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Factors Affecting the Consumption of Energy-Efficient Lighting Products: Exploring Purchase Behaviors of Thai Consumers

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Abstract: The continued usage of inefficient lighting products in residential sectors is one of the major causes of the rapid growth in global energy consumption. Their replacement with highly efficient lighting appliances could avoid large amounts of electricity consumption and reduce CO_2 emissions worldwide. In this regard, the collective contribution by the residential sector is extremely important and the increase in demand for energy-efficient lighting products can help achieve sustainability goals. This study aims to examine the determinants of household consumers' behaviors in purchasing energy-saving lighting products by applying the Theory of Planned Behavior (TPB) as the main theoretical framework. Data (n = 288) from a survey in Thailand were analyzed using causal Structural Equation Modeling (SEM). The results suggested that attitude has the largest direct effect, while subjective norm was the weakest predictor of purchase intention towards light-emitting diode (LED) products. In addition, this study expands the TPB by including an investigation of a direct effect of attitude on purchase behavior. The results suggest that attitudes have a strong direct influence on the purchasing behavior for LED products. Additionally, only some socio-demographic variables have significant effects on purchase behavior. The study's findings highlight several implications for policymakers, the private sector, and green marketers in developing practical strategies. Furthermore, suggestions and future research directions are discussed.

Keywords: environmentally sustainable behavior; Theory of Planned Behavior; consumer behavior; green marketing; LED bulbs; Thailand

1. Introduction

Over the past few decades there has been a substantial increase in electricity consumption, the strongest growth coming from the increased ownership and usage of electrical appliances in the residential sector [1,2]. Several countries have integrated energy efficiency as a partial solution to energy-related challenges such as the increasing electricity consumption per capita, increasing population and rising fossil fuel costs, among others [3]. Energy efficiency, as one of the key national policies to address environmental challenges, has become a priority in many countries, particularly in developing countries like Thailand, which has created the Energy-Efficiency Development Plan [4].

Global household energy consumption in lighting products accounts for 15% of global electricity consumption and 5% of greenhouse gas emissions worldwide [5]. It is estimated that the improved efficiency of lighting appliances from traditional incandescent lamps to light-emitting diode (LED) lamps could save up to 801 Mt of CO_2 emissions annually, virtually equivalent to displacing more than 684 coal-fired power plants [6]. Similarly, according to the United Nations Environment Programme

report in 2017 [7], developing countries could avoid almost $40 billion in electricity expenses and reduce CO_2 emissions by 320 million Mt annually by simply shifting to LED lighting technology. Looking at the characteristics of LED products, they serve as a sustainability solution in several different ways. Firstly, LEDs consume less energy than other lighting product types, contributing to less demands for electricity generation. Secondly, LEDs last longer and are more durable than other types, thus minimizing waste generation from usage. Thirdly, they are made from recyclable materials and no harmful chemicals are used in construction [5]. Clearly, the benefits of LED replacement actions are remarkable, particularly the significant shift from the consume-and-waste culture to the "circular economy", i.e., minimizing the use of traditional energy sources as well as waste generation [8,9].

More attention has been paid to large companies as well as government agencies across Thailand in sustainable energy conservation through adopting energy-efficient products such as LED lighting products in the buildings [10] in order to address environmental issues more seriously. However, in Thailand, the adoption of energy-efficient products is still at an unsatisfactory level, particularly relating to the use of energy-efficient lighting products such as LEDs. The statistics show that LED products accounted for fewer than 20% of the 4–5 billion light bulbs in use in 2015 [10]. With an attempt to address growing concerns over climate change and CO_2 emissions, the adoption of LED products—being the most advanced technology—by large consumers is necessary to significantly reduce society's heavy dependence on fossil fuel generation and greenhouse gas emissions. Particularly in developing countries like Thailand, the authors' own calculations project that, if the commercial and household sectors adopted LED lighting products for half of their current usage, Thailand as a whole would enjoy large energy-savings amounting to a cost of up to 40,949.9 million Thai baht per year, which is equivalent to 29.4% of total electricity consumption for lighting purposes (source: authors' own calculation). Clearly, an adoption of a more efficient product would benefit not only the end-consumers, but also the environment.

In an attempt to understand householders' energy-efficient purchase behaviors, the majority of studies in the literature in this field has paid attention to covering the variation in product types (e.g., air-conditioners, televisions, washing machines, etc.) [11–13]. However, the results from these studies are unable to be generalized, since some factors may differ with various types of products. In fact, based on the currently available literature, we found only one previous study related to the adoption behavior related to LED lamps in Thailand [10]. The study, conducted in 2014, aimed at investigating factors affecting the intention to buy LED lamps among Bangkok consumers. So far, no research efforts have been made in the last five years to examine LED products in studying energy-efficient purchase behavior in Thailand. It is important to note that, during the past few years, consumers have witnessed substantial technological advancement as well as an increase in price competitiveness in energy-efficient products, which has facilitated new behavioral patterns [5]. There is a scarcity of literature on the specific types of energy-efficient products, particularly LED products, which have already surpassed the efficiency and quality of existing technologies such as Compact Fluorescent Lamps (CFL) and incandescent lights. Therefore, in order to narrow down the literature and the contextual gap, this study seeks to empirically investigate purchase behavior related to energy efficiency in the context of LED lighting products. This study applies the Theory of Planned Behavior (TPB) as the main theoretical framework to investigate determinants and antecedents of purchase behavior.

This research contributes to the existing literature in various ways. Firstly, it advances the current research on LED products, particularly accounting for the changes in consumer behavior now that the prices of LED lamps are more competitive compared to when the previous literature was published. Secondly, it attempts to examine the validity and applicability of the TPB framework among different demographics at a different point in time, when compared to past studies. Thirdly, it strives to unravel the direct influence of the main determinants in the model on actual purchase behavior through exploring the direct relationship between attitude and behavior by proposing purchase intention as a mediating variable. Lastly, it furthers the knowledge of the predictors of energy-efficient buying

behaviors among household consumers in Thailand, which in turn supports green marketers as they formulate marketing strategies to promote sustainability.

The organization of this paper is as follows. Section 2 provides an overview of the theoretical background as well as hypotheses development adapted from the previous literature. Section 3 presents the research methods and its measures. Structural Equation Modeling (SEM), which has been widely applied in behavioral and psychological research, was used in this study due to its suitability to smaller sample size. Section 4 explains the results from the data collected, verifies data validity and reliability, tests the hypothesized model, and analyzes the obtained prediction results. Section 5 elaborates the main discussions from the findings, outlining the policy and practical implications of this research. Lastly, Section 6 draws conclusions, discusses limitations, and provides future research directions.

2. Theoretical Background and Hypotheses Development

This study required a theoretical model that could adequately capture significant aspects of human behavior; it needed to be simple, with a strong predictive ability and be applicable for certain adaptations in order to match the research objectives. After extensive research of the available theoretical options, this study decided to apply the model based on the Theory of Planned Behavior (TPB) developed by [14] (Figure 1). The TPB argues that attitude, subjective norm, and perceived behavioral control combined together have positive causal relationships with intention, which leads to an execution of behavior. The model has been one of the most widely used frameworks for investigating environmental behaviors, and several researchers strongly agree that the TPB model can explain the behavioral intentions of sustainable consumption and predict future consumption behavior [15–17].

Literature on energy-efficient appliances has concentrated on investigating consumer intentions to purchase energy-saving home products. Although several behavioral researchers have improved the explanatory power of TPB by including some cognitive factors [11,13,15], there is a scarcity of literature giving empirical evidence on both purchase intention and purchase behavior towards energy-saving home products in this framework. Previous literature has focused more on investigating consumers' purchase intentions rather than actual purchase behaviors [11–13], while some previous studies have researched the inconsistency between intention and behavior towards sustainable products [17]. This creates an acute research gap in investigating the relationship between consumers' purchase intention and purchase behaviors towards energy-efficient products like LEDs. The TPB framework can not only help to examine factors affecting purchase behaviors towards LED products, but will also offer certain empirical evidence of the relationship of all constructs which collectively represent consumers' actual purchase behaviors.

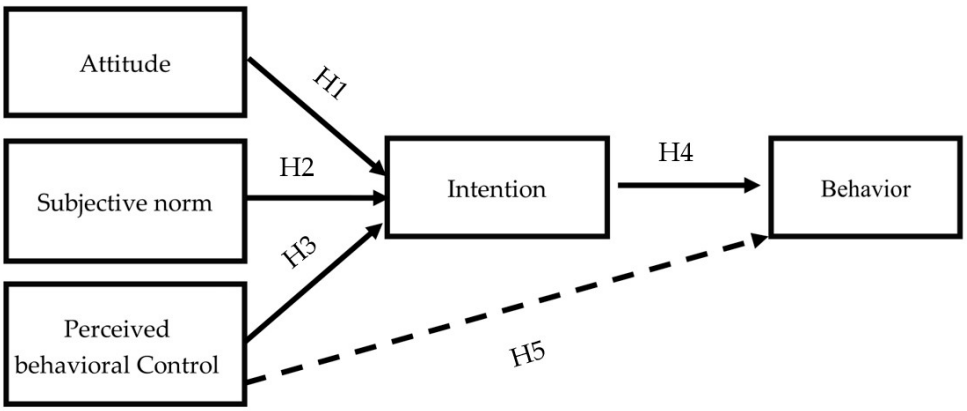

Figure 1. Theory of Planned Behavior [14].

2.1. The Components of the TPB Model

Recently, the TPB model has become academically popular due to its ability to measure various constructs in different contexts and settings. This study uses the TPB model to examine the purchase behavior of LED products, which are discussed below.

2.1.1. Attitude and Purchase Intention

Attitude is a determinant of purchase intention, i.e., an interaction in memory between a given product and psychological evaluation of the product [18], and somehow predicts actual human behavior [17]. Numerous studies have agreed on the strong relationship between attitude and behavioral intention. For instance, Mostafa [19] found that attitude plays a major role in predicting intention in many cultures. Similarly, Birgelen et al. [20] described that if consumers have strong positive attitude towards the environment, they are more likely to purchase environmentally-friendly products. In fact, a number of studies show that Thai consumers have positive attitudes towards green products [21–23], which reflects positive influences on purchase intention towards green products. Based on the literature review, this study believes that attitude will have a positive influence towards purchasing energy-efficient products like LED products. As a result, the hypothesis (H1) can be drawn:

Hypothesis 1 (H1). *Attitude towards LED products is positively associated with purchase intention towards LED products.*

2.1.2. Subjective Norm and Purchase Intention

Subjective norm refers to consumers' perceived peer pressure, which dictates that they behave in certain ways in order to meet social expectations [24,25]. Consumers are more likely to perform or not perform particular behaviors based on whether the behavior meets social expectations or not. Numerous studies have found a positive relationship between subjective norm and purchase intention in green purchase behavior [15,26], environmentally conscious behavior [27,28], and particularly green products consumption in Thailand [29]. In support of this, recent studies have found that subjective norm is an important determinant of purchase intention of energy-saving products [13,28]. The empirical evidences from past studies have confirmed the role of subjective norm on the purchase intention of energy-efficient home appliances. As such, this study proposes that subjective norm has a positive effect on purchase intention towards purchasing LED products.

Hypothesis 2 (H2). *Subjective norm is positively associated with purchase intention towards LED products.*

2.1.3. Perceived Behavioral Control and Purchase Intention

Perceived behavioral control (PBC) refers to an individual's perceived difficulty or ease to perform a particular behavior. In other words, PBC consists of two aspects. One aspect refers to the consumer's confidence to perform a given behavior, whereas another aspect relates to the availability of resources (e.g., time and money) required for performing a behavior [14,30]. A number of studies reported a positive causal relationship between PBC and purchase intention in various contexts including green products [27], energy-saving intention [31] and environmentally conscious consumption behavior [15,26]. Therefore, this research hypothesized the following:

Hypothesis 3 (H3). *Perceived behavioral control is positively associated with purchase intention towards LED products.*

2.1.4. Purchase Intention and Purchase Behavior

Purchase intention refers to the extent to which consumers think they will buy such products [32]. It is obvious that consumers with a high intention to buy will be more likely to perform the purchase behavior than those who have no intention of buying [33]. According to Ajzen [14], purchase intention acts as a strong indication of an individual's readiness to perform a given behavior, which is argued to be an antecedent of behavior. Numerous studies confirmed a strong positive relationship between purchase intention and purchase behavior in different contexts [34,35]. More importantly, this positive relationship has also been confirmed in empirical studies focusing on the purchase of energy-saving home products [16,19].

In addition, according to the TPB model, purchase intention will directly affect actual purchase behavior. However, in order to better predict actual purchase behavior, PBC, together with purchase intention, can be used to determine the actual behavior [14,36]. In other words, PBC is also thought to have a direct influence on actual behavior; PBC is often used as a substitute for a measure of actual purchase behavior [14]. Within the context of purchasing LED products, this study expects that purchase intention and PBC will act as important determinants of purchase behavior. In this regard, the following hypotheses are proposed:

Hypothesis 4 (H4). *Purchase intention is positively associated with purchase behavior towards LED products.*

Hypothesis 5 (H5). *Perceived behavioral control is positively associated with purchase behavior towards LED products.*

2.1.5. Attitude and Purchase Behavior

Empirical studies have found that favorable attitudes towards environmental protection positively affect green purchase intention and behavior [16,37,38]. Specifically, consumers who believe that pro-environmental behavior is crucial for environmental protection were more likely to adopt energy-efficient home appliances [1,16]. Within the context of purchasing LED products, this study hypothesizes that attitude will have a strong direct influence towards purchase behavior. Therefore, the following hypothesis (H6) can be drawn:

Hypothesis 6 (H6). *Attitude is positively associated with purchase behavior towards LED products.*

2.2. Socio-Demographic Variables

Additionally, previous studies suggest that demographic variables play important roles in influencing pro-environmental purchasing behaviors [27,37]. In support of this, socio-demographic characteristics such as education, age, gender, income level, and home ownership have been identified as key determinants of the sustainable consumption behavior of energy-efficient products [21,31]. Understanding consumers' characteristics are necessary for targeted consumer segmentation and tailored marketing campaigns, particularly in developing countries like Thailand. Based on voluminous literature concerning demographic impacts on green purchase behaviors, this study attempts to investigate the effects of socio-demographic variables on the purchase behavior related to LED products. Therefore, this paper aims to investigate the following socio-demographic factors (including gender, age, education level, residence, monthly household income, home ownership, family member, and electric bill paying status) adapted from previous similar studies [17,21,31].

3. Materials and Methods

To test the above outlined hypotheses, the main methodology in this research is a quantitative survey of Thai consumers in purchasing LED products. Based on the proposed theoretical framework,

the constructs of attitude, subjective norm, perceived behavioral control, purchase intention and purchase behavior, derived from the Theory of Planned Behavior, will be analyzed for their causal inter-relationships using Structural Equation Modeling (SEM) through a program called "Analysis of Moment Structure" (AMOS 22). Attitude, subjective norm, and PBC were included as independent variables (Xs), while purchase intention and purchase behavior were the dependent variables (Ys); at the same time, purchase intention was included as a mediating variable of the three exogenous variables in terms of their effect on purchase behavior.

3.1. Sample and Data Collection

The sample for this research included customers living in Thailand that are over 18 years old with experience of purchasing lighting products. Based on the guidelines for incorporating the numbers of required samples by [39], a minimum sample size of 250 respondents would require a model containing 7 or fewer constructs with modest item communalities (0.5), with no under-identified (<3) constructs. Based on this sampling method, the minimum sample size of 250 participants was considered suitable for the hypothesized model in this study. Additionally, according to [39], an appropriate pilot study sample size should be 10% of the sample size anticipated for the parent study. A sample size for the pilot study of 25 respondents was adopted accordingly.

The survey questionnaire was first trialed with 30 light bulb customers at an electrical shop in Bangkok to gain a preliminary understanding of the survey content by conducting face-to-face interviews. After that, the questionnaire was revised for its clarity and suitability based on the customers' feedback. Then, the main study was conducted through online survey channels from January 2019 to August 2019 throughout Thailand by using a snowball sampling method for greater reach. A total of 328 responses were received. The data were screened for missing data and outliers, leaving a final data set for analysis of $n = 288$ (see Section 3.3).

3.2. Measures of Constructs

The statements or constructs in the questionnaire were adapted from various studies in the literature which applied the TPB as the main instrument, in which a pre-test is required to ensure reliability and validity. All scale items were scored on a 5-point Likert-type scale ranging from (5) Strongly Agree to (1) Strongly Disagree. These constructs were modified to suit this study and a summary of each variable is depicted in Table 1.

Table 1. Example statements for influencing factors.

Constructs/Observed Variables	Source (s)
Attitude	
ATT1 (I believe that using LED bulb helps solve global warming issues and environmental degradation)	[17,19,20]
ATT2 (I believe that using energy-efficient products is favorable)	
ATT3 (Helping relieve global warming by using energy-efficient products means an intrinsic reward for myself)	
Subjective Norm	
SN1 (Advice from others influenced my decision to adopt LED products)	[14,29]
SN2 (People which influence my decisions think that I should use more EE products)	
SN3 (Nowadays, LED products are far superior to others)	
Perceived Behavioral Control	
PBC1 (I am confident that I can afford to buy an LED bulb in the future)	[14,30,31]
PBC2 (I bought an LED bulb because it is easily available in my area)	
PBC3 (Decisions to buy LED and other energy-efficient products help society and the environment)	
Purchase Intention	
PI1 (In the future, I will definitely buy LED bulbs)	[14,34,35]
PI2 (I intend to use LEDs in order to save energy at home)	
PI3 (If possible, I will share my knowledge about LEDs to others)	
Purchase Behavior	
PB1 (I bought an LED because I have used it previously; past behavior)	[14,36]
PB2 (I always recommend others to adopt LED bulbs)	
PB3 (I normally buy an LED bulb, even if it is more expensive)	

3.3. Tools for Data Analysis

Prior to the data analysis, data were screened for missing values and outliers (univariate and multivariate outliers) in accordance with the recommendations by Kline [39]. The frequency distribution of z-scores of an absolute value greater than 3 were classified as univariate outliers and were excluded from the data [39,40]. Similarly, any data with Mahalanobis Distance (D2) values greater than the χ^2 were considered multivariate outliers. These mentioned outliers were deleted before computing the causal relationships of the model. Prior to the standardized effects and results of the TPB model being discussed, it was important that all required goodness-of-fit indices were taken into account in the model. It is recommended [39,40] to calculate numerous goodness-of-fit indices, including Chi-Square (Cmin/df), Comparative Fit Index (CFI), Goodness of Fit Index (GFI), Root Mean Square Residual (RMR), and Root Mean Square Error of Approximation (RMSEA)**.** In addition, a one-way Analysis of Variance (ANOVA) was conducted in to investigate the effects of socio-demographic variables on the purchase behavior related to LED products.

4. Results

4.1. Descriptive Statistics of Respondents and TPB Constructs

The descriptive statistics of respondents are reported in Table 2. The majority of respondents were female (52%), are aged between 18 and 35 years (50%), have a Bachelor's degree (57%), live in Bangkok (83%), have a monthly household income in the range 25,000–75,000 THB (47%) ($1 = 30.23 THB as of 1 December 2019), own a house (86%), have a family size of 4–6 persons (45%), and are responsible for paying electric bills regularly (60%). All items also indicated a significantly positive correlation in the inter-correlation matrix (the correlation is significant at the 0.001 level; two-tailed). As such, this suggested the appropriateness of the inclusion of all measure scales in the composite variables. The results show that all three components of the TPB (attitude, subjective norm, perceived behavioral control) are significantly correlated with purchase intention, while the strongest relationship was with perceived behavioral control ($r = 0.59$), followed by attitude ($r = 5.83$) and subjective norm ($r = 0.41$) at significant level $p = 0.01$. In addition, all inter-correlations were considerably lower than 1, indicating that a discriminant validity was achieved [14,25].

The descriptive statistics of all composite variables in the hypothesized model were computed, as were the overall means for the variables of each construct. The mean scores indicated positive results for all parameters. Specifically, the mean scores show that survey participants had positive intention ($\overline{x} = 4.62$); attitude ($\overline{x} = 4.61$); perceived behavioral control ($\overline{x} = 4.55$); purchase behavior ($\overline{x} = 4.31$); and subjective norm ($\overline{x} = 4.14$) in relation to energy-efficient products (Table 3). It is appropriate in this study to use mean scores of all construct variables for data analysis since these variables were collected and derived using similar methods that facilitate the comparison across variables (as suggested by [14,25]). In addition, all scales indicated high internal consistency scores of above 0.7 (Cronbach's alpha: 0.789). The Cronbach's alpha value indicates internal consistency between the three items that were combined to form the composite variable.

Table 2. Descriptive statistics of survey participants (n = 288).

Category	Frequency (%)	
Gender		
Male	139	48%
Female	149	52%
Age		
Gen Y (18–35 years)	145	50%
Gen X (36–49 years)	104	36%
Baby Boomers (50–70 years)	39	14%
Education Level		
Lower than Bachelor's	35	12.4%
Bachelor's	165	57.3%
Higher than Bachelor's	87	30.2%
Other	1	0.1%
Residence		
Bangkok	240	83%
Other	48	17%
Household Income		
Low Income (0–25,000)	44	15%
Middle Income (25,000–75,000)	135	47%
High Income (75,000–100,000+)	109	38%
Home Ownership		
Owned	249	86%
Rent	39	14%
Family Member		
Small HH (1–3)	125	43%
Medium HH (4–6)	130	45%
Large HH (7–10+)	33	12%
Electric Bill Paying Status		
Unreported	2	0.7%
Never Paid	97	34%
Paid Some Months	15	5.3%
Paid Regularly	174	60%

HH, household. Source: Author's own calculation.

Table 3. Descriptive statistics of the Theory of Planned Behavior (TPB) constructs (n = 288).

		Min	Max	Mean		S.D.	Variance
	Stat.	Stat.	Stat.	Stat.	S.E.	Stat.	Stat.
Attitude	288	3.33	5.00	4.6146	0.02519	0.42746	0.183
Subjective Norm	288	2.00	5.00	4.1400	0.04357	0.73940	0.547
Perceived Behavioral Control	288	3.33	5.00	4.5567	0.02480	0.42093	0.177
Purchase Intention	288	3.33	5.00	4.6273	0.02634	0.44695	0.200
Purchase Behavior	288	2.33	5.00	4.3148	0.03889	0.65999	0.436
Valid n (listwise)	288						

4.2. Testing the Structural Equation Modeling

Prior to the path analysis, the data were screened for missing values and univariate and multivariate outliers in accordance with the recommendations [39]. Some of the survey data were deleted due to (1) Z-scores being greater than ±3 (univariate outliers), and (2) Mahalanobis Distance (D2) values being more than the χ^2 (multivariate outliers). According to the AMOS output, all the direct effects in the hypothesized model were statistically significant. However, a number of general model-fit indices should also be taken into account in the model. It has been recommended [39] to apply numerous goodness-of-fit indices including Chi-Square (Cmin/df), CFI, GFI, RMR, and RMSEA. From the proposed model, the results indicated inappropriate fit for both the Chi-Square/df (Cmin/df = 5.128; not fit) and RMSEA values (RMSEA = 0.120; not fit).

The model-fit indices can be improved by re-specifying the model considering the relationships between variables as suggested by the Modification Indices (MI) output. The MI results suggest that the model could be improved by adding a few structural paths. However, it should be noted that structural equation modelling should be theory driven, and the largest MI values should be considered first [40]. The largest MI value (5.438) was described by a structural path from attitude to purchase behavior, suggesting that household consumers' attitudes had a direct effect on their purchase behavior. Fazio [18] also found a statistically significant correlation between attitudes and purchase behavior. The results of re-specifying the model show that all goodness-of-fit indices were within acceptable values. The Chi-Square/df (Cmin/df) was reduced to Cmin/df = 1.660, and the RMSEA value was reduced to RMSEA = 0.048; other indices (i.e., RMR, GFI, AGFI) were within the acceptable range (Table 4). As such, the re-specified model was considered to be the final model since the MI did not suggest a need to add more meaningful paths.

Table 4. Goodness-of-fit indices for the final model.

Model Fit Indices	Recommended Value	Model Value (Final Model)
Chi-Square/df (Cmin/df)	<3 good; <5 sometimes permissible	1.660
p-value for the model	>0.05	0.198
CFI	≥0.9	0.999
GFI	>0.95	0.998
AGFI	>0.80	0.965
RMR	<0.09	0.06
RMSEA	≤0.08; (<0.5 good)	0.048
TLI	≥0.9	0.987
NFI	≥0.9	0.997

CFI, Comparative Fit Index; GFI, Goodness of Fit Index; AGFI, Adjusted Goodness of Fit Index; RMR, Root Mean Square Residual; RMSEA, Root Mean Square Error of Approximation; TLI, Tucker Lewis Index; NFI, Normed Fit Index. Source: Author's own calculation.

4.3. Hypothesis Testing

Table 5 indicates the results of the structural model as well as their standardized path coefficients, which show positive direct effects among the TPB constructs. In total, all six hypotheses were supported. H1 was supported by the SEM output with a standardized path coefficient ($\beta = 0.37$, $p < 0.001$), indicating a moderate to strong positive relationship between attitude and purchase intention. More importantly, attitude was found to have the strongest weight among other direct predictors of purchase intention. H2 was also supported. It is also important to note that subjective norm had the weakest positive effect on purchase intention among the three main predictors, with a standardized path coefficient to purchase intention of $\beta = 0.17$, $p < 0.001$. This result is in accordance with one of the previous findings of a TPB study by [41], which found that attitude has the largest direct effect on purchase intention and subjective norm is the weakest predictor of purchase intention.

Table 5. Standardized results of the final model.

			Estimate	S.E.	C.R.	*p*	Label	Hypothesis Results
Purchase Intention	<—	Attitude	0.370	0.050	7.811	***	par_1	H1 (Supported)
Purchase Intention	<—	Subjective Norm	0.174	0.027	3.824	***	par_2	H2 (Supported)
Purchase Intention	<—	Perceived Behavioral Control	0.358	0.052	7.349	***	par_3	H3 (Supported)
Purchase Behavior	<—	Purchase Intention	0.438	0.085	7.602	***	par_4	H4 (Supported)
Purchase Behavior	<—	Perceived Behavioral Control	0.232	0.082	4.424	***	par_5	H5 (Supported)
Purchase Behavior	<—	Attitude	0.154	0.080	2.954	0.003	par_9	H6 (Supported)

Note: *** *p*-value < 0.001.

H3 suggested that PBC is positively associated with purchase intention towards LED products. H3 was supported as well, with a standardized path coefficient to purchase intention of $\beta = 0.36$,

$p < 0.001$. H4 was supported, with a standardized coefficient to purchase behavior of $\beta = 0.44$, $p < 0.001$. The results indicate that there is a strong positive relationship between purchase intention and purchase behavior. H5 argued that PBC is positively associated with purchase behavior towards LED products. H5 was supported, with a standardized path coefficient to purchase behavior of $\beta = 0.232$, $p < 0.001$. Lastly, H6 was supported, and the results indicated a standardized path coefficient from attitude to purchase behavior of $\beta = 0.154$, $p < 0.003$. This result shows that household consumers' attitudes had a direct effect on their purchase behavior (Figure 2).

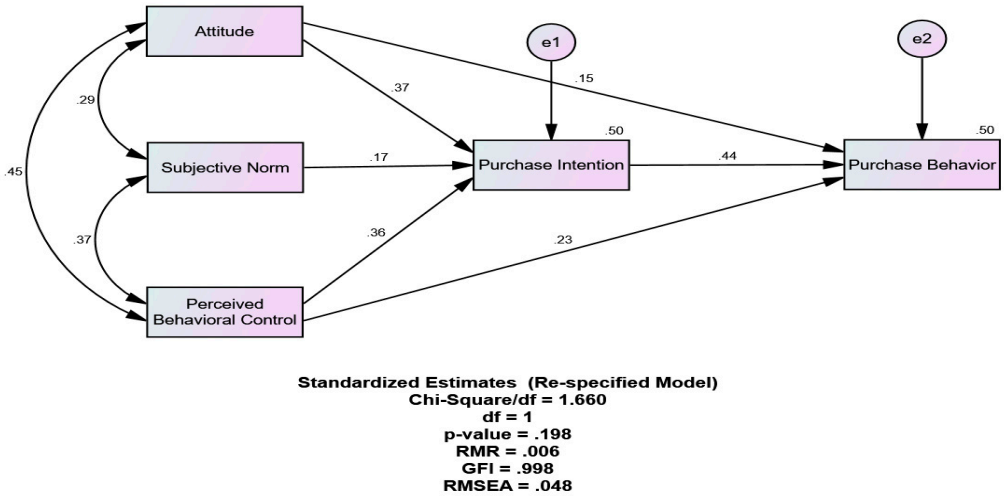

Figure 2. Path diagram for the final model of theory of planned behavior to understand light-emitting diode (LED) product purchase behavior among Thai households.

Moreover, the results also show that the indirect effect estimates for all these hypotheses were insignificant and small, indicating that there are no mediating effects of purchase intention on these three relationships. In other words, the direct effects from the three independent variables (attitude, subjective norm, and PBC) towards purchase behavior were significantly higher when compared to indirect effects. Furthermore, the results indicate that these three exogenous variables (i.e., attitude, subjective norm, and perceived behavioral control) collectively explained 49.9% of the variance in purchase intention. Similarly, purchase intention, attitude, and perceived behavioral control jointly explained 50.0% variance in purchase behavior towards LED products.

Additionally, an ANOVA test was conducted to investigate the effects of socio-demographic variables on consumers' purchase behavior towards LED products. However, only age factor and electricity bill paying status were found to have significant differences. Respondents were categorized into three age groups: Group 1 (Gen Y: 18–35 years old); Group 2 (Gen X: 36–49 years old); and Group 3 (Baby Boomers: 50–70 years old). The results discovered a statistically significance difference in purchase behavior scores between the three age groups, $F(2, 286) = 5.308$, $p = 0.05$. Post-hoc comparisons using the Scheffe test revealed the mean score for Group 3 ($M = 4.55$, $SD = 0.53$) was significantly higher than the mean score for Group 1 ($M = 4.20$, $SD = 0.71$) (see Supplementary Materials).

The impact of being an electric bill payer on the purchase behavior of LED products was also investigated by conducting a one-way ANOVA analysis. Respondents were divided into three groups: (1) Those who are responsible for paying electric bills regularly, (2) those who sometimes paid, and (3) those who have never paid. The results indicated a statistically significant difference in purchase behavior scores for the three groups, $F(3, 287) = 5.509$, $p = 0.001$. Post-hoc analysis using the Scheffe test showed that the mean score for Group 1 ($M = 4.43$, $SD = 0.60$) was significantly higher than the mean scores reported by both Group 2 ($M = 3.91$, $SD = 0.66$) and Group 3 ($M = 4.16$, $SD = 0.71$). However, Group 2 did not significantly differ from Group 3.

In addition, the results from the preliminary interview study revealed that the major behavioral barriers to adopting LED bulbs at home were: (1) their current satisfaction with the previous (inefficient)

bulbs; and (2) their habit of buying the same bulbs, that is, those currently installed at home (status quo bias). Interestingly, these qualitative findings are crucial for further investigations of purchase behaviors of energy-efficient products like LED bulbs among household consumers.

5. Discussion and Policy Implications

Overall, the results confirm that the TPB model and its measures were suitable for this study group. Attitude has been highlighted as the strongest predictor of the purchase intention of LED products. H1 suggested a positive association between attitudes and purchase intention. The result was in line with the TPB model from previous studies [11,39]. Since the prices of LED products are becoming increasingly competitive in the lighting market in Thailand, efforts should be made to increase the individual's contribution to society, rather than providing financial incentives to consumers, or any production subsidies to manufacturers. With an attempt to support future purchases of LED products, policymakers should focus on encouraging green attitudes by creating a favorable image regarding the usefulness of LED products in terms of what they can bring to the wider public. Another way forward is that government or the Ministry of Energy could develop a clear and ambitious plan to phase out inefficient light bulbs through public campaigns. A number of Asian countries have formed policies to encourage replacing old (inefficient) light bulbs with more efficient ones. Examples include the "Tokyo's Lightbulb Switching Campaign" in 2017 [42] and the "Together Brighter-Kyrgyzstan Campaign" initiated by the United Nations Development Programme (UNDP) in 2019 [43]. In Thailand, initiatives have so far mainly concentrated on government sectors, less so on the residential sector.

Subjective norms, according to this study's results, were the weakest determinants of purchase intention towards LED products. H2 indicated that a consumer's subjective norm was positively associated with purchase intention towards LED products. This result is in accordance with one of previous findings of the TPB studies by [38], which found that subjective norm was the weakest predictor and attitude had the largest direct effect on purchase intention. Subjective norms being the weakest determinants among other variables implies that Thai household consumers would not be significantly affected by advice from other individuals around them on their decisions to purchase LED products. Nevertheless, in order to promote the positive effect of subjective norms on consumers' purchase intentions, policymakers should strengthen the social norms of energy-saving behaviors. Nowadays, the environmental sector has embraced social media as the medium to support environmental campaigns and movements locally and globally. Social enterprises or environmental organizations might use social media channels to spread normative messages to either encourage specific behavioral changes, or generate public pressure for environmental protection.

PBC has a strong direct influence on purchase intention towards LED products. H3 proposed a positive relationship between consumers' perceived behavioral control and their purchase intentions towards LED products. This result is consistent with findings in the literature [12,13]. Furthermore, the results also show that PBC was found to have a direct influence on purchase behavior related to LED products. H5 suggested a positive association between PBC and purchase behavior towards LED products; this hypothesis was supported ($\beta = 0.232$, $p < 0.001$). The result was in line with those in previous literature [12,24,41]. The main impact of PBC is that when individuals are more confident on their capacity to purchase, they are more likely to purchase products. In this regard, policymakers should make sure that when consumers are making purchase transactions, clear and reliable information on the benefits of LED lighting products must be available to them. Effective information is of great importance for their decision-making process, which assures their confidence and capacity to purchase such products. Similarly, energy labels play a vital role in influencing purchase decisions, particularly product choices. Effective energy labels should contain comprehensive information which guides consumers to be aware of making the right choices for themselves and the environment. The significance of effective energy labels would therefore encourage consumers to select the most rational and energy-efficient options [44].

Purchase intention was found to have a significant influence on purchase behavior in relation to LED products. H4 predicted that purchase intention was positively associated with purchase behavior around LED products. The finding was in line with those of previous studies [45,46]. Since purchase intention was found to be an important determinant of purchase behavior towards LED products, it is vital for green marketers or policymakers to put more effort into improvements of the three main variables in the proposed model, i.e., attitude, subjective norms, and perceived behavioral control.

This study highlights the significant and direct relationship of attitude and purchase behavior, even when purchase intention is presented into the model. H6 was supported ($\beta = 0.154$, $p < 0.003$). The findings of a significant and direct relationship between attitude and purchase behavior is in accordance with previous studies by [16,18,21], which found theoretical arguments and statistically significant correlations between attitude and purchase behavior. Based on the constructs of "Attitude" in this survey, the questionnaire constructs mainly captured the respondent's evaluation of their previous experience with an object (Table 1). More importantly, the researcher selects only respondents who have previous experience with LED products. As such, the implication from [18] is that attitudes based on direct behavioral experience with an object should be (1) more accessible in the sense that the evaluation times to respond to questions about these attitudes should be quicker; and (2) more predictive of actual behavior toward that object. Therefore, attitudes that were retrieved from the respondents' memory rapidly and easily is more likely to be activated whenever the attitude object is presented.

There were significant differences between age groups and status as an electric bill payer in relation to purchase behavior relating to LED products. The results suggest that older people might have more time or put more effort into selecting home products that are more efficient to reduce household expenditure. However, the results contradicted those from a number of previous studies [47–49], which argued that younger individuals tend to prefer up-to-date technology and are more willing to pay for environmental protection than older generations. A possible explanation is that the previous studies were conducted more than 10 years ago, when information and communication channels were not ubiquitously distributed. However, older generations nowadays gain access to updated technology and knowledge about energy-efficient measures much faster than older generations from previous studies. In terms of bill paying behavior, differences were found between those who were responsible for paying electricity bills regularly and those who sometimes and/or never paid the bills in relation to their reported purchase behavior towards LED products. A possible explanation is that those who paid electric bills regularly would witness an increase in household energy expenditure and might seek useful energy-saving tips, in which adopting energy-efficient lighting products would serve as a solution to reduce energy costs at home.

This study's findings highlight several implications which might help in developing practical strategies or sound policy recommendations for eco-friendly products or energy-efficient products like LED bulbs. With attitudes exerting the strongest impact, policymakers/marketers should attempt to attract more consumption by using promotions and infomercials which trigger consumers' attitudes towards energy-saving possibilities as well as increasing environmental awareness. As such, policymakers should provide consumers with more product accessibility and more direct behavioral experience with LED products, in the sense that in the future it will be more quickly, automatically, and easily retrieved from memory and past experience.

Practically, the government, entrepreneurs, or the private sector should develop public interventions to enable faster decision-making while showcasing how the consumption of LED products could help reduce individual energy expenditure at home as well as reduce adverse environmental impacts at a wider scale. In this regard, a modern approach for green marketing should raise awareness of the importance of energy-efficient products' benefits, referring to such benefits as always being available to customers, particularly when they are making purchase transactions. For instance, the availability of shelf display information of the LED products' benefits as well as eco-labelling at the point-of-sale would signal green consumption behavior and reduce search costs

for more energy-efficient options. Furthermore, as more than 74% of the Thai population own a smartphone and have access to the Internet, the government should see this as an opportunity to cultivate green attitudes, disseminating LED products' benefits to the general public through various online channels to help make it a social norm. As such, the importance of LED products' benefits being "omnipresent" would encourage brands to create strategies for individual channels including retail, social media, and modern E-commerce applications.

6. Conclusions

This study offers a few points on research originality which distinguished it from other studies. First, unlike several previous studies on energy-saving home products, which paid more attention to purchase intentions rather than purchase behaviors, this study takes into account both purchase intention and purchase behaviors towards LED products in its framework. Purchase behaviors were reflected by respondents' actual or past behaviors towards LED products. The second novelty of this paper lies in the generalizability of its results for specific types of energy-saving home products. Previous literature relied on the concept of "macroscopic" scale by using the variation of energy-saving home product types (e.g., air-conditioners, washing machines, televisions). However, these results were not generally applicable, since some influencing factors may differ across various types of energy-saving home products. This study attempted to overcome the generalizability challenges by focusing on one specific type of energy-saving home product, i.e., LED lighting products.

The result provides a theoretical contribution to describing the purchase behavior of energy-efficient products like LED bulbs, particularly among household consumers in developing countries like Thailand. In a practical manner, the result from this study provides a managerial insight to educate household consumers about preserving energy and raise the importance of the individual's contribution towards environmental sustainability by using energy-efficient products like LEDs at home. This study contributes to the energy-efficient purchase behavior literature by elaborating the roles of psychological factors as well as socio-demographic factors. The results not only provide implications for further research but can also be utilized by environmental and governmental organizations focusing on the challenge of minimizing household energy consumption in Thailand.

Limitations and Future Directions

There are some limitations to this study which must be acknowledged. Firstly, the sample collected was concentrated on young household consumers. Future research should target other age groups, which may provide new insights. Meanwhile, the majority of samples were Bangkok residents, which may cause some bias in the results. Other parts of Thailand should also be examined to expand and potentially re-affirm the findings. Secondly, household consumers' purchasing behavior can be affected by various factors other than those mentioned in this study. Future research should include some new factors, such as environmental knowledge, as new variables for an extended TPB framework, or provide qualitative approaches in order to construct a more comprehensive understanding of LED product purchase behavior. For instance, researchers may further develop the qualitative findings of the main behavioral barriers to the adoption of LED bulbs in this present study. On the other hand, researchers may include some risks associated with LED products, such as health or economic risks [50]. As consumer behavior is too complex to be explained by one overarching theoretical framework, future research directions should find a balance between its theoretical generality and behavioral patterns intended to investigate [51]. Nevertheless, this study acts as a good starting point to further explore individuals' behavior towards energy-efficient products like LED bulbs, which could be applied to other types of energy-efficient products when consumers are faced with different choices of energy-efficient options.

Supplementary Materials: The following are available online at http://www.mdpi.com/2071-1050/12/12/4887/s1, Table S1: Correlation Matrix of TPB Constructs, Table S2: Descriptive Statistics of the TPB Constructs, Table S3: Cronbach's Alpha, Table S4: Goodness-of-Fit Indices, Table S5: Indirect Effects, Total Effects, and Squared

Multiple Correlation, Table S6: Age groups-ANOVA score and Post-hoc comparisons using Scheffe test, Table S7: Electric Bill Payer groups comparisons-ANOVA and Post-hoc using Scheffe test.

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References

1. Antunes, D.; Gaspar, R.; Lino, J. Energy efficient appliances and energy efficient behaviors: From consumer's assessment to behavior intervention. In *Energy Efficiency: Methods, Limitations and Challenges*; Nova Science Publishers: Hauppauge, NY, USA, 2012.
2. Taylor, P.G.; d'Ortigue, O.L.; Francoeur, M.; Trudeau, N. Final energy use in IEA countries: The role of energy efficiency. *Energy Policy* **2010**, *11*, 6463–6474. [CrossRef]
3. Reynolds, T.; Kolodinsky, J.; Murray, B. Consumer preferences and willingness to pay for compact fluorescent lighting: Policy implications for energy efficiency promotion in Saint Lucia. *Energy Policy* **2012**, *41*, 712–722. [CrossRef]
4. Ministry of Energy. *Thailand Power Development Plan 2015–2036 (PDP2015)*; National Energy Policy Council (NEPC): Bangkok, Thailand, 14 May 2015; Available online: https://www.egat.co.th/en/images/about-egat/PDP2015_Eng.pdf (accessed on 15 November 2018).
5. International Energy Agency. *Global Energy & CO2 Status Report*; IEA: Paris, France, 2019.
6. Clean Energy Ministerial. *Global Lighting Challenge Fact Sheet*; CEM: Paris, France, 2018.
7. United Nations Environment Programme. *Accelerating the Global Adoption of Energy-Efficient Lighting*; UNEP: Paris, France, 2017.
8. Molina-Moreno, V.; Leyva-Díaz, J.C.; Sánchez-Molina, J.; Peña-García, A. Proposal to Foster Sustainability through Circular Economy-Based Engineering: A Profitable Chain from Waste Management to Tunnel Lighting. *Sustainability* **2017**, *9*, 2229. [CrossRef]
9. Molina-Moreno, V.; Núñez-Cacho Utrilla, P.; Cortés-García, F.J.; Peña-García, A. The Use of Led Technology and Biomass to Power Public Lighting in a Local Context: The Case of Baeza (Spain). *Energies* **2018**, *11*, 1783. [CrossRef]
10. Electricity Generating Authority of Thailand. *EGAT Annual Report*; EGAT: Nonthaburi, Thailand, 2016.
11. Tan, C.S.; Ooi, H.Y.; Goh, Y.N. A moral extension of the theory of planned behavior to predict consumers' purchase intention for energy-efficient household appliances in Malaysia. *Energy Policy* **2017**, *107*, 459–471. [CrossRef]
12. Ali, S.; Ullah, H.; Akbar, M.; Akhtar, W.; Zahid, H. Determinants of Consumer Intentions to Purchase Energy-Saving Household Products in Pakistan. *Sustainability* **2019**, *11*, 1462. [CrossRef]
13. Hua, L.; Wang, S. Antecedents of Consumers' Intention to Purchase Energy-Efficient Appliances: An Empirical Study Based on the Technology Acceptance Model and Theory of Planned Behavior. *Sustainability* **2019**, *11*, 2994. [CrossRef]
14. Ajzen, I. The theory of planned behavior. *Organ. Behav. Hum. Decis. Process.* **1991**, *50*, 179–211. [CrossRef]
15. Fielding, S.K.; McDonald, R.; Louis, W.R. Theory of planned behaviour, identity and intentions to engage in environmental activism. *J. Environ. Psychol.* **2008**, *28*, 318–326. [CrossRef]
16. Nguyen, T.N.; Lobo, A.; Greenland, S. Energy efficient household appliances in emerging markets: The influence of consumers' values and knowledge on their attitudes and purchase behaviour. *Int. J. Consum. Stud.* **2017**, *41*, 167–177. [CrossRef]
17. Ritter, Á.M.; Borchardt, M.; Vaccaro, G.L.; Pereira, G.M.; Almeida, F. Motivations for promoting the consumption of green products in an emerging country: Exploring attitudes of Brazilian consumers. *J. Clean. Prod.* **2015**, *106*, 507–520. [CrossRef]
18. Fazio, R.H. Attitudes as object-evaluation associations: Determinants, consequences, and correlates of attitude accessibility. *Attitude Strength Anteced. Conseq.* **1995**, *4*, 247–282.
19. Mostafa, M.M. A hierarchal analysis of the green consciousness of the Egyptian consumer. *Psychol. Mark.* **2007**, *24*, 445–473. [CrossRef]

20. Birgelen, M.; Semeijn, J.; Keicher, M. Packaging and pro-environmental consumption behaviour: Investigating purchase and disposal decisions for beverages. *Environ. Behav.* **2009**, *41*, 125–146. [CrossRef]
21. Nguyen, N.; Greenland, S.; Lobo, A.; Nguyen, H.V. Demographics of sustainable technology consumption in an emerging market: The significance of education to energy efficient appliance adoption. *Soc. Responsib. J.* **2019**, *15*, 803–818. [CrossRef]
22. Maichum, K.; Parichatnon, S.; Peng, A.K.-C. Factors Affecting on Purchase Intention towards Green Products: A Case Study of Young Consumers in Thailand. *Int. J. Soc. Sci. Humanit.* **2017**, *7*, 330–335.
23. Saichao, L. *A Study on Factors Affecting Customer's Attitude toward Intention to Purcahse Green Products in Bangkok, Thailand*; Bangkok University: Bangkok, Thailand, 2016.
24. Han, H.; Hsu, L.-T.J.; Sheu, C. Application of the Theory of Planned Behavior to Green Hotel Choice: Testing the Effect of Environmental Friendly Activities. *Tour. Manag.* **2011**, *31*, 325–334. [CrossRef]
25. Ajzen, I. Consumer Attitudes and Behavior. *Handb. Consum. Psychol.* **2008**, *1*, 525–548.
26. Collins, S.E.; Carey, K.B. The theory of planned behavior as a model of heavy episodic drinking among college students. *Psychol. Addict.* **2007**, *21*, 498–507. [CrossRef]
27. Moser, A.K. Thinking green, buying green? Drivers of pro-environmental purchasing behavior. *J. Consum. Mark.* **2015**, *32*, 167–175. [CrossRef]
28. Nguyen, T.N.; Lobo, A.; Greenland, S. The influence of cultural values on green purchase behaviour. *Mark. Intell. Plan.* **2017**, *35*, 377–396. [CrossRef]
29. Wiriyapinit, M. Is Thai culture the right culture for knowledge management? An exploratory case study research. *Chulalongkorn Rev.* **2007**, *74*, 80–90.
30. Taylor, S.; Todd, P. Decomposition and crossover effects in the theory of planned behavior: A study of consumer adoption intentions. *Int. J. Res. Mark.* **1995**, *12*, 137–155. [CrossRef]
31. Liu, X.; Wang, Q.; Wei, H.-L.; Chi, H.-L.; Ma, Y.; Jian, I. Psychological and demographic factors affecting household energy-saving intentions: A TPB-based study in Northwest China. *Sustainability.* **2020**, *12*, 1–20.
32. Blackwell, R.D.; Miniard, P.W.; Engel, F.J. *Consumer Behaviour*; Harcourt College Publishers: San Diego, CA, USA, 2001.
33. Brown, M. Buying or browsing? An exploration of shopping orientations and online purchase intention. *Eur. J. Mark.* **2003**, *37*, 1666–1684. [CrossRef]
34. Thøgersen, J.; Ölander, F. Spillover of environment-friendly consumer behavior. *J. Environ. Psychol.* **2003**, *23*, 225–236. [CrossRef]
35. Sheppard, B.H.; Hartwick, J.; Warshaw, P.R. The theory of reasoned action: A meta-analysis of past research with recommendations for modifications and future research. *J. Consum. Res.* **1988**, *15*, 325–343. [CrossRef]
36. Chang, M.K. Predicting Unethical Behavior: A Comparison of the Theory of Reasoned Action and the Theory of Planned Behavior. *J. Bus. Ethics* **1998**, *17*, 1825–1834. [CrossRef]
37. Yadav, R.; Pathak, G.S. Determinants of Consumers' Green Purchase Behavior in a Developing Nation: Applying and Extending the Theory of Planned Behavior. *Ecol. Econ.* **2017**, *134*, 114–122. [CrossRef]
38. Chaudhary, R.; Bisai, S. Factors influencing green purchase behavior of millennials in India. *Manag. Environ. Qual.* **2018**, *29*, 798–812. [CrossRef]
39. Kline, R.B. Methodology in the Social Sciences. In *Principles and Practice of Structural Equation Modeling*, 3rd ed.; Guilford publications: New York, NY, USA, 2011.
40. Jöreskog, K.G.; Sörbom, D. *Lisrel 8: Structural Equation Modeling with the SIMPLIS Command Language*; Scientific Software International: Skokie, IL, USA, 1996.
41. Armitage, C.J.; Conner, M.T. Efficacy of the Theory of Planned Behaviour: A Meta-Analytic Review. *Br. J. Soc. Psychol.* **2010**, *40*, 471–499. [CrossRef] [PubMed]
42. The Japan Times. Koike Kicks off Free Lightbulb-Switching Campaign with Pikotaro. 10 July 2017. Available online: https://www.japantimes.co.jp/news/2017/07/10/national/metro-government-begins-campaign-get-residents-switch-incandescent-led-bulbs/ (accessed on 1 May 2020).
43. United Nations Development Programme in Kyrgyzstan Republic. UNDP in Kyrgyzstan Promotes Energy Conservation and Energy Efficiency Through Light Bulb Exchange Campaign. 6 November 2019. Available online: https://www.kg.undp.org/content/kyrgyzstan/en/home/presscenter/articles/2019/11/undp-is-promoting-energoeffciency-in-kyrgyzstan--results-of-the-.html (accessed on 1 May 2020).

44. Brocklehurst, F. Choosing energy efficiency—Consumer response to operating costs at the point of sale. In Proceedings of the British Institute of Energy Economics Conference: Consumers at the Heart of the Energy System? Oxford, UK, 18–19 September 2018.
45. Hair, J.F.; Black, W.C.; Babin, B.J.; Anderson, R.E. *Multivariate Data Analysis*, 7th ed.; Prentice Hall: Upper Saddle River, NJ, USA, 2010.
46. Connelly, L.M. Pilot Studies. *Medsurg. Nurs.* **2008**, *17*, 411–412. [PubMed]
47. Howell, S.E.; Laska, L.B. The changing face of the environmental coalition: A research note. *Environ. Behav.* **1992**, *24*, 134–144. [CrossRef]
48. Linden, A.-L.; Carlsson-Kanyama, A.; Eriksson, B. Efficient and inefficient aspects of residential energy behaviour: What are the policy instruments for change? *Energy Policy* **2006**, *34*, 1918–1927. [CrossRef]
49. Torgler, B.; García-Valiñas, M.A.; Macintyre, A. *Differences in Preferences towards the Environment: The Impact of a Gender, Age and Parental Effect*; FEEM Working Paper No. 18; Fondazione Eni Enrico Mattei: Milan, Italy, 2008.
50. Nguyen, T.P.L.; Peña-García, A. Users' Awareness, Attitudes, and Perceptions of Health Risks Associated with Excessive Lighting in Night Markets: Policy Implications for Sustainable Development. *Sustainability* **2019**, *11*, 6091. [CrossRef]
51. Antonides, G. Sustainable Consumer Behaviour: A Collection of Empirical Studies. *Sustainability* **2017**, *9*, 1686. [CrossRef]