

Article

Determining the Factors Affecting Filipinos' Acceptance of the Use of Renewable Energies: A Pro-Environmental Planned Behavior Model

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Abstract: Renewable energies (RE) are naturally replenishable and sustainable energy sources. Solar, wind, hydro, geothermal, biomass, and ocean energy are among these sources. This study sought to determine the factors influencing the acceptance of Filipinos' renewable energy utilization using the Pro-Environmental Planned Behavior (PEPB) model. A questionnaire survey was disseminated to obtain the required information and ascertain the variables affecting the behavioral intention of Filipinos in accepting RE. In examining the results, Structural Equation Modeling (SEM) was utilized with Partial Least Squares SEM (PLS-SEM) to identify other existing relationships. Findings revealed that Perceived Authority Support (PAS) is the most significant variable affecting Perceived Environmental Concern (PEC), inducing an indirect effect on the Behavioral Intention (BI) of Filipinos. The factor with the highest significance affecting BI is the Subjective Norm (SN). Accordingly, such results suggest that the government should implement incentive-based strategies, while considering the impact of SN, by gaining the public's favor on the transition from traditional energy sources to green alternatives. In addition, educational programs and campaigns may be administered to spread awareness and fill in information gaps among Filipino citizens.

Keywords: renewable energies; PEPB; TPB; behavioral intention



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1. Introduction

Renewable energy is energy generated from natural sources that are replenished constantly and will not be depleted over time. Solar, wind, water, geothermal, and biomass are all types of sustainable energy [1]. Renewable energy sources do not pollute the environment with toxic pollutants and greenhouse gases like fossil fuels [2]. Hence, this makes the air cleaner and fights climate change [3]. According to McCauley & Stephens [4], the renewable energy sector has the potential to create new jobs and stimulate economic growth.

Moreover, the cost of renewable energy technologies is decreasing, making them more accessible and affordable. In a study by Ulucak & Khan [5], it was mentioned that renewable energy sources are sustainable, meaning they can provide energy without depleting natural resources. This helps to ensure that future generations have access to clean and affordable energy.

Several studies have highlighted the importance of renewable energy as a solution to several challenges, including climate change, energy security, and economic development. A study by De Vries et al. [6] looks at how green energy sources could be used worldwide in the first half of the 21st century. The authors conclude that renewable energy could meet a significant portion of the world's energy needs and that switching to renewable energy sources is technically and financially possible. Another study by Abolhosseini et al. [7] examines the potential of renewable energy and energy efficiency technologies to reduce global greenhouse gas emissions. The authors find that renewable energy and energy efficiency have the potential to cut global emissions by a large amount, and that

developing countries play a crucial role in reaching this goal. Batinge et al. [8] present a framework for transitioning to a sustainable energy future, focusing on renewable energy sources. The authors argue that renewable energy is the key to achieving sustainable development and that a rapid transition to renewable energy sources is necessary and feasible. Furthermore, a study by Ntanos et al. [9] examines the potential of renewable energy to create jobs and stimulate economic growth. The authors find that renewable energy has the potential to create millions of new jobs worldwide and that the renewable energy sector is rapidly expanding.

Hence, renewable energy sources offer sustainability, benefiting environmental, economic, and social aspects. In an ecological context, transitioning to renewable energy sources will considerably lower the resulting emissions from fossil fuel burning [10]. Furthermore, renewable energy sources are economically beneficial due to their relatively lower prices in several countries worldwide, as the impending scarcity of non-renewable energy will spike their costs [11].

Kamran [12] pointed out that the global situation of renewable energy includes consumers, researchers, and policymakers attracted to progressing toward green alternative energy sources; such attention is due to the increase in energy demand and the necessity to cut conventional fossil fuel-generated pollutants. Consequently, a sharp upward trend has been observed in renewable energy markets, where well-established technologies were rapidly implemented [13].

Renewable energy is becoming increasingly important in the Philippines due to the country's growing energy demand and the need to reduce dependence on fossil fuels [14]. The Philippine government has established policies and regulations to support renewable energy development. These include the Renewable Energy Act of 2008, which gives incentives for renewable energy projects, and the Net Metering Program, which lets people sell back to the grid any renewable energy they do not use [15]. Currently, renewable energy makes up about 30% of the country's total fixed capacity. Hydropower and geothermal power are the most significant sources of renewable energy. Solar and wind power are increasing, and several big projects are underway [16]. The Department of Energy says the country has about 246,000 MW of potential renewable energy capability [17]. This means that the government has a lot of room for renewable energy, especially solar, wind, hydro, and geothermal power.

However, renewable energy development in the Philippines faces several challenges, including high upfront costs, regulatory barriers, and grid integration issues [18]. Although the government has its fair share of renewable energy-based projects, implementations are limited to a few areas [19]. Therefore, expanding sustainable green technologies is a prerequisite to achieving a nationwide shift from fossil-fueled energies to renewable energy sources.

Given these conditions, this paper aims to determine the Filipinos' acceptance of using renewable sources. Since the Philippines is facing an energy crisis, renewable energy sources can help to alleviate this problem. The successful adoption of renewable energy sources requires social acceptance from the public. Hence, by studying the acceptance of renewable energy, policymakers can understand how to increase the adoption of these energy sources, which can help the country to become more energy independent and secure.

2. Review of Related Literature

Several literature studies have been conducted to analyze and determine the factors that may affect consumers' use of renewable energies or their complete switch to them. The studies by Avicenna and Febriani [20] and Sardianou and Genoudi [21] found that consumers' education level affects their acceptance of renewable energy. Consumers with a broader knowledge of the benefits of renewable energy and the adverse effects of fossil-fueled energy sources tend to have a higher acceptance rate than those without such knowledge [22,23]. Supported by the study by Watts et al. [24], findings suggest a clear cor-

relation between a person's willingness to embrace renewable energy and their perceptions of its efficacy, care for the environment, awareness, and ideas about its advantages.

Additionally, Lloyd and Nakamura [23] reported through an 'adjust knowledge' variable that respondents with high claimed levels of knowledge about renewable energy sources have a higher tendency to patronize renewable energy-based technologies than those in opposition because of their limited grasp of the benefits that come along with their implementation. The fear of seeing or trying new things that are very different from the perceived norm may cause skepticism about such new concepts. Thus, as discussed by Stigka et al. [22], the extent of comprehension is directly proportional to one's willingness to embrace renewable energy-based systems.

As a result, prior studies suggest that the knowledge and attitude of consumers about renewable energy could significantly impact their willingness to accept renewable energy sources.

2.1. Theory of Planned Behavior

The Theory of Planned Behavior (TPB) has been extensively employed to predict intention and behavior [25]. TPB has been used to examine how people behave environmentally in various countries. A study by Gao et al. [26] determined the link between consumer perceptions and eco-friendly behavior. They discovered a significant positive association between the two variables. Research by Scalco et al. [27] also determines sustainable consumer purchasing trends for organic food, and finds that attitude is the most crucial factor influencing a person's intention to purchase. Similarly, to find the pertinent predictor of customer preference for automobiles or other environmentally friendly modes of transportation, Lanzini and Khan [28] conducted a study. They discovered that environmental factors significantly influence how people intend to behave when choosing their mode of transportation.

A study by Waris et al. [29] also applies the TPB to analyze household adoption of renewable energy technologies. The authors find that factors such as perceived benefits, social norms, and the availability of information play essential roles in adopting renewable energy technologies. Another study by Kumar & Nayak [30] reviews the literature on household acceptance of renewable energy technologies, focusing on behavioral models such as the theory of planned behavior and the diffusion of innovation model. The authors conclude that these models can provide valuable insights into the factors that influence the adoption of renewable energy technologies. Hence, previous studies have found that TPB can be used to determine customers' intentions to use environmentally friendly products.

2.2. Pro-Environmental Planned Behavior Model

Several studies have attempted to extend the TPB model to investigate individuals' attitudes towards environmental behavior. Conner [31] argues that expanding the TPB is essential to highlighting its contributions. Various attempts have been made to expand the TPB to include additional possibly important behavioral factors to improve prediction [32–34]. The extended TPB's environmentally related topics aim to support environmental sustainability [35,36]. One of the extension models for TPB is pro-environmental planned behavior or PEPB. Persada [37] introduced the PEPB model, which is an extension of the theory of planned behavior (TPB) and focuses on behavior. The PEPB model comprises six factors, including perceived authority support (PAS), perceived environmental concern (PEC), attitude (AT), subjective norms (SN), perceived behavior control (PBC), and behavioral intention (BI). Most of the items used in the PEPB model were adapted from the TPB model, such as attitude, subjective norms, perceived behavior control, and behavioral intention, while the items for perceived authority support (PAS) and perceived environmental concern (PEC) were not part of the TPB model. In essence, Persada built upon the TPB model to develop the PEPB model by adding factors such as PAS and PEC to better understand and predict behavior related to environmental concerns.

The Pro-Environmental Planned Behavior Model (PEPB) has been widely used in environmental studies to understand and predict pro-environmental behaviors. A study by Lin et al. [38] aimed to explore the intention of senior citizens to participate in mandatory and voluntary pro-environmental programs. The study used the Pro-Environmental Planned Behavior (PEPB) model as a theoretical framework to investigate the relationship between attitudes, subjective norms, perceived behavioral control, environmental knowledge, and behavioral intention in using ecolabel products. The study results show that the PEPB model can explain 60% of environmental impact assessment subjects and 77% of subjects' behavioral intentions about ecolabel products. A study by Mufidah et al. [39] also used the PEPB model to know the behavioral intentions of ecolabel product usage of citizens in developing and developed regions. The results show that the PEPB model explains 49% of the intention to purchase an ecolabel product in Taiwan and 72% of the intention to buy an ecolabel product in Indonesia. The results showed that the most significant factor that affects behavioral intention (BI) in both Taiwan and Indonesia is attitude (AT). The factors of the Pro-Environmental Planned Behavior (PEPB) model that influence people to purchase green skincare products were also found in a study by Puspita et al. [40]. The study results show that perceived authority support and perceived environmental concern positively affect attitude, subjective norms, and perceived behavioral control, all of which can positively affect the desire to buy green skincare products. Moreover, in Indonesia, Kusmantini et al. [41] also used the PEPB model in investigating the factors that lead to environmentally conscious attitudes towards purchasing pesticide-free fruits and vegetables and their impact on intentions and actual buying behavior. The findings from the study show that the three factors that lead to green consumption attitudes all have a good and significant effect, but the most crucial factor is the effectiveness of green consumption. It has also been shown that a better attitude about green consumption significantly affects whether or not people buy green goods. In the Philippines, the PEPB model was also used in a study by German et al. [42] to choose a package provider during COVID-19. It was found that consumers' perception of pro-environmental activities was an essential contributor to choosing a package carrier, since perceived environmental concern and perceived authority support indirectly affect Filipinos' behavioral intention.

Overall, the PEPB model has been shown to be a valuable tool for understanding and predicting pro-environmental behaviors in various contexts, including ecolabels, green skincare purchases, green consumption, and the use of package carriers. Thus, the present study aims to adopt the PEPB model in examining Filipinos' behavioral intentions to use renewable energy sources, which have yet to be explored in prior research.

The framework created for this study contributes to consumer behavior modeling by validating the relevant role of PEPB variables on consumer acceptance of renewable energy sources. Studying the acceptance of renewable energy in the Philippines is crucial for achieving sustainable energy development and promoting the country's economic and environmental well-being. Studying behavioral intentions to use renewable energies could contribute to a new body of knowledge and address several research gaps. First, there is a need to better understand the factors that influence the adoption of renewable energies, including the role of behavioral intention. By studying the behavioral intention to use renewable energies, the study results could identify the key drivers of adoption and develop strategies to promote the use of renewable energies. On the other hand, studying behavioral intention to use renewable energies could also identify the barriers to adoption and develop interventions to overcome these barriers. Second, there needs to be a greater understanding of the factors influencing the adoption and sustained use of renewable energy sources at the individual level. Thus, to bridge the gap, researching the factors influencing the adoption and sustained use of renewable energy sources can fill the gap in Filipinos' understanding of the barriers and drivers of behavioral change in this domain. The research could also contribute to developing effective interventions and policies for promoting the adoption and sustained use of renewable energy sources and a

better understanding of the social, cultural, economic, and political factors influencing the transition to renewable energy systems.

The study's findings may improve renewable energy use, thus making more industries interested in using it. The study's findings may also provide additional knowledge of what the target market wants, concerning renewable energy technologies. Understanding these trends will be beneficial, as this can lead to switching to an efficient process and production manner and an increase in profit. Companies may also obtain the public's favor by making environmentally sustainable products, increasing their profit. The study's findings could provide additional information and a point of view on Filipino consumers' willingness to use renewable energy products or processes, potentially substantiating or broadening previous studies' findings. The outcome might serve as a fundamental basis for influential individuals and manufacturers to design a suitable course of action to increase the number of renewable energy consumers. Consequently, the growth in the target market and improvement in the use of renewable energies may lead to consumer expansion and more companies leaning towards creating products that benefit the environment.

3. Materials and Methods

3.1. Theoretical Framework

The present study's theoretical framework is based on Pro-Environmental Planned Behavior (PEPB) used in prior studies [38–42] to predict Filipinos' acceptance of renewable energy sources. Consumers' intention to behave pro-environmentally is the primary predictor of such behavior, and various researchers have explored this link [43–45]. According to prior studies, the intention construct is the motivating factor that influences a particular behavior and has a significant, direct, and favorable impact on the behavior itself.

Numerous studies have attempted to identify the factors that impact pro-environmental behavior as awareness of the interconnectedness between human conduct and the environment has grown. Li et al. [46] divided the factors that influence pro-environmental behavior into two groups: individual factors, which include demographic and psychological factors, and external factors, which include things like social norms, cost, and convenience. Early research mainly focused on demographic and environmental factors to understand the mechanisms behind pro-environmental conduct. However, recent studies revealed behavioral factors as the most accurate predictors of pro-environmental behavior [47–49]. The behavioral factor that is most frequently used is attitude, or the degree to which a person's assessment of behavior is positive or negative.

Using the PEPB model, this study explores the variables that affect Filipinos' behavioral intentions regarding the acceptance of renewable energy sources. As shown in Figure 1, the suggested model identifies six variables: Perceived Authority Support (PAS), Perceived Environmental Concern (PEC), Attitude (AT), Subjective Norms (SN), Perceived Behavior Control (PBC), and Behavioral Intention (BI).

Determinants of Behavioral Intention to Use Renewable Energy Sources

Perceived Authority Support (PAS) can be viewed as a person's perspective on the rules, facilities, resources, and assistance offered by the agency or by the government authority that can assist people in engaging in certain behaviors [37,38]. The authority figure in this study is the government that established the rules governing the usage of renewable energy sources. The government's initiative to promote the use of RE programs is anticipated to have an impact on customer demand for RES. Several studies have highlighted the importance of government policies in promoting the use of renewable energy. For example, a study by Menz & Vachon [50] found that financial incentives, renewable energy targets, and renewable portfolio standards were effective in increasing renewable energy production. The study also found that the effectiveness of policies varied depending on the specific context, such as the size of the policy target, the availability of resources, and the level of public support. Another study by Jacobsson & Lauber [51] identified several key factors that contribute to the effectiveness of renewable energy policies, including political

leadership, public support, regulatory frameworks, and institutional capacity. The authors also highlighted the importance of a holistic approach to policy design, taking into account the specific context and goals of the policy. Prior studies suggest that government policies play a critical role in promoting the adoption of renewable energy sources. People will be more inclined to employ renewable energy sources if the government runs the RE program flawlessly. It has been demonstrated that the PAS has a favorable impact on the AT, SN, PBC, and PEC's participation in environmental impact assessments [43] and green product purchasing behavior [52]. As a result, this study suggests that the PAS affects the PEC, AT, SN, and PBC favorably when using RE sources.

H1: *Perceived Authority Support (PAS) has a significant positive influence on Perceived Environmental Concern (PEC).*

H2: *Perceived Authority Support (PAS) has a significant positive influence on Attitude (AT).*

H3: *Perceived Authority Support (PAS) has a significant positive influence on Subjective Norm (SN).*

H4: *Perceived Authority Support (PAS) has a significant positive influence on Perceived Behavioral Control (PBC).*

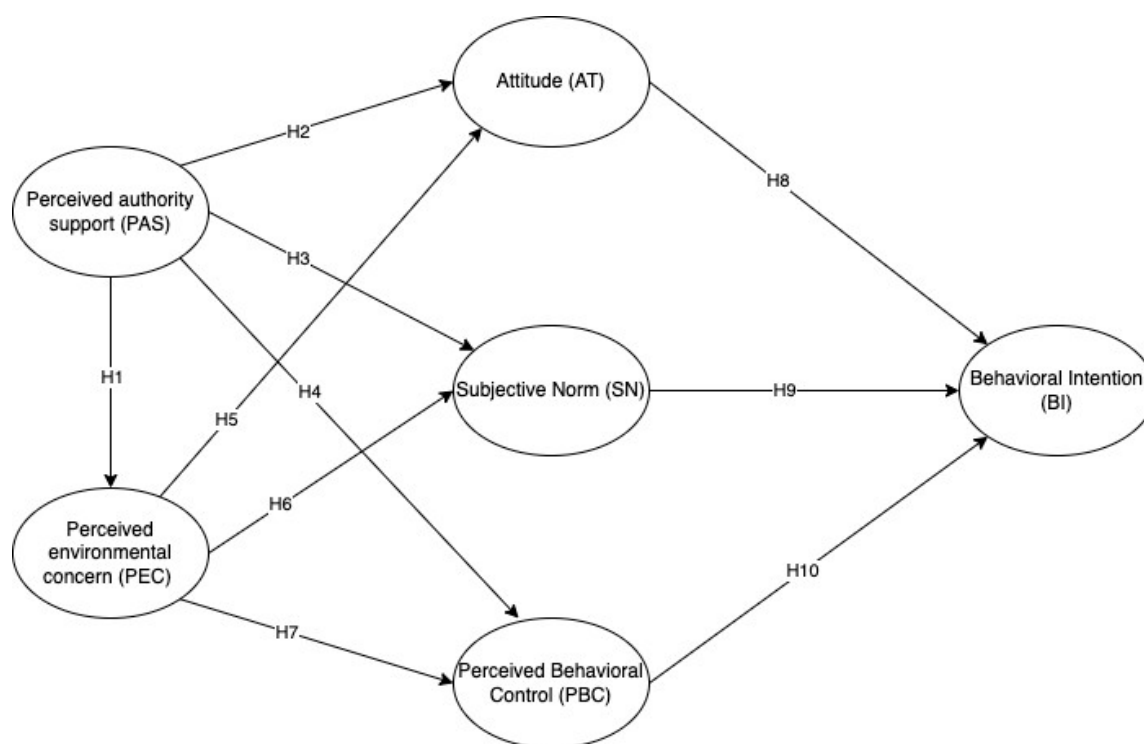


Figure 1. Pro-Environmental Planned Behavior (PEPB) Model.

Perceived Environmental Concern (PEC) can be considered an evaluation of a person's view of environmental effects [53]. The PEC in this study represents customers' attitudes toward Renewable Energy Sources (RES). It was anticipated that how consumers felt while using the RES would affect their choice. Customers will undoubtedly use RES if they believe it to be beneficial. According to the majority of researchers, environmental concern is a broad and overarching mindset that revolves around how people think and feel about environmental protection [54,55]. This mindset encompasses both cognitive (thinking and knowledge-based) and affective (emotional and value-based) evaluations of environmental protection, meaning that it involves both an understanding of the importance of protecting the environment and a positive emotional response to this objective. In other words, environmental concern is not just a single behavior or action, but rather a broader attitude that influences people's thoughts, emotions, and actions related to the environment [56].

Research has shown that people who perceive a higher level of environmental concern are more likely to adopt renewable energy technologies such as solar panels, wind turbines, and electric vehicles [57]. Additionally, they are more likely to engage in environmentally conscious behaviors, such as conserving energy, recycling, and reducing waste [58]. Perceived environmental concern can also influence policy decisions related to renewable energy [59]. When politicians and policymakers perceive a high level of concern among their constituents, they may be more likely to support policies that promote the development and use of renewable energy sources. Thus, this study suggests that PEC positively impacts how AT, SN, and PBC are used when using RES.

H5: *Perceived Environmental Concern (PEC) has a significant positive influence on Attitude (AT).*

H6: *Perceived Environmental Concern (PEC) has a significant positive influence on Subjective Norm (SN).*

H7: *Perceived Environmental Concern (PEC) has a significant positive influence on Perceived Behavioral Control (PBC).*

Behavioral Intention (BI) is a depiction component that might characterize people's attempts to engage in a specific behavior [60]. There will be a particular action resulting from the intention [52]. When someone expresses a positive desire to engage in certain conduct, that is what is meant by "Attitude" (AT). The AT in this study is the positive consumer perception of using sustainable products such as Renewable Energy Sources (RES). It was anticipated that consumer perceptions of sustainable products would affect their product choice. Several studies have consistently found a connection between a consumer's positive attitude towards sustainability and their willingness to use sustainable products. In other words, people who have a positive attitude towards sustainable practices are more likely to purchase products that are environmentally friendly or socially responsible [61,62]. Thus, this study suggests that AT significantly affects BI for renewable energy sources.

H8: *Attitude (AT) significantly influences Behavioral Intention (BI) to use renewable energy sources.*

Perceived social pressure, known as the "Subjective Norm" (SN), significantly impacts whether or not someone chooses to act in a certain way. The social pressure the study's participants felt to use RES is referred to as the SN. According to Vesely et al. [63], subjective norms play a crucial role in shaping an individual's attitude towards energy consumption. This means that people are more likely to buy or make energy from renewable sources if they think it is the social norm. Norms also shape several other behaviors that affect the environment. The public will use RES if there is strong public support. Thus, SN affects the BI favorably when it comes to accepting RES.

H9: *Subjective Norm (SN) significantly influences Behavioral Intention (BI) to use renewable energy sources.*

The notion of how easy or difficult it is for a person to carry out a particular behavior is known as Perceived Behavioral Control (PBC). The study's participants perceive the ability of the consumer to regulate how they use the RES as PBC. It was expected that how consumers thought about their own ability to use the RES would influence how likely they were to actually use these sources. In other words, the perception of their own ability to use RES was considered a significant factor in determining their willingness to use them [64]. According to Bandara et al. [65], users' confidence and trust in their decision-making abilities when faced with environmental constraints, as well as their positive attitude towards future use, are important factors that contribute to their perceived behavioral control. Therefore, it is implied that perceived behavioral control directly influences the intention to use renewable energy sources.

H10: *Perceived Behavioral Control (PBC) significantly influences Behavioral Intention (BI) to use renewable energy sources.*

3.2. Methodology

3.2.1. Setting

Due to the unknown population of possible users of renewable energy sources, a convenience sampling technique was employed for data collection in this study. The target respondents are users in the National Capital Region (NCR).

3.2.2. Participants and Sampling Technique

The non-probability sampling method was utilized in this research, specifically convenience sampling using an online survey. The target respondents are residents of the National Capital Region (NCR). The expected minimum number of respondents is 300, as suggested by the study conducted by Yamane [66], where the margin of error was set at 10%.

3.2.3. Data Gathering Tools

The online survey was self-administered and distributed via a Google form. The questionnaire was distributed in multiple cross-sectional designs, and the link to the survey was sent to the target respondents for two months.

The survey consists of 30-item questions and is presented in the English language. The respondent's demographics were determined in the first section of the questionnaire using 5-item questions, including age, gender, civil status, area of residence, and monthly income.

The questionnaire's second part is composed of the indicators based on the PEPB model: Perceived Authority Support (PAS), Perceived Environmental Concern (PEC), Attitude (AT), Subjective Norm (SN), and Perceived Behavioral Control (PBC). This measured the users' perceived intention to use the RES. The survey consisted of item questions where all answers were on a 5-point Likert scale, which ranged from "strongly disagree" to "strongly agree." Additionally, six latent variables were used in the survey. The summary of measures and constructs is shown in Table 1. The items for the constructs were adopted from existing studies.

Table 1. Construct and Measurement Items.

Items	Measure	Supporting References
Perceived Authority Support		
PAS1	I believe that producers and consumers have the option to participate in the Environmental Impact Assessment (EIA) process using government-provided methodologies.	[37,39,42]
PAS2	I believe that producers and consumers have the option to take part in a government-established environmental program, such as the Environmental Impact Assessment (EIA) procedure.	
PAS3	The government supports the law allowing citizen-consumers to participate in the Environmental Impact Assessment (EIA) procedure.	
Perceived Environmental Concern		
PEC1	I firmly believe that producers and consumers should be involved in the Environmental Impact Assessment (EIA) process because I am very concerned about the state of the environment around the globe and what it will imply for my future.	[37–39]
PEC2	Because of the enormous environmental abuse committed by humanity, producers and consumers should take part in the Environmental Impact Assessment (EIA) procedure.	
PEC3	It concerns me that producers and consumers should participate in the Environmental Impact Assessment (EIA) process, as human interference with the natural world frequently results in disastrous outcomes.	

Table 1. Cont.

Items	Measure	Supporting References
Attitude		
AT1	I usually think about using renewable energy sources due to climate change.	[39,42]
AT2	Using renewable energy sources is a good idea for our society.	
AT3	Using renewable energy sources will benefit our society, especially our environment.	
AT4	I think using renewable energy sources is valuable, especially for our environment.	
AT5	I want to be safe; that is why I prefer to use renewable energy sources.	
Subjective Norm		
SN1	People who are important to me think I should use renewable energy sources.	[37,38,42]
SN2	People who are important to me approve of my usage of renewable energy sources.	
SN3	People who are important to me want me to use renewable energy sources.	
SN4	I feel under social pressure to use renewable energy sources.	
SN5	I usually think about using renewable energy sources.	
Perceived Behavioral Control		
PBC1	I believe the use of renewable energy sources improves our society.	[37–39]
PPBC2	Using renewable energy sources is entirely under my control.	
PPBC3	I have the resources, knowledge, and skills to use renewable energy sources.	
PBC4	I have the capability to choose the renewable energy sources I want to utilize	
Behavioral Intention		
BI1	I intend to use renewable energy sources.	[38,39,42]
BI2	I intend to encourage others to use renewable energy sources.	
BI3	I predict that our society will predominantly support the use of renewable energy sources.	
BI4	I intend to explain the positive aspects of using renewable energy sources.	
BI5	I recommend that other people should use renewable energy sources.	

3.2.4. Research Procedures

The researchers created an online survey for the research's data gathering through Google Forms. The questions from relevant existing studies served as a guide and were modified for the current questionnaire's use to ensure timeliness, accuracy, and applicability. After checking and assuring the validity of the questionnaire, the researchers acquired a written consent form for conducting the procedure. The researchers approached the survey's respondents, receiving the survey link and the mentioned consent form through various online platforms, such as Facebook Messenger, Microsoft Teams, and via email (Outlook and Gmail). As the questionnaire was set up online, the researchers were able to track and manage the gathered data more efficiently. The data gathering of the study targeted Filipinos residing in the National Capital Region (NCR) as its respondents and aimed to have a minimum number of 300 respondents. The procedure was expected to be finished within two months after its start. Moreover, after succeeding with the initial measures necessary and obtaining the data, the researchers utilized Partial Least Squares SEM (PLS-SEM) to analyze the relationship between the results obtained from the survey.

3.2.5. Data Analysis

The collected data from the survey were analyzed using multivariate analysis. In this study, a variance-based Partial Least Squares SEM (PLS-SEM) was utilized with maximum likelihood estimation. PLS-SEM is a means for studying the relationships between abstract

ideas [67]. It deals with complex constructs with higher levels of abstraction and aims for construct reliability and validity, making it great for prediction [68] and helpful in this study. Its main goal is to explain the variation in the dependent constructs as much as possible. The data quality is also judged based on the properties of the measurement model. According to Ouellette and Wood [69], PLS-SEM differs from previous modeling approaches as it considers the direct and indirect effects on presumptive causal links and is increasingly seen in scientific investigations and studies. Furthermore, PLS-SEM is the best method for developing new theories and making predictions, while CB-SEM is better for testing and proving existing theories [67].

Several fit indices were utilized to justify the study's model fit using PLS-SEM, like Standardized Root Mean Square Residual (SRMR), Normal Fit Index (NFI), and Chi-square. For SRMS, a value of under 0.08 is considered a good fit [70]. According to Baumgartner and Homburg [71], a value of 0.80 and over indicates an acceptable fit for NFI, whereas for Chi-square, a value under 5.0 indicates a well-fitting model.

3.2.6. Ethical Considerations

The questionnaire was briefly discussed with each respondent, and written consent was obtained. Following the Data Privacy Act or Republic Act No. 10173 in the Philippines, the respondents were asked to sign a consent form, which stated that the responses and information they gave would only be used for academic and research purposes. Before collecting data, the researchers also asked the Mapúa University Research Ethics Committee for permission.

4. Results

The visual representation of a model in determining the factors affecting Filipinos' acceptance of renewable energies is illustrated in Figure 2. This model comprises six latent variables and twenty-five indicators. The model's factor loading and its indicators' reliability and validity are presented in Table 2; this reliability analysis is necessary before conducting structural equation modeling (SEM). In an analysis of behavioral intention models, it is expected that Cronbach's alpha (α) will be used, and that the analysis will be further justified for reliability and validity with Factor Loading (FL), Composite Reliability (CR), and Average Variance Extracted (AVE). Firstly, Cronbach's alpha, FL, and CR need to exceed a value of 0.7 [72,73]. According to Hair [74], determining each component's function in defining a factor is made possible by Factor Loading. By taking into account the FL perspective, CR measures the overall reliability of a group of items that make up the latent variables. On the other hand, the value for AVE should exceed a value of 0.5 [75]. The AVE gauges the degree of variance caused by measurement error to the amount of variance collected by the construct. Consequently, Table 2 shows that two out of 25 measures have low outer loading values, i.e., SN4 and PBC2, as they did not meet the necessary value for FL. However, the remaining 23 have exceeded the mentioned values and can be considered valid and reliable. Ultimately, this analysis evaluates the internal consistency of each, and whether the constructs and measures correlate.

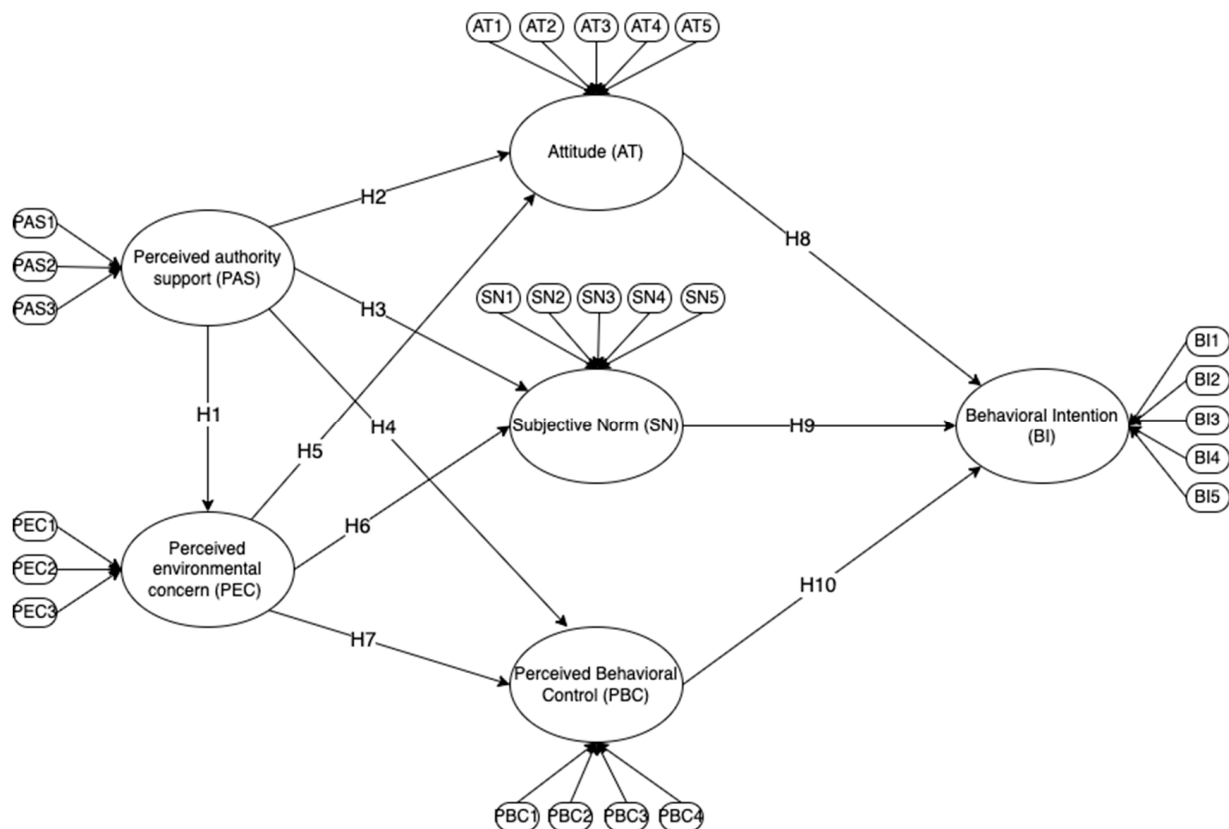


Figure 2. Initial SEM Model.

Table 2. Reliability and convergent validity results.

Construct	Items	Mean	S.D.	FL (≥ 0.7)	α (≥ 0.7)	CR (≥ 0.7)	AVE (≥ 0.5)
Perceived Authority Support (PAS)	PAS1	4.31	0.76	0.886	0.807	0.822	0.887
	PAS2	4.28	0.77	0.899			
	PAS3	3.97	0.93	0.762			
Perceived Environmental Concern (PEC)	PBC1	4.53	0.72	0.902	0.745	0.819	0.854
	PBC2	4.57	0.59	0.895			
	PBC3	4.02	1.13	0.72			
Attitude	AT1	4.27	0.89	0.7	0.858	0.856	0.899
	AT2	4.67	0.57	0.856			
	AT3	4.68	0.59	0.842			
	AT4	4.71	0.52	0.827			
	AT5	4.42	0.76	0.767			
Subjective Norm	SN1	4	0.93	0.781	0.802	0.863	0.752
	SN2	4.02	0.86	0.814			
	SN3	3.91	0.86	0.803			
	SN4	2.95	1.24	0.606			
	SN5	3.96	0.98	0.765			
Perceived Behavioral Control (PBC)	PBC1	4.52	0.72	0.795	0.766	0.891	0.738
	PBC2	3.25	1.2	0.617			
	PBC3	3.39	1.01	0.726			
	PBC4	3.59	1.15	0.783			
Behavioral Intention (BI)	BI1	4.11	0.89	0.844	0.881	0.885	0.913
	BI2	4.15	0.84	0.807			
	BI3	3.99	0.89	0.755			
	BI4	3.96	0.89	0.863			

To determine the significant correlation between the given factors and evaluate the measurement model, the study used the discriminant validity of the Fornell–Larcker criterion and the Heterotrait–Monotrait ratio of correlation, as suggested by Henseler [76]. When the Heterotrait–Monotrait ratio for assigned constructs is less than 0.85 when utilizing variance-based SEM, and when assigned constructs have a higher value than all other construct loadings for Fornell–Larcker, discriminant validity has been proven [77]. In addition, the highest value per column is placed on top of its respective column. As seen in Tables 3 and 4, all of the data fit the expected range. Each is well within 0.85. Thus, all the values have acceptable reliability and convergent validity. This proves that the overall results of the constructs are satisfactory.

Table 3. Discriminant Validity: Fornell–Larcker Criterion.

	AT	BI	PBC	PAS	PEC	SN
AT	0.800					
BI	0.475	0.824				
PBC	0.412	0.650	0.753			
PAS	0.395	0.384	0.314	0.841		
PEC	0.447	0.413	0.415	0.450	0.816	
SN	0.448	0.675	0.518	0.226	0.353	0.743

Table 4. Discriminant Validity: Heterotrait–Monotrait Ratio.

	AT	BI	PBC	PAS	PEC	SN
AT						
BI	0.537					
PBC	0.338	0.648				
PAS	0.470	0.464	0.309			
PEC	0.526	0.486	0.365	0.557		
SN	0.478	0.721	0.351	0.243	0.396	

Figure 3 illustrates the final SEM model of the study, which is a Pro-Environmental Behavioral Model (PEPB). The solid lines indicate the significant positive relationship between one construct and the other, whereas the broken lines show that the specific correlation between the two is insignificant. As a result, the model allocates a 59.2% variation in the behavioral intention to use renewable energy sources. Hair et al. [74] implied that with the R^2 score at 0.20 or higher in a paper. It is deemed high, since this paper describes behavioral intentions and usage behavior.

Subsequently, the model fit analysis is done to perceive the PEPB model's validity. It comprises and uses Standardized Root Mean Square Residual (SRMR), Chi-square, and Normal Fit Index (NFI). Table 5 shows that the study's SRMR parameter estimates are at 0.062, Chi-square at 4.03, and NFI at 0.921. Each model fit's parameter estimates are within the suggested cutoff value, values of which were mentioned previously, making the model considered valid.

Table 5. Model Fit.

Model Fit for SEM	Parameter Estimates	Minimum Cutoff	Recommended By
SRMR	0.062	<0.08	[57]
(Adjusted) Chi-square/dF	4.03	<5.0	[64]
Normal Fit Index (NFI)	0.921	>0.80	[58]

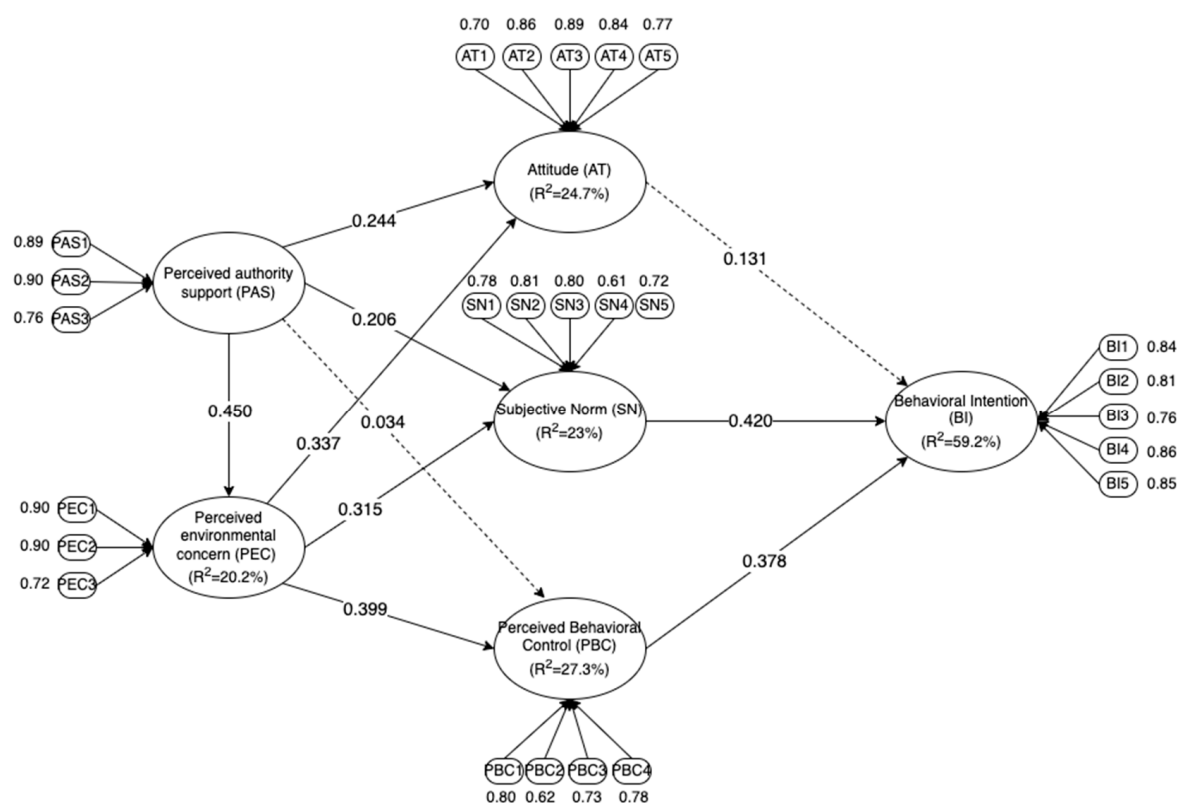


Figure 3. Final SEM Model.

The results of the performed PLS-SEM to test the suggested hypotheses using the Pro-Environmental Planned Behavior Model are presented in Table 6. The results imply that the Perceived Authority Support significantly influences Perceived Environmental Concern ($\beta = 0.450, p < 0.001$) and Subjective Norm ($\beta = 0.420, p < 0.001$) to Behavioral Intention. Furthermore, Perceived Behavioral Control ($\beta = 0.399, p = 0.005$), Attitude ($\beta = 0.337, p = 0.016$), and Subjective Norm ($\beta = 0.315, p = 0.004$) are significantly influenced by Perceived Environmental Concern. Other notable relationships are Perceived Behavioral Control ($\beta = 0.378, p < 0.001$) to Behavioral Intention; Attitude ($\beta = 0.244, p < 0.001$) and Subjective Norm ($\beta = 0.206, p = 0.033$) with Perceived Authority Support. These relationships of factors are within the cutoff value of 0.05 in p -value, contrary to the Perceived Authority Support to Perceived Behavioral Control and Attitude to Behavioral Intention, as they have a p -value of 0.808 and 0.075, respectively. As such, it is rejected due to its insignificant relation.

Table 6. Hypothesis Test.

No	Relationship	Beta Coefficient	p -Value	Result	Significance	Hypothesis
1	PAS→PEC	0.450	<0.001	Positive	Significant	Accept
2	PAS→AT	0.244	<0.001	Positive	Significant	Accept
3	PAS→SN	0.206	0.034	Positive	Significant	Accept
4	PAS→PBC	0.034	0.808	Positive	Not Significant	Reject
5	PEC→AT	0.337	0.016	Positive	Significant	Accept
6	PEC→SN	0.315	0.004	Positive	Significant	Accept
7	PEC→PBC	0.399	0.005	Positive	Significant	Accept
8	AT→BI	0.131	0.075	Positive	Not Significant	Reject
9	SN→BI	0.420	<0.001	Positive	Significant	Accept
10	PBC→BI	0.378	<0.001	Positive	Significant	Accept

5. Discussion

With the persistence of climate change, which brings social, economic, and environmental concerns, the search for alternative, sustainable energy sources have risen in the 21st century. In order to measure whether proposed alternatives will be widely used to achieve the foreseen positive outcome, it is essential to understand the motivations and behavioral intentions of consumers' willingness to use such. Thus, the aim of the present study was to determine the significant factors affecting Filipino acceptance of the use of renewable energies using Structural Equation Modeling (SEM). During the analysis, several latent factors were used, such as Perceived Authority Support (PAS), Perceived Environmental Concern (PEC), Attitude (AT), Subjective Norms (SN), Perceived Behavior Control (PBC), and Behavioral Intention (BI).

As seen in the results, Perceived Authority Support (PAS) holds the highest significance and direct influence on Perceived Environmental Concern (PEC) ($\beta = 0.450$, $p < 0.001$), which validates H1. Thus, the extent of authority support positively affects Filipinos' environmental concerns. Perceived authority refers to an individual's subjective perception or belief that another person or group has the right to exert influence or control over them. This perception may be based on a variety of factors, such as the other person's position of power, expertise, or social status [78].

This suggests that authorities are important in fostering environmental concern among Filipino citizens. The study by Mohanty et al. [79] showed that government initiatives have a significant effect, not only on a consumer's behavioral intention but also on their environmentally friendly behavior. Thus, if the government wants to increase PAS, the results of this study will provide information on how sustainability and environmental concerns can be included in spreading and keeping an eye on PAS for the good of the people. Such a claim shows that green policies increase awareness of existing environmental issues [80]. Moreover, authorities must introduce policies with benefits to further the growth of public concern for the environment and encourage pro-environmental behavior [81].

It was also revealed that PAS directly affects Attitude (AT) ($\beta = 0.244$, $p < 0.001$) and Subjective Norm ($\beta = 0.206$, $p = 0.033$), thereby supporting H2 & H3. This proves that Filipinos' perception of authority support significantly contributes to their attitude and subjective norm. This means that Filipinos value the government's impact and implementation of environmental protection efforts. Irfan et al. [82] suggest that when the government provides support for the use of renewable sources of energy, consumers are more likely to have a positive attitude towards using these sources of energy. In essence, this statement is saying that government support can influence people's perceptions and attitudes towards renewable energy. This means that the government has a considerable effect on its citizens. AT is referred to as an inclination to support renewable energies. OECD [83] proves how government policies offering incentives influence the attitude and actions of consumers favorably. For instance, providing incentives for metering and billing urges households to use efficient water appliances, which leads to a 20 percent reduction in water consumption. Thus, for this strategy to be effective, policymakers must consider low-income households prone to the negative effects of the abrupt charge increase. They may opt for financial provisions that are provided directly to these households or introduce tax reductions, while still considering the vitality of broadening the masses' knowledge of the benefits of environmental-related charges [84].

In addition, how Filipinos see authority support influences social pressure to use eco-friendly energy sources and creates an increase in Filipino citizens' interest and willingness to use such alternatives. This may be done by utilizing public figures and community chiefs [80]. This would attract mass attention, leading to the perception that everyone is consuming these services, thus heightening the patronization of renewable energies. To extend the effectivity of this relationship, the various effects of different policies must be monitored to see whether measures result in reduced participation or increased motivation to take into account the social factor of green behavior (e.g., recycling, zero-waste practice and composting) [83].

On the contrary, PAS was found to have an indirect effect on perceived behavioral control (PBC) ($\beta = 0.034$, $p = 0.808$), therefore, rejecting H4. According to Brahim [14], the Philippines has an existing public inadequacy of knowledge of the benefits of renewable energy projects and a limited market for efficient and effective renewable energy sources. Thus, the insignificant relationship of the aforementioned indicators may be attributed to how the Philippine government has yet to offer concrete alternatives for sustainable energy sources, which leads to a lack of understanding of the difficulty or ease of adopting eco-friendly measures. Regardless, as high awareness constitutes the willingness of consumers to utilize renewable energy sources, it is recommended that the Philippine government conducts informational training programs to aid this gap.

A significant direct influence was also observed between Perceived Environmental Concern (PEC) and Attitude (AT) ($\beta = 0.337$, $p = 0.016$), which leads to the acceptance of H5. Given that there is a general outlook that sufficient knowledge of the environmental consequences of human activities is linked to a higher likelihood of adopting certain behaviors toward a more environmentally friendly society [39], it is intuitive to connect raised environmental consciousness to a more positive attitude. Furthermore, the study by Nanggong and Rahmatia [81] about customer behavior on technology adoption supported this, showing that consumers who are ecologically aware are more inclined to make use of digital e-ticketing instead of its traditional counterpart. With that, the essential role of education is implied to widen the public use of renewable energy sources and induce a gradual general adoption of sustainable practices.

Perceived Environmental Concern (PEC) was also observed to have a direct effect on the Subjective Norm (SN) ($\beta = 0.315$, $p = 0.004$) and Perceived Behavioral Control (PBC) ($\beta = 0.399$, $p = 0.004$), thereby accepting H6 and H7. The results suggest that environmental concern has a significant effect on subjective norms. As a result of this, a strong understanding of the environment is linked to a solid social push to self-impose green practices. This significance is higher than the results of the study by Chin et al. [81] ($\beta = 0.22$), which were significantly less than the other presented correlations. This may be due to the study's specifications on skincare, which cater to a smaller population in comparison to the scope of this study. In the present study, it was also shown that environmental concern among consumers contributes to their perception of accepting the idea of using renewable energy sources. Hartmann et al. [84] conducted a study which found that consumers' support for environmentally friendly products is driven by their awareness of environmental issues. The level of environmental knowledge among citizens is a factor that influences their behavior towards the environment. Since people are aware of the problems in the environment, they are more likely to accept renewable energy sources as a means of reducing the negative impact of non-renewable energy on the environment.

The correlations of AT, SN, PBC, and BI are the primary constructs of the Theory of Planned Behavior. Many studies have found strong and positive relationships between these variables, however, inconsistencies with the result may still appear because the AT and BI in this study do not show a positive direct effect ($\beta = 0.131$, $p = 0.075$). It can be seen that AT has a direct effect on BI among all correlations, making it insignificant, rejecting H8. This means that the consumers' perception of the acceptance of renewable energy does not affect their choice of BI for a particular product. This is similar to the results of the study by Best and Mayerl [85], which assessed the consistency of attitude and behavioral intentions to protect the environment among different countries. It was found that the environmental attitude was insignificant to the environmental intention. Compared to the countries with high GDP, poor or third-world countries are most likely to show an insignificant relationship between the two variables. This concerns the national wealth acts and the individual socioeconomic resources that influence their attitude. Since the Philippines is still a third-world country, there is a low indicator of the attitude toward environmental intentions.

Similarly, the other indicators, such as SN ($\beta = 0.420$, $p < 0.001$) and PBC ($\beta = 0.378$, $p < 0.001$), appeared to have a significant direct effect on the BI among consumers, thereby

accepting H9 and H10. This finding is similar to that of the study by Abeysekera et al. [86], which analyzed the factors influencing green purchase intention and behavior in a Philippine setting using the theory of planned behavior. Findings showed that SN and PBC significantly affect consumers' green purchase intention. Considering the culture in the country, wherein subjective norms are rampant, this is one of the reasons why SN has a significant direct effect on purchase intention. As long as other people encourage consumers to behave in a certain way, they will be more likely to be persuaded. Meanwhile, the PBC of consumers includes external factors such as the accessibility of green products, thus making it also a significant factor in their purchase intention. Another study by Eugenio et al. [87] states that students' subjective norms and perceived behavioral control significantly affect their environmental sustainability. However, there is a greater engagement between students with Higher Education Institutions (HEIs) as they are aware of the importance of a sustainable society.

It was also found that PEC ($\beta = 0.328, p \leq 0.001$) and PAS ($\beta = 0.228, p = 0.009$) indirectly affect the behavioral intention of consumers. It can be seen in Figure 2 that PEC and PAS have a significant direct effect on the SN. Then, SN has a significant direct effect on the BI. Therefore, since PEC and PAS directly affect SN, it indirectly affects consumers' behavioral intention (BI). Multiple factors contribute to the relationship between PEC and PAS to SN, which made the results significant. However, one of the contributing factors that made SN significant to the BI of consumers is the culture present in the country, wherein subjective norms are observed almost everywhere. This implies that authority support and knowledge about environmental problems significantly affect, indirectly, the intention of consumers to use renewable energy sources.

6. Conclusions

This study utilized the PEPB model to analyze the factors contributing to Filipino citizens' acceptance of using Renewable Energy Sources (RES) in the National Capital Region. The PEPB model has six factors which are Perceived Authority Support (PAS), Perceived Environmental Concern (PEC), Attitude (AT), Subjective Norm (SN), Perceived Behavioral Control (PBC), and Behavioral Intention (BI). The results indicated that PAS has the highest significance to the PEC of Filipino citizens, which produces a positive indirect effect on the individual's BI. Another factor that appears to have a high significance is the SN, which is the strongest factor affecting citizens' BI. By contrast, AT appears to be the weakest factor, making it insignificant.

The results implied that out of the ten hypotheses made, eight hypotheses were accepted, H1, H2, H3, H5, H6, H7, H9, and H10, and only two were rejected, H4 and H8. This signifies that Filipinos in the NCR have a high acceptance of switching to renewable energy sources as they are concerned with the environmental effects that contribute to climate change. The authority support from the government impacts the environmental concern, attitudes, and subjective norms of consumers. In such a way, consumers tend to accept renewable energy whenever there is social pressure from the government. However, due to the relatively low authority support, the PBC of consumers is also low, which suggests that the government should provide programs that educate its citizens about renewable energy sources to aid the inadequate awareness of the advantages of renewable energy sources. Consumers have a higher acceptance when they know about sustainable energy's benefits. Moreover, different factors affect their BI: the PBC and SN for the direct effect and PAS and PEC for the indirect effect. This suggests that Philippine culture has rampant subjective norms that its citizens follow. As long as the products are accessible, citizens will switch to those products, as suggested by the people. However, the country's socioeconomic status impacts the AT of consumers, making AT an insignificant factor in their BI. The perception of consumers regarding sustainable energy does not affect their BI due to their limited socioeconomic resources.

6.1. Practical Implications

The Philippine government and its assistance play an integral role in advancing sustainability and environmental actions among Filipinos. Authorities may use the study's results as a fundamental basis for actions in the renewable energy field because it explores the positive impact of government support on citizens' attitudes and willingness to use such energies. To attain this desired sustainability, the government must consider the potential impact of increased charges on its citizens while also gaining the public's opinion in favor of this transition, as the subjective norm heavily influences it. Subjective norms, along with peers and authorities, play a significant role in shaping consumer behavior. Therefore, promoting the advantages of switching to renewable energies and raising awareness of their benefits on environmental concerns may prompt Filipinos to adopt them. They may use informational campaigns or programs that can aid in filling this gap and boosting awareness among citizens. The public's awareness of such environmental aspects is linked to their willingness to adopt green practices. While putting into practice strategies and programs aimed at encouraging renewable energy sources and minimizing the damaging effects of non-renewable energies on the environment, policy makers must take into account these considerations.

6.2. Theoretical Implications

Understanding the factors influencing consumers' behavior toward renewable energies still proves relevant due to prevailing environmental issues in the Philippines and the rest of the world. Similar to prior results of other studies, the researched factors have shown significant correlations with one another, except for perceived authority support to perceived behavioral control and attitude to behavioral intention. The main difference the current study provides from previous research is its extensive analysis of a larger scope. This is evident when compared to a study by Chin et al. [80], whose results showed less significance between measures, as they only catered to skincare products with a smaller population, contrary to the current study, which analyzes the acceptance of renewable energies as a whole. Moreover, the results provide more insights into the inconsistencies of other studies with attitude and behavioral intention [38,39,85,86], which may serve as a basis for future research in the same niche. However, various environmental attitudes and behavior toward the topic from different populations are still present and should be considered. With the Pro-Environmental Planned Behavior Model, the study presented relevant results and additional insights on the relations of government initiatives, public awareness, and knowledge of environmental issues to consumers' behavior toward adopting renewable energies.

6.3. Limitations and Future Research Studies

There are limits to this study that can be investigated more in the future. The first limitation is that the model used in this study is limited to the PEPB model's pre-determined factors. Other models can be explored to test the variation of results between different models. Another area for improvement is the scope of the study in terms of location, as it was limited to Filipino citizens residing in NCR, an urbanized area. Future studies can be conducted in a different region or among the country's rural areas. Lastly, the sampling method in this study utilized the convenience sampling method. Future studies can use other probability sampling methods to gather data, which can produce different results due to the diversity of respondents.

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