Household awareness, acceptance, and willingness to pay for renewable energy

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A B S T R A C T

The purpose of this quantitative study was to investigate the level of household awareness, acceptance, and willingness to pay for renewable energy, with a particular emphasis on identifying significant differences and relationships. The study analyzed the specific influence of individual profiles on the willingness to pay for renewable energy, the relationship between awareness and willingness to pay, and the relationship between technology acceptability and willingness to pay. The data was gathered using an adapted survey questionnaire through stratified random sampling technique for 300 households. Furthermore, statistical analyses, such as logistic regression and one-way ANOVA, were conducted on the data to determine significant differences and relationships. The findings revealed significant results. First, the willingness to pay for renewable energy varied significantly by respondent profile, highlighting the impact of individual characteristics on payment preferences. Secondly, a significant relationship was found between level of awareness and willingness to pay, highlighting the significance of awareness in determining individuals' financial commitment to renewable energy. A significant relationship was found between the level of technology acceptance, specifically perceived usefulness, and willingness to pay, emphasizing the importance of technology perception in influencing payment intentions. This study contributes to the knowledge of household attitudes and behaviors regarding renewable energy, particularly in terms of willingness to pay. The insights obtained may assist policymakers, stakeholders in energy sources, and decision-makers in the development of effective strategies to promote the adoption of renewable energy. This research facilitates the development of targeted interventions to transition to sustainable energy sources by identifying the significant influence of individual profiles, awareness levels, and technology acceptability on payment attitudes.

RESUMO

O objetivo deste estudo quantitativo foi investigar o nível de consciência, aceitação e disposição dos agregados familiares para pagar por energias renováveis, com especial ênfase na identificação de diferenças e relações significativas. O estudo analisou a influência específica dos perfis individuais na disposição de pagar por energia renovável, a relação entre consciência e disposição de pagar, e a relação entre aceitabilidade tecnológica e disposição de pagar. Os dados foram recolhidos através de um questionário de inquérito adaptado através da técnica de amostragem aleatória estratificada para 300 agregados familiares. Além disso, análises estatísticas, como regressão logística e ANOVA unidirecional, foram realizadas nos dados para determinar diferenças e relações significativas. As descobertas revelaram resultados significativos. Primeiro, a disposição de pagar por energia renovável variou significativamente de acordo com o perfil do entrevistado, destacando o impacto das características individuais nas preferências de pagamento. Em segundo lugar, foi encontrada uma relação significativa entre o nível de sensibilização e a vontade de pagar, destacando a importância da sensibilização na determinação do compromisso financeiro dos indivíduos com as energias renováveis. Foi encontrada uma relação significativa entre o nível de aceitação da tecnologia, especificamente a utilidade percebida, e a disposição a pagar, enfatizando a importância da percepção da tecnologia em influenciar as intenções de pagamento. Este estudo contribui para o conhecimento das atitudes e comportamentos das famílias relativamente às energias renováveis, nomeadamente em termos de disponibilidade para pagar. Os conhecimentos obtidos podem ajudar os decisores políticos, as partes interessadas nas fontes de energia e os decisores no desenvolvimento de estratégias eficazes para promover a adopção de energias renováveis. Esta investigação facilita o desenvolvimento de intervenções direcionadas para a transição para fontes de energia sustentáveis, identificando a influência significativa dos perfis individuais, dos níveis de sensibilização e da aceitabilidade da tecnologia nas atitudes de pagamento.

Introduction

The transition to renewable energy sources has become a focal point in global discussions on sustainable development, driven by the imperative to mitigate climate change and secure energy access for future generations (Minas, et. al., 2024). Renewable energy encompasses diverse sources such as solar, wind, hydro, and biomass, offering environmentally friendly alternatives to traditional fossil fuels (Djurisic, et. al., 2020). This transition holds promise for achieving multiple Sustainable Development Goals (SDGs), including affordable and clean energy (SDG 7) and climate action (SDG 13), by reducing greenhouse gas emissions and fostering energy independence (UN, 2015). However, despite the increasing recognition of renewable energy's potential, challenges persist in understanding public perceptions and behaviors towards its adoption.

In many regions, there exists a substantial gap between the growing importance of renewable energy and public awareness and acceptance of these technologies (Del Río & Kiefer, 2022; Gamper-Rabindran, 2022). This disparity is particularly pronounced in developing nations, where limited research has been conducted on public attitudes towards renewable energy (Oluoch, et al. 2022; Bergquist et al., 2020). Such knowledge gaps hinder the formulation of effective policies and strategies to promote renewable energy adoption, exacerbating energy poverty and environmental degradation (Damodaram et al., 2020). Moreover, the lack of understanding regarding public willingness to pay for renewable energy services further complicates efforts to accelerate the transition to sustainable energy systems (Hassan et al., 2024). Consequently, addressing these gaps in knowledge is essential for advancing global efforts towards achieving the SDGs and ensuring a sustainable energy future.

Despite the burgeoning interest in renewable energy, there remains a paucity of research focusing on household-level awareness, acceptance, and willingness to pay for renewable energy services, especially in developing nations (Gareiou et al., 2024; Adnan, 2024). Existing studies have primarily focused on industrial or institutional perspectives, overlooking the nuanced factors influencing individual and household-level decision-making (Simon, 2024; Al-Sarihi, & Cherni, 2023). Consequently, there is a critical research gap in understanding the determinants of renewable energy adoption at the household level, including socio-economic, cultural, and technological factors (Gajdzik et al., 2023; Elasu, et al., 2023; Alipour, et al., 2023). Bridging this gap is crucial for designing targeted interventions and policies that effectively promote renewable energy uptake and address barriers to adoption.

Addressing these research gaps is crucial in advancing the transition to renewable energy and achieving sustainable development goals. With escalating climate change impacts and energy insecurity looming, there is an urgent need to decarbonize the energy sector

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(Gordon et al., 2024; Hussain, et al., 2023). Moreover, as the global population grows and energy demand increases, ensuring universal access to affordable, reliable, and sustainable energy sources becomes imperative (UNDP, 2020). By investigating household perceptions, behaviors, and willingness to pay for renewable energy, this study seeks to provide actionable insights for policymakers, energy practitioners, and stakeholders. Ultimately, bridging these research gaps is essential for advancing global energy transition efforts and fostering a more sustainable and resilient future for all (Hassan et al., 2024).

justification

The justification for this study lies in the pressing need to address energy sustainability challenges and promote renewable energy adoption, particularly in developing nations. While renewable energy offers promising solutions to environmental concerns and the global energy crisis, there remains a significant knowledge gap regarding household perceptions and behaviors towards renewable energy adoption, especially in developing nations. Filling this gap is crucial for informing the development of effective strategies and policies to promote renewable energy adoption and achieve a more sustainable energy landscape globally. By investigating household awareness, acceptance, and willingness to pay for renewable energy, this study seeks to provide valuable insights that can inform decision-making processes and contribute to the advancement of renewable energy initiatives in developing nations.

objective

The primary purpose of this study was to determine the level of awareness, acceptance, and willingness to pay for renewable energy. Specifically, (1) to examine the relationship among the level of awareness, acceptance, willingness to pay for renewable energy. (2) to determine the significant difference between the level of awareness, acceptance, willingness to pay for renewable energy with the profile.

Method

This study used quantitative research methodology to gather numerical data to address research questions through computational, statistical, or mathematical methods (Mohajan, 2020; Bhandari, 2020). A descriptive correlation research design (Ayodele, et. al., 2021) is used to describe and examine the technology acceptance, level of awareness, and willingness to pay for renewable energy among the households in Davao City. The design describes relationships between variables over which the researcher does not control or manipulate any of them (Wagner et al., 2024; Mustafa et al., 2024). This study follows a two-step analysis, such as (1) a test of relationship using Logistic Regression and (2) a test of difference using Analysis of Variance (ANOVA), to answer the objectives of the study (Hwang, et al., 2023; Skordoulis, et al., 2020).

sources of data

The research respondents' inclusion criteria were individuals who are members of households capable of paying bills, 18 years old and above, and living in Davao City. Exclusion criteria included respondents who did not agree to participate in the study, were not responsible for paying household electricity bills, and were underage. The study adopted a cross-sectional research design, allowing for the collection of data at a single point in time to examine relationships between variables (Wang & Cheng, 2020). Additionally, the study employed the Stratified Random Sampling Technique to obtain 300 respondents, where the population was split into subgroups, and units were randomly chosen from each (Nguyen, 2021). Stratified random sampling techniques are frequently applied when conducting corporate, governmental, and related field surveys, researchers must understand how to make and evaluate stratified sampling. A good use of the stratified random sampling technique would be effectively acquiring an ethnically balanced sample using a standardized area-based randomized sampling technique (Verma, et al., 2024).

Ethical consideration

The data collection involved permission to conduct the study and letter to the respondents to accept the participation of the study through the adapted questionnaires. The collection of data period spanned two months, allowing the adequate coverage of the target number of respondents for the study. Moreover, the collected data were used to analyzed and interpreted afterward for the research conclusions. Furthermore, measures were implemented to ensure participant confidentiality and informed consent was obtained from all participants before their inclusion in the study and the right to withdraw.

Results and Discussions

The findings of the study addressing specific objectives are discussed in this chapter and the interpretation and analysis of the results. The findings are primarily derived from data obtained from households in Davao City. Tables and figures are used to explain the outcome of the analysis. In addition, for easy understanding, discussion, and analysis, tabular analysis was presented.

Understanding respondents' profile and willingness to pay for renewable energy

The analysis reveals that the majority of respondents are single (184 out of 303, 60.73%) or married (113 out of 303, 37.29%), with a smaller percentage being divorced (3 out of 303, 0.99%) or widowed (3 out of 303, 0.99%). This demographic distribution aligns with existing studies that indicate a higher prevalence of single and married individuals in survey populations, potentially due to higher availability and willingness to participate in such studies (Szeberényi, et. al., 2022).

Notably, the data indicates that the majority of respondents willing to pay are in the higher income brackets, particularly in the Php 25,000 and above category (87 out of 303,

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28.71%). This supports the argument that higher income individuals are more likely to invest in renewable energy due to greater disposable income and environmental awareness (Menyeh, 2021). However, even among lower income brackets, there is still a significant proportion of respondents expressing willingness to pay. For instance, in the Php 10,000 - Php 15,000 income bracket, 67 out of 303 respondents (22.11%) are willing to pay, which suggests a growing acceptance and perceived necessity of renewable energy across various economic strata (Behera, et al., 2024).

Table 1.

The Profile of the Respondents and Their Willingness to Pay

Profile	Frequency	Percentage
Civil Status		
Single	184	60.73
Married	113	37.29
Divorced	3	0.99
Widowed	3	0.99
Monthly Income		
Php 25,000 above	87	28.71
Php 20,000 - Php 25,000	46	15.18
Php 15,000 - Php 20,000	58	19.14
Php 10,000 - Php 15,000	67	22.11
Php 5,000 - Php 10,000	26	8.58
Php 5,000 below	19	6.27
Total	303	100
Willingness To Pay		
No	50	16.5
Yes	253	83.5
Total	303	100
Amount of the Willingness to Pay		
Php 0 - Php 2500	269	88.78
Php 2501 - Php 5000	30	9.9
Php 5001 - Php 7500	2	0.66
Php 7501 - Php 10000	1	0.33
Php 10001 Above	1	0.33
Total	303	100

When considering the amount of willingness to pay, the majority of respondents (269 out of 303, 88.78%) are willing to pay amounts within the range of Php 0 to Php 2500, indicating a preference for lower payment options. This preference for lower costs is consistent with consumer behavior theories that emphasize budget constraints and value perception in purchasing decisions (Kotler, et al., 2019; Islam, & Ali Khan, 2024). However, smaller

proportions are willing to pay higher amounts, with 30 respondents (9.9%) willing to pay between Php 2501 and Php 5000. This tiered willingness highlights a niche segment of the market that values renewable energy highly enough to allocate more substantial financial resources (Bachan et al., 2024; Vardopoulos, et al., 2023).

Additionally, while married or single individuals are more likely to be willing to pay compared to those who are divorced or widowed, the sample size for the latter groups is relatively small, warranting cautious interpretation. For instance, out of the 184 single respondents, 150 (81.52%) are willing to pay, while out of the 3 divorced respondents, only 1 (33.33%) is willing to pay. This discrepancy may reflect differing financial priorities or stability associated with varying marital statuses (Ayodele, et al., 2021).

These findings emphasize the complexity between demographic factors and willingness to pay, stressing the need for a nuanced understanding of consumer behavior in market analysis and decision-making processes. Understanding these dynamics is crucial for developing targeted marketing strategies and policies that promote renewable energy adoption effectively across different demographic groups (Polcyn, et al., 2021).

Assessing awareness and acceptance levels of renewable energy among households

Table 2 provides a detailed descriptive summary of the level of awareness and technology acceptance among households regarding renewable energy. The data indicates that households generally exhibit a high level of awareness regarding renewable energy, as reflected in the mean score of 3.73 with a standard deviation of 0.59. This suggests that a significant portion of households are well-informed about renewable energy sources and their benefits, supporting findings from recent studies that emphasize the growing public awareness of environmental issues (Rakuasa, & Latue, 2024; Calculli et al., 2021).

Moreover, the perceived usefulness of renewable energy technologies is also notably high, with a mean score of 3.96 and a standard deviation of 0.77. This indicates that households overwhelmingly view renewable energy as valuable and beneficial, likely due to its environmental sustainability and potential cost savings (Maxim, et al., 2022). This perception aligns with research highlighting the perceived economic and ecological advantages of renewable energy, which drive consumer interest and acceptance (Lloyd, & Nakamura, 2022; Wall, et al., 2021).

Additionally, the perceived ease of use of renewable energy technologies is relatively high, with a mean score of 3.75 and a standard deviation of 0.89. This suggests that households find renewable energy technologies accessible and user-friendly, which may contribute to their willingness to adopt and integrate these technologies into their daily lives. The ease of use is a critical factor in technology acceptance models, where user-friendliness significantly impacts the adoption rate (Davis, 1989).

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Overall, the descriptive statistics point towards a positive attitude and acceptance of renewable energy technologies among households, highlighting the importance of promoting renewable energy initiatives and providing support for their widespread adoption. As awareness and acceptance are crucial for the transition towards sustainable energy systems, these findings underscore the need for continuous educational efforts and incentives to facilitate the adoption of renewable energy solutions (Rogers, et al., 2014). This approach is vital for mitigating climate change and ensuring a sustainable energy future (Hoffman & High-Pippert, 2010).

Table 2.

The Descriptive Summary of the Level of Awareness and Technology Acceptance of Household for Renewable Energy

Variable	Mean	Std. Dev.	Description
Level of Awareness	3.73	0.59	High
Perceived Usefulness	3.96	0.77	High
Perceived Ease of Use	3.75	0.89	High

Evaluating factors influencing households' willingness to pay for renewable energy

Table 3 provides insights from a logistic regression analysis exploring the relationship between household level of awareness, technology acceptance, and their willingness to pay for renewable energy. The analysis reveals several key findings. Firstly, the constant term indicates low baseline odds of willingness to pay when other factors are not considered (β = -8.046, p < 0.001). This suggests that without considering other variables, households are less likely to express willingness to pay for renewable energy. This aligns with existing literature that emphasizes the inherent reluctance or inertia among consumers towards adopting new technologies without sufficient motivation (Rogers, et al., 2014).

However, when accounting for predictors, both level of awareness and perceived usefulness emerge as significant factors influencing willingness to pay. Specifically, for every one-unit increase in the level of awareness, the odds of willingness to pay increase significantly by a factor of 3.06 (β = 1.114, OR = 3.056, p = 0.020). Similarly, perceived usefulness significantly increases the odds by a factor of 2.81 (β = 1.036, OR = 2.810, p < 0.001). These findings underscore the importance of increasing awareness and highlighting the practical benefits of renewable energy in encouraging households to invest in it. This is consistent with studies that suggest awareness and perceived value are critical drivers of consumer behavior towards sustainable practices (Dangelico, et al., 2024).

Additionally, perceived ease of use, while not statistically significant at the conventional level (β = 0.569, OR = 1.768, p = 0.052), shows a positive effect on willingness to pay. This suggests that making renewable energy technologies more user-friendly could further enhance adoption. The marginal significance indicates that ease of use is likely an important factor, echoing the Technology Acceptance Model (TAM) which posits that both perceived usefulness and ease of use significantly influence technology adoption (Davis, 1989).

Overall, the results highlight the potential of informed awareness campaigns and emphasizing the practical advantages of renewable energy in driving its adoption among households. By focusing on educational initiatives that increase awareness and demonstrating the tangible benefits of renewable energy, policymakers and stakeholders can effectively promote a sustainable energy transition. The integration of user-friendly designs in renewable energy technologies can further bolster this transition, making sustainable energy solutions more accessible and appealing to a broader audience (Altassan, 2023; Batool et al., 2023).

Table 3.

The Logistic Regression Analysis of Household Level of Awareness, Technology Acceptance, and Willingness to Pay for Renewable Energy

Willingness to Pay	Coefficient	Odds Ratio	Std. Err.	z	P>z	Decision on Ho
Constant	-8.045905	0.0003201	1.392782	-5.78	0.0000	
Level of Awareness	1.114065	3.055534	0.4773064	2.33	0.0200	Reject Ho
Perceived Usefulness	1.036049	2.810106	0.2961133	3.5	0.0000	Reject Ho
Perceived Ease of Use	0.5689952	1.767645	0.2925642	1.94	0.0520	Failed to Reject
Number of obs	**303**					
Log likelihood	**-93.313707**					
LR chi2(3)	**84.8**					
Prob > chi2	**0.0000**					
Pseudo R2	**0.3124**					

Analyzing the impact of demographic profiles on willingness to pay for renewable energy

Table 4 presents an analysis of the significant differences between household willingness to pay for renewable energy and various demographic profiles, including the amount of willingness to pay, civil status, and monthly income. The results reveal meaningful variations in willingness to pay across different levels of payment amounts, as indicated by a large F statistic of 25.983 and a p-value of 0.000, leading to the rejection of the null hypothesis. This suggests that the amount individuals are willing to pay significantly influences their

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willingness to invest in renewable energy. This finding aligns with economic theories that suggest individuals make decisions based on the perceived benefits and costs associated with a product or service (Higueras-Castillo, et al., 2024; Ciu, & Wijayanti, 2024).

However, civil status does not appear to have a significant impact on willingness to pay, as indicated by a non-significant F statistic of 0.858 and a p-value of 0.463. This implies that marital status alone may not be a determining factor in household decisions regarding renewable energy investment. This finding contrasts with previous studies that have suggested differences in environmental attitudes and behaviors based on marital status (Osorio, 2024). It is possible that other factors, such as income and education, play a more significant role in shaping environmental preferences among households.

In contrast, there are notable differences in willingness to pay across various income brackets, with a significant F statistic of 8.189 and a p-value of 0.000, leading to the rejection of the null hypothesis. This finding underscores the importance of considering socioeconomic factors, particularly income levels, in understanding and promoting renewable energy adoption among households. Lower-income households may face financial constraints that limit their ability to invest in renewable energy technologies, despite potential long-term cost savings (Azimi et al., 2023; Berkouwer, & Dean, 2021). Addressing affordability concerns and providing financial incentives or assistance programs could help overcome barriers to adoption and promote equitable access to renewable energy solutions (Falcone, 2023; Qayyum, et. al., 2021).

Table 4.

The Significant Difference Between the Household Willingness to Pay for Renewable Energy and Its Profile

Profile	Sum of Squares	df	Mean Square	F	Sig.	Decision on Ho
Amount of Willingness to Pay						
Between Groups	34.385	46	0.747	25.983	0.0000	Reject Ho
Within Groups	7.365	256	0.029			
Total	41.749	302				
Civil Status						
Between Groups	0.356	3	0.119	0.858	0.4630	Failed to Reject
Within Groups	41.393	299	0.138			
Total	41.749	302				
Monthly Income						
Between Groups	5.058	5	1.012	8.189	0.0000	Reject Ho
Within Groups	36.691	297	0.124			
Total	41.749	302				

Implications and Limitations

The study offers insightful conclusions regarding household perceptions and behaviors towards renewable energy adoption. Notably, it highlights a high level of awareness and positive attitudes among households towards renewable energy technologies. Factors such as perceived usefulness and ease of use significantly influence willingness to pay for renewable energy. Moreover, the study underscores the pivotal role of socioeconomic factors, particularly income levels, in shaping household decisions regarding renewable energy investment. Building upon these findings, several recommendations emerge. Firstly, targeted awareness campaigns should be developed to increase knowledge about renewable energy benefits. Additionally, investment in research to improve the usability and accessibility of renewable energy technologies can enhance adoption rates. Financial incentives or assistance programs should also be implemented to address affordability concerns, especially among lower-income households. Policymakers, industry stakeholders, and environmental advocates can utilize these insights to inform policy development, market strategies, and sustainability efforts. However, it's essential to acknowledge the study's limitations, such as sample size constraints, reliance on self-reported data, and the cross-sectional design, which may impact generalizability and causal inference. Future research addressing these limitations can provide a more comprehensive understanding of household attitudes and behaviors towards renewable energy adoption, guiding more effective strategies for sustainable energy transition.

Funding agency

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