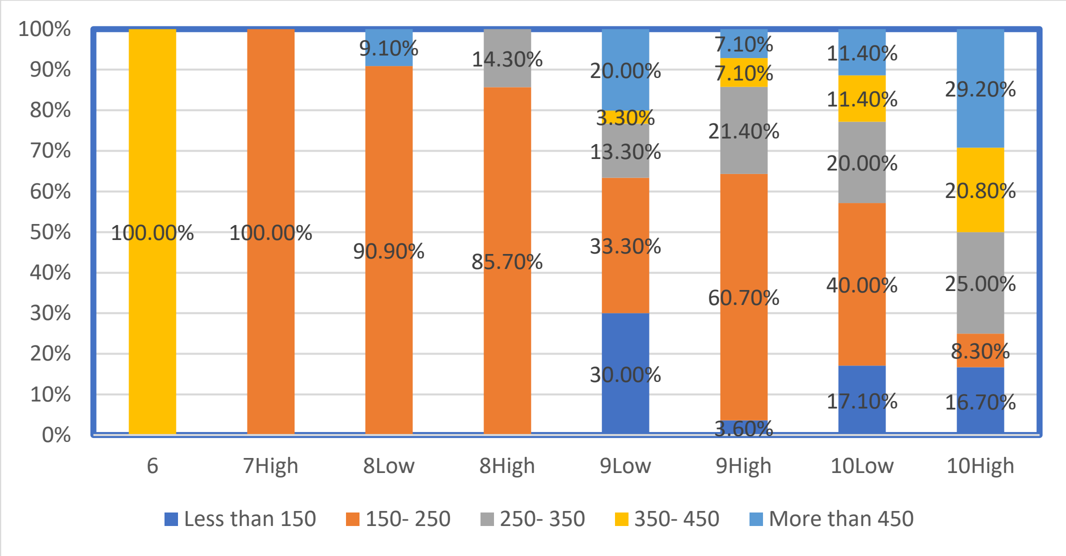
Standard of living and Electricity consumption

Standard of Living is a multidimensional facet and SAARF SLM covers 29 elements to calculate the standard of living rating. These 29 elements include 17 elements that relate to electrical equipment usage and 12 elements that are non-electrical elements (SAARF, 2012). Hence, the researchers hypothesized a significant association between standard of living and electricity consumption. According to the distribution of contingency table, 80% of cells have expected count less than 5, and the degrees of freedom was 28. Therefore, SPSS was unable to run the chi-square test using the respective method. Hence, the researchers used Monte Carlo exact method to run the chi-square test. According to the test results, there is a statistically significant association between Standard of Living rating and current electricity consumption (FET=40.211, P=.001). Whereas, the proportion of relatively low electricity consumption (Less than 250 units per month) has declined with the higher standard of living ratings, while the proportions of high level electricity consumptions increased among the households with high standard of living. The results indicated that, even though the sample was selected based on their 1st January 2016 electricity consumption, they have shown diverse levels of electricity consumption based on the improved standard of living.

Standard of Living and Solar electricity Usage

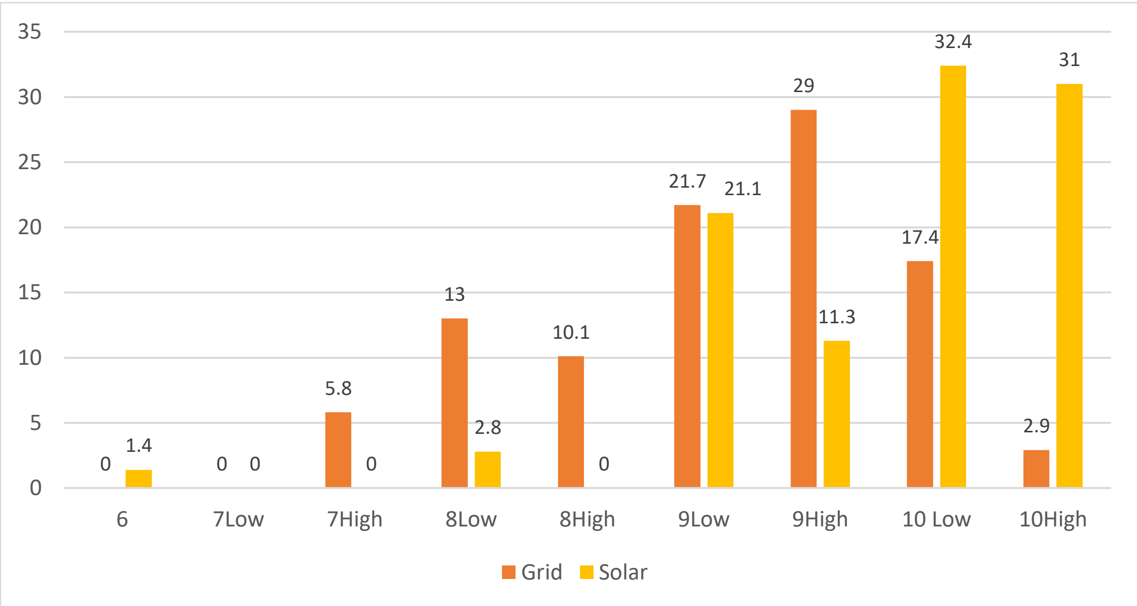
In order to explain whether there is an association between Standard of living and source of electricity, the Chi-square analysis was conducted. Results of the cross-tabulation data are presented in figure 5 and indicate that among the Solar power users, more than 63% are having 10 Low (32%) and 10 High (31%) ratings for standard of Living. Another 32% of solar panel users are having 9 Low (21%) and 9 High (11%) standard of living ratings. Only 4.2% of solar users ranked lower than 8 Low rating for their standard of living. In contrast, among grid electricity users, 28% of the households' rate 8High (10%) or lower Standard of living ranking and 67% rate between 9Low and 10Low categories. Only 2.9% of the households rate the highest standard of living rating, 10High.

Since the contingency table contained 37% of cells with an expected count of less than 5, Fisher's exact test chi-square value was used to test the significance of the association between standard of living and source of electricity. According to the test results, there is a statistically significant association between standard of living and source of electricity (FET=43.282, P=.000). The strength of the association indicates low to moderate level association (Cramers V= .546).



Fishers Exact Test =40.211, Moto Calo P=.001, Cramers V=.326

Figure 6: Percentage distribution of Standard of Living ranking by Electricity consumption



37% of the cells have expected count less than 5, therefore Fisher's exact test has been used
Fisher's Exact test $\chi2$= 43.283, P =.000, Cramer's V=.546

Figure 7: Standard of living ratings of households by Source of electricity

Discussion

During the last decade, the significance of renewable energy sources has been taken into consideration in developing countries. There are national and regional level discussions on assessing the economic and environmental benefits of using renewable energy sources. Installation of Solar panels at the household level is the most popular renewable electricity source in Sri Lanka, which is a lower middle-income country in South Asia. Promotional campaigns for renewable energy sources mainly highlight the long-term cost savings for households and national level environmental benefits. As per limited studies in the field, environmental motivations, economic considerations, demographic characteristics and network relations influencing the adoption and diffusion of innovations have been hypothesized as the motivators for residential solar power usage (Schelly, 2014). Even though there are previous studies conducted to determine the relationship between economic status and standard of living (Apergis & Payne, 2009). Further, some attempts have been taken to determine the association between electricity consumption(irrespective of grid or solar) and standard of living in Asia(Niu et al., 2016). However, there is hardly any empirical study in the context of South Asia to demine the association of source of electricity on the standard of living. Therefore, the present study has filled the existing knowledge gap by explaining the positive association between standard of living and solar power as household electricity and also the positive association between monthly electricity consumption and solar power as household electricity.

Since the meaning of "saving" is reserving money for future consumption by foreseeing and expecting an increase of economic wealth through investment, economic growth would help improve the standard of living. Shifting from grid power to solar power is a high-cost long term investment. However, without waiting for the return on investments gained through the payback period, instantly solar power investment allows the household to improve their standard of living by directly transferring the energy cost saving to use more electricity that can make their lives easy. Therefore, apart from the cost savings aspect, investment in solar power actually generate a "psychological feeling of an additional income" for households to spend more on consumption. The significant association between high standard of living ratings and solar power usage suggests that, solar power has improved the "freedom" of life style choices among the households to invest the cost savings on electrical equipment make their lives easy.

There might be more than one reason why households shift from grid electricity to solar electricity. Most marketed reasons are environmental concerns and the need for reducing the electricity bill. However, none of these factors were significant motivators for residents to go for solar energy (Schelly, 2014). As per Schelly (2014) biasness toward robust technologies; they discussed their curiosity of innovative electricity technologies as a motivating factor influencing their decision to adopt solar. However, Schelly's study did not explore the consumption changes after adapting solar electricity at the household level. According to the findings of the present study, biasness of technology driven standard of living or need for increasing the standard of living by adopting state of the art technology equipment might be a major reason for household solar power usage in Sri Lanka. Owing to this technology bias, when getting used to solar power, households might change their priority towards standard of living rather than cost saving. Owing to the high electricity bill, households might not be able to use many of the electric equipment that they would want to use in the past. However, the installation of solar power allows the households to use more electrical equipment at low electricity bills.

The findings of the study have introduced another marketing dimension to Government, Solar power companies or any party those who are interested in encouraging households to move from grid electricity to solar electricity. The positive association between solar power usage and standard of living would be a great motivator to convince the citizens. As per current electricity consumption patterns, the majority of the Sri Lankans are electricity light-users deepening on a subsidized tariff. Since this is not a sustainable strategy, CEB should encourage users to shift to solar energy while increasing their standard of living through making them consume electrical devices that make their lives easy.

The results of the present study indicate that there is no association between household sizes; either the number of members or the number of rooms available is significantly associated with the source of electricity. However, there is a significant association between economic wealth and source of electricity, where monthly income has a positive association with source of electricity usage where higher income earners tend to use solar power than grid electricity. Therefore, shifting from grid electricity to solar power might be high among the high-income categories. This trend might cause a problem for the Ceylon electricity board since according to their tariff system, high income earners are the ones who absorb the subsided low-income consumers electricity subsidy. Hence, the government has to make some strategic decisions to face serious challenges to generate enough income from grid electricity, in the likely case the high-income earners (high consumers) shift to solar power rapidly.

Conclusion

The findings of the present study indicate the glimpse of the association of socio-psychological dimension in the adaptation of renewable energy by the household sector in a developing country. Even though the general discussions and marketing efforts on promoting solar PV electricity at the household level often highlight environmental protection, cost savings and energy conservational habits, solar users tend to increase their electricity consumption by getting high standard of living in return. The findings of the present study align with the theoretical proposition presented by Schelly 2014, "Humans make decisions about technology adoption from within a social context shaped not only by environmental values or economic structures but also by a complex mixture of considerations regarding lifestyle choices".

This study is one of the initial studies that attempted to identify the association between standard of living and solar power electricity. The present study has used SAARF LSM scale to measure the standard of living of the sample. Inherently the scale gives categorical outputs, which restricts the possibility of using nonparametric statistics to make the inference. Therefore, future researchers would be able to test the same hypotheses of this study using high-end parametric statistics. Furthermore, this study was not designed to identify the causal relationship between the solar power usage and standard of living. Future researchers would be able to conduct casual research to identify whether solar power usage influence on standard of living or standard of living influence on solar power usage.

Reference

Apergis, N., & Payne, J. E. (2009). Energy consumption and economic growth: Evidence from the Commonwealth of Independent States. Energy Economics, 31(5), 641–647. https://doi.org/10.1016/J.ENECO.2009.01.011

Athukorala, P. P. . W., & Wilson, C. (2010). Estimating short and long-term residential demand for electricity: New evidence from Sri Lanka. Energy Economics, 32, S34–S40. https://doi.org/10.1016/J.ENECO.2009.08.005

De Silva, M. T. K., Attanayaka, T. L. B., Hapuarachchi, D. C., Wijekoon, R. B., & Sumudith, B. G. D. L. (2013). Long Term Generation Expansion Planning Studies. Retrieved from http://www.pucsl.gov.lk/english/wp-content/uploads/2013/11/LTGEP 2013-2032.pdf

Department of Census and Statistics. (2013). Principle Sources of Lighting in Sri Lanka. Retrieved January 11, 2018, from http://www.statistics.gov.lk/PopHouSat/CPH2012Visualization/htdocs/index.php?u secase=indicator&action=Data&indId=600

Ellabban, O., Abu-Rub, H., & Blaabjerg, F. (2014). Renewable energy resources: Current status, future prospects and their enabling technology. Renewable and Sustainable Energy Reviews, 39, 748–764. https://doi.org/10.1016/J.RSER.2014.07.113

Faul, F., Erdfelder, E., Lang, A.-G., & Buchner, A. (2007). G*Power 3: A flexible statistical power analysis program for the social, behavioral, and biomedical sciences. Behavior Research Methods, 39(2), 175–191. https://doi.org/10.3758/BF03193146

Hosenuzzaman, M., Rahim, N. A., Selvaraj, J., Hasanuzzaman, M., Malek, A. B. M. A., & Nahar, A. (2015). Global prospects, progress, policies, and environmental impact of solar photovoltaic power generation. Renewable and Sustainable Energy Reviews, 41, 284–297. https://doi.org/10.1016/J.RSER.2014.08.046

Huenteler, J., Niebuhr, C., & Schmidt, T. S. (2016). The effect of local and global learning on the cost of renewable energy in developing countries. Journal of Cleaner Production, 128, 6–21. https://doi.org/10.1016/J.JCLEPRO.2014.06.056

Jamasb, T. (2006). Between the state and market: Electricity sector reform in developing countries. Utilities Policy, 14(1), 14–30. https://doi.org/10.1016/J.JUP.2004.11.001

Kebede, E., Kagochi, J., & Jolly, C. M. (2010). Energy consumption and economic development in Sub-Sahara Africa. Energy Economics, 32(3), 532–537. https://doi.org/10.1016/J.ENECO.2010.02.003

Mai, T., Mulcahy, D., Hand, M. M., & Baldwin, S. F. (2014). Envisioning a renewable electricity future for the United States. Energy, 65, 374–386. https://doi.org/10.1016/J.ENERGY.2013.11.029

Ministry of Power and Renewable Energy. (2016). Battle for Solar Energy. Retrieved January 9, 2018, from http://powermin.gov.lk/bfse/

Nasreen, S., & Anwar, S. (2014). Causal relationship between trade openness, economic growth and energy consumption: A panel data analysis of Asian countries. Energy Policy, 69, 82–91. https://doi.org/10.1016/J.ENPOL.2014.02.009

Niu, S., Jia, Y., Ye, L., Dai, R., & Li, N. (2016). Survey data on household electricity consumption and living status in Northwestern China. Data in Brief, 7, 1106–11. https://doi.org/10.1016/j.dib.2016.03.093

Rao, N. D., & Pachauri, S. (2017). Energy access and living standards: some observations on recent trends. Environmental Research Letters, 12(2), 25011. https://doi.org/10.1088/1748-9326/aa5b0d

SAARF. (2012). Living Standard Measure. Retrieved January 10, 2018, from http://www.saarf.co.za/lsm/lsms.asp

Schelly, C. (2014). Residential solar electricity adoption: What motivates, and what matters? A case study of early adopters. Energy Research & Social Science, 2, 183–191. https://doi.org/10.1016/j.erss.2014.01.001

Sen, A. (1984). THE LIVING STANDARD, 36, 74–90. Retrieved from http://www.jstor.org/stable/2662838

Shafiee, S., & Topal, E. (2009). When will fossil fuel reserves be diminished? Energy Policy, 37(1), 181–189. https://doi.org/10.1016/J.ENPOL.2008.08.016

Sims, R. E. H., Rogner, H.-H., & Gregory, K. (2003). Carbon emission and mitigation cost comparisons between fossil fuel, nuclear and renewable energy resources for electricity generation. Energy Policy, 31(13), 1315–1326. https://doi.org/10.1016/S0301-4215(02)00192-1

Stigka, E. K., Paravantis, J. A., & Mihalakakou, G. K. (2014). Social acceptance of renewable energy sources: A review of contingent valuation applications. Renewable and Sustainable

Energy Reviews, 32, 100–106. https://doi.org/10.1016/J.RSER.2013.12.026

Tsoutsos, T., Frantzeskaki, N., & Gekas, V. (2005). Environmental impacts from the solar energy technologies. Energy Policy, 33(3), 289–296. https://doi.org/10.1016/S0301-4215(03)00241-6

Walker, G., & Day, R. (2016). Necessary energy uses and a minimum standard of living in the United Kingdom: Energy justice or escalating expectations? Energy Research & Social Science, 18, 129–138. https://doi.org/10.1016/J.ERSS.2016.02.007

Zhang, Y.-F., Parker, D., & Kirkpatrick, C. (2008). Electricity sector reform in developing countries: an econometric assessment of the effects of privatization, competition and regulation. Journal of Regulatory Economics, 33(2), 159–178. https://doi.org/10.1007/s11149-007-9039-7