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DETERMINANT FACTORS OF RESIDENTIAL SOLAR PV ADOPTION IN THE PHILIPPINES: A MULTIVARIATE STRUCTURAL EQUATION MODEL ANALYSIS

TITUS JAMES R. RAGRAGIO[1], RIANINA D. BORRES[1], SATRIA FADIL PERSADA[2], MICHAEL NAYAT YOUNG[1], ARDVIN KESTER S.ONG[1], YOGI TRI PRASETYO[3,4], RENY NADLIFATIN[5]

[1] School of Industrial Engineering and Engineering Management, Mapua University, 658 Muralla St., Intramuros, Manila 1002, Philippines
[2] Entrepreneurship Department, BINUS Business School Undergraduate Program, Bina Nusantara University, Malang 65154, Indonesia
[3] International Bachelor Program in Engineering, Yuan Ze University, 135 Yuan-Tung Road, Chung-Li 32003, Taiwan
[4] Department of Industrial Engineering and Management, Yuan Ze University, 135 Yuan-Tung Road, Chung-Li 32003, Taiwan
[5] Department of Information Systems, Institut Teknologi Sepuluh Nopember, Kampus ITS Sukolilo, Surabaya 60111, Indonesia
Email: tjrragragio@mymail.mapua.edu.ph (T.J.R.R), rdborres@mapua.edu.ph (R.D.B), mnyoung@mapua.edu.ph (M.N.Y); aksong@mapua.edu.ph (A.K.S.O), satria.fadil@binus.ac.id (S.F.P), yogi.tri.prasetyo@saturn.yzu.edu.tw (Y.T.P), reny@its.ac.id (R.N)

ABSTRACT

The objective of this research endeavor is to examine the attitudes and intentions of householders in the Philippines with respect to the implementation of Residential Rooftop Solar Photovoltaic Systems (RSPVS) and the subsequent adoption of this renewable energy technology. The research is motivated by favorable circumstances in the Philippines, which encompass abundant irradiance, favorable policies regarding solar photovoltaics, and declining expenses for systems. Gaining insight into the viewpoints of prosumers (consumers and producers) is essential for expediting the implementation of RSPVS, thereby facilitating the increased utilization of solar energy. Expanding upon prior investigations that underscore householders' profound fascination with solar technology despite significant obstacles such as exorbitant installation expenses and a dearth of comprehension, the present study endeavors to illuminate the determinants that impact prosumers' intentions to utilize RSPVS. By integrating Technophilia and Perceived Risk as supplementary constructs and utilizing a conceptual framework that combines the Technology Acceptance Model (TAM), Theory of Planned Behavior (TPB), and Unified Theory of Acceptance and Use of Technology (UTAUT), this research endeavors to identify the factors that promote or hinder the adoption of RSPVS. The research utilizes an online survey that was disseminated in prominent urban areas where Residential RSPVS is accessible. The sample consists of 239 participants, which satisfies the minimum sample size requirements. In addition to demographic information (e.g., gender, age, education, income, and sources of solar PV data), the questionnaire inquires about constructs associated with the adoption of RSPVS as outlined in TAM, TPB, and UTAUT. Using Partial Least Squares Structural Equation Modeling (PLS-SEM), the collected data are analyzed to determine the hypothesized model and to examine the relationships between variables. Technophilia, Price Value, and Social Influence are significant predictors of prosumers' intent to adopt MRSPVS, according to the findings. Significantly, Technophilia, which denotes a profound interest in novel technologies, surfaced as a crucial determinant, indicating that prosumers are driven by the appeal of solar energy. Furthermore, the research determined that Perceived Risk did not serve as a substantial impediment.

***Keywords**: Residential Solar PV, Technophilia, TAM, UTAUT, TPB*

1. INTRODUCTION

In light of the climate crisis and the escalating energy demands of the twenty-first century, renewable energy sources have emerged as a pivotal catalyst in the effort to mitigate global warming [1]. The advancement of solar photovoltaic (PV) technology has led to a more competitive Levelized Cost of Energy (LCOE), which has resulted in a substantial increase in its deployment from 6.6 GW in 2006 to 500 GW in 2018 [2]. The term "LCOE" denotes the mean expense incurred in the production of electricity from a specific source throughout its operational

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lifespan, encompassing expenses related to fuel, construction, and upkeep. In addition to their economic advantages, solar photovoltaics are the most ecologically sustainable energy source [3]. Solar photovoltaics operate by converting DC power (distributed solar radiation that travels through the PV cells) into grid-compatible AC power. This AC power can be utilized in a variety of applications, including residential, commercial, industrial, and utility scale systems that supply energy to entire communities.

As one of the most important physical factors influencing the performance of solar PVs, countries located near the equator have year-round access to consistently high levels of solar energy, which increases their viability. In the Philippines, where solar radiation potential is high at 4.0 to 5.6 kWh/m²/day [4] (see Figure 1), solar PV deployment increased exponentially from 1 MW in 2013 to 1317 MW in 2021 [5]. Additionally, in order to maintain its rate of development, the Philippine Electricity Market Corporation (PEMC) reports that the country's electricity demand rose by 4.6%, or 69.9 GWh [6].

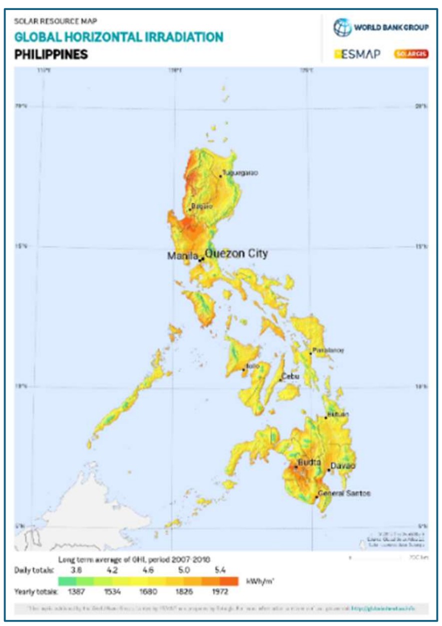
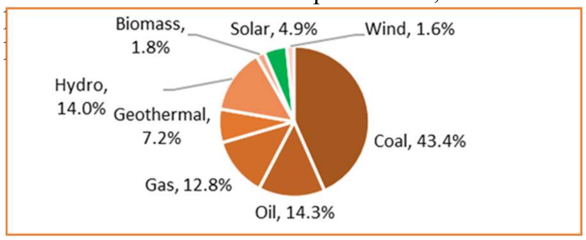


Figure 1. Global Horizontal Irradiation – Philippines ((Solargis, 2020)

As shown in Figure 2, the Philippines continues to rely heavily on fossil fuel-based energy sources such as coal, gas, and oil. Renewable Energy (RE) sources account for a mere 29.4% of the total energy balance, while solar photovoltaics (PV) contribute only 4.9%. The Philippines has set a target of achieving 35% renewable energy (RE) reliance by 2030 (5,585 MW solar PV) and 50% by 2040 (27,162 MW solar PV) via the National Renewable Energy Program (NREP) [7]. In order to enhance the deployment of solar photovoltaics (PV) in the Philippines, the Renewable Energy Act (RE Act) of 2008 was enacted and subsequently executed via policies such as Net Metering and Feed-in-Tariff (FIT). The FIT was designed to operate at a fixed tariff of 9.68 PHP/kWh (approximately $0.16 USD/kWh) for Phase 1 in 2012, which involved a 50 MW market capitalization, and 500



`Figure 2. Installed Capacity by Plant Type, DOE 2020

Net-metering is a significant policy mechanism within the residential sector that enables owners of solar PV sites to sell any surplus energy generated back to the grid at a predetermined generation rate. This feature enhances the financial feasibility of residential solar PV deployment, particularly for homeowners who are seeking to offset the exorbitant retail electricity prices [8]. The primary objective of deploying solar PV in the residential sector is to achieve cost savings compared to the exorbitant retail electricity prices [9]. Additionally, the reduced investment costs associated with solar PV enhance its appeal to homeowners. The DOE has 5,716 qualified end-users of net metering as of 2021 [10]. Meralco, a prominent electrical utility provider in the nation, disclosed that its residential retail tariff was one of the most exorbitant in 2018. At 0.1772 USD/kWh, it ranked 26th highest in the country [11].

David et al. [12] argue that social-economic and policy considerations take precedence over physical factors such as solar irradiance when it comes to the implementation of residential rooftop solar photovoltaic systems. The expenses associated with solar photovoltaic (PV) initiatives have decreased in recent years, mirroring the exponential expansion observed on a global scale [13]. Surprisingly, this expansion was not primarily driven by utility-scale solar PV; rather, it was accomplished by householders in the residential RSPVS sector [14, 15].

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Due to favorable circumstances such as elevated levels of irradiance, backing for solar PV policies, and the decreasing expenses associated with solar PV systems, Philippine households are well positioned to benefit from residential RSPVS. In order to expedite the implementation of this environmentally and economically beneficial renewable energy source, it is crucial to comprehend how prosumers (producers and consumers) perceive this technology [16]. Parag and Sovacool [17] posit that residential RSPVS consumers have the capacity to alter the electrical production and consumption landscape by means of decentralization and environmental friendliness. This could potentially assist the Philippines in attaining its objective of increasing its reliance on renewable energy.

Most participants in a prior investigation conducted by Solangi [18] expressed interest in solar technology. Nevertheless, the primary impediment to the widespread adoption of solar-powered electricity in Malaysia is the considerable expense and lack of comprehension associated with its installationGiven the long-term advantages and environmental significance of residential RSPVS, Jayaraman [19] concurs with this study that the exorbitant cost of such systems affects consumers' intent to purchase.

Considering the increasing adoption of solar photovoltaic (PV) energy in the Philippines, the purpose of this research is to investigate homeowners' perspectives on residential RSPVS (which entails having it fully installed by an EPC for the homeowner's use) and to gain a better understanding of the factors that influence consumers' intentions to utilize it. By gaining insight into consumer perception regarding residential RSPVS, both policymakers and the solar PV industry can develop a more targeted strategy to promote these systems, emphasizing the critical factors that influence their adoption.

This research will employ theoretical frameworks that provide explanations for individuals' intentions to utilize technology, including the Technology Acceptance Model (TAM), Theory of Planned Behavior (TPB), Unified Theory of Acceptance and Use of Technology (UTAUT), and Technophilia (TECH) and Perceived Risk (PR), which will be incorporated as supplementary constructs\

2. THEORETICAL BACKGROUND

2.1. Operation Of Residential RSPVS

When most people think of solar energy, they envision photovoltaic modules mounted on rooftops or the ground. Nonetheless, for the operation of the system, supplementary elements such as inverters, PV module mountings, cables, and protective devices are indispensable. Solar photovoltaic cells generate direct current (DC) from sunlight. Multiple PV modules connected in series produce DC current and voltage, which are then routed through surge protection devices and DC breakers. By connecting the DC breaker to the inverter, which transforms the DC input into grid-compatible AC voltage, the primary distribution panel of the residence is powered. In accordance with the net-metering regulation, surplus energy may be exported or resold to the grid at the Generation Charge (GC) rate of 6.93 PHP/kWh (0.12 USD/kWh), as opposed to the 10.61 PHP/kWh (0.18 USD/kWh) applicable to retail electricity. [20].

Solar engineering, procurement, and construction (EPC) businesses in the Philippines are thriving and competitive, leading to more competitive pricing for solar projects. As of September 2022, a market survey of residential RSPVS providers in Metro Manila revealed that the current price per kilowatt ranges from PVZP 45,000 to 85,000 or USD 765 to 1445. Based on the mean expenditure for installation, which is PHP 60,000 (USD 1052), this figure represents a reduction of 50% in comparison to the cost estimated in the 2014 study conducted for the Net Metering Reference Guide [21]. The overall expenditure is subject to variation contingent upon the brand of components employed and is influenced by the PV module and inverter, which generally account for 50% and 20%, respectively, of the total project cost.

2.2. RSPVS Literature In The Philippines

With the uptake of solar projects in the Philippines, the literature on RSPVS previously focused on policies, feasibility, and rural electrification. Rocha et al. [22] evaluated the effectiveness of FIT and net-metering (NM) policies for residential RSPVS. The results showed that high retail electricity prices are the main driver of the value and success of NM.

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Further, Pacudan et al. [23] found that the net metering program for residential RSPVS has gained traction as more participants have joined, mainly due to the declining cost of RSPVS for smaller-sized systems reaching above grid-parity rates in the country.

An investigation was conducted by Gunoa et al. [24] into the economic viability of incorporating solar energy into various types of residential buildings. The researchers employed the Real Options Approach (ROA), a methodology that incorporates risk and uncertainty, in addition to the typically utilized return on investment. Without requiring a down payment, the distribution of PV system costs over a ten-year installment period appears to be the most advantageous investment strategy among the payment plans analyzed. Lower-income and risk-averse consumers whose adoption of solar PV is impacted by price barriers, economic status, and household income may benefit from this strategy. Industrial establishments have identified critical industrial sectors that can optimize the benefits of the RSPVS in terms of investment quality and CO2 emission reduction [25]. The industrial RSPVS has a potential of 1035 MWp.

The primary drivers behind the implementation of RSPVS for rural electrification were the enhanced social status within the community and the efficient use of electricity [26]. Brooks & Urmee [27] examined the efficacy of the individual training component in a number of RSPVS installation projects in the Philippines via a survey and focus group discussion. The authors concluded that proper user and local technician training is an essential element in the successful implementation of PV power systems for rural electrification. For training to be efficacious, consensus must exist regarding the intended performance behaviors as well as the appropriate methods for their assessment.

2.3. Residential RSPVS Adoption

With the advantages of new technology in the renewable energy sector, such as residential RSPVS, consumers can be energy-sufficient and avail of local policies such as NM, which help in decarbonization. This technology must be user-friendly and perceived as more valuable than traditional energy sources to gain public acceptance [28]. To further understand the key factors for adoption of the residential RSPVS, researchers employed technology and innovation models such as the Technology Acceptance Modeling (TAM) of Davis [29], the Theory of Planned Behavior (TPB) by Ajzen [30], and the Unified Theory of Acceptance and Use of Technology (UTAUT) of Venkatesh et al. [36]. Additionally, Ajzen and Cote [32] proposed that one of the best predictors of people's desire to utilize a technology is people's attitude toward that technology.

Initially conceived as a theoretical information system (IS) model, the TAM framework assesses the degree to which consumers adopt and employ novel technologies. Acceptance is influenced by user input in system design; therefore, TAM emphasizes attitudinal explanations of intent to utilize a particular technology or service. Consumers can attain energy independence and benefit from decarbonization-promoting local policies, such as NM, by employing new technologies in the renewable energy sector, including residential RSPVS, according to Legris et al. [31], TAM i. To achieve public acceptability, this technology must possess the qualities of being user-friendly and being perceived as more valuable than traditional energy sources [28]. Academics employed innovation and technology frameworks such as Davis's Technology Acceptance Modeling (TAM) [29], Ajzen's Theory of Planned Behavior (TPB) [30], and Venkatesh et al.'s Unified Theory of Acceptance and Use of Technology (UTAUT) [36] to acquire a more comprehensive understanding of the factors that influence the adoption of residential RSPVS. Moreover, according to Ajzen and Cote [32], attitudes of individuals toward a specific technology are among the most precise indicators of their likelihood to employ that technology.is regarded as a beneficial theoretical framework for elucidating and comprehending information system user behavior. A study conducted in Malaysia [34] found that behavioral intention (BI) was substantially impacted by perceived ease of use (PEOU), perceived usefulness (PU), and attitude toward use (ATU) when TAM was applied to residential RSPVS. Saqib et al. [33] documented that the decomposition of PU (into social, economic, and environmental utility) and POEU (into discomfort and insecurity) occurred via a modified TAM approach. Their findings are consistent with the previous research indicating that PU and PEOU have a significant and positive impact on consumer perceptions of RSPVS adoption in Pakistan.

For residential RPSVS adoption experiments, the TPB framework, an expansion of the Theory of Reasoned Action (TRA), was also implemented. A correlation has been observed in Taiwan [34] between personal characteristics, psychological advantages, attitude towards rooftop photovoltaics, and government incentives pertaining to the intention to deploy solar PV. Wenling et al. [35] implemented the TPB framework and a logit model in Shandong, China. The study revealed that participants held a favorable view of renewable energy in light of the environmental benefits associated with solar PV. Furthermore, their inclination to utilize renewable energy was found to be significantly impacted by factors such as income level, understanding of solar PV, and cost perceptions.

The unified theory of acceptance and use of technology (UTAUT), which was formulated by Venkatesh et al. [36], incorporated the eight models and theories of individual acceptance, namely TRAC, TAM, MM, TPB, C-TAM-TPB, MPCU, IDT, and SCT. The UTAUT model was utilized by Malaysian researchers to examine the ways in which knowledge, price value, social influence, and facilitating conditions impact the intention to utilize solar PV systems [37]. In contrast to knowledge, price value exerted a more pronounced influence on social influence, which in turn affected behavioral intention more strongly than facilitating conditions. These results are corroborated by Aggarwal et al. [38], who conducted a study in India and found that subjective norms and social beliefs are the most influential determinants of solar PV purchase intent.

3. METHODOLOGY

3.1. Conceptual Framework

As shown in Figure 3, the conceptual framework will be comprised of the following three frameworks: UTAUT, TAM, and TPB, in addition to the constructs of perceived risk and technophilia. The UTAUT paradigm comprises the following constructs: facilitating conditions (FC), price value (PV), and social influence (SI). Motivationally speaking, technophilia was also incorporated as a UTAUT construct [42]. It is defined as the eagerness to utilize novel technologies. The TPB provides the Attitude Toward Use (ATU) and Perceived Behavioral Control (PBC), whereas the TAM utilizes the Perceived Usefulness (PU) and Perceived Ease of Use (PEOU) constructs. Finally, perceived risk was incorporated as an additional factor that impacts ATU.

The Statement of Hypotheses regarding these constructs will be elaborated upon in the following section.

3.1.1. Technology Acceptance Model (TAM)

The construct known as Perceived Ease Of Use (PEOU) refers to the extent to which an individual perceives the system as requiring no effort on their part [28]. This study employs the PEOU construct to examine the relative ease of facilitation, operation, and maintenance of a Residential RSPVS system that will be entirely installed and commissioned by an EPC. The following hypotheses are formulated in support of this analysis:

Hypothesis 1 (H1). PEOU has a positive and significant impact to ATU.

Hypothesis 2 (H2). PEOU has a positive and significant impact to PU.

Hypothesis 3 (H3). PU has a positive and significant impact to ATU.

3.1.2. Unified Theory Of Acceptance And Use Of Technology (UTAUT)

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Social influence (SI) refers to the degree to which an individual believes that the newly implemented system, Residential RSPVS in this instance, should be adopted by others [36]. Social influence is the extent to which a user's choice to adopt a specific technology is impacted by the opinions of trusted acquaintances, family members, and respected community members, according to Camilleri [39]. The subsequent hypothesis regarding social influence is formulated as follows:

Hypothesis 5 (H5). SI has a positive and significant impact to ATU.

Price Value (PV) is an essential concept to contemplate due to the fact that the expense of utilizing a new technology will be borne by the end-user. Additionally, PV represents the consumer's evaluation of the perceived benefit in relation to the cost of utilization [40] [41]. By utilizing Residential RSPVS, prosumers can take advantage of the present overall cost decline, which results in a shorter payback period. The subsequent hypothesis is put forth regarding Price Value:

Hypothesis 6 (H6). PV has a positive and significant impact to ATU.

Technophilia (TECH) refers to an individual's extreme fervor for novel and emerging technologies [42]. It has been utilized as a conceptual framework for various technological applications [43] [44] [45]. Abbasi et al. [45] discovered that technophilia exerts a significant impact on consumers with regard to environmentally efficient and utilitarian technologies, including electric vehicles. Proposed is the hypothesis regarding Technophilia:

Hypothesis 7 (H7). TECH has a positive and significant impact to ATU.

The term "Facilitating Condition" (FC) is defined as "the degree to which an individual believes that the System is supported by an organizational or technical infrastructure" [36]. Early adopters of a technology are obligated to implement FC considerations such as the availability of support [46]. Regarding prosumers, the facilitating condition for residential RSPVS in the context of solar PV is the availability and promptness of support [47]. The subsequent hypothesis is put forth regarding the Facilitating Condition:

Hypothesis 8 (H8). FC has a positive and significant impact to ATU.

3.1.3. Theory Of Planned Behavior (TPB) And Perceived Risk

Perceived risk in energy technologies refers to an individual's direct perception of the potential injury that an energy source could inflict on humans [48]. In the study of solar PV adoption, perceived risk (PR) has been incorporated into the Extended Theory of Planned Behavior framework [49]. Perceived risks associated with residential RSPVS may include the possibility of electrocution, fire hazards, and structural damage to the roof. These risks have the potential to adversely affect an individual's inclination to implement RSPVS. Proposed is the hypothesis regarding Perceived Risk:

Hypothesis 4 (H4). PR has a positive and significant impact to ATU

As defined, Attitude Towards Use (ATU) is an individual's favorable evaluation or aversion toward the specified act or behavior [29]. In this instance, ATU refers to the adoption of Residential RSPVS. ATU, which is supported by Vabo and Hansen [50], is concerned with the positive or negative consequences of individuals' responses to particular behaviors and objectives. The subsequent hypothesis is put forth regarding ATU:

Hypothesis 9 (H9). ATU has a positive and significant impact to BI.

Perceived Behavioural Control (PBC) pertains to the degree of ease or difficulty an individual attributes to a particular behaviour, in addition to the degree of control they believe they possess over the behaviour's intended outcomes. Within the framework of this research, PBC pertains to an individual's robust conviction regarding their capacity to effectively utilize Residential RSPVS. The subsequent hypothesis is put forth regarding Perceived Behavioral Control:

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Hypothesis 10 (H10). PBC has a positive and significant impact to BI.

3.2. Sample Size

In order to conduct this research, an online survey will be administered in strategic Philippine communities where residential RSPVS are presently provided by local EPCs. Based on the principle that sample size should be four to five times the number of variables [51], the minimum number of randomly sampled respondents for this study is 185, given that the identified constructs comprise 37 variables.

3.3. Questionnaire

The survey should encompass details regarding the respondents' demographics, including their place of residence, gender, age, occupation, educational attainment, monthly household income, utility bill, and source of information regarding solar photovoltaics. The second section describes the various residential RSPVS constructions. The constructs shall be evaluated by the respondents using a 5-point Likert scale, which spans from strongly disagree (1) to strongly agree (5). Table 1 contains an inventory of these constructs.

3.4. Structural Equation Modelling

The collected data are subjected to analysis using Statistical Equation Modelling (SEM) in order to illustrate the relationships between variables and evaluate the hypothesized model quantitatively [57]. This study employs partial least squares SEM (PLS-SEM) to examine the interrelationships among abstract concepts [58].

4. RESULTS

4.1. Data Analysis

The present study employed integrated UTAUT, TPB, and TAM models to examine the impact of perceived risk and reward factors on the intentions of Filipino consumers to install residential solar PV systems. During the period spanning from November 3, 2022, to January 10, 2023, a grand total of 239 responses were collected via the questionnaire. The respondents' demographic information is summarized in Table 2. Among the entire sample of participants, 51.5% identified as female, 47.3% as male, and 1.7% declined to provide their gender information. With regard to age, the proportion of respondents falling within the age range of 18 to 25 years old is 8.58%, followed by those aged 26 to 35 years old at 50.21%, 20.60% for those aged 36 to 45, 46 to 55 at 14.59%, and 6.01% for those aged 56 to 72 years old. Regarding place of domicile, the NCR comprises the largest proportion of respondents (65.3%). Region 5 (12.1%), followed by Regions 4A and 4B (8.4% and 10%, respectively), follows. The proportion of respondents from the Visayas and Mindanao regions is a mere 1.7%. With respect to educational attainment, it is observed that 69% of the population possesses a bachelor's degree or higher, 16.7% hold a master's degree or higher, 7.1% hold certificates or diplomas, and 7.1% have completed primary school and secondary school. With regard to household income, the following percentages are as follows: 18.4% earn Php 43,829 to 76,669, 41% have a total household income between Php 21,194 and Php 43,828; 14.2% have an income between Php 76,670 and Php 131,484; 13.8% have an income below Php 21,194; and 12.5% have household incomes of Php 131,485 or more. Based on the income levels of the participants, the percentage of monthly electricity costs that exceed Php 3000 (41%) corresponds to less than 250kWh. This is followed by Php 3001–5000 (38.5%) for 251–420kWh, and Php 5,001–9,000(15.1%) for 421–760kWh. Lastly, at 764 kWh and above, Php 9001 contributes a mere 5.4%.

For the source of information for solar, sources from Colleague, Friends, &and Relatives with Solar Installed ranks highest at 38.9%, followed by Social Media at 28.9%, information from Solar Contractor contributes to 10.9% and News contributed to 9.2%.

Three (3) parameters—Cronbach's alpha, composite reliability, and average variance extracted—were used in the data fit test and were applied to both lower-order and higher-order constructs. By evaluating the factor loadings and composite reliability, the internal consistency of the measure is evaluated to determine the dependability of each individual construct. According to Hair et. al. [59], the construct's validity is evaluated using convergent and

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discriminant validity, wherein convergent validity refers to the degree of agreement among several items used to measure the same concept in the study. For acceptable scores, Cronbach's alpha is acceptable above 0.6 [60], while for average variance extracted (AVE) and outer loadings values, the acceptable value of AVE must be at least 0.5 [61]. Table 4.3 summarizes the measurement model, item loadings, construct reliability, and convergent validity of the constructs.

The respective ranges for Cronbach's α, AVE, and CR are 0.653 to 0.904, 0.558 to 0.741, and 0.753 to 0.920. The measurement parameters are deemed acceptable due to the fact that these values lie within predetermined ranges (Hair, Hult, Ringle, & Sarstedt, 2014). Insufficient factor loading led to the elimination of several constructs, including PV1, SI1, SI4, FC3, FC4, and ATU3, all of which obtained scores below 0.7 [62].

4.2. Structural Model Assessment

Discriminant validity is the condition in which two or more concepts that are distinctly distinct from one another are not related (Hair, Hult, Ringle, & Sarstedt, 2014). By employing the Fornell-Larcker Criteria and Heterotrait-Monotrait (HTMT) Ratio Analysis, it is possible to ascertain the discriminant validity of the construct. Prior to conducting cross-loading analysis, the factor loadings are obtained utilizing PLS factor techniques in PLS-SEM. In order to assess reliability, a threshold value of 0.5 was assigned to all factor loadings pertaining to reflective constructs [61]. The dataset contained no elements with loading values below 0.5. Low loadings serve as an indication of the model's exceedingly restricted explanatory capacity and result in a reduction of estimated parameters connecting the constructs. Conversely, high loadings suggest that a more substantial amount of variance is shared among the constructs [63]. In accordance with Hair et al. [62], the HTMT must not surpass 0.90. The HTMT Ratio Analysis and the Fornell-Larcker Criteria are displayed in Tables 4.4 and 4.5, respectively.

	ATU	BI	FC	PBC	PEOU	PR	PU	PV	SI	TECH
ATU	0.867									
BI	0.651	0.955								
FC	0.57	0.521	0.866							
PBC	0.485	0.392	0.58	0.819						
PEOU	-0.288	-0.213	-0.248	-0.147	0.774					
PR	0.503	0.515	0.367	0.312	-0.271	0.79				
PU	0.485	0.337	0.533	0.538	-0.307	0.532	0.799			
PV	0.619	0.663	0.502	0.315	-0.245	0.521	0.434	**0.82**		
SI	0.531	0.531	0.338	0.321	-0.185	0.436	0.38	0.532	**0.855**	
TECH	0.662	0.654	0.682	0.482	-0.304	0.549	0.516	0.709	0.529	**0.861**

Table 4.4 Fornell-Larcker Criterion Analysis for Checking Discriminant Validity of Construct

	ATU	BI	FC	PBC	PEOU	PR	PU	PV	SI	TECH
ATU										
BI	0.834									
FC	0.848	0.67								
PBC	0.679	0.47	0.8							
PEOU	0.366	0.23	0.308	0.2						
PR	0.686	0.601	0.501	0.403	0.32					
PU	0.646	0.382	0.713	0.684	0.354	0.655				
PV	0.852	0.787	0.696	0.416	0.282	0.639	0.526			
SI	0.764	0.671	0.503	0.418	0.258	0.574	0.481	0.716		
TECH	0.856	0.723	0.891	0.59	0.345	0.645	0.595	0.853	0.65	

Table 4.5 Heterotrait-Monotrait Ratio (HTMT) Analysis for Checking Discriminant Validity of Inner Model

A bias in a regression model that results from the significant correlation between two or more exogenous variables is one of the concerns associated with multicollinearity [64]. Multicollinearity often leads to inflated estimates of regression, including beta and R2 coefficients, which significantly influence the study's overall findings and conclusions [61]. When the variance inflation factor (VIF) value for each variable surpasses 5, this concern can be identified through the application of the collinearity evaluation [62].

A full collinearity approach may be utilized by researchers to assess prevalent method bias. The absence of common method bias in the model is indicated by a VIF value below 3.3 [65]. The assessments of collinearity and common method bias for each independent latent variable in the research model are detailed in Table 4.6. The results indicate that neither multicollinearity nor common method bias are identified as issues. The VIF values for all constructs are below the critical values of 5 and 3.3, respectively, for multicollinearity and common method bias. This accounts for the absence of collinearity and common method bias issues in the research. The assessments of collinearity and common method bias for the inner model are summarized in Table 4.6.

Table 4.6 Collinearity and Common Method Bias Assessment of Inner Model

Indicators	VIF	Collinearity Problem (VIF>5)?	Common Method Bias Problem (VIF>3.3?)
ATU	1.307	No	No
BI	0	No	No

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FC	1	No	No
PBC	1.307	No	No
PEOU	1.142	No	No
PR	1.752	No	No
PU	2.577	No	No
PV	2.229	No	No
SI	1.556	No	No
T	2.506	No	No

The structural model can be determined using a bootstrapping approach [66], and an assessment of the structural model was conducted in order to examine the derived hypotheses. This test may only be conducted after an analysis of the measurement model has attested to the absence of any violations. In the structural evaluation, the path coefficients and R2 values are initially assessed. Subsequently, the significance of the path coefficients is ascertained through the utilization of a bootstrap analysis. The value of the path coefficient (β) can be utilized to assess the magnitude and direction of postulated associations. Standardised values approaching +1 indicate a substantial positive correlation between the constructs; conversely, values near -1 indicate the inverse relationship [62]. The path values (β) utilized in the present investigation are displayed in Table 4.8 and Figure 4.2.

The R2 indicates the proportion of the variance in the endogenous variable that can be attributed to exogenous factors [62]. While the permissible range for R2 is variable [67], previous studies have deemed R2 values equal to or greater than 0.26 to be statistically significant [58]. Regarding social science and business research, R2 greater than 0.10 was deemed acceptable by [68]. With an R2 value of 0.532, the model explains a significant proportion of the variability in the Attitude Towards Use of RSPVS. In a similar vein, the R2 value for Behavioral Intention of RSPVS is 0.C, indicating that the model explains a considerable proportion of the variation in this variable (see table 4.7). The predicted model fit is substantial for both the ATU and BI of RSPVS, as indicated by these results.

Table 4.7 R^2 of Endogenous Latent Variables

Construct	R^2	Result
ATU	0.532	Substantial
BI	0.431	Substantial
PBC	0.336	Substantial
PU	0.283	Substantial

The bootstrapping PLS-results SEM analysis revealed that eight of the ten proposed hypotheses received support, while the remaining two were rejected. A statistically significant and positive relationship exists between PEOU and PU (β = 0.532, t = 11.242, p<0.000). SI and PV exhibit significant and positive effects on ATU at respective times (β = 0.171, t = 2.519, p = 0.012; β = 0.208, t = 2.920, p = 0.004). An important discovery indicates that TECH and ATU have a highly significant and positive correlation (β = 0.306, t = 4.199, p<0.000). In contrast, PR demonstrated a negligible but negative effect on ATU (β = -0.056, t = 1.474, p = 0.141). Both PU and PEOU had negligible effects on ATU, with respective β values of 0.115, 1.818, and 0.070 (t = 1.380, p = 0.168 and 0.075, p = 0.177, respectively).

A significant positive correlation was observed between FC and PBC (β = 0.580, t = 13.326, p<0.00). In conclusion, both Perceived Behavioral Control (β = 0.100, t = 2.094, p = 0.037) and Attitude Towards Use (β = 0.602, t = 10.462, p<0.00) exhibit a statistically significant positive influence on Behavioral Intent. Table 8 provides a summary of the hypothesis validation.

Table 4.8 Summary of the Direct Effect

Hypotheses	Relationship	Beta	SE	t-value	p-value	Statistic Decision
H1	PEOU -> ATU	0.123	0.060	2.044	0.041	Supported
H2	PEOU -> PU	0.532	0.047	11.252	0.000	Supported
H3	PU -> ATU	0.065	0.057	1.134	0.257	Not Supported
H4	PR -> ATU	-0.061	0.040	1.519	0.129	Not Supported
H5	SI -> ATU	0.164	0.071	2.315	0.021	Supported
H6	PV -> ATU	0.208	0.074	2.815	0.005	Supported
H7	T -> ATU	0.310	0.079	3.916	0.000	Supported
H8	FC -> PBC	0.580	0.044	13.255	0.000	Supported
H9	ATU -> BI	0.602	0.059	10.269	0.000	Supported
H10	PBC -> BI	0.100	0.046	2.172	0.030	Supported

The effect size (f2) was computed in PLS-SEM to determine whether a particular exogenous latent variable (or independent variable) had a significant influence on an endogenous latent variable (or dependent variable) by examining the change in R2. This suggests that the observed changes in R2 occurred in the absence of a particular exogenous variable in the model.

The impact size f2 of an exogenous latent variable or predictor that is greater than 0.02 (small), 0.15 (medium), or 0.35 (large) can be employed as a criterion to ascertain whether the variable has a structural level effect [57]. The effect size of this study is presented in Table 4.9, which elucidates the relatively small effect size of

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Perceived Ease of Use on Attitude Towards Use of Residential RSPVS in conjunction with Perceived Usefulness and Perceived Risk. Technophilia, Social Influence, and Price Value all have a moderate impact on Attitude Towards Use. Significant effects are also observed between ATU and BI, FC and PBC, and PEOU and PU.

Table 4.9 *The Effect Size of the Model*

Hypotheses	Latent Variables	F Squared
H1	PEOU -> ATU	0.018
H2	PEOU -> PU	0.395
H3	PU -> ATU	0.005
H4	PR -> ATU	0.007
H5	SI -> ATU	0.037
H6	PV -> ATU	0.041
H7	T -> ATU	0.082
H8	FC -> PBC	0.506
H9	ATU -> BI	0.487
H10	PBC -> BI	0.014

5. DISCUSSION

This research endeavored to provide insight into the determinants that influence prosumers' behavioral intentions to adopt residential RSPVS in the Philippines by developing a framework based on the TAM, TPB, and UTAUT outlines, in light of the rising cost of electricity and the growing use of renewable energy sources to combat global warming.

In accordance with the UTAUT framework, PV has demonstrated a substantial positive effect on ATU, resulting in BI ($\beta = 0.208$, $p < 0.004$). Based on the survey demographics, 87.5% of respondents value the financial viability of a solar PV system highly, 87.4% believe that a solar PV system can reduce their electricity bill, and 79.1% agree that a solar PV system can generate a profit. Consequently, despite the relatively high initial investment, 45.6% of respondents are willing to utilize residential RSPVS. In light of the declining cost of PV modules and the financial proposition of residential RSPVS, 74.9% of respondents believe that government subsidies could improve the price-value proposition of residential RSPVS, thereby increasing purchase intent. The SI factor, as reported by respondents (38.9%), was the primary source of information regarding solar PV. Social media (28.9%) and colleagues, relatives, or peers provided the remaining source ($\beta = 0.171$, $p < 0.012$). The findings of PV and SI are consistent with those of prior research [55], [38], and [37]. FC exhibits a significant correlation with PBC ($\beta = 0.580$, $p < 0.000$); nevertheless, the relationship between PBC and BI is of lesser magnitude ($\beta = 0.100$, $p < 0.026$). The survey findings indicate that participants hold an impartial opinion regarding several aspects of residential RSPVS: their understanding of the process, the accessibility of support in the event of issues, the difficulty in locating a dependable installer, and the minimum area in their residence that can accommodate a solar PV system. These exemplify the obstacles in FC that a potential buyer may reassess in light of the residential RSPVS capabilities and after-sales support provided by the residences.

Existing literature has demonstrated that TECH is a potent influencer in persuading consumers to adopt new technologies, particularly those that are environmentally beneficial and serve a practical purpose. The findings indicate that the incorporation of TECH into the UTAUT framework provides support for the prior research conducted by [45], [69], and [70]. It is noteworthy that the influence of TECH on ATU is greater than that of PV or SI ($\beta = 0.306$, $p < 0.000$). This finding could potentially be accounted for by the high level of enthusiasm expressed by respondents (85.8%) regarding the adoption of novel technologies, such as residential RSPVS, as well as their optimistic conviction that such technologies will become more affordable and require less maintenance in the future (79.1%).

ATU was marginally impacted negatively by the PR according to the TPB Framework ($\beta = -0.061$, $p < 0.129$). This result is consistent with the findings of a study conducted in Zambia [71] and [72], which concluded that acceptance of novel energy sources is influenced more by perceived benefits than by perceived risks. The sentiment expressed by the respondent regarding the overall risk associated with installing a solar PV system at home is as follows: 65.7%. This sentiment can be attributed to the favorable reviews gathered from peers and social media, which primarily emphasize the advantages of having the system installed by solar contractors in accordance with the Philippine Electrical Code. Such professional installation mitigates the risks that may arise from do-it-yourself installations. Moreover, prior to being processed for net metering, the Net Metering Program stipulates that a professional

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electrical engineer must certify that the installation and plans comply with electrical standards [21].

The ATU is influenced positively by PEOU from the TAM framework ($\beta = 0.123$, $p < 0.000$). This observation is consistent with the outcomes of research conducted in Malaysia [73] [74] and Pakistan [52], which indicate that the level of convenience of use associated with a new technology significantly influences adoption attitudes. The existing policies regarding the safety and compliance of solar energy photovoltaics (RPVs) in the Philippines primarily emphasize the operational-free nature of these systems. The end-user is solely responsible for monitoring the energy generated by the residential RSPVS. Moreover, this underscores the research's concentration on photovoltaic (PV) systems that are professionally installed by a solar contractor. This results in pre-sales and post-sales assistance that is beneficial to potential prosumers when making a purchase decision. Alone, and positively, PEOU influences PU ($\beta = 0.532$, $p < 0.000$); this supports the conclusions drawn by Ahmad et al. [32]. An intriguing finding of the research is that PU has no discernible effect on ATU; this is represented by $\beta = 0.065$, $p < 0.257$. The PU can be delineated according to its environmental, social, and economic utility [52]. This investigation has incorporated these dimensions into distinct constructs within the TPB framework: SI, PV, and Tech—all of which exert a substantial positive influence on ATU.

Relating to prior studies this study has provided information from the Philippines that Percieved Usefulness (PU) was not significant which was was found significant in the study of Ahmad [32], and Saqib [33]. In conclusion, the ATU has demonstrated a statistically significant positive effect on the BI ($\beta = 0.602$, $p < 0.000$), confirming the findings of prior research [56] [55] that suggests the direct factors that contribute to the ATU subsequently influence the BI's Behavioral Intent to embrace Residential RSPVS.

5.1. Research Contribution

By employing the integrated technology acceptance model, the theory of planned behavior, and the unified theory of acceptance and use of technology, this research constructed the framework necessary to examine the determinants influencing consumers' intention to adopt residential RSPVS. The study additionally incorporated novel constructs like Technophilia and Perceived Risk in an effort to assess pertinent factors associated with the adoption of new technologies, specifically those pertaining to renewable energy sources. This study's contribution to the residential scale of solar PV adoption seeks to provide policymakers and relevant stakeholders with an understanding of the most effective local policies or marketing initiatives that will benefit end-users.

5.2. Policy Implications

Based on the findings of this research, price value and social influence continued to exert a substantial influence, whereas technophilia emerged as a prominent determinant in the process of adoption. The enthusiasm and interest of respondents in adopting residential RSPVS is bolstered by the existence of local policies, including the Net Metering Program, which further encourages such installations. This observation indicates that consumers remain inquisitive regarding the use of solar energy as a personal source of power and suggests that additional information should be distributed. The lack of a significant negative impact on adoption due to the perceived risk factor suggests that the civil and electrical standards of the Philippines instill greater confidence among consumers regarding the security of residential RSPVS in their residences. With a reference list of certified solar contractors and a comprehensive guideline that is easier for prosumers to comprehend, they will be able to assess whether or not their residences are suitable for residential RSPVS. Additionally, this will eliminate any concerns or risks associated with adoption.

5.3. Limitation and Future Directions

The research is confined to residential RSPVS that were constructed, energized, and designed with the assistance of solar contractors. And the limitations are:

Sampling Bias and Generalizability: The research primarily focused on respondents from

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the Metro Manila Region, which may not represent the diversity of perspectives and conditions across different regions of the Philippines. Consequently, the findings may not be fully generalizable to the entire population of potential prosumers in the country. Future research should aim to incorporate a more diverse and representative sample from various regions to enhance the generalizability of the findings.

Exclusion of DIY Installations: The study only considered residential RSPVS installations that were constructed with the assistance of solar contractors, potentially overlooking valuable insights from consumers who have installed systems themselves. This exclusion might introduce a bias towards perceptions of ease of adoption and maintenance, as experiences with contractor-built systems could differ significantly from DIY installations. Future studies could benefit from including a broader spectrum of installation approaches to capture a more comprehensive understanding of adoption dynamics.

Limited Scope of Constructs: While the study integrated multiple theoretical frameworks (TAM, TPB, and UTAUT), it reduced the number of constructs to prioritize those deemed crucial for adoption. However, this reduction might overlook the potential influence of other relevant factors on prosumers' behavioral intentions. Future research could explore additional constructs or perspectives that might contribute to a more nuanced understanding of residential RSPVS adoption, thereby enriching the theoretical framework.

Focus on Financial Considerations: While the study highlights the significant influence of financial factors on prosumers' intentions to adopt residential RSPVS, it might overlook other non-economic barriers or motivators that could impact adoption decisions. For instance, environmental concerns, regulatory policies, or cultural factors could play a significant role in shaping adoption behaviors but may not have been thoroughly explored in the current research. Future studies could investigate a broader range of factors beyond financial considerations to provide a comprehensive understanding of adoption dynamics.

6. CONCLUSION

In summary, this research has examined the various determinants that impact residential RSPVS in an effort to support the nation's objective of augmenting renewable energy usage. By utilizing an integrated model with the TAM, TPB, and UTAUT frameworks, the previously employed constructs regarding the adoption of renewable energy were preserved, in addition to the Technophilia and Perceived Risk constructs. Through the administration of an online survey using a Likert scale and the collection of 239 responses, the data were analyzed using structural equation modeling. Technophilia emerged as a significant determinant in consumers' inclination to adopt, with price value and social influence ranking subsequently. Prior studies, which may have been undertaken when residential RSPVS were more expensive, provide substantial support for these factors; thus, financial considerations emerged as the most significant determinant. When considering social influence, it is worth noting that social media and peer-to-peer information are the most highly regarded sources of knowledge for prosumers. This grants them an understanding of solar technology and largely positive reviews, particularly regarding the desire for significantly reduced electricity costs and the belief that countries with abundant sunlight, like the Philippines, have significant potential for solar energy. This finding suggests that there was a positive correlation between the prosumers' awareness of solar energy as a source and their eagerness to adopt this emerging technology for their individual energy needs. Conversely, the perceived risk was found to be negligible, which demonstrates prosumers' confidence and trust in solar technology. Policies safeguarding prosumers against substandard installations and the availability of support through technicians or solar contractors are also in place.

Utilizing an integrated model provides a greater degree of explanatory capability with regard to technology adoption, according to this study. Additionally, the research enhances comprehension of the objectives and priorities of prosumers regarding the long-term commitment to adopting a renewable energy source. This includes an assessment of their capabilities, which is contingent upon their knowledge and confidence in operating a residential RSPVS, the structural integrity and available space in their residences, and the proficiency of their solar installers, upon whom they will be dependent for

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the installation and maintenance of their solar PV systems. The fact that even at the residential level, prosumers are enthusiastic about adopting renewable energy sources, demonstrating the potential and popularity of solar energy adoption in the Philippines. Prosumers' support enables larger-scale renewable energy projects to be funded. Given the recent advancements and forthcoming utility projects in the Philippines that support renewable energy sources such as solar, it may be prudent to develop policies that specifically target residential adoption. This approach would enable quicker installation and incentivize consumers to be more environmentally conscious, thereby contributing to the nation's objective of a renewable energy-dependent future.

Despite the fact that the research contributes to the comprehension of adoption dynamics, its validity is hampered by sampling bias resulting from the concentration on Metro Manila respondents, the omission of do-it-yourself installations, and the reduction of constructs. In order to inform effective policy interventions and provide a more comprehensive understanding of residential RSPVS adoption, future research could resolve the aforementioned limitations.

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References

[1] IRENA. (2021). *World Energy Transitions Outlook: 1.5°C Pathway,.* Abu Dhabi: International Renewable Energy Agency.

[2] GMO. (2019). *Global Market Outlook for Solar Power 2019 - 2023.*

[3] GIZ. (2013). *It's more sun in the Philippines.* Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH .

[4] Solargis. (2020). Global Solar Atlas 2.0. Retrieved from Solargis: https://solargis.com/maps-and-gis-data/download/philippines

[5] Department of Energy. (2021). Power Statistics. Retrieved 10 23, 2022, from https://www.doe.gov.ph/energy-statistics/philippine-power-statistics

[6] PEMC. (2017). Philippine Electricity Market Corporation (PEMC), 2017. WESM Works: 2016-2017.

[7] Department of Energy. (2020). National Renewable Energy Program 2020 - 2040. DOE.

[8] Rocha, A. P.-C.-S. (2019). Solar photovoltaic policy review and economic analysis for on-grid residential installations in the Philippines. Journal of Cleaner Production 223, 45-56.

[9] Lang T, G. E. (2015). Don′ t just follow the sun–A global assessment of economic performance for residential building photovoltaics. Renew Sustain Energy.

[10] PHILSTAR. (2022, April 24). PHILSTAR GLOBAL. Retrieved from PHILSTAR: https://www.philstar.com/business/2022/04/24/2176259/net-metering-manual-issued

[11] IEC. (2018). Regional/Global Comparison of Retail Electricity Tariffs.

[12] David E.H.J. Gernaat, H.-S. d. (2020). The role of residential rooftop photovoltaic in long-term energy and climate scenarios. Applied Energy.

[13] GMO. (2019). Global Market Outlook for Solar Power 2019 - 2023.

[14] IEA. (2019). IEA-PVPS. Trends in photovoltaic applications 2019 Photovoltaic Power Systems.

[15] Gielen, D., Kempener, R., Taylor, M., & Boshell, ,. A. (2016). Letting in the light. IRENA.

[16] Setyawati, D. (2020). Analysis of perceptions towards the rooftop photovoltaic solar system policy in Indonesia. Energy Policy .

[17] Parag, Y., & Sovacool, B. (2016). Electricity market design for the prosumer era . Nature Energy.

[18] Solangi, K. B. (2013). Public acceptance of solar energy: The case of Peninsular Malaysia. IEEE Paper presented at the TENCON Spring.

[19] Jayaraman, K. P. (2017). 2017. Reasons for low penetration on the purchase of photovoltaic (PV) panel system among Malaysian landed property owners. Renew. Sustain. Energy, Rev. 80, 562–571.

[20] MERALCO. (2022, August). Retrieved from Meralco News and Advisories: https://company.meralco.com.ph/news-and-advisories/august-2022-rates-updates

[21] GIZ. (2014). Net Metering Reference Guide. Manila: Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH.

[22] Pacudan, R. (2018). The Economics of Net Metering Policy in the Philippines . International Energy Journal 18, 283 – 296.

[23] Gunoa, C. S., Agaton, C. B., & Villanueva, R. O. (2021). Optimal Investment Strategy for Solar PV Integration in Residential Buildings: A Case Study in The Philippines. Int. Journal of Renewable Energy Development (IJRED), 79-89.

[24] Jara, P. G., Castro, M. T., Esparcia, J. E., & Ocon, J. D. (2020). Quantifying the Techno-Economic Potential of Grid-Tied Rooftop Solar Photovoltaics in the Philippine Industrial Sector. Energies.

[25] Lozano, L., & Taboada, E. (2021). Applying User-Perceived Value to Determine Motivators of Electricity Use in a Solar Photovoltaic Implementation in a Philippine Island. Sustainability.

[26] Brooks, C., & Urmee, T. (2014). Importance of individual capacity building for successful solar program implementation: A case study in the Philippines. Renewable Energy.

[27] Alam, S., Hashim, H., Rashid, , M., Omar, , N., Ahsan, , N., & Ismail,, M. (2014). Small-scale households' renewable energy usage intention: Theoretical development and empirical settings. Renewable Energy, 255-263.

[28] Davis, F. (1989). Perceived Usefulness, Perceived Ease of Use, and User Acceptance of Information Technology. MIS Quartelry, Vol. 13 No. 3, 319-340.

[29] Ajzen, I. (1991). The theory of planned behavior. . Organizational behavior and human decision processes, 50(2),, 179-211.

[30] Ajzen, I., & Gilbert Cote, N. (2008). Attitudes and the prediction of behaviour in Crano, W.D. and Prislin, R. (Eds),. Attitudes and Attitude Change, Psychology Press, NewYork, NY,, pp. 289-311.

[31] Legris, P., Ingram, J., & Collerette, P. (2003). Why do people use information technology? A critical review of the technology acceptance model. Inf Manage, 191 - 204.

[32] Ahmad, S., Tahar, R., Cheng, J., & Yao, a. L. (2017). Public acceptance of residential solar photovoltaic technology in Malaysia. PSU Research Review: An International Journal, 242-254.

[33] Saqib, A., Poulova, P., Akbar, A., Javed, H., & Danish, M. (2020). Determining the Influencing Factors in the Adoption of Solar Photovoltaic Technology in Pakistan: A Decomposed Technology Acceptance Model Approach. Economies.

[34] Sun, P.-C. W.-M.-L.-W. (2020). Consumer attitude and purchase intention toward rooftop photovoltaic installation: The roles of personal trait, psychological benefit, and government incentives. Energy & Environment, 31(1), 21-39.

[35] Wenling Liu, C. W. (2013). Rural public acceptance of renewable energy deployment: The case of Shandong in China. Applied Energy, Volume 102, 1187 - 1196.

[36] Venkatesh, V., Morris, M. G., Davis, G. B., & Davis, F. D. (2003). User Acceptance of Information Technology: Toward a Unified View. MIS quarterly, 425-478.

[37] Lin-Sea Lau, L., Yuen-Onn, C., Chooi-Yi , W., Ai-Na , S., Chee-Keong , C., Abdelhak , S., & Suet-Ling , C. (2020). Investigating nonusers' behavioural intention towards solar

photovoltaic technology in Malaysia: The role of knowledge transmission and price value. Energy Policy.

[38] Aggarwal, A. K., Syed, A. A., & Garg, S. (2019). Factors Driving Indian Consumer's Purchase Intention of Roof Top Solar. Int. J. Energy Sect., 539-555.

[39] Camilleri, M. (2019). The online users' perceptions toward electronic government services. J. Inf. Commun. Ethic-Soc. 18, 221-235.

[40] Venkatesh, V. T. (2012). . Consumer Acceptance and Use of Information Technology: Extending the Unified Theory of Acceptance and Use of Technology. . MIS Quarterly, 36(1),, 157–178.

[41] Dodds, W. B. (1991). Effects of Price, Brand, and Store Information on Buyers. Journal of Marketing Research, 307-319.

[42] Osiceanu, M.-E. (2015). Psychological Implications of Modern Technologies: "Technofobia" versus "Technophilia". Procedia - Social and Behavioral Sciences, 1137-1144.

[43] Cavdar Aksoy, N. K. (2020). "Individuals' intention to use sports wearables: the moderating role of technophobia". International Journal of Sports Marketing and Sponsorship,, 225-245.

[44] Światowiec-Szczepańska, J., & Stępień, ,. B. (2022). Drivers of Digitalization in the Energy Sector—The Managerial Perspective from the Catching Up Economy. Energies, 15(4).

[45] Abbasi, H., Johl, S., Shaari, Z., Moughal, W., Mazhar, M., Musarat, M., Farooqi. (2021). Consumer Motivation by Using Unified Theory of Acceptance and Use of Technology towards Electric Vehicles. Sustainability 13.

[46] Yang, K. F. (2013). The moderating role of consumer technology anxiety in mobile shopping adoption: differential effects of facilitating conditions and social influences. J. Electron. Commer. Res. 14(4), 334-347.

[47] Lin-Sea Lau, L., Yuen-Onn, C., Chooi-Yi , W., Ai-Na , S., Chee-Keong , C., Abdelhak , S., & Suet-Ling , C. (2020). Investigating nonusers' behavioural intention towards solar photovoltaic technology in Malaysia: The role of knowledge transmission and price value. Energy Policy.

[48] Ho, S. S., Yu, P., Tandoc Jr, E. C., & Chuah, A. S. (2022). Mapping risk and benefit perceptions of energy sources: Comparing public and expert mental models in Indonesia, Malaysia, and Singapore. Energy Research & Social Science 88.

[49] Tanveer, A., Zeng, S., Irfan, M., & Peng, R. (2021). Do Perceived Risk, Perception of Self-Efficacy, and Openness to Technology Matter for Solar PV Adoption? An Application of the Extended Theory of Planned behavior. . Energies.

[50] Vabø, M., & Hansen, H. (2016). Purchase intentions for domestic food: A moderated TPB-explanation. Br. Food J., 2372-2387.

[51] Chawla, D. a. (2011). Research Methodology: Concepts and Cases. Vikas Publishing House.

[52] Ali, S., Poulova, P., Akbar, A., & Usama Javed, H. (2020). Determining the Influencing Factors in the Adoption of Solar Photovoltaic Technology in Pakistan: Model Approach sector is worldwide. Economies.

[53] Featherman, M., & Pavlou, P. (2003). Predicting e-services adoption. A perceived risk facets perspective. Int. J. Hum Comput Stud. 59, 451-474.

[54] Kapser, S., & Abdelrahman, M. (2020). Acceptance of autonomous delivery vehicles for last-mile delivery in Germany – Extending UTAUT2 with risk perceptions. Transportation Research Part C 111, 210–225.

[55] Bekti, D., Prasetyo, Y., Redi, A., Budiman, A. S., Mandala, I., Putra, A., . . . Young, M. N. (2021). Determining Factors Affecting Customer Intention to Use Rooftop Solar Photovoltaics in Indonesia. sustainability.

[56] Alam, S., Hashim, H., Rashid, , M., Omar, , N., Ahsan, , N., & Ismail,, M. (2014). Small-scale households renewable energy usage intention: Theoretical development and empirical settings. Renewable Energy, 255-263.

ISSN: 1992-8645 www.jatit.org E-ISSN: 1817-3195

[57] Prasetyo, Y., Tanto, H., Mariyanto, M., Hanjaya, C., Young, M., Persada, S., . . . Redi, A. (2021). Factors affecting customer satisfaction and loyalty in online food delivery service during the COVID-19 pandemic: Its relation with open innovation. J. Open Innova. Technol. Mark Complex. , 76.

[58] Hair, J., Astrachan, C., Moisescu, O., Radomir, L., & Sarstedt, M. (2021). (2021). Executing and interpreting applications of PLS-SEM: Updates for family business researchers. Journal of Family Business Strateg.

[59] Hair Jr, J. F., Hult, G. T., Ringle, C., & Sarstedt, M. (2017). A primer on partial least squares structural equation modeling (PLS-SEM). Sage Publications.

[60] Hajjar, S. (2018). Statistical analysis: internal-consistency reliability and construct validity. Int. J. Quan. Qualit. Res. Meth., 46–57.

[61] Hair, J. F. (2010). Multivariate Data Analysis (7th ed.; Upper Saddle River, Ed.). New Jersey: Prentice Hall.

[62] Hair, J. F., Hult, G. T., Ringle, C. M., & Sarstedt, M. (2014). A primer on Partial Least Squares Structural Equation Modeling (PLS-SEM). Thousand Oaks, CA: SAGE Publications Ltd.

[63] Côrte-Real, N., Oliveira, T., & Ruivo, P. (2017). Assessing business value of big data analytics in European firms. Journal of Business Research, 379–390.

[64] Block, J. H., Miller, D., & Wagner, D. (2014). Bayesian methods in family business research. 2014Journal of Family Business Strategy, 5(1), 97–104.

[65] Kock, N. (2015). Common method bais in PLS-SEM: A full collinearity assessment approach. . International Journal of E-Collaboration, 11(4), , 1–10.

[66] Zhao, X., Lynch, J. G., & Chen, Q. (2010). Reconsidering Baron and Kenny: Myths and truths about mediation analysis. Journal of Consumer Research, 37,, 197-206.

[67] Moksony, F., & Heged, R. (1990). Small is beautiful: The use and interpretation of r2 in social research. Szociológiai Szemle, (Special issue),, 130–138.

[68] Duarte, P. A., & Raposo, M. L. (2010). A PLS model to study brand preference: An application to the mobile phone market. In V. E. Vinzi, W. W. Chin, J. Henseler, & H. Wang (Eds.), Handbook of Partial Least Squares: Concepts, Methods and Applications. Berlin, Heidelberg.: Springer.

[69] Seebauer, S., Stolz, R., & Berger, M. (2015). Technophilia as a driver for using advanced traveler information systems. . Transp. Res. Part C Emerg. Technol. , 498-510.

[70] Schlüter, J., & Weyer, J. (2019). Car sharing as a means to raise acceptance of electric vehicles: An empirical study on regime change in automobility. . Transp. Res. Part F Traffic Psychol. Behav. , 185–201.

[71] Zulu, S., Chabala, M., & Zulu, E. (2021). Perceptions and beliefs influencing intention to use solar energy solutions in Zambian households. Built Environment Project and Asset Management, Vol. 11 No. 5, https://doi.org/10.1108/BEPAM-01-, 918-933.

[72] Visschers, V., & Siegrist, M. (2014). Find the differences and the similarities: Relating perceived benefits, perceived costs and protected values to acceptance of five energy technologies. J. Environ. Psychol., 117-130.

[73] Roozbeh, K., Sumiani, Y., & Fatimah, K. (2016). Renewable energy technology acceptance in Peninsular Malaysia, . Energy Pol., 1-10.

[74] Malik, S. A., & Ayop, A. R. (2020). Solar energy technology: Knowledge, awareness, and acceptance of B40 households in one district of Malaysia towards government initiatives. Technology in Society .

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Table 1. Residential RSPVS Adoption Constructs

Constructs	Measure	Source
Perceived Usefulness	Solar PV System can lower my electricity bill	[52]
	Solar PV System investment can return a profit	
	Solar PV System can reduce my reliance to non – renewable energy sources like coal, oil, and gas.	
	Solar PV System in my residence helps me develop an eco-friendly behavior	
Perceived Ease Of Use	I find solar PV system to have low need for operation and maintenance	[32]
	It is easy to source a Solar PV Contractor that can install or maintain a solar PV system in my residence	
	Learning the operation of Solar PV System is easy	
	I find Solar PV System easy to use	
Perceived Risk	Overall, having Solar PV System in my home is risky	[53]
	Using Solar PV System as a source of energy is risky	
	I am worried that Solar PV System will cause a fire	
	I am worried that Solar PV System will easily be damaged by strong typhoons in the Philippines	
	I am worried that Solar PV System will not last	
	I am worried that I won't get my investment back for Solar PV System	
Social Influence	I always consult my friends, colleagues, and influencers (vloggers, technical expert, etc.) about their experiences before deciding to buy	[38]
	If my friends, colleagues, and influencers (vloggers, technical expert, etc.) have good experience with Solar PV System, I will consider having one as well.	
	I have heard from friends, colleagues, and influencers (vloggers, technical expert, etc.) that I should consider using Solar PV System	
	I will share information about sustainable products with my friends and family members.	[40]
Price Value	Solar PV System has become more affordable	[38]
	Government Subsidy will help increase my intent to buy a Solar PV System	
	Solar PV System will reduce my electricity bill	
	The financial viability of Solar PV System is important	
Technophilia	I believe the new technology of Solar PV System will have fewer issues in maintenance, that can save cost and time	[45]
	Innovative energy technologies make me enthusiastic to adopt Solar PV System.	
	I am excited to utilize renewable energy sources like Solar PV	
Facilitating Condition	I have the knowledge resources necessary to consider a Solar PV System	[54]
	I can get help from others when I have difficulties using Solar PV System	
	I have a sufficient area at my residence to have Solar PV System installed	[55]
	Having reliable technical support is important for Solar PV Systems	
Attitude Towards Use	I find solar PV system to be a major source of energy in future	[32]
	I believe it is a good time to have a Solar PV System in my house	
	I like the idea of having a renewable energy source in my house	
Perceived Behavioral Control	It is easy for me to find a contractor to install a Solar PV System in my house	[55]
	Having a Solar PV System installed is entirely within my control	[56]
	I will use Solar PV solar technology even if the upfront cost is relatively expensive	
Behavioral Intention	I have the resources (money, time, effort) necessary to have a solar PV system installed	[37]
	I want to utilize free energy from the sun for my electricity needs	

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Table 2. Demographic Profile (n = 239)

Characteristics	Category	N	%
Gender	Female	122	51.0%
	Male	113	47.3%
	Prefer not to Say	4	1.7%
	Total	239	100.0%
Age	18-25	156	65.3%
	26-35	120	50.2%
	36-45	49	20.5%
	46-55	36	15.1%
	56-72	14	5.9%
	Total	239	100.0%
Residence	NCR	156	65.3%
	REGION 1	3	1.3%
	REGION 3	20	8.4%
	REGION 4A	24	10.0%
	REGION 4B	1	0.4%
	REGION 5	29	12.1%
	REGION 6	1	0.4%
	REGION 7	3	1.3%
	REGION 11	1	0.4%
	REGION 12	1	0.4%
	Total	239	100.0%
Education level	Primary School	1	0.4%
	Secondary School	16	6.7%
	Certificate or Diploma	17	7.1%
	Bachelor's Degree	165	69.0%
	Master's Degree or Above	40	16.7%
	Total	239	100.0%
Total household income (monthly)	P21,194 below	33	13.8%
	Between ₱21,194 to ₱43,828	98	41.0%
	Between ₱43,828 to ₱76,669	44	18.4%
	Between ₱76,669 to ₱131,484	34	14.2%
	Between ₱131,484 to ₱219,140	17	7.1%
	At least ₱219,140 and up	13	5.4%
	Total	239	100.0%
Monthly Electricity Bil	Below Php 3,000	98	41.0%
	Between Php 3,001 to 5,000	92	38.5%
	Between Php 5,001 to 9,000	36	15.1%
	Between Php 9,001 to 15,000	11	4.6%
	Above Php 15,001	2	0.8%
	Total	239	100.0%
Source of Information for Solar PV Systems	Social Media (Facebook, Instagram, Twitter, TikTok, LinkedIn, etc.)	69	28.9%
	YouTube	10	4.2%
	News	22	9.2%
	Social Influencer	1	0.4%
	Solar Contractor	25	10.5%
	Colleague / Friends / Relatives with Solar Installed	93	38.9%
	Others	19	7.9%
	Total	239	100.0%

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Table 4.3 Result Summary for Reliability and Validity of Constructs Convergent Validity

Constructs	Indicator	Loadings	Cronbach's Alpha	AVE	CR
Attitude Toward Use	ATU1	0.862	0.668	0.699	0.797
	ATU2	0.871			
Behavioral Intention	BI1	0.949	0.904	0.605	0.753
	B2	0.961			
Facilitating Condition	FC1	0.899	0.671	0.533	0.820
	FC2	0.832			
Perceived Behavioral Control	PBC1	0.865	0.755	0.741	0.851
	PBC2	0.763			
	PBC3	0.827			
Perceived Ease of Use	PEOU1	0.747	0.811	0.638	0.876
	PEOU2	0.775			
	PEOU3	0.825			
	PEOU4	0.845			
Perceived Risk	PR1	0.791	0.867	0.598	0.899
	PR2	0.768			
	PR3	0.755			
	PR4	0.729			
	PR5	0.794			
	PR6	0.804			
Perceived Usefulness	PU1	0.794	0.800	0.625	0.869
	PU2	0.775			
	PU3	0.797			
	PU4	0.795			
Price Value	PV2	0.749	0.759	0.558	0.832
	PV3	0.867			
	PV4	0.841			
Social Influence	SI2	0.777	0.653	0.577	0.796
	SI3	0.927			
Technophilia	T1	0.848	0.884	0.741	0.920
	T2	0.897			
	T4	0.845			

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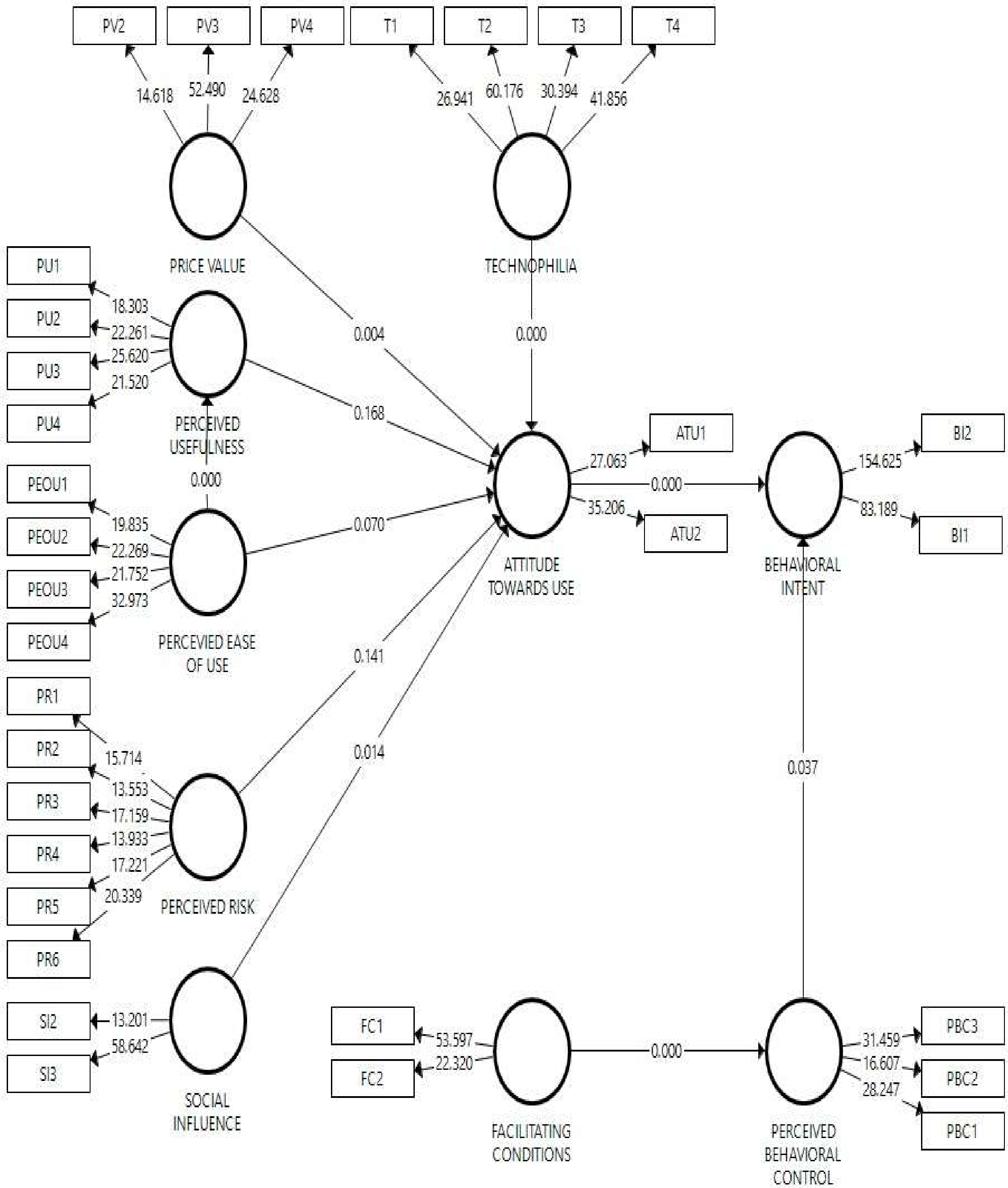

Figure 4.2 Structural Model