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ARTICLE

Social Acceptance of Green Electricity: A Case Study in Putrajaya

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ABSTRACT

In recent years, the majority of the renewable energy programmes and initiatives introduced have been industry and commercial centric. Little focus has been given by the government to domestic consumers' acceptance. The concept of "social acceptance" is used to evaluate the readiness of the public in embracing renewable investments within their area. It is a tool to measure the attitude of citizens, either active or passive, towards different green products or technologies. This study aims to identify factors that influence the social acceptance of green electricity among consumers and, subsequently, the relationship between these factors. An empirical study was conducted on the residents of Putrajaya, involving 185 respondents. Descriptive analysis and Pearson correlation were used as analysis methods in this study. The results showed that attractiveness, compatibility, and reliability are the main factors that influence their intention to use green electricity. These results suggest that the respondents' intention to use green electricity is not affected by their level of environmental knowledge or the cost of using green electricity.

Keywords: sustainable development, green electricity, social acceptance

1. Introduction

Climate change is one of the most debated issues among scientists and policymakers as it poses a major threat to the environment, public health, and economic development (Bell et al., 2011). One of the main causes of climate change is energy consumption through economic and human activities, such as the mass production of technological goods, rapid intensification of agricultural activities, increased urbanization, and rising fossil fuel demands for energy and transportation (Ockenden et al., 2014). Consequently, the process of burning fossil fuels to generate electricity has increased greenhouse gas emissions and, undoubtedly, global temperatures (Stern, 2015).

Green electricity has been introduced as a sustainable alternative. Green electricity, in general, is produced using renewable energy sources such as photovoltaic, wind turbines, hydropower, and other renewable energy sources (Zhang & Wu, 2012). Nevertheless, as renewable energy infrastructure is deemed to be costly for society, it is currently trending downward. There are also arguments that the growth of renewable energy in most countries is influenced by social awareness and understanding of the community (Fredric, 2005; Wüstenhagen et al., 2007). Therefore, to garner the public's support of renewable energy development, it is important to explore and understand their attitudes and intentions to use renewable energy or green electricity.

By focusing on Putrajaya as one of the pioneer cities that has actively promote green technology development in Malaysia (Putrajaya Corporation, 2012), the current study aims to determine the factors that influences the social acceptance of green electricity. The development of Putrajaya was based on two concepts, Garden City and Intelligent City, which embraced sustainable development practices. In fact, in 2010, Putrajaya Corporation introduced an initiative called Putrajaya Green City 2025, which focuses on three pertinent themes (Azhar & Wang, 2019):

- Low Carbon Putrajaya: a 60% reduction in greenhouse gas emissions due to energy consumption.
- Cooler Putrajaya: reduction of 2 degrees Celsius of the peak temperature.
- 3R Putrajaya: reduction of 50% of final disposal of solid waste to landfill and greenhouse gas emissions.

Under the initiative, Putrajaya Corporation increased the use of solar photovoltaics through the concept of Building-Integrated Photovoltaics (BIPV) systems by installing the systems in residential and government buildings with a capacity of 12 kWh and 48 kWh, respectively. As it has been more than a decade since this initiative was introduced, it is reasonable to evaluate the social acceptance of green electricity in Putrajaya and the extent to which the green agenda has been adopted by its community. Accordingly, this study will provide inputs for government policy and planning in expanding the renewable energy incentive for the community.

This paper begins with an introductory section, Section 2 presents a literature review, Section 3 explains the methods used in this study, while Section 4 discusses the data analysis and research findings. Finally, the paper ends with concluding remarks.

1.1 Green Electricity and Sustainability

The consumption of fossil fuels and the production of cement has resulted in about 400 billion tonnes of coal being released into the atmosphere since 1751 (Boden et al., 2017). For example, in 2013 alone, the power sector contributed approximately 54.8% of total carbon dioxide (CO2) emission (World Bank, 2017). As such, the Paris Climate Agreement was ratified by 196 countries in 2015 who jointly declared that greenhouse gas emissions should be almost zero by the end of the century. Accordingly, an exit strategy from the issues of carbon dioxide (CO2) emission, aimed at decarbonizing the energy sector, was rolled out and it has been one of the most effective strategies to date. As an early measure to phase out fossil fuels and coal in the energy sector, renewable energy has been introduced as an alternative. Hence, making the switch to renewable energy as an alternative energy source is believed to support the Sustainable Development Goals agenda.

Due to the depletion of natural resources caused by human-driven activities and their impacts on the environment such as greenhouse gases, alternative energy supplies are required (Harris, 2003) .This involves decentralizing the current non-fossil systems so as to adapt to local conditions and utilize the advancement of technological innovations, especially those related to renewable energy such as wind, geothermal, biomass, biogas, solar, bioenergy, and tidal/wave power (Smith-Sebasto, 2013). Furthermore, the use of renewable energy technologies has a significant impact on economic development as they can turn solar, wind, water, thermal, and plants into forms of energy and further provide clean energy for human needs (International Renewable Energy Agency, 2016).

Green electricity is one of the pillars for achieving the sustainable development goals of a green economy. Green electricity refers to electricity generated from renewable energy sources and its usage is based on self-contained facilities such as solar panels, wind turbines, hydropower, and other renewable energy sources (Zhang & Wu, 2012). To attain a green economy level, extensive studies are required, particularly that in formation conditions, the formation of system components, and their impact on national-level sustainable development. Therefore, cooperation between the government, the industry, and the public is crucial for achieving a green economy.

While "green innovation" is aimed at generating high-quality and innovative products to help reduce environmental footprint, green management knowledge is crucial in sustainable development, specifically in the creation, exchange, acquisition, and use of knowledge, in addition to assessing the implications of green technology, eco-innovation, and the socio-economic aspects (Abbas et al., 2019). In the same vein, market orientation contributes to an improved environmental performance (Minjian et al., 2020); hence, this calls for a study on the social acceptance of green electricity in order to better understand the actual demands of society.

1.2 Social Acceptance of Green Electricity

Energy systems are more than just a symbiotic relationship between technology and its associated infrastructure. They are a part of society, or in other words, a socio-technical system, in which institutions, social practices, and economics play vital roles in a specific type of social connection. The transfer from the steam engine to the internal combustion engine, for example, is the outcome of social, political, economic, and spatial development (Ellis & Ferraro, 2016). In this regard, the ongoing interplay and the relationship between society and energy technology must be acknowledged (Bijker & Law, 1992). Moreover, since technical development is reliant on social factors and society's intricate interaction may influence the success or failure of technologies, understanding social dynamics is, therefore, of the utmost importance (Sovacool, 2009).

Through the "social acceptance" concept, public willingness to adopt renewable investments in their area can be assessed (Liu et al., 2013). According to Upham et al. (2015), acceptance in this context denotes “a favourable or positive response (including attitude, intention, behaviour and – where appropriate – use) relating to a proposed or in situ technology or socio-technical system, by members of a given social unit (country or region, community or town and household, organization)” (p.17). Meanwhile, Caporale et al. (2015) described “social acceptability” as a technique for analysing people's active or passive attitudes toward various green technologies. As such, understanding the influence, structure, and type of collaboration is required in the study of social acceptance (Gaede & Rowlands, 2018).

Several frameworks related to the idea of social acceptance and renewable energy technology have been developed, for example, the "triangle of social acceptance" by Wüstenhagen et al. (2007). The framework suggests three components to characterize social acceptance, as follows:

- Market acceptance: Market acceptance refers to a financial institution’s willingness to invest in or lend to the technology, including large-scale production of technology and consumer participation in markets created by the technology.
- Socio-political acceptance: Socio-political acceptance reflects the larger scale acceptance-related issues such as state policies and institutional frameworks that would encourage the deployment of specific technologies and broader public opinion which would further contribute to the technology's improvement.
- Community acceptance: Community acceptance refers to residents' and local governments' acceptance of specific siting resolutions and energy projects.

Although Wüstenhagen et al. (2007) did not specify which of the three components is the most important, socio-political acceptability, according to Wolsink (2012), is most crucial for assessing social acceptance of renewable energy. Furthermore, while acceptance in the community and marketplace is dependent on institutional and governmental support, institutional changes are likely to necessitate the establishment of a link to the current system.

Later, in 2015, Upham et al. (2015) revised Wüstenhagen et al.'s (2007) framework by categorizing the key elements that influence social acceptance. The authors introduced three different levels of acceptance-related analysis which comprises of three stakeholders: macro (policy or country level), meso (community and town levels), and micro (household or organization level).

Globally, numerous studies have been conducted to discuss factors that influence the public's affinity towards the use of green electricity, such as the attractiveness of benefits (Hartmann & Apaolaza-Ibanez, 2012), knowledge (Fashina et al., 2018), and risk factors (Friedl & Reichl, 2016; Tampakis et al., 2017). Notwithstanding the barriers to green electricity usage, highlighting the lower risk or harm to customers makes it easier in gaining the public's trust in green electricity. Cost is another major barrier to the use of green energy (Sarangi, 2018). For instance, based on a study by Zahari and Esa (2018) involving 501 residential users, cost was found to be the only factor that negatively correlated with the intention to adopt renewable energy and this finding was supported by Zakaria et al. (2019) who demonstrated that cost is a major barrier to the adoption of renewable energy in Malaysia. However, Kardooni et al. (2018) found that cost, knowledge, and trust significantly influence the use of renewable energy in Malaysia.

1.3 Green Energy in Malaysia

Among Southeast Asia's top CO2 emitters, Malaysia came in third after Indonesia and Thailand, emitting 236.5 Mt of CO2 in 2013 from only 56.6 Mt in 1990 (Rina et al., 2017). Hydropower, for instance, one of the main sources of electricity in Malaysia, has contributed to the high CO2 emission (Sharvini et al., 2018). Thus, to address these issues and pursue the green agenda, Malaysia ratified the Paris Agreement for 45% reduction of greenhouse gas emissions by 2030 instead of 2005 as the base level, where 35% of the reduction constitutes unconditional terms while the remaining 10% constitutes conditional commitments such as climate finance, technology transfer, and capacity building based on the receipt of incentives from advanced countries.

In 2000, Malaysia introduced the Five-Fuel Diversification Policy which included renewable energy as part of the sources in the national energy mix (Mendonca et al., 2020). Subsequently, in the Eighth Malaysia Plan from 2001 to 2005, the renewable energy target was set at 5% of energy demand - equivalent to 500MW. Furthermore, to promote more private sector investment in the renewable energy business, especially in small-scale energy generation projects, the Small Renewable Energy Programme was introduced and contributed 0.3% of the national energy mix in 2005 (Mendonca et al., 2020). Later, in the year 2009, the Malaysian government introduced the National Renewable Energy Policy and Action Plan (NREPAP), followed by the gazettement of the Renewable Energy Act (Act 725) and then the formation of the Sustainable Energy Development Authority. Correspondingly, various initiatives were introduced under these policies, namely Feed-in Tariff (FiT), Net Energy Metering (NEM), Large Scale Solar Programme, Green Investment Tax Allowance, and Green Investment Tax Exemptions.

Indeed, the Malaysian government has made remarkable efforts to incorporate renewable energy into the country's energy mix with the target of fulfilling Malaysia's commitment of a 45% reduction of CO2 emissions by 2030 (Haiges et al., 2018). Nonetheless, most of the initiatives and programmes designed by the government have been industrial-driven and commercialisation-centric, with less attention given to the public's needs. Therefore, it is important to investigate users' attitudes and intention to use renewable energy in order to have continuous public support for renewable energy development. Given the crucial role of social acceptance in the implementation of renewable energy technologies in Malaysia, this study intends to investigate the factors that influence domestic customers' social acceptance of green electricity as a basis for government policy and planning to increase the public's affinity towards renewable energy.

2. Hypothesis and Conceptual Framework

Park's (2019) research model in examining the drivers and barriers to social acceptance of green electricity in South Korea was applied in this study. Using the theory of planned behaviour, Park (2019) showed the relationships between attractiveness and reliability, benefits, value, and intention; as well as between cost and reliability, risk, value, and intention in adopting green electricity (Figure 1).

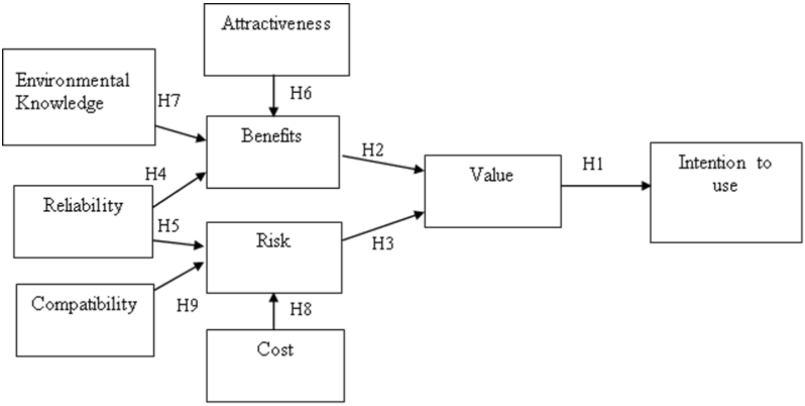

Figure 1: Research Model by Park (2019)

Based on Park (2019), the following hypotheses were proposed:

H1: Positive perceived value of green electricity will lead to high intention of using green electricity.

H2: Perceived benefits of green electricity will eventually lead to a higher perceived value of green electricity.

H3: Perceived risk of green electricity will lead to a lower perceived value of green electricity.

H4: Perceived reliability of green electricity will lead to higher perceived benefits of green electricity.

H5: Perceived reliability of green electricity will lead to a lower perceived risk of green electricity.

H6: Attractiveness of green electricity will lead to higher perceived benefits of green electricity.

H7: Significant environmental knowledge of green electricity will lead to higher perceived benefits of green electricity.

H8: Negative perceived cost of green electricity will lead to a higher perceived risk of green electricity.

H9: Higher compatibility of green electricity will lead to a lower perceived risk of green electricity

3. Methodology

Using a quantitative method, the sample size for this study was derived from the formula of multiple correlation analysis proposed by Tabachnick and Fidell (2007).

$$N > 50 + 8m$$

N= number of participants

m = number of independent variables

Correspondingly, based on the calculation, the study requires a minimum of 122 respondents.

$$N > 50 + 8\,(9) = 122$$

The survey instrument for this study was adopted from Park's (2019) research on the social acceptance of green electricity in South Korea. The questionnaire developed by Park (2019) has been tested on approximately 1,200 respondents, thus confirming its reliability. However, before adopting Park's (2019) questionnaire, written permission to use the questionnaire in this study was first obtained from Park through e-mail and the questionnaire was used upon receiving consent.

The questionnaire is designed with a five-point Likert scale ranging from "strongly disagree" (1) to "strongly agree" (5) to indicate the level of respondent perception of each question in each variable. Specifically, each of the variables in this study is measured with 3 sets of questions and the total number of questions designated for all variables is 27.

The questionnaire was distributed to residents and individuals working in Putrajaya between March 15, 2021, and April 11, 2021. The administrative capital of Malaysia, Putrajaya, is located 25 kilometres south of Kuala Lumpur on a 4,931-hectare plot of land. The city has a population of about 91,900 people, the majority of whom serve in the government (Department of Statistics Malaysia, 2019). To distribute the questionnaire to respondents, the survey link was shared via the Google Forms platform with the Putrajaya community via social media platforms such as WhatsApp, Telegram and Facebook. The survey was actively distributed for three weeks and was halted when the number of responses received became stagnant for more than five days. In the end, the study obtained a total of 185 respondents who completed the survey.

The data was analysed using descriptive statistics and Pearson's correlation. Descriptive statistics were employed to determine the elements impacting consumers' social acceptance of green electricity, while Pearson's correlation was utilised to characterise the relationships between variables and the correlation between two variables.

4. Data Analysis and Findings

4.1 Descriptive Analysis

Table 1 depicts the results of descriptive analysis, which was carried out to determine the factors that influence domestic consumers' acceptance of green electricity. From these results, we can explain the key factors that influence the respondents' attitude towards green electricity and their intention to use it over conventional electricity from fossil fuel sources. Overall, most of the respondents were interested in using green electricity and this finding coincides with Park's (2019) study, where notable factors such as attractiveness, compatibility, and reliability of green electricity affect the intention to use green electricity based on the benefits and risks.

Table 1: Summary of Descriptive Statistics

Factor	N	Mean	Std. Deviation	Variance
Attractiveness	185	4.2018	.14846	.022
Environmental Knowledge	185	3.0811	.05213	.003
Reliability	185	3.8162	.13792	.019
Compatibility	185	4.0360	.20755	.043
Cost	185	3.7586	.07198	.005
Benefit	185	4.3604	.07496	.006
Risk	185	4.0486	.02703	.001
Value	185	3.6775	.05930	.004
Intention to use	185	4.2595	.00541	.000
Valid N (listwise)	185			

Based on the current findings, the respondents perceived green electricity to be more attractive than fossil fuel electricity and they believed that the use of green electricity is not only reliable and able to meet their electricity demands but it also does not jeopardize compatibility. These findings verify Hartmann and Apaolaza-Ibanez's (2012) assertion that the attractiveness of benefits is one of the factors to be considered in evaluating the intention to use green electricity.

The findings of this study, however, differ from Kardooni et al.'s (2018) in which high costs and the lack of knowledge have discouraged consumers from using green electricity. On the contrary, the current study suggests that the respondents' attitudes toward green electricity are changing and are becoming more dynamic and open to new products on the market. This has resulted in the respondents being more willing to shift to green electricity rather than making decisions based on rigid and timid regimes such as cost and knowledge.

4.2 Pearson's Correlation

Figure 2 summarizes the results of Pearson's correlation analysis in this study.

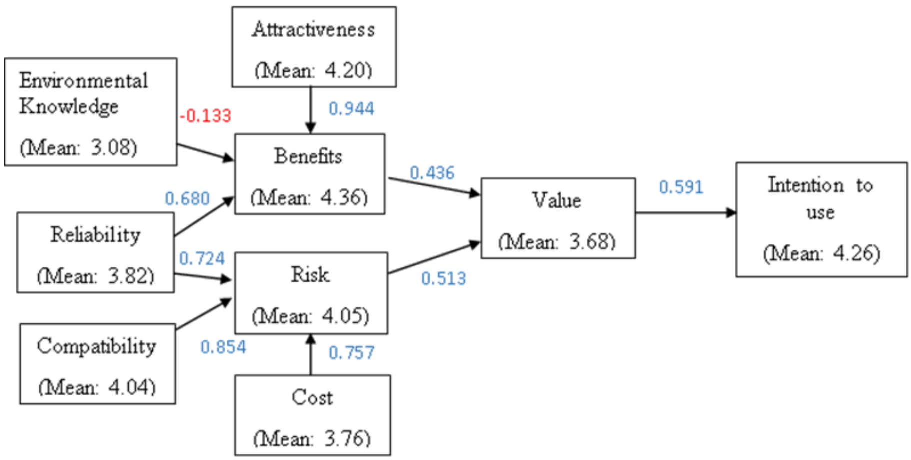

Figure 2: Summary of Pearson Correlation Result

Based on the results, H1 indicates a significant relationship between value and the intention to use green electricity. However, to further discuss value, the benefit and risk factors outlined in H2 and H3 must also be considered because the respondents' decisions regarding the value of green electricity is associated with the benefits and risks of green electricity. The results showed that both H2 and H3 have a positive and significant relationship with H1, confirming Hartmann and Apaolaza's (2012) assertion that the element of benefits and the value of technology and services are both influential. Similarly, as for the risk factor, Friedl and Reichl (2016) and Tampakis et al. (2017) suggested that the element of risk also influences consumers' intention to use green electricity; therefore, by minimizing the risk factor, consumers are more likely to be confident in using green electricity.

Subsequently, based on the positive and significant relationships shown in both H4 and H5, the reliability of green electricity has been proven to be one of the main factors that influences the respondents' decision to use green electricity apart from its benefits and risks. Perceived reliability plays a big role in users' perceptions of the systems and services (Chung et al., 2008). Reliability, for instance, is closely related to the technical aspect of the product and system involved such as network, stability of the supply, and security. Reliability is important because if the features of a product or system seem reliable, the respondents will be more convinced to use it.
H6 shows a positive and significant relationship between attractiveness and perception of green electricity. It can be seen that while the respondents analysed the benefits of green electricity, the attractiveness of green electricity itself is able to influence the respondents' decisions to use green electricity. H7 surprisingly showed a negative relationship between environmental knowledge and the intention to use green electricity, hence suggesting that the respondents do not rely on their knowledge when it comes to making decisions about whether to use green electricity. Of all the factors proposed in the current study, environmental knowledge is the only factor that exhibits a negative relationship with intention to use.

Finally, H8 and H9 showed a positive and significant relationship between cost and compatibility where both are proven to influence the respondents' intention to use green electricity. In terms of compatibility, the technical aspect of green electricity is often considered, particularly in the quality of electricity received from the distribution network. This is because the respondents are only likely to use green electricity if its performance is on par with or better than conventional electricity.

5. Conclusion

The purpose of this study was to study the factors that affect domestic consumers' social acceptance of green electricity. In essence, it can be concluded that attractiveness, compatibility, and reliability are the key factors to be considered in promoting social acceptance of green electricity. As evidenced in the study, the respondents are more concerned about the benefits of using green electricity than the risk of using it. However, among all the factors taken into consideration, environmental knowledge was the least important factor in their decision-making process.

By using the framework proposed by the previous research, this study has shown that all factors directly impact the respondents' attitudes and intention of using green electricity. Thus, the findings of this study has provided new insights into the social acceptance of green electricity among domestic consumers in which factors such as attractiveness, compatibility, and reliability play vital roles. This suggests that while the cost of utilizing green electricity has become the main impediment and is burdensome for the people, the supply consistency and security provided play an important role in meeting the expanding green electricity demand.

Green electricity offers prospects that will support the agenda of the Sustainable Development Goals, including energy access, mitigating climate change, and lowering environmental impacts. Pertinent to this, to encourage society to adopt green electricity, policymakers, regulators, and utility companies must be creative in promoting green electricity to persuade more people to use it. This study could provide the government with an early indicator and empirical evidence on public's perception of green electricity. Furthermore, the findings of this study will help policymakers strike the right balance in the energy trilemma, that is, allowing Malaysia to avoid an energy crisis that would have a negative impact on social, infrastructure, and economic development. In addition, dialogue between the main stakeholders—the government, industry, and community—is crucial for fostering an environment that will support the promotion of green electricity.

Sustainable development, which promotes environmental, social, and economic balance, can serve as the foundation for human civilization. Civilization, according to Abdul Razak and Sanusi (2010), necessitates that society is responsible, respects and lives in harmony with nature. Therefore, since humans and nature must coexist in order to thrive, the sustainable development approach allows for a better decision-making process on the issues that affect human lives apart from strengthening the pursuit of a sustainable society and human civilization.

6. Conclusion

This study's sample size was too small to be generalised. However, the amount is sufficient to demonstrate the link between variables and identify the key criteria or aspects to be considered by the respondents. Additionally, since this study was carried out during the third wave of the COVID-19 pandemic in Malaysia, the government's movement control measures made it challenging to conduct a physical survey and obtain a higher response rate.

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