The Scale Validation of Public Participation of Renewable Energy (RE) Development in Malaysia: An Exploratory Factor Analysis (EFA)

Wan Abdullah, W.M.Z., Zainudin, W.N.R.A., Mohamad Ishak, W.W.

Abstract: Renewable Energy studies are gaining more interest by involved parties such as energy producer as well as research community. However, there are still limited number of studies in particular concerning instrument to measure public participation towards Renewable Energy (RE) development in Malaysia. The instrument for assessing public participation seem to require some extent of revalidation. Thus, the purpose of this paper is to validate the factor structure of public participation instrument that measured by willingness to pay level and it determinants. The questions of this developed scale were derived from previous published quantitative study. Validity and reliability of the instruments were assessed with Exploratory Factor Analysis (EFA) and Cronbach' Alpha respectively. Four hundred and five respondents had participated in this study. Results from this study revealed that the originally validated form of every factor structure, i.e. Willingness to pay (WTP), Awareness on RE (ARE), Knowledge on RE (KRE), Willingness to adopt RE technology (WTA) and Attitude towards RE usage (AURE) and Environmental concern (EC) had performed as per previous literatures within this research context. Furthermore, all the revised factors had a good reliability with the Cronbach's Alpha value well above 0.70 of threshold. Therefore, a total of 45-items revised in public participation toward RE measurement might be better suited for use within the selected population. This information provides preliminary evidence that the public participation towards RE instrument is a reliable and a valid measure that can be used to provide the data regarding Renewable Energy (RE) development in Malaysia. However, in order to cross validate, in future study can be conducted by engaging other location to cater different public opinion.

Index Terms: Renewable Energy (RE), Willingness to Pay (WTP), Exploratory Factor Analysis (EFA) And Measurement Scale,

I. INTRODUCTION

Unanticipated economic growth triggered by technology revolution and globalization has led to market driven growth in consumption pattern for the emerging economies[1]. Variation in consumption pattern has led to unsustainable consumption or over exploitation of resources. Energy is a basic necessity for human kind, it is important to improve the quality of people lives and increase a nation growth. Therefore, energy consumption usually grows together with a country development [2]. Currently, the concern over environmental downturn, reduction of environmental impact and sustainable development has become important research issues being debated among academicians, industrial entities and practitioners. Environment pollution such as burning of fossil fuels to generate energy sources and exhaust fumes from vehicles is at an alarming state. Thus the society and government need to plan for improvement in environmental sustainability. Moreover, for upcoming years, usage of non-renewable energy (RE) such as fossil fuels and natural gas focusing to generate electricity will eventually be exhausted. This state serves as a substantially major issue for society since electricity relies heavily on it [3]. An effective and efficient mechanism should be put in place to focus on the Renewable Energy (RE) development as alternative energy sources in Malaysia. Furthermore, a continuous efforts, strong support and participations from the public also are fundamental to ensure Renewable Energy (RE) development can reach its maximum potential. Therefore, this study aim to analyze the relationship between public participation by measuring their willingness to pay (WTP) for electricity generated from Renewable Energy (RE) sources and its determinants that influenced the WTP level.

In this study, the concept of public participation can be defined as the consumer participation in the process by which an organization consults with interested or affected individuals, organizations or government entities before making a decision regarding Renewable Energy (RE). This process is an opportunity for public to share their facts, experience, knowledge, ideas, preferences, opinions and values. This two way communication and collaborative effort can be used to solve problem and achieve better and more acceptable decisions [4]. The public participation is being measured using WTP since it is denotes a maximum price that a consumer is willing to pay for a particular development and it influences on their choice of behavior [5]. Thus, WTP instrument is proposed as a measure of the social value [6] and it also used to derive value from the public communities in different ways to treat on a same problem. Hence, advancement in Renewable Energy (RE) development as an alternative energy source inclusive of green product consumption depends on their tendency to pay the green price premium.

The Scale Validation of Public Participation of Renewable Energy (RE) Development in Malaysia: An Exploratory Factor Analysis (EFA)

The present study will analyze the factors influencing public intention to pay the energy generated from Renewable Energy (RE) or green price and their participation.

However, many previous studies have been embarked to identify the factors that influence the WTP level. Since Renewable Energy (RE) is a relatively new energy source that being promoted, the benefits and the options for adoption of this energy may not be aware by public. Moreover, according in a finding reference [7], knowledge of specific renewable technologies varies among the public. Therefore, it has been identified by previous research that individuals who are aware and acknowledge these different kind of energy resources, could increases their understanding and WTP levels on energy generated from Renewable Energy (RE) sources [8]. For instance, one of the predictors of behavioral intentions is also known as attitude. Those who seeming the negative impacts of electricity generation using non- Renewable Energy (RE) to the environment were found to be willing to pay more for Renewable Energy (RE) as compared to those who perceived otherwise [9].

Thus, this study was undertaken to examine several significant factors since less focus has been given to social science research particularly on Renewable Energy (RE). According to literatures, there are a few selected variables that might affect the WTP for Renewable Energy (RE). These variables include awareness and knowledge on RE, willingness to adopt Renewable Energy (RE) technologies, environmental concern and attitude towards Renewable Energy (RE) usage. This study using instrument that were adapted and modified from literature. Every developed instrument asked a few related items that were rated by using 5-Point Likert Scale. Thus, the validated and reliable instrument is crucial component in research quality. The instruments must be developed to reduce error [10] and can assess the factors associated with the public participation towards Renewable Energy (RE) development in Malaysia effectively. This paper is organized as follows. In section two, a brief description of the research materials and methodology is presented followed by the results and analysis of data in third section. The last section provides the conclusion of the study.

II. MATERIALS AND METHOD

A. Participants

The study applied a survey method [11]. The sample was composed of 405 prospective respondents selected randomly. Hence, 405 samples selected for present study is more than sufficient to generalize the findings to the population and appropriate for the application of exploratory factor analysis (EFA) [12]. An urban residential area for population and sample frame in this study will be chosen from the respondents who are residing in Klang Valley, Peninsular Malaysia (Kuala Lumpur, Selangor and Negeri Sembilan). This is due to easy accessibility on the population target.

B. Instrumentation

- Demographic analysis

The survey questions contained of three section that aim to gauge the public participation by measuring the WTP for electricity generated using Renewable Energy (RE) and its factors that affect the WTP level. Section one consist six questions to measure the demographic background of the respondents including gender, marital status, age, education, occupation and income. All item asked in this section were rated using nominal and ordinal scale. Therefore, these variables were not included in the factor analysis.

- Public willingness to pay on Renewable Energy (RE) (denotes as WTP).

Second section is regarding dependent variable, it comprised a set of items that show the extent of respondents' willing to pay for Renewable Energy (RE) development in Malaysia. There were four items [13] and two items [14] which was adopted to measure the WTP level. The response format consisted of a 5-Point Likert Scales type, where 1 indicates the "definitely not willing to pay" to 5 which indicates "definitely willing to pay". Previously reference [14] validated and checked the reliability of the items and shown that acceptable with Cronbach's Alpha 0.846.

- Public awareness and knowledge on Renewable Energy (RE) (denote as ARE and KRE).

The following section is regarding independent variable; it was divided into five variables. The first variable determines the level of public awareness on Renewable Energy (RE). It consists of ten items [8] that were adapted. The awareness towards energy is defined as the state or condition of being aware, having knowledge and consciousness. Thus, the set of items was shown to which extent the respondents aware of Renewable Energy (RE) in Malaysia. Meanwhile, the second variable relates to the respondent perspective and to analyze the knowledge of respondents toward Renewable Energy (RE). All six items were adopted from previous literature [7]. The scale for both constructs was measured using a 5-Point Likert Scale response format where 1 indicates the "very disagree" to 5 which indicates "very agree".

- Willingness to adopt Renewable Energy (RE) technology (denotes as WTA).

On the other hand, the third variable is consisting of a set of items that relate to the respondent's perspective on Renewable Energy (RE) technology. These Renewable Energy (RE) technologies have been proposed to address global warming and safe the environmental impact. The questions were asked regarding the environmental impact, which technologies that they would be using. Respondents are in which level they are willing to adopt the RE technology development in Malaysia. All six selected items were adopted [15]. Also using a 5-Point Likert Scale response format where 1 indicates the "definitely not willing to use" to 5 which indicates "definitely willing to use".

- Environmental concern and Attitude towards Renewable Energy (RE) usage (denotes as EC and AURE). Environmental concern defined as an attitude towards facts, one's own behavior, or others' behavior relate to environment.

Those environmental concern may refer to both specific attitude directly determining intentions or more broadly to a general attitude or value orientation [16].

Therefore, the fourth variable is consisting of a set of items that relay to respondent's point of view towards environmental concern. The respondents to choose the level of concern towards environment in Malaysia. All ten selected items were adopted [17]. The 5-Point Likert Scale was applied. In addition, the last adapted variable gauged the level of respondents' attitude [17]. The attitude is defined as an individual's evaluative state, associated with psychological feelings of distress or worries regarding the usage of electricity that generated using Renewable Energy (RE) and may be accompanied by supporting behavior [18]. Subsequently, the respondents were asked to which extent their attitude towards the usage of Renewable Energy (RE). The scale for the fifth variable which consist of 7 items were measured using a 5-Point Likert Scale response format ranging from 1 "very disagree" to 5 "very agree".

C. Data Collection

Probability sampling method was used by adapting systematic sampling method that produces a random sample. This is because it could eliminate sample selections that create bias. Two steps were imposed in this research. First, continuous list was made containing 1500 emails selected from random organizations such as universities, government companies and private companies located around Klang Valley, Peninsular Malaysia. Second step, using the systematic sampling method, the questionnaires systematically sampled to the 300 respondents by distributing the link of the survey form through the email and face to face distribution.

D. Data Analyses

In order to conduct EFA testing, a theoretically driven factor structure should be proposed prior to the analysis. In basic factor model, the observed variables are assumed will reflect the underlying factors. Two forms involved. First, there are common factors which identify as two or more observed variables but can be correlated or uncorrelated to all observed variables. Secondly, there are unique factors which recognize as specific to each variable and statistically uncorrelated to each other and to all common factors [19]. The major purpose of factor analysis is the identification of the minimum number of common factors required to reproduce the initial correlation or covariance matrix.

Unlikely, a principal component analysis (PCA) identifies components on the basis of variance [19]. Factor analysis, on the other hand, tries to explain the set of correlations or covariance represented in the data. Thus, EFA also applied to data sets with no a prior expectations or simply as an exercise in data reduction.

The factor analysis process is conducted in three stages, i.e. pre-analysis checks, extraction and rotation. The purpose of the pre analysis check is to ensure that the data set is appropriate for the application of EFA. On the other hand, the purpose of extraction is to identify and retain those factors which are necessary to reproduce adequately the initial correlation matrix. However, if the extraction procedure produces more than one factor, the extracted factors should be rotated for easier interpretation.

In extraction stage, Eigenvalue [20] and Scree Plot [21] test were used as the factor extraction criteria to determine the number of factors to retain. Meanwhile under rotation step, if the factors are assumed to be largely uncorrelated, an orthogonal rotation should be use. If the factors are assumed to be correlated, an Oblique Rotation should be used. Only factor loading with value above .40 should be retained for further analysis [22] and the minimum item for each component should be at least 4 item left [23] to be tested in further data analysis. All analyses were conducted in the Statistical Package for Social Sciences (SPSS), version 20.0.

III. RESULT AND ANALYSIS

A. Demographic characteristics of the sample

A total of 405 questionnaires were usable and included in the sample. Approximately 60.25% female and 39.75% male that participate in the survey. Respondent participating are from various ages, the respondents aged 25 to 30 years and 31 to 35 years consisted of 92 (22.72%) and 67 (16.54%) respectively. There are also 53 (13.09%) respondents aged between 36 to 40 years and 109 (26.91%) respondents are aged 40 years old and above. Other than that, most of them have a degree as the highest education level (63.70%). Meanwhile, majority of the respondent have the household income between RM2, 000 to RM5, 000 (35.8%).

B. Exploratory Factor Analysis

To test the EFA applicability, two methods have been used, i.e. Kaiser-Mayer-Olkin (KMO) and Bartlett Test Sphericity. Results of the Kaiser-Mayer-Olkin (KMO) and Bartlett Test (for all variables - KMO>.60, and Bartlett Test p<.000) supported the use of the factor analysis for examining the factor structure of the 45 items of public participation towards Renewable Energy (RE) instrument that were included in this study. Based on Oblique Rotation, results show that for both dependent and independent variables were suitable to do EFA analysis with KMO above 0.60 and Bartlett Test were significant (p< .05). (refer Table I).

Under factor extraction, results of Kaiser'Criterion shows that all five independent variables, i.e. awareness on RE (ARE), knowledge on RE (KRE), willingness to adopt RET (WTA), Environmental Concern (EC), and Attitude towards RE usage (AURE) and one dependent variable, i.e Willingness to pay (WTP) were loaded onto one factor. Scree Plot has been used to double confirm the factor structure of the instrument. Results of Scree Plot shows that all variables of dependent and independent were also loaded onto one factor. Factor structures of the instrument being obtained were conformed as per literatures and thus validate to be used in the data collection.

Table I. Summary Result on EFA

Variables	Constructs	Factor Suitability		Factor Extraction			
		Bartlet Test (p<0.05)	Kaiser- Mayer-Olkin (KMO> 0.6)	Eigenvalues > 1		Variance Explained (%)	Scree Plot
Dependent Variable	Willingness to pay (WTP)	.000	0.844	One Factor	3.429	57.147	One Factor
Independent Variables	Awareness on RE (ARE)	.000	0.909	One Factor	5.137	51.370	One Factor
	Knowledge on RE (KRE)	.000	0.762	One Factor	3.082	51.364	One Factor
	Willingness to adopt RET (WTA)	.000	0.843	One Factor	3.124	52.075	One Factor
	Environmental Concern (EC)	.000	0.810	One Factor	3.447	34.467	One Factor
	Attitude towards RE usage (AURE)	.000	0.879	One Factor	3.733	53.335	One Factor

Results obtained confirmed the components that have been acquired for every variable involved. Results for eigenvalue and scree plot have certified and validated the items for each component. In detail, the eigenvalue result for component under dependent variable - WTP was 3.429 with variance explained 57.147, and independent variables - ARE (eigenvalue 5.137, variance explained 51.370), KRE (eigenvalue 3.082, variance explained 51.364), WTA (eigenvalue 3.124, variance explained 52.075), EC (eigenvalue 3.447, variance explained 34.467), and AURE (eigenvalue 3.733, variance explained 53.335). However due to only one factor structure has been obtained, factor rotation is not necessary to be conducted. (refer Table I).

C. Reliability of Instruments

Test of reliability construct have been conducted to measure internal consistency between variables. Result of Cronbach's Alpha for consistency show that all variables, i.e. dependent and independent are well above .70. The reliability coefficients for each of the six variables of Public Participation towards Renewable Energy (RE) Development were as follows: (i) WTP (.850), (ii) ARE (.893), (iii) KRE (.805), (iv) WTA (.814), (v) EC (.762), and (vi) AURE (.853). (refer Table II).

Table II. Summary of Reliability Statistic (n=405)

Variables	Item After EFA Testing	
	Number of items	Cronbach's Alpha
Willingness To Pay (WTP)	6	0.850
Awareness on RE (ARE)	10	0.893
Knowledge on RE (KRE)	6	0.805
Willingness to Adopt RET (WTA)	6	0.814
Environmental Concern (EC)	10	0.762
Attitude towards RE Usage (AURE)	7	0.853

IV.   DISCUSSIONS

In terms of generalization, original instrument from previous literatures should be adjusted in order to acquire data in different study context, thus, adapted instrument has been modified to suit new research context. CFA testing and content validity have been done in order to develop the appropriate instrument scales in gathering opinion of improving public participation towards Renewable Energy (RE) development in Malaysia. As the electricity cost is one of the biggest portion in monthly spending, renewable Energy can be an alternative source of energy to Malaysian. Thus, it is imperative for this study to develop a reliable and valid instrument to assess public participating opinion regarding Renewable Energy (RE) development. Findings from this study show that the originally validated variables perform as per previous literatures in this research context. For dependent variable, i.e. WTP, 6 items were retained (4 items [13] and 2 items [14]). As for independent variables, i.e. (1) ARE, 10 items retained, (2) KRE, 6 items were retained (5 items [7] and 1 item [24]), (3) WTA, 6 items were retained,

(4) EC, retained original 10 items [17], and (5) AURE, retained original 7 items. In terms of inter-items reliability, the adapted public participation towards Renewable Energy (RE) instruments demonstrated good reliability for items under each of the variables, i.e. dependent and independent variables. All six adapted variables show that Cronbach 'Alpha value well above 0.70 against threshold.

Taken together, this information provides preliminary evidence that the public participation towards Renewable Energy (RE) instrument is a reliable and valid measure to obtain the data from prospective respondents.

However, in this study the sampling location maybe viewed as confine in certain area which is not larger enough, thus, future study can be conducted by engaging different location in order to cater different public opinion.

V. CONCLUSION

The aim of this study was to attain the public opinion regarding the development of the Renewable Energy (RE) in Malaysia. It is the valuable effort by conducting this study to helps encourage the public awareness on the possibility of Renewable Energy (RE) as an alternative source of energy for public basic needs in future. The findings of this study will also help government and energy players of the electricity in impelling the ideas and inputs of how public awareness and acceptance towards Renewable energy (RE) in Malaysia.

VI. ACKNOWLEDGMENT

REFERENCES

1. A. Biswas, "A Study of Consumers ' Willingness to Pay for Green Products", vol. 4, no. 3, pp. 211–215, 2016.
2. S. Mustapa, L. Y. P. L. Y. Peng, and A. Hashim, "Issues and challenges of renewable energy development: A Malaysian experience", Energy and Sustainable Development: Issues and Strategies (ESD2010), Proceedings of the International Conference on, pp. 1–6, 2010.
3. M. H. M. Ashnani, A. Johari, H. Hashim, and E. Hasani, "A source of renewable energy in Malaysia, why biodiesel?", Renewable and Sustainable Energy Reviews, vol. 35, pp. 244–257, 2014.
4. A. Biswas and M. Roy, "Green products: An exploratory study on the consumer behaviour in emerging economies of the East", Journal of Cleaner Production, vol. 87, no. 1, pp. 463–468, 2015.
5. T. Li and Z. Meshkova, "Examining the impact of rich media on consumer willingness to pay in online stores", Electronic Commerce Research and Applications, vol. 12, no. 6, pp. 449–461, 2013.
6. C. Donaldson, "Eliciting patients â€™ values by use of ` willingness to pay ': letting the theory drive the method", Health Expectation, no. 4, pp. 180–188, 2000.
7. Scottish Executive, "Attitudes and Knowledge of Renewable Energy amongst the General Public", 2003.
8. I. Morgil, N. Secken, A. S. Yucel, O. O. Oskay, S. Yavuz, and E. Ural, "Developing a renewable energy awareness scale for pre-service chemistry teachers", Turkish Online Journal of Distance Education, vol. 7, no. 1, pp. 57–67, 2006.
9. R. Bord, R. O'Connor, and A. Fisher, "In what sense does the public need to understand global climate change?", Public Understanding, vol. 9, no. 2000, pp. 205–218, 2000.
10. C. L. Kimberlin and A. G. Winterstein, "Validity and reliability of measurement instruments used in research", American Journal of Health-System Pharmacy, vol. 65, pp. 2276–84, 2008.
11. J. E. Bartlett, J. W. Kotrlik, and C. C. Higgins, "Organizational Research: Determining Appropriate Sample Size in Survey Research", Information Technology, Learning, and Performance Journal, vol. 19, no. 1, pp. 43–50, 2001.
12. A. Field, Discovering Statistics Using SPSS, vol. 81, no. 1. London, 2013.
13. H.-K. Bang, A. E. Ellinger, J. Hadjimarcou, and P. A. Traichal, "Consumer concern, knowledge, belief, and attitude toward renewable energy: An application of the reasoned action theory", Psychology and Marketing, vol. 17, no. 6, pp. 449–468, 2000.
14. M. S. Aini and M. Goh Mang ling, "Factors Affecting the Willingness to Pay for Renewable Energy amongst Eastern Malaysian Households : A Case Study", Social Science and Humanities, vol. 21, no. 1, pp. 147–164, 2013.
15. T. E. Curry, "Public Awareness of Carbon Capture and Storage: A Survey of Attitudes toward Climate Change Mitigation", no. 1999, p. 94, 2004.
16. N. Fransson and T. Garling, "Environmental Concern : Conceptual Definitions , Measurement Methods , And Research Findings", Journal of Environmental Psychology, vol. 19, pp. 369–382, 1999.
17. A. M. Salleh, "The Economic Valuation of Solar Water Heating Systems and The Determinants of Its Adoption by Libyan Households", 2015.
18. D. H. Carlson, "Environmental Concern on South Africa: The Development of A Measurement Scale", 2004.
19. E. Ferguson and T. Cox, "Exploratory Factor Analysis: A Users' Guide", International Journal of Selection and Assessment, vol. 1, no. 2, pp. 84–94, 1993.
20. M. R. Matthews-Ewald, A. Posada, M. Wiesner, and N. Olvera, "An exploratory factor analysis of the Parenting strategies for Eating and physical Activity Scale (PEAS) for use in Hispanic mothers of adolescent and preadolescent daughters with overweight", Eating Behaviors, vol. 19, pp. 193–199, 2015.
21. H. F. Kaiser, "The Application of Electronic Computers To Factor Analysis", Educational And Psychological Measurement, Vol. xx, No. 1, Pp. 141–151, 1960.
22. R. B. Cattell, "The Scree Test For The Number Of Factors", Multivariate Behavioral Research, vol. 3171, no. April, 1966.
23. Z. Awang, A Handbook on SEM for Academicians and Practitioners: The Step by Step Practical Guides for the Beginners. Bandar Baru Bangi.: MPWS Rich Resources., 2014.
24. R. Kardooni, S. B. Yusoff, and F. B. Kari, "Renewable energy technology acceptance in Peninsular Malaysia", Energy Policy, vol. 88, pp. 1–10, 2015.