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# WILLINGNESS TO PAY OF THE HOUSEHOLDS FOR SOLAR ENERGY-A CASE STUDY IN KUALA LUMPUR MALAYSIA

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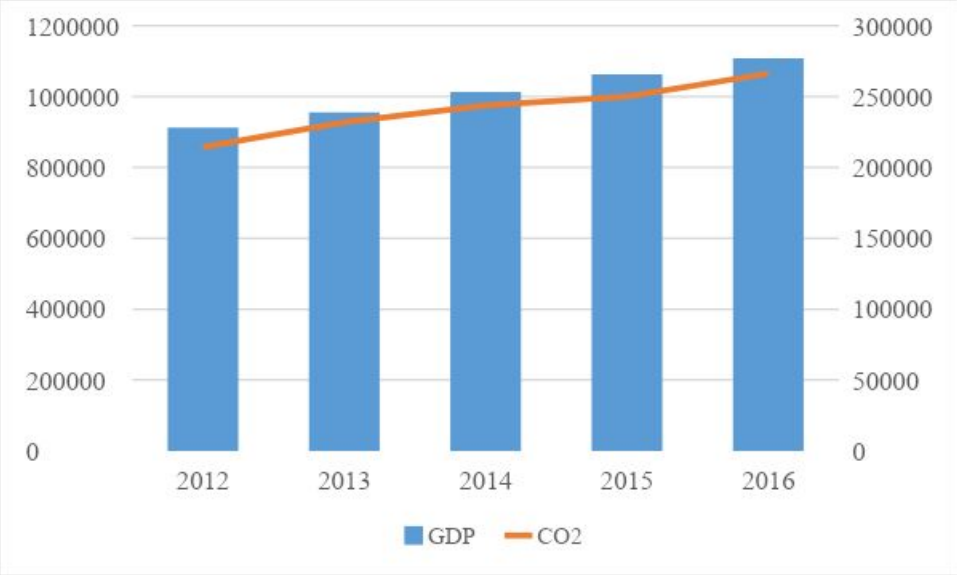
**Abstract.** The objective of this study is to analyze and evaluate public acceptance and their willingness to pay (WTP) for solar energy for their household use in Kuala Lumpur. For this reason, a contingent valuation method (CVM) was conducted to recognize the WTP of individuals and the features persuading it. Inhabitants of 400 families in Kuala Lumpur were questioned face to face. A logit model was estimated to investigate the factors that may affect the willingness of the households to pay additional electricity bills for solar energy. It was found that the average WTP value per family is RM 16, which will be paid monthly as an additional charge in electricity bills. The results of the logit model show that income, household size and knowledge about climate change positively and significantly affect the WTP of the households to pay additional electricity bills.

**Key words:** Public Acceptance, Willingness to pay, Solar energy, Logit model

## 1. Introduction

In recent years, climate change which can lead to overwhelming economic significances universal is one of the existential threat to the Earth's atmosphere and social well-being, because the main vital products disrupt the supply of natural resources that provide water, food and energy (Hsu, 2019; Stern, 2007). The climate in Malaysia demonstrates the same trends as in the world (Bindoff et al., 2007; Trenberth, 2009). According to MOSTE (2000), the country's heat has increased by 0.18°C over the period for more than 40 years. UTM (2007) also described a sea level increase of about 1.25 mm in the southern coastal area of Malaysia from the time when 1986. The "regular business" scenario (that is, the continuation of the current trend) proposes that without extra mitigation procedures, Malaysia will emit 285.73 million tons of $CO_2$ in 2020, which is 68.86% more than the amount of $CO_2$ released in 2000 (Safaai et al., 2011). Figure 1 shows GDP and $CO_2$ emissions in Malaysia from 2012 to 2016. It is observed that $CO_2$ emissions tend to increase with a growth rate of 6.8 percent over the same period of time.

*Figure 1: GDP and $CO_2$ emission in Malaysia during 2012 to 2016*




In this perspective, renewable energy sources have the possible solution for the problem due to its unique features of being cleaner sources for energy which is not exhaustible and susceptible to energy safety issues. For the past thirty years, the Malaysian government has been applying energy policy such as the 'Four Fuel Diversification Policy', 'Fifth Fuel Diversification Policy' and the 'Renewable Energy Act 2011' with the main purposes to confirm energy safety, utilize energy resulting from renewable sources and intensification of the share of renewable energy in electricity production, respectively. The Feed-in-Tariff (FiT) instrument was recognized under the Renewable Energy Act to deliver for the establishing and implementation of a different tariff system to expedites the generation of RE (Petinrin & Shaaban 2015).

In line with the goal of the Malaysian government through the 11th Malaysia Plan, the country is aiming a 33% decrease in greenhouse gas discharges strength of GDP associated to the 2005 levels as of 2013 (EPU, 2015). Malaysia is also aiming to attain 2080MW or 11% of electricity created from renewable energy sources by 2020 and 4000MW or 17% by 2030 (EPU, 2015). Although the government has intended many policies to provision the development of cleaner energy sources, Malaysia is facing serious challenge on how to upsurge the contribution of renewable energy in the energy mix. At the conference of Parties in Copenhagen, Malaysia has pledged to reduce 40% carbon discharge by the year 2020 from the base year 2005 (COP 15, 2009). Nevertheless, the progress of renewable energy is relatively slow, where only 1% of the total energy mix being renewable (Chua et al. 2011; Oh et al. 2010,). As of 2014, RE sources contributed 243.4MW or 1% of the total installed capacity in Peninsular Malaysia and Sabah and this inventiveness reduced GHGs discharge by 432,000tCO2eq (EPU, 2015). One of the possible reasons of this low percentage of renewable energy is the fact that construction of

renewable energy is more expensive than fossil fuel energy. Moreover, a continuous increase in renewable energy supply will effect in an intensification of production costs for most renewable energy sources. According to REN21 (2015), global investment in renewable energy equipment has scaled to more than 270 billion US$ in 2014, an increment of 21% from 2013 (214 billion US$ in year 2013). The production costs for renewable energy are predictable to continue high in the upcoming.

With this background, it is vital to recognize public's recognition and inclinations for clean energy growth in this nation. Success of energy and eco-friendly policies be influenced by mainly on the provision from not only the private sector and government but also from the consumers. The researchers used the CVM method to find out how people value properties and facilities for which there is no market (Arrow et al., 1993). Numerous studies have inspected the willingness of residents to pay (WTP) for renewable energy. Nomura and Akai, 2004 showed the results of a survey using the CVM of the willingness of Japanese households to pay more, in the form of a flat monthly surcharge, for renewable energy. The median value of willingness to pay for renewable energy by Japanese households is estimated at about 2000 yen (around 17 US$ with the exchange rate 115 yen/US$) per month per household. Ntanos et al. (2018) deliberate public awareness and WTP for RE for Greece and found that respondents have a good information of solar energy system to show their positive attitude towards energy system. Estimated WTP found 26.5 euros per periodical bill from the respondents for a wider penetration of RES. Zarnikau, 2003 respected the willingness to pay for renewable energy development and energy efficient resources in Texas, USA. Li et al., 2009 presented telephone and online surveys to discover household WTP to decrease US fossil fuel dependence. In our study, we concentrated only on the urban population, because more than 80% of electricity consumers are comprised in this sample, and because differences between rural and urban households were noted in terms of increasing welfare for RES (Bergmann et al., 2008). Result of a study by Azlina et al. (2018) using CVM, consumers of Malaysia willing to pay RM3.2 on average per month for the Renewable Energy Fund. The purpose of this study is to estimate willingness to pay (WTP) of the households for solar energy for their household use in Kuala Lumpur. For this purpose, a contingent valuation method (CVM) was conducted using the dichotomous choice double-binding format to identify the WTP of people and the factors influencing it.

## 2. Data Collection Procedure and Sample

This study used surveys as the primary tool for collecting data. Twenty participants were pre-tested in Kuala Lumpur to modify the questionnaire according to their understanding. The survey questionnaire has three parts. Part A consists of socioeconomic information about participants including gender, age, income, education and housing. Part B consists of questions designed to measure the barriers and willingness to use the solar energy of the households. Data were collected using a purposeful sampling method in Kuala Lumpur. For the sample size, this study uses Yamane's (1967) formula. This formula is given below:

$$n = \frac{N}{1+N(e)^2}$$

where: n = the desired sample size; N = the population size; e = the level of precision or the sampling error (the sampling error in this study is 5%). By applying the formula, the total desired sample size or n became 400. It was calculated based on a 95% confidence level and a 5 per cent error. In this survey, 400 households were interviewed face to face. In total, 240 (60%) were usable for data analysis purposes.

## 3. Results and Discussion

A total of 260 questionnaires were returned of which 240 (92.31%) questionnaires were usable. Table 1 shows the socioeconomic information of the respondents. Male (53%) respondents are slightly more than female (47%) respondents. The majority of the respondents are young. The respondents' ages ranged from 20 to 30 years (56%), followed by those aged 31 to 40 (19%) years, and those above 40 (25%) years. A significant figure of 56% of the respondents are still single while 39% married. The highest education level of the respondents is Bachelor (54%), followed by secondary school (16%) and Diploma (15%). Many respondents earn between RM1000 to RM3000 (32%), followed by those earning less than RM1000 (29%), and RM3001 to RM4000 (27%). The majority (59%) of the respondents stayed in rented houses while the remaining respondents (41%) stayed in their own houses. The average household size is 4.

*Table 1. The socio-economic information of households*

| Socio-economic information | Frequency | Percentage |
|---|---|---|
| **Gender** | | |
| Male | 127 | 53 |
| Female | 113 | 47 |
| **Age** | | |
| 20-30 | 134 | 56 |
| 31-40 | 46 | 19 |
| 41-50 | 31 | 13 |
| Above 50 | 29 | 12 |
| **Marital Status** | | |
| Single | 134 | 56 |
| Married | 94 | 39 |
| Divorced | 12 | 5 |
| **Educational Level** | | |
| No education | 5 | 2 |
| Secondary school | 38 | 16 |
| Diploma | 36 | 15 |
| Bachelor | 130 | 54 |
| Post Graduate | 31 | 13 |
| **Income level** | | |
| Less than 1000 | 70 | 29 |
| 1000-2000 | 36 | 15 |
| 2001-3000 | 41 | 17 |
| 3001-4000 | 38 | 16 |

| | | |
|---|---|---|
| 4001-5000 | 26 | 11 |
| More than 5000 | 29 | 12 |
| **Type of Houses** | | |
| Rented | 142 | 59 |
| Owned | 98 | 41 |

Next, respondents were asked regarding the challenges they faced and the underlying reasons that prevent potential consumers from using solar energy. Table 2 shows the obstacles households faced in using solar energy. The most important factors that obstruct households from using solar energy are led by the initial cost (91%), limited information on renewable energy (84%), limited financial information (74%), obtaining the best possible price (64%), lack of access to the technology (51%) and lack of awareness (49%).

*Table 2. The Obstacles faced by households to use solar energy.*

| **Public Obstacles** | **Most Important** | | **Important** | | **Least important** | | **No Response** | |
|---|---|---|---|---|---|---|---|---|
| | **Yes** | **%** | **Yes** | **%** | **Yes** | **%** | **Yes** | **%** |
| Limited information on Renewable energy | 190 | 79 | 11 | 5 | 6 | 3 | 33 | 13 |
| Initial cost | 210 | 86 | 12 | 5 | 5 | 3 | 13 | 5 |
| Limited financial information (i.e. ROI) | 160 | 67 | 17 | 7 | 18 | 8 | 19 | 8 |
| Obtaining best possible price | 140 | 58 | 15 | 6 | 14 | 5 | 71 | 30 |
| Lack of awareness | 100 | 42 | 16 | 7 | 12 | 5 | 112 | 47 |
| Lack of access to the technology | 98 | 41 | 25 | 10 | 32 | 13 | 85 | 35 |

Finally, this study examines the willingness of respondents to pay for organic solar energy in their homes. Upon request, many of the respondents (47%) stated that they were ready to pay. According to the Malaysian government's energy policy, about 60% of the current energy price is subsidized by the government. Against this background, the CVM was conducted to study the public interest in purchasing solar panels and using electricity on solar batteries in their homes. After the participants asked about the problems they encountered when installing solar energy in their homes, participants were offered a proposed CVM that can help prevent barriers and help Malaysia to create a low carbon society. The respondents were informed about the advantages of the system / devices based on organic solar energy, how these devices work, how the electricity bill is reduced, about its low cost and about the experience of other users. Later they were asked if they were ready to pay additional electricity charges. 47% of respondents were willing to pay additional electricity charges. This result proves that Malaysia has a large solar market, if initial installation costs can be reduced and if customers receive accurate information about the process of buying and installing solar energy devices. It is hoped that the proposed project will benefit society.

In this study, a logit model was used to investigate the factors that affect the willingness of the households to pay additional electricity charges. If the households are willing to pay, it is counted as 1 and 0 otherwise.

The independent variables are presented in Table 3. Maximum likelihood method was used to estimate the parameters. In this study, data analysis was done using Statistical Package for the Social Science (SPSS) version 16.0.

The results of the logit model on the determinants of households' willingness to pay are presented in Table 4. We find that income, household size and knowledge about climate change affect significantly and positively the willingness of the households to pay for solar energy. Furthermore, age and education also have positive impacts on the households' willingness to pay but they are not significant variables.

*Table 3. Description of the independent variables*

| Variables | Description |
|---|---|
| Age | Age in years |
| Education | Highest level of schooling attained by the head of the household. 1 = None, 2 = Primary, 3 = Secondary, 4 = College. 1 if educated and 0 otherwise. |
| Income | In RM |
| Household size | Number |
| Knowledge about climate change | If the head of the household knows the impacts of climate change. If yes 1, otherwise 0. |

*Table 4. Logit regression of determinants of willingness to Accept the Model*

| Variables | Coefficient | Standard error | Z-value | Sig |
|---|---|---|---|---|
| Age | .420 | .545 | 0.91 | .420 |
| Education | .223 | .243 | 1.41 | .160 |
| Income | .014 | .017 | 2.73 | .005 |
| Household size | .539 | .117 | 3.46 | .000 |
| Knowledge about climate change | .051 | 1.411 | 3.00 | .003 |
| Pseudo R-square | 0.436 | | | |

## Conclusion

The implementation of the proposed model to find participants and investors of funds will potentially provide more benefits for households, solar farms, energy service providers (Tenaga National, SESB, SEB) and crowdfunders. The results of this study show that it will not be enough to introduce the proposed system to attract more households to pay additional electricity bills. Households need to develop the belief that accepting the proposed project will benefit them. The government, therefore, needs to focus on the development of these households' beliefs. The government can assist households by organising awareness campaigns and offering tax incentives for individual households.

According to the findings of this study, if the costs of solar panels are reduced, the potential to reach the solar energy target improves significantly. Therefore, the realisation of these proposals will help Malaysia to increase solar energy usage to reach the 65 MW target in Malaysia's solar energy production. The research shows that the government can start small-scale projects to raise awareness of renewable energy and include the renewable energy curriculum in academic curricula of higher education institutions. Also, greater efforts and resources should be invested in sustainable renewable energy development, government initiatives, private sector participation and user awareness.

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