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ASSESSING PREFERENCES AND WILLINGNESS TO PAY FOR RENEWABLE ENERGY INVESTMENT AMONG MANUFACTURING SECTORS IN MALAYSIA: A CHOICE EXPERIMENT METHOD

SITI NORADIAH AMAR[1], MAHIRAH KAMALUDIN[1,3]*, AZLINA ABD AZIZ[1], MUHAMAD RIAS K V ZAINUDDIN[1], KHAIRUL IZZUDDIN SULAIMAN[2]

[1]Faculty of Business, Economics and Social Development, Universiti Malaysia Terengganu, 21030 Kuala Nerus, Terengganu, Malaysia. [2]Department of Strategic Planning, Sustainable Energy Development Authority (SEDA), Persiaran Perdana, Presint 4, 62100 Putrajaya, Wilayah Persekutuan Putrajaya, Malaysia. [3]Institute of Tropical Agriculture & Food Security, Universiti Putra Malaysia, Jalan Maklumat, 43400 Serdang, Selangor, Malaysia.

**Corresponding author: mahirah.k@umt.edu.my*
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Abstract: Green energy has become a hot debate among countries. Most countries prefer green energy over fossil resources that can violate the environment and health. The manufacturing sector was the most energy-intensive sector in Malaysia, and Johor was the fastest-growing industrial state and the biggest user of fuel energy. The cost factor has become one of the reasons why renewable energy is less used in this country. If not curbed, this situation will thwart the government's target to reduce the dependency on non–renewable energy. Thus, participation from the manufacturing sector is important to support government efforts to empower renewable energy. Support from the manufacturing sector and their Willingness to Pay (WTP) for energy production from renewable energy resources remain key ingredients for a successful energy policy. This study aims to estimate the WTP for renewable energy investment attributes among the manufacturing sectors in Johor, Malaysia. A series of stated Choice Experiments (CE) was used in which the Multinomial Logit (MNL) model was valued to ascertain manufacturing sectors' WTP based on their preferences for the attributes. The results revealed that the manufacturing sector values project location and annual GHG reduction.

Keywords: Fuel energy, Choice Experiment, Multinomial Logit, Johor, Malaysia.

Introduction

Renewable energy has become the energy source with the greatest growth rate as the globe heeds the demand for "less carbon" and "more sustainable energy". Any primary energy sources are derived from natural and inexhaustible resources. For example, solar, biomass, biogas, and hydropower can be classified as renewable energy. Using renewable energy sources provides more benefits to people and the environment than using non-renewable energy sources such as fossil fuels. This is because the main element of fossil fuels is carbon, which can harm the environment and health. One benefit of renewable energy, also known as alternative energy, is that it helps to reduce pollution. For example, Bianchi *et al.* (2014) discovered that alternative energy sources can reduce carbon dioxide emissions and environmental problems. It was supported by a study by Lian (2019), which established that using alternative energy can reduce greenhouse gas emissions.

Climate change is primarily a result of energy use. It produces 73% of the greenhouse gases that are created by humans (United Nations Development Programme, 2023). According to the Energy Commission of Malaysia (2020), in 2018, the total number of electricity consumers in Malaysia was 10, 335, 335, with a total electricity consumption of 144, 640 GWh. Out of this number, the highest number of consumers is coming from the domestic sector (8,456183.19) followed by commercial (1,744926.69), public lighting (92925.09), manufacturing (30975.03), and others (10325.01). Despite the domestic sector having the highest number of electricity consumers, it does not make it the highest electricity consumption (29651.20 GWh) in Malaysia. Note that the highest number of electricity consumption in Malaysia is coming from the manufacturing sector (66534.40 GWh). This implies that the manufacturing sector dominates the electricity consumption in Malaysia.

Energy use is the dominant contributor to climate change. Therefore, the role of the manufacturing sector in electricity generation using renewable energy sources is important to help reduce global warming. The movement to the use of renewable energy sources to generate electricity in this sector can accelerate the achievement of the 7th Sustainable Development Goal (SDG). This is to ensure that every individual obtains clean and affordable energy, which is the key to the development of agriculture, business, communication, education, health care, and transportation.

There are seven types of manufacturing industries in Malaysia, namely electrical & electronic, petroleum & chemicals, woods & papers, foods & beverages, textiles & clothes, non-metal & metals, and transportation & others. Maamor & Sahlan (2005) determined that GDP is affected by the use of electricity sources. The rapid development of the manufacturing sectors, which leads to the generation of economic growth in Malaysia, causes a high demand for energy resources. Consequently, the effect of the relationship between the use of energy resources and economic growth is clear because the use of energy resources is important to generate production or economic sector activities that will ultimately lead to economic growth.

Malaysia has abundant renewable energy resources, for example, solar, hydropower, biogas, and biomass. Nevertheless, the consumption of renewable energy in Malaysia is still far lower than that of non-renewable energy at the world level and among the 10 ASEAN countries (World Bank Data, 2020). This implies that the awareness about the benefits and advantages of renewable energy is low among Malaysians. Therefore, if not curbed, this situation will spoil the government's target to reduce the dependency on non–renewable energy. This is because Malaysia has set its target to reach 31% of renewable energy installed capacity in 2025 and 40% in 2035 (Malaysia Renewable Energy Roadmap, 2021).

Malaysia is among the major oil and gas producers, but its domestic production is insufficient to satisfy its entire demand for petroleum and related products. To meet its energy needs and support various industries that depend on these resources, Malaysia must import crude oil, refined petroleum products, and other petrochemicals. It was predicted that the nation would continue to rely more on imported oil (Yudha & Masaru, 2012). Although Malaysia is rich in renewable energy sources, many alternative energies have not been exploited because there is no attempt to commercialise the discoveries involved. Other than that, the move by the government to introduce some new initiatives to encourage the use of renewable energy among Malaysians is a step forward to improve environmental cleanliness and to reduce the dependence on non-renewable energy in the future. The use of renewable energy is beneficial to our environment. This has been proved by previous studies conducted by Inglesi–Lotz (2016), who analysed that using renewable energy has a lower impact on the environment than non-renewable energy.

Willingness to Pay for Renewable Energy

This paper aims to estimate the Willingness to Pay (WTP) among manufacturing sectors for renewable energy investment attributes in Johor, Malaysia. Knowing which attributes influence WTP is particularly useful for the government to understand what attributes they should consider and focus on when planning to achieve their target of renewable energy by 2030.

WTP is the maximum price an individual will pay for a product or service. Numerous WTP surveys have been conducted across a wide range of settings, and a multitude of determinants that influence renewable energy using stated preference techniques, particularly contingent valuation and Choice Experiments (CE), have been discovered (Menyeh, 2021)the integral role that household investors can play is being realised and understanding the preferences of such household investors is crucial to raising the necessary investments to bridge the gap. Using a discrete choice survey administered to Ghanaian household investors, this paper presents findings on household investor willingness to pay for the attributes associated with renewable energy (RE. However, there are also several studies but very limited on WTP for renewable energy investment have been conducted in other developing countries using CE methods such as India (Sagebiel & Rommel, 2014), Indonesia (Siyaranamual *et al.,* 2020), Africa (Menyeh, 2021)the integral role that household investors can play is being realised and understanding the preferences of such household investors is crucial to raising the necessary investments to bridge the gap. Using a discrete choice survey administered to Ghanaian household investors, this paper presents findings on household investor willingness to pay for the attributes associated with renewable energy (RE, and Kenya (Oluoch *et al.,* 2021)this study applied a choice experiment analysis to determine how attributes (type of energy, ownership, impact on environment, distance and visibility, community job creation, and yearly renewable energy tax. Table 1 presents several studies on WTP.

Studies that employed economic valuation methods are relatively limited regarding renewable energy sources in Malaysia. Researchers have only employed the Contingent Valuation Method (CVM) until this point, focusing on renewable energy sources where the respondents were households (Azlina *et al.,* 2018; 2022; Afroz *et al.,* 2019). Therefore, this study is the first to conduct the CE method to investigate the WTP for renewable energy investment, with the targeted respondent being the manufacturing sector.

Table 1: Studies on Willingness to Pay (WTP) for Attributes of Renewable Energy Investment in Developing Countries.

No.	Authors	Survey Area	Attributes	Signs	Value of WTP
1.	Sagebiel and Rommel, (2014)	India	**Duration of scheduled power cuts**	+	**INR0.286**
			Duration of unscheduled power cuts	+	INR0.039
			Renewable energy in the energy mix	+	INR0.020
			Institutional set up	-	INR0.223
			Additional costs per month	-	
2.	Siyaranamual *et al.* (2020)	Indonesia	Rural electrification	+	IDR90.0
			Shorter duration outage	+	IDR61.5
			Hydropower	+	**IDR155.4**
			Electricity bill	-	
3.	Menyeh (2021)	Africa	Rate of return	+	GHS19.47
			Track record of the project developer	+	**GHS476.16**
			Project viability	+	GHS315.18
			Hold time	-	GHS7.85
			Origin of project developer	+	GHS147.92
			Price of investment	-	
4.	(Oluoch *et al.,* 2021)	Kenya	**Type of renewable energy**	+	**KSH1.543**
			Ownership	Not significant	KSH0.218
			Impact on the environment	+	KSH2.973
			Distance and visibility	+	KSH1.119
			Community job creation	+	KSH0.647
			Proposed yearly tax on renewable energy development	-	KSH8.814

Source: Author's own compilations.

Methodology

Choice Experiment (ce) Method

A CE survey is a stated preference valuation tool to determine the (WTP) for goods and services. In this study, the CE is used, and the Multinomial Logit (MNL) model was valued to ascertain the manufacturing sector's attribute preferences based on their WTP. Generally, there are seven steps in implementing CE, which are (i) characterise the decision problem, (ii) identify and describe the attributes, (iii) develop an experimental design, (iv) develop the questionnaire, (v) collect data, (vi) estimating model, and (vii) interpret results for policy analysis or decision support.

This study referred to experts and officers in the Sustainable Energy Development Authority (SEDA) to learn about the growth of renewable energy sources in Malaysia. A detailed discussion was conducted to gather information to identify appropriate attributes and their levels for this study.

The first attribute is related to the types of renewable energy. The decision to use this attribute matches Malaysia's objective to achieve 31% or 12.9 GW of renewable energy installed capacity by 2025 and 40% or 18.0 GW of renewable energy installed capacity by 2035. To date, Malaysia's total generation of renewable energy sources is at 23% or 8.45 GW (Malaysia Renewable Energy Roadmap, 2021). The highest number of renewable energy source generation is represented by solar (424, 191 MW), followed by biomass (228, 540 MW), biogas (216, 890 MW), and small hydropower (75, 552 MW) (Sustainable Energy Development Authority, 2021). The amount of renewable energy generation that has not yet reached the target has caused the government to encourage using renewable energy sources other than solar energy, such as biomass, biogas, and small hydropower. This is because Malaysia has abundant renewable energy resources that have yet to be fully exploited. Therefore, the option of generating renewable energy sources through the exploitation of renewable energy sources such as biomass, biogas, and small hydropower by the manufacturing sector can help to swiftly achieve the government target. The attribute levels chosen for this attribute are solar as level 1, biomass as level 2, biogas as level 3, and small hydropower as level 4. We choose solar as the status quo because currently, solar has the highest generation of electricity from renewable sources among Malaysians. However, solar energy is not the only renewable source that can achieve the government target by 2035 since Malaysia has abundant other renewable energy resources. Since manufacturing sectors use electricity more than other users, this study proposed that manufacturing sectors use renewable energy besides solar to help achieve the target set by the government quickly by utilising the abundance of renewable energy sources in Malaysia.

The selection of project location attributes was based on renewable energy resource sites developed in several areas in Malaysia. To date, there are only three renewable energy power plants in Johor, with one in Pengerang and two in Pasir Gudang (Energy Commission, 2022). The distance between the project location and the factory is important to ensure that the noise from the processing of renewable energy sources at the project site will not disturb manufacturing activities (Ek, 2002). Hence, the attribute levels selected for this attribute are unchanged as level 1, where the site of the renewable energy source power plant is maintained in the existing location. On the other side, near level 2, where the site of the renewable energy source power is developed in the same area as the factory, and far as level 3, where the site of the renewable energy source power plant is developed in an area different from the factory location.

The third attribute is the GHG annual reduction. The decision to use this attribute matches Malaysia's objective to reduce the intensity of its carbon emissions, notably a 45% reduction (compared to 2005 levels) by 2030. In enhancing environmental sustainability, Malaysia has reduced GHG emissions to GDP by 29.4% in 2016 based on the intensity of emissions in 2005 (The 12th Malaysia Plan, 2021). To reach a 45% GHG emission reduction by 2030, this study follows a study by Waldau *et al.* (2020) that uses the Compound Annual Growth Rate (CAGR) formula to calculate GHG emission reductions. Therefore, this study chooses a reduction in the intensity of GHG emissions to GDP by 29.4% in 2016 based on the intensity of emissions in 2005 as first level, average GHG reduction, which is 36.7% as level 2, and reduction in the intensity of GHG emission to GDP by 45% in 2030 based on the intensity of emissions in 2005 as level 3. This study includes the average GHG reduction of 36.7% to avoid a large difference between 29.4% and 45.0%.

This study selected a renewable energy fund, the KWTBB, as an attribute for a monetary attribute. KWTBB is an additional charge imposed on all electricity users who use electricity above RM77 or 300kwh per month. This KWTBB was first introduced by the government in 2011 as an investment measure for renewable energy sources with a charge of 1% of the consumer's electricity bill. In 2014, the charges applied were increased by 0.6%, making the value of KWTBB as much as 1.6%. According to the Minister of Energy & Natural Resources Malaysia, Dr Shamsul Anuar Nasarah, 0.6% is the optimum value to achieve the target of 31% renewable energy in power capacity in 2025 and 40% in 2035. To achieve this target, Malaysia needs RM33 billion, and in 2021, the investment in renewable energy in Malaysia will be only RM3 billion, to which KWTBB will contribute RM770.18 million (Annual Report Renewable Energy Fund, 2020). Investment in renewable energy sources should be made by all parties, including the manufacturing sector. Note that the manufacturing sector is seen as an investor that has the potential to help achieve the target of generating renewable energy sources more quickly through investment in KWTBB. This is because the manufacturing sector in Malaysia uses the most electricity compared to other electricity users. This implies that the manufacturing sector dominates the electricity consumption in Malaysia. Therefore, the additional charge to the manufacturing sector should be different from other electricity users through this KWTBB collection. Thus, the level chosen for this attribute is based on the optimal value of 0.6%, where 1.6% is level 1, 2.2% is level 2, and 2.8% is level 3. The investment value that does not exceed this 3% is considered reasonable and does not burden the manufacturing sectors. The included attributes, their descriptions, and levels are summarised in Table 2.

Table 2: Attributes Descriptions and Levels.

Attributes	Descriptions	Levels
Types of renewable energy (TOREG)	The types of renewable energy sources responsible for supporting the government target to achieve 31% or 12.9GW of renewable energy installed capacity by 2025 and 40% or 18.0%GW of renewable energy installed capacity by 2035.	**Level 1: Solar photovoltaic** Level 2: Biomass Level 3: Biogas Level 4: Small hydropower
Project Location (PL)	The distance between the project location and the manufacturing sectors.	**Level 1: Unchanged** Level 2: Near Level 3: Far
GHG annual reduction (GHG)	The impact of renewable energy on GHG annual reduction.	**Level 1: 29.4%** Level 2: 36.7% Level 3: 45.0%
Monthly increase in KWTBB (PRICE)	Additional charges are implied to all manufacturing sectors except for factories that use electricity below 300kWh or RM77 per month.	**Level 1: 1.6%** Level 2: 2.2% Level 3: 2.8%

Note: Bold font demonstrates the *status quo* in the study.

There are four attributes that resulted in a full factorial with 108 combinations (4*3*3*3). Generally, it is examined as too expensive and lifeless to have respondents rate all possible combinations in a full factorial design (Kuhfeld, 2005). Therefore, fractional factorial design was used in this study to consider a selection of possible alternatives and to avoid cognitive burden for the respondents. Thus, using the 2^k design, in which k is the number of attributes, only 16 choice tasks will be created in this study (Tazliqoh *et al.* 2019). According to Mariel *et al.* (2021), presenting respondents "with more than four or eight choice tasks" would be too much for them because it would be too complex and would tire them when having to respond to numerous tasks. Therefore, to reduce the fatigue effect on the respondents, this study will separate the 16 choice tasks into 2 blocks, each containing 8 choice tasks only.

The survey questionnaire comprises four sections. The first part contains CE analysis designed to elicit respondents' WTP for renewable energy investment by estimating trade-offs between price and other attributes. To obtain respondents' understanding, infographic photos of renewable energy sources, for example, solar photovoltaic, biomass, biogas, and small hydropower, were included in this section. The second part contained questions on why manufacturing sectors are willing and not willing to pay for renewable energy investment. The third part contains questions about perceptions of environmental issues. Note that the last part was used to obtain the respondent's background profile of the manufacturing sectors in Johor. A series of questionnaires was provided in which the choice alternatives for the renewable energy investment attributes differed according to the choice tasks. Each choice task had three alternatives, in which alternative A and B were the alternatives while alternative C was the status quo. The status quo was provided mainly for the respondents who desired to choose a current condition. Figure 1 illustrates an example of a choice task used in the questionnaire. This choice task has been automatically constructed by STATA software using the opt-out (status quo) with block design.

Data Sampling

The study follows a stratified sampling technique because this technique is the most common sampling strategy applied in the CE method (Louviere *et al.*, 2000). For this study, the sample size calculation for the CE method will be based on Johnson and Orme (2003), similar to a study conducted by Bridges *et al.* (2011). The rule of thumb, as proposed by Johnson and Orme (2003), suggests that the sample size required

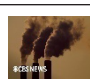
Attribute	Alternative A	Alternative B	Alternative C
Types of renewable energy	 Biomass	 Small hydropower	No change
Project location	 Near	 Far	
GHG annual reduction	 36.7%	 29.4%	
Monthly increase in KWTBB	 1.6%	 2.2%	
Your choice?	**[A]**	**[B]**	**[C]**

Figure 1: Example of the choice task in the questionnaire

for the main effects depends on the number of choice tasks (t), the number of alternatives (a), and the number of analysis cells (c) according to the following equation:

$$N \geq 500c / (t \times a).$$

By considering the main effects, ‘c’ represents the largest number of levels for any of the attributes. When considering all two–way interactions, ‘c’ is equal to the largest product of levels of any attributes (Johnson & Orme, 2003). Thus, the calculation of data samples as in Equation 2:

$$N \geq 500(4) / (8 \times 2), \quad (2)$$
$$N \geq 2000 / 16,$$
$$N \geq 125.$$

Therefore, the minimum sample size for this study must be equal to or greater than 125 registered and active manufacturing sectors in Johor. The selected 200 respondents in this study were sufficient to proceed with CE data analysis.

Specification of Multinomial Logit (MNL) Model

This section also presents the CE result using the MNL model. This model is assumed to be a linear function of the choice’s attributes. Consequently, the econometric function for the MNL model can be written as in Equation 3:

$$U = \beta_1 X_{TOREG2} + \beta_2 X_{TOREG3} + \beta_3 X_{TOREG4} + \beta_4 X_{PL2} + \beta_5 X_{PL3} + \beta_6 X_{GHG2} + \beta_7 X_{GHG3} + \beta_8 X_{PRICE}, \quad (3)$$

where
X_{TOREG2} = Biomass
X_{TOREG3} = Biogas
X_{TOREG4} = Small hydropower
X_{PL2} = Near
X_{PL3} = Far
X_{GHG2} = 36.7%
X_{GHG3} = 45.0%
X_{PRICE} = Monthly increase in KWTBB.

Marginal Willingness to Pay (mwtp)

The CE involves calculating Marginal Willingness to Pay (MWTP) for an attribute. The coefficient β (Equation 3) can be applied to estimate the MWTP for each non-monetary attribute. In order to estimate the MWTP, the coefficients for each attribute will be divided by the coefficient for the price term. The MWTP model can be written as in Equation 4:

$$MWTP = -\frac{\beta i}{\beta price}, \quad (4)$$

where
βi = Biomass, Biogas, Small hydropower, Near, Far, 36.7%, 45.0%,
$\beta price$ = Monthly increase in KWTBB.

Pre-test Results

There were 30 respondents involved in the pre-test from 6 districts such as Kulai, Kota Tinggi, Johor Baharu, Pontian, Kluang, and Batu Pahat. It was reliable and convenient to show that the respondents were from various manufacturing sub-sectors. Table 3 demonstrates the total of respondents involved in the final pre-test.

The selection of 30 respondents was convenient because they were not too divergent from the actual respondents. The statistical sample for pre-testing is unnecessary since the pre-testing process focuses on determining if the respondent has difficulty understanding the

Table 3: Total of Respondents in Pre-test

District	No. of Respondents
Kulai	5
Kota Tinggi	5
Johor Baharu	5
Pontian	5
Kluang	3
Batu pahat	7
Total	30

questionnaire (Zikmund, 2000). Subsequently, the pre-test was implemented to avoid any unclear and unbiased questions in the questionnaire.

Results

This study was conducted in the manufacturing sector in Johor. According to the Department of Statistics Malaysia (2021), based on the data from the economic census in 2016, the number of registered manufacturing sectors in Malaysia was 49, 101 and there are 8, 046 active manufacturing sectors in Johor. This study uses the manufacturing sector in Johor because the biggest energy user in Malaysia is the manufacturing sector, and Johor is the fastest-growing industrial state in Malaysia.

This study employed face-to-face interviews by conducting the stated CE survey, with a sample population involving 200 registered manufacturing sectors with electricity bills above RM77 per month in Johor, Malaysia, in various sub-sectors with the assistance of trained enumerators. The information was collected from the managing director or general manager responsible for the factories' energy resources. A survey was conducted for about five months, from April 2022 until September 2022. The data analysis was performed with the econometric software Nlogit Version 4.0.

Descriptive Characteristics of Manufacturing Sectors

Table 4 presents the descriptive characteristics of manufacturing sectors. There were 200 manufacturing sectors in the survey. Out of the total number of respondents, 22 manufacturing (11.00%) generated electricity from renewable energy resources, while 178 (89.00%) generated electricity from fossil resources. The mean and standard deviation are 1.89 and 0.31, respectively. The result presented that

Table 4: Characteristics of manufacturing sectors (n=200)

Characteristics	Frequency	Percent (%)	Mean	Std. Deviation
Electricity generation from renewable energy resources			1.89	0.31
Yes	22	11.00		
No	178	89.00		
Types of renewable energy resources used to generate electricity			0.26	0.85
Solar photovoltaic	8	4.00		
Biomass	3	1.50		
Biogas	7	3.50		
Small hydropower	2	1.00		
Others	2	1.00		
None	178	89.00		
Company interest in generating electricity from renewable energy resources			1.24	0.63
Yes	109	54.50		
No	69	34.50		
Generated	22	11.00		
KWTBB info			1.12	0.33
Yes	176	88.00		
No	24	12.00		

the majority of the manufacturing sectors are still using traditional resources to generate electricity. Therefore, this study is important to determine if the manufacturing sector that uses non-renewable energy sources is interested in using renewable energy sources in the future.

The result of this study also found that out of 178 manufacturing sectors that do not use renewable energy resources to generate electricity, 109 manufacturing (54.50%) were interested in generating electricity from renewable energy resources. Meanwhile, 69 manufacturing (34.50%) were not interested in generating electricity from renewable energy resources. The mean and the standard deviation are 1.24 and 0.63, respectively. This shows that the number of manufacturing sectors interested in using renewable energy sources in the future is higher than those not interested in using renewable energy sources. Therefore, this manufacturing sector has a high opportunity to achieve the government's target.

Out of 22 manufacturing sectors that generated electricity from renewable energy resources, about 8 sectors (4.00%) used solar photovoltaic, 3 sectors (1.50%) used biomass, 7 sectors (3.50%) used biogas, 2 sectors (1.00%) used small hydropower, and 2 sectors (1.00%) used others resources to generate electricity. The mean and the standard deviation were 0.26 and 0.85, respectively. This study presented that the use of solar is the highest among the 22 manufacturing sectors that use renewable energy sources. Moreover, this implies that solar power is the preferred among the manufacturing sectors to generate electricity in their factories.

Most respondents (88.00%) were familiar with renewable energy funds and the KWTBB information, and only 12.00% were unfamiliar with the KWTBB information. The mean and the standard deviation are 1.12 and 0.33, respectively. This demonstrates that most manufacturing sectors are still unaware of the additional charges applied to their electricity bills as an investment in renewable energy sources.

Manufacturers Preparedness for Renewable Energy Investment

Figure 2 demonstrates the result of the preparedness for renewable energy investment among the manufacturing sectors. Of the 200 respondents, 82 (41%) were ready for renewable energy investment, while 118 (59%) were not. This implies that most of the respondents are not aware of the importance of renewable energy resources and are not willing to contribute to this kind of resource.

Multinomial Logit (MNL) Results

Table 5 shows the results for the MNL model. The estimated equations are statistically significant at a 1% level except for the price attribute, which is statistically significant at a 5% level. This study is consistent with the study conducted by Kim *et al.* (2019), where they discovered that the price coefficient has a negative sign and significance at a 5% level. Judging from the statistical result, the coefficients on all the attributes are significant except for the TOREG at levels 2 and 4. Furthermore, the signs of the coefficients are consistent with the expectation. For example, the coefficient of project location (PL2 and PL3) and greenhouse gas annual reduction (GHG2 and GHG3) are significant and positive. This implies that if the level of any of these attributes increases, the utilities of respondents are increased. Nevertheless, the coefficient of the TOREG (TOREG2 and TOREG4) is not statistically significant and

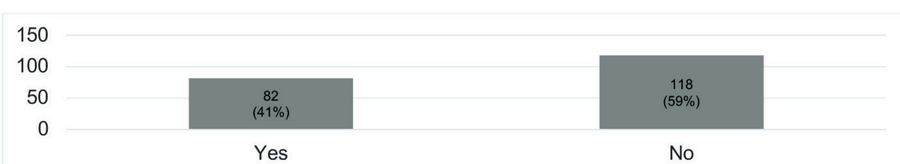


Figure 2: Manufacturers' preparedness for renewable energy investment

Table 5: Multinomial Logit model.

Attributes	Coefficient (t-ratio)	Standard Error	95% Confidence Interval
TOREG2	-0.06157 (-0.69)	0.08932	-0.23663 to 0.11349
TOREG3	-0.25158 (-2.77)***	0.09082	-0.42958 to -0.07357
TOREG4	-0.13305 (-1.50)	0.08841	-0.30632 to 0.04023
PL2	0.29156 (3.83)***	0.07610	0.14242 to 0.44071
PL3	0.39507 (5.26)***	0.07515	0.24778 to 0.54236
GHG2	0.33000 (4.29)***	0.07688	0.17930 to 0.48069
GHG3	0.24846 (3.43)***	0.07429	0.10285 to 0.39407
PRICE	-0.13722 (-2.17)**	0.06327	-0.26122 to -0.01321

Notes: ***significant at 1%, **significant at 5%, *significant at 10%.

has a negative sign. This does not indicate that manufacturing sectors derive significant value from this attribute. Meanwhile, TOREG3 is statistically significant but has a negative sign in the relationship. This indicates that manufacturing sectors derive significant value from this attribute. The negative sign for the price attribute in this study, PRICE, is within the expectation and meets the rule of thumb in the CE method. This means that the higher the price, the lesser the respondents' utilities.

Marginal Willingness to Pay (mwtp) Results

Table 6 presents the result of the MWTP. The negative sign for the TOREG3 implied that the manufacturing sectors are unwilling to contribute to 31% of renewable energy installed capacity by 2025 and 40% by 2035 through biogas. Instead, they preferred to stay in the current condition (*status quo*) of using solar photovoltaics.

The estimated value is 2.12 to change the project location from the current condition (unchanged) to the near location (PL2), and the t-value is computed as 2.10. It can be explained that each one-unit increase in project location has a marginal value of 2.12%. Meanwhile, the estimated value for far location (PL3) is 2.88, and the t-value is computed as 2.09. It can be explained that the project location from near to far is highly valued by the manufacturing sectors because the estimated value of PL3 is higher than that of PL2. The finding implies that the manufacturing sectors preferred to invest more in distant locations.

In terms of annual GHG reduction, the result illustrates that GHG annual reductions are also highly valued by the manufacturing sectors. The estimated value is 2.40 to denote the improvement from 29.4% (current condition) to 36.7% (GHG2), and the t-value is computed as 2.05. In other words, each one-unit increase

Table 6: Estimation of the Marginal Willingness to Pay (MWTP) and the t-value for the model

Attributes	MWTP	t-value
TOREG2	-0.44872	-1.61
TOREG3	-1.83343	-0.63**
TOREG4	-0.96962	-1.18
PL2	2.12485	2.10**
PL3	2.87916	2.09**
GHG2	2.40492	2.05**
GHG3	1.81072	2.01**

in GHG annual reduction has a marginal value of 2.40%. Meanwhile, the estimated value for GHG3 is 1.81, and the t-value is computed as 2.01. It can be explained that the GHG annual reduction from GHG2 to GHG3 is less valued by the manufacturing sectors because the estimated value of GHG2 is higher than that of GHG3. The manufacturing sectors preferred to invest more, from 29.4% to 36.7%, for GHG annual reduction.

Conclusion

The findings on the economic valuation of renewable energy investment in Johor using the CE method provide a new highlight to the government to achieve the target in 2030 by acknowledging the attributes preferences among the manufacturing sectors. The main objective of this study was to demonstrate the empirical analysis of CE to estimate the manufacturing sector's WTP for renewable energy investment attributes in Johor using the MNL model. Consequently, the estimated marginal value results showed that investment in terms of project location and GHG annual reduction are highly valued by the manufacturing sectors, with a value of 2.88% and 2.40%, respectively. From the empirical result, we can conclude that the manufacturing sector in Johor preferred to invest more in using solar photovoltaic (current condition) to support the government's target to achieve 31% or 12.9GW of renewable energy installed capacity by 2025 and 40% or 18.0 GW of renewable energy installed capacity by 2035, the project location far from their factories and GHG annual reduction is at 36.7%.

There is still the need for more studies on the WTP to promote renewable energy investment using the CE, especially in the manufacturing sectors in developing countries. On the other hand, no study has been conducted in Malaysia focusing on renewable energy investment using the CE. This study, therefore, aims to estimate the WTP for renewable energy investment attributes among manufacturing sectors in Johor, Malaysia, and eventually contribute to the increase in the number of studies. The outcome of this study can benefit policymakers by providing relevant policies for renewable energy investment in the manufacturing sector. Other than that, policy changes need to be reviewed to achieve long-term advantages. KWTBB is one of the mechanisms used by the government to collect funds from Malaysians for renewable energy. It is not necessary for the funds charged to all consumers to be the same because the highest amount of electricity consumption comes from the manufacturing sector. Thus, this study helps policymakers develop a new policy on KWTBB according to the WTP for renewable energy investment attributes among the manufacturing sectors.

Based on the result of this study, manufacturing sectors greatly demonstrate their concern about project location, followed by the GHG annual reduction from the current condition to the third and second levels of attributes. This is based on the value they put for their WTP, which is 2.88% and 2.40%, respectively. The outcome of the study is in line with the aim of Johor, which is to become a major producer of eco-friendly energy in Southeast Asia with the opening of solar power in Pengerang, Kota Tinggi, which is worth RM1.4 billion (Malaysia Investment Development Authority, 2021). This is based on the result of marginal WTP, which shows a negative sign for the types of renewable energy at all levels. This result explained that the manufacturing sector preferred to use solar photovoltaic to support the government target. Note that the significant value with a negative sign shown by TOREG3 implies that the utilities of manufacturing sectors are decreased if the level of these attributes increases.

Several significant limitations are unavoidable in this study and should be considered in the future study. This study is the first to use the CE method in Johor, even in Malaysia, with manufacturing sectors as the targeted respondents. Therefore, there is a lack of reliable and available data, which limits the scope of the study. Furthermore, the sample size in this study includes all subsectors in the manufacturing sector. It is suggested that it would be better if the sample size for future studies is a subsector contributing to Malaysia's highest energy consumption.

This study also helps achieve one of the SDG targets of providing everyone with universal access to affordable, reliable, sustainable, and modern energy by 2030. Renewable energy solutions are becoming more reliable and efficient every day. Applying these new energy solutions as fast as possible is vital to combat climate change, one of the significant pressures to our survival. Relating to Goal 7 in SDGs, investing in renewable energy sources such as biomass, biogas, and small hydropower is necessary to guarantee everyone access to affordable electricity by 2030. Adopting reasonable standards for a broader range of technologies might also cut the amount of electricity used by buildings and industries worldwide by 14%.

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