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Factors Influencing Consumer's Adoption of Renewable Energy

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Abstract: The objective of this study was to investigate the factors that influence the consumer adoption of renewable energy in Thailand. The study adopted an extended theory of planned behavior (TPB) by including three additional variables. The study applied a quantitative study methodology, with primary data collected using a survey of consumers in five major cities in Thailand. The data were analyzed using structural equation modeling (SEM). The findings of the study indicated that perception of self-effectiveness, environmental concern, renewable energy awareness, and beliefs about renewable energy benefits have a significant and positive effect on consumers' intention to adopt renewable energy. The cost of renewable was found to have a negative but non-significant influence on consumers' adoption of renewable energy, while risk/trust perception was found to have a positive but non-significant influence on consumers' adoption of renewable energy. The study concluded that stakeholders should take into account the aspects of perception of self-effectiveness, environmental concern, renewable energy awareness, and beliefs about renewable energy benefits when running campaigns to promote the consumer adoption of renewable energy in Thailand

Keywords: renewable energy; consumers' adoption; theory of planned behavior; self-effectiveness; environmental concern

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1. Introduction

Energy production and consumption are essential sources of growth for economies. However, the increased consumption of conventional energy leads to increased environmental degradation. For instance, in Thailand, nonrenewable energies from fossil fuels and coal contribute to the high levels of environmental degradation due to their limited availability and the long time taken to replenish these resources. Renewable energy thus refers to clean energy harnessed from natural sources that can be constantly replenished. Renewable energy is harnessed from sources including sunlight and wind to generate power used in transportation, heating, and lighting, among other applications. While renewable energy is not a new technology, there has been an increase in innovative ways to capture and produce renewable energies from solar and wind energy [1]. Therefore, innovative technologies used in harnessing renewable energies have led to the increased use of clean energy in many parts of the world and on large scales.

Various forms of renewable energy exist that have been relied on up by humans for years. For instance, solar energy is the most common form of renewable energy that is harnessed from sunlight. The sun emits solar energy to the earth's surface, which is then harnessed through solar technologies to produce electrical energy. Solar panels are used to concentrate the solar radiation into energy used to generate electricity. Wind energy is the other form of renewable energy that is generated from wind power. Technologies used in the generation of wind power involve wind turbines that use wind energy to

turn the turbine blades to generate electricity [2]. The use of wind power continues to increase worldwide due to the low costs involved in generating electricity. Geothermal energy is another form of renewable energy harnessed from natural heat from the earth's surface. Geothermal energy is often converted to generate electricity. However, the use of geothermal energy is negligible in many parts of the globe. Other forms of renewable energy include biomass energy harnessed from solid fuel from plant materials to generate electricity. Moreover, hydropower is one of the most commercialized forms of renewable energy harnessed from water reservoirs used to turn turbines that generate electricity [3–6].

The use of renewable energy continues to play a significant role in the current modern technologies due to high-efficiency energy production. The increased need for energy-efficient products is also aimed at attaining sustainability goals. The use of renewable energy provides various benefits, including the reduction of the dependency on imported fossil fuels that are costly and have negative impacts on economic growth. Renewable energies are also vital in the reduction of global warming through the reduction in the emission of greenhouse gases. For instance, in 2018, the use of fossil fuels contributed to 89% of the global carbon emissions that contribute to global warming [7–11]. Renewable energy is often referred to as "clean energy", and it contributes to improved public health. The environmental pollution caused by the use of fossil fuels is linked to various health problems. Fossil fuels cause pollution to the air and water environments, leading to various health complications, including breathing problems, cancer, and premature deaths from illnesses, among others. Renewable energies are harnessed from natural resources, including wind, water, and solar sources that cause limited environmental pollutions.

Despite the dominance of fossil fuel use around the world, the global transition to the use of clean energy has increased over the years. For instance, there is an increased shift in the use of electricity, with greater renewable energy capacities installed compared to new fossil fuel capacities. In 2018, up to 181 GW of renewable energy capacities were installed, contributing to more than one-third of the global installed power capacities. Further, there has been an increase in the use of solar energy, with up to 100 GW of solar capacities being installed by 2018 [12,13]. Developed countries lead the shift towards renewable energies, including China, the United States, Japan, Germany, and India. Similarly, the increasing consumption of renewable energies continues to increase due to the shift by major cities worldwide towards clean energies. Overall, cities contribute to a higher percentage of global energy demand. The increase in the number of cities using renewable energy contributes to the increased global shift towards clean energy. For instance, at least 100 cities worldwide have shifted to 100% use of renewable electricity.

However, the consumption of renewable energies worldwide faces various challenges, limiting the attainment of sustainable energy. For instance, the shift towards the use of renewable energy is limited by the continued fossil fuel subsidies. The fossil fuel industry continues to compete with renewable energies by influencing governments in top economies to offer huge subsidies to the fossil fuel industry affecting the increased transition to the use of clean energy. Moreover, many developing countries are unable to transition to renewable energies due to a lack of appropriate innovative technologies to harness natural energies [14]. Despite developing countries having sizable natural resources, the lack of renewable energy technologies continues to limit the transition towards the use of clean energy in these countries.

With the above discussion as a guide, the main objective of this research was to explore the factors that influence consumer's adoption of renewable energy in Thailand. Climate change concerns and the safety of the planet have seen most countries change their long-term policies on fossil fuels. The alternative is renewable energy, which is considered safer for both humans and the environment, especially with regard to sustainability. The rest of the paper is arranged in sections that that present discussions on renewable energy in Thailand with the facts from available literature, followed by the theoretical framework, formulation, and development of the study hypotheses, research methodology, results, and

discussion, implications of the findings, as well as some of the limitations and how they impacted the results.

1.1. Consumer's Renewable Energy

The consumer's willingness to consume renewable energy is significant in the transition towards sustainable energy use. The increased effects of global warming, climate change, and pollution continue to influence the consumer's concerns about the environment and their attitudes towards the consumption of renewable energies. Thailand has a renewable energy use target of 25% by 2037. Thus, to achieve this target, there is a need to understand the consumer's willingness to pay for renewable energies. According to [15] various aspects influence the consumer's willingness to pay for renewable energies, including the age and education level of the consumers. The empirical research suggests that middle-aged individuals and highly educated people are more likely to adopt the use of renewable energies. Sources of income also influence the level of willingness to adopt renewable energies by consumers. A financial policy aimed at the increased consumption of clean energies is vital in increasing the consumer's willingness to pay for renewable energy. Financial policies such as tax deductions are vital in promoting consumer acceptance of renewable energies.

Individuals willing to adopt renewable energies in their homes form a market segment for the consumption of clean energies. An increase in the consumption of renewable energy has the potential of increasing investments in sustainable energy [16]. An analysis of consumer behavior towards renewable energy products indicates an increased willingness to support renewable energy development despite having to pay slightly higher power bills than those for conventional fossil fuel energy products. The study by [17] suggests that consumers in New Zealand are willing to pay 2% more than their current power bills to increase the percentage of renewable energy products in the country.

1.2. Renewable Energy in Thailand

Thailand is one of the fast-growing economies in Southeast Asia and thus faces a rising demand for energy. However, based on the current energy demand, the country faces the challenge of depleting its gas and oil resources in the next decade. Thus, to address the possible future energy resources challenges, the country aims at increasing its diversification towards renewable energy. For instance, Thailand has set targets to ensure 30% of the country's total energy consumption by 2036 would come from renewable energy. The target would be double the renewable energy consumption rate in 2015 in the country [12,18,19]. Thailand's major renewable energy resources include solar and wind power, biomass and hydropower. In 2019, Thailand's renewable energy consumption 2019 consisted of biomass power with 28% installed capacity and solar energy with 25% capacity. The other renewable energy sources included large hydropower at 24% and wind energy at 12% [12]. A large amount of renewable energy in Thailand is used for electricity purposes.

Renewable energy contributes to 10% of Thailand's electricity and 15% of the total power consumption in the country. The country's ambition to develop sustainable energy in the future is based on the government's strategic plan, namely the Power Development Plan (PDP), that aims to increase the country's renewable energy consumption to 30% in 2036 [11]. Thailand's ambition to transition towards a low carbon society is also based on various strategic improvements, including increased investments in renewable energy resources to see the power development plan towards transitioning to a low carbon society. The government also promotes the transition towards renewable energy through the development of innovative technologies aimed at promoting green energy, such as the development of smart grids in the energy sector [1,20].

The increased improvements in renewable energy use in Thailand can also be attributed to the various support programs aimed at renewable energy development. For instance, the Thailand Board of Investment provides support for renewable energy projects in the country through incentives such as tax exemptions. Moreover, corporations engaging

in renewable energy projects stand to benefit from an eight-year income tax holiday and import duty exemption on renewable energy products, such as solar cells or renewable energy sources. The various support programs indicate the government's commitment to the development of renewable energies in the country [2,21,22], as well as their application in agriculture to reduce fears of emission and improve sustainability [22–24].

The consumption of renewable energy in Thailand varies among the various types of clean energy resources. Bioenergy is the commonly utilized form of green energy, and it involves energy from plant materials. Based on the country's PDP, Thailand has a huge potential to improve the use of bioenergy through biogas digester technologies that will increase the use of liquefied petroleum gas (LPG) products in the future. Thermal energy forms the other form of clean energy that is most utilized in Thailand. While much of the thermal energy is generated from solar energy, the country indicates great potential in harnessing thermal energy from biomass [12,25]. Moreover, Thailand's strong automobile industry provides an increased potential for energy. The development of electric vehicles paves the way towards an increased demand for renewable energies that power electric vehicles (EV) [26]. Thus, to achieve the increasing demand for energy, the government of Thailand has put in place various technological and infrastructural development that promote the development of renewable energy.

2. Theoretical Framework

The behavioral adaptations of individuals to different spheres of life's processes have been documented in several studies [27–30], along with the different outcomes that arise from them [31–34]. Public acceptance is significant in the consumers' adoption of renewable energy in Thailand. There is thus a need to promote the intention to use and adopt renewable energies among the public. Understanding the consumer decision-making process can be complex as various aspects are taken into consideration before the decision to adopt a particular technology. The Theory of Planned Behavior (TPB), which was adopted to develop the theoretical framework of this study, resonates with the consumers' influences and predictions in adopting renewable energy in Thailand. The theory of planned behavior is used to explain behaviors in which individuals can exercise self-control. The theory uses various constructs that predict the individuals' control over the behaviors, including attitude, subjective norms, and perceived behavioral control.

Attitude involves individuals' feeling of either favorable or unfavorable towards a particular behavior action. The aspect of attitude under the theory of planned behavior is linked to the consumers' behavior towards the adoption of renewable energy. According to [35], the aspect of an attitude positively influences the consumers' intentions to adopt renewable energy. The government of Thailand has invested in massive renewable energy projects that are likely to offer social and economic benefits to the public in the coming years. The positive attitudes may thus be influenced by the positive benefits the consumers would have by adopting the use of renewable energy compared to traditional fossil fuel energy. Similarly, the current changes in the climate coupled with pollution, global warming, and climate change are likely to change the consumer attitudes towards favoring the adoption of renewable energy to minimize the effects of climatic changes.

Subjective norms are constructs of the theory of planned behavior, and they involve the beliefs that a group of individuals or prominent individuals approve of particular products and behavior. The subjective norms can be determined by perceived social pressure that influences an individual to behave and act in a particular manner. The study by [2] suggests a link between subjective norms and the consumers' willingness to adopt renewable energy. The society in Thailand is integrated through family, relatives, and social groups that play a vital role in decision making among individuals. Previous experiences in using renewable energy among the communities in Thailand are thus likely to positively impact peer decision-making towards the adoption of renewable energy. The PDP in Thailand was developed from 2018 to 2037. Thus, the adoption rates of renewable technology are

in their initial stages, an aspect that may limit the social effect to drive the adoption of renewable energy.

Perceived behavioral control is the other construct of the theory of planned behavior that can be used to predict the consumer adoption of renewable energy in Thailand. Perceived behavioral control involves the opinion of an individual towards a particular behavior in terms of it being either easy or difficult. The study by [36] indicates a link between perceived behavioral control and the consumers' intentions to adopt renewable energy. Makki & Mosly [37] suggest that the user-friendly nature of renewable energy products positively influences the consumers' intentions to purchase and adopt renewable energy. Products such as solar panels are easy to install and likely to positively influence the consumers' perceived behavioral control towards the adoption of green energy. In Thailand, the consumers' perceived behavioral control can be influenced through increased awareness of the use of renewable energy products to influence the adoption of green energy.

However, TBP has evaluated three variables, with normative, behavioral, and control beliefs to determine consumers' intention to adopt a particular behavior. From the researchers' perceptive, the model overlooks other important variables. To complete the model, three additional variables were added in this research, which were the perception of self-effectiveness, perception of neighbor's participation, and belief about renewable energy benefits. The perception of self-effectiveness implies the individuals' level of effectiveness perception, while the perception of neighbor's participation is considered as the influence of the neighboring or close individuals on a person's behavior towards adopting a particular technology. The belief about renewable energy benefits implies the expectation of individuals regarding the positive outcomes gained from consuming renewable energy. Figure 1 shows the research framework adopted.

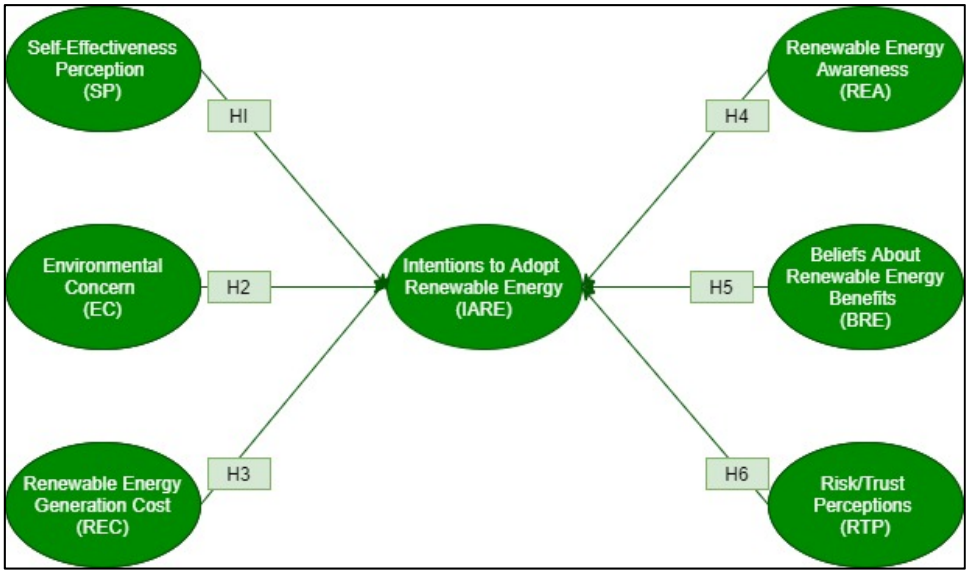

Figure 1. Adopted Research Model for the Study.

3. Formulation of Hypothesis

Towards the development of the hypothesis, an extensive critical review of existing literature was conducted, incorporating research papers, policy documents, and official statistics.

3.1. Perception of Self-Effectiveness

The adoption of renewable energy is complex and is influenced by aspects, including the consumer's perceptions of self-effectiveness in the use of the new renewable energy. The concept of self-efficacy in the adoption of new technologies involves the beliefs in the individuals' abilities to perform the technological tasks using renewable energy. Often, the

idea of self-effectiveness does not involve the individuals' skills, rather their perceptions regarding achievement of the desired outcomes of using the new technologies. Thus, when the consumers do not show positive perceptions of self-effectiveness (SP), it becomes difficult to adopt the new technologies.

According to [37], the consumer perceptions of self-effectiveness influence the adoption of renewable energy based on either the ease or struggle of adopting the technologies. Ease of technological adoption is associated with access to the resources for the adoption of renewable energy technology, including ease of installation and utilization. Similarly, the study by [38] indicates that the perception of self-effectiveness by consumers has a positive influence on the consumers' intention to adopt renewable energy. For instance, the choice of purchasing particular technological gadgets or vehicles is often influenced by the perception of self-effectiveness. Consequently, the need to adopt renewable energy will be determined by the consumer's perceptions to accomplish desired tasks with the new, clean, energy-efficient devices.

Similarly, the perception of self-effectiveness positively influences consumers in adopting renewable energy by purchasing energy-efficient products. In the study by [39], consumer perception is a strong indicator of the intention to adopt renewable energy. The competitive nature of energy-efficient products in Thailand greatly influences the consumers' perception of self-effectiveness and positively contributes to the adoption of renewable energy.

Hypothesis 1 (H1). *Perception of self-effectiveness positively influences consumer adoption of renewable energy in Thailand.*

3.2. Environmental Concern

Environmental concern refers to the knowledge and attitudes of households in addressing environmental issues ranging from climate change to pollution. With the increased global awareness of the emerging and existing environmental problems, consumers are increasingly becoming concerned and committed to resolving these issues. According to the study by [35], consumers are increasingly becoming aware of their consumption habits and the degree to which their consumption habits affect the environment. The concept of environmental concern is thus essential in the adoption of renewable energy, as consumers with serious environmental concerns demonstrate a positive attitude towards the adoption of renewable energy [39]. In the case of adopting renewable energy, environmental concern plays an important role in promoting consumer attitudes towards their willingness to purchase clean energy technology.

Progress towards addressing environmental issues like climate change is slow despite the efforts being made to ensure sustainable environments. According to [2], consumers often find it difficult to trust the information provided on products manufactured for ensuring green energy. It is thus vital for the manufacturers to provide reliable information regarding the effectiveness of the products towards protecting the environment. The concept of environmental concern is thus a critical factor towards understanding the consumer's intention to adopt renewable energy. Consumers exhibiting a positive "Environmental Concern" are thus likely to demonstrate a positive behavior towards purchasing and adopting renewable energy. Referring to [40], the intention to adopt renewable energy by consumers in a country is greatly influenced by the consumers' awareness of the environmental problems. In most cases, consumers choose to adopt green energy technology with the aim of promoting environmental conservation. Therefore, it is most likely that the environmental concern among the consumers in Thailand will positively affect the consumers' willingness to adopt renewable energy.

Hypothesis 2 (H2). *Environmental concern positively influences consumer adoption of renewable energy in Thailand.*

3.3. Cost of Renewable Energy Generation

The cost of generating renewable energy is another essential determinant that influences the consumers' adoption of clean energy. Often, consumers take into consideration the costs associated with the purchase of renewable energy technology. Referring to [14], renewable energy projects are capital intensive due to the high-interest rates demanded by lenders as a result of the high risks associated with such projects. Consequently, investors end up demanding higher returns, in turn making the renewable energy products costly. In this case, therefore, the adoption of renewable energy is challenged by the high costs associated with the purchase of renewable energy products. In the study by [37], the author outlines that, despite the continued reduction in the cost of renewable energy technologies, the cost of renewable energy remains high for consumers compared to conventional fossil fuel energy. There is thus a negative effect of the cost of renewable energy generation on the consumers' willingness to adopt renewable energy.

Similarly, the study by [7] indicates a negative association between the consumers' willingness to purchase renewable energy and cost. With the changing economic trends, consumers are often reluctant to pay extra to adopt renewable energy technology while they have the option of spending on the alternative affordable traditional fossil energy. Similar to developed countries, the adoption of renewable energy in Thailand is likely to face a major hurdle due to the negative influence of cost on the consumers' willingness to adopt renewable energy technology.

Hypothesis 3 (H3). *The cost of renewable energy generation negatively influences consumer's adoption of renewable energy in Thailand.*

3.4. Awareness

The other major element influencing consumer adoption of renewable energy involves awareness. Awareness refers to the level of consumers' knowledge and perception of the facts regarding renewable energy technologies. Awareness involves having clear knowledge of the effectiveness of renewable energy technology and the costs associated with the technologies. Consumers with clear knowledge and understanding of renewable energy technology are likely to have positive intentions towards the adoption of green energy [35]. The study by [14] on the adoption of renewable energy in India indicated some challenges in the knowledge awareness on the benefits of renewable energy technologies that affect the consumers' perceptions of adopting their new technology. It is thus clear that the consumers' intentions to adopt new renewable technology are positively associated with their levels of awareness.

Similarly, consumers' awareness of climate change issues also positively influences the adoption of renewable energy technology. With the increased awareness of the effects of climate change, consumers are continuously exposed to positive messages concerning the need to embrace green energy attitudes to mitigate carbon emissions and consequently manage climate change. The increased awareness of the benefits of renewable energy technology to ensure a sustainable environment thus positively influences the consumers' attitude to adopt green energy [41]. However, the levels of awareness regarding renewable energy technologies are often limited by the levels of education of the consumers. In cases where the consumers have limited formal education, such as populations in some developing countries, it may negatively influence the consumers' willingness to adopt renewable energy technologies.

Hypothesis 4 (H4). *Awareness positively influences consumer adoption of renewable energy in Thailand.*

3.5. Renewable Energy Benefits Expectations

Consumer beliefs in the benefits of particular products have a significant effect on their intentions to purchase. Similarly, the consumers' beliefs in the benefits of renewable energy are linked to their willingness to adopt green energy. Beliefs on the benefits of renewable energy are also associated with the consumers' knowledge and understanding of the advantages of green energy over conventional fossil fuel energy. The study by [42] indicates that many consumers intending to adopt new renewable technologies make decisions based on the associated socioeconomic benefits of the technology. Thus, to ensure the positive consumer adoption of green energy technologies in Thailand, there is a need to expand consumer knowledge on the benefits of renewable energies.

Like the consumption decisions made on other products, consumers are unwilling to spend on products that they believe will add little benefits to their socio-economic statuses. Thus, the consumers are likely to match the performance of the renewable energy technologies with the traditional fossil fuel energies before making decisions concerning the adoption of green energy. Therefore, in this case, positive consumer beliefs in renewable energy technologies are likely to positively influence the adoption of green energy in Thailand.

Hypothesis 5 (H5). *Beliefs about renewable energy benefits positively influence consumer adoption of renewable energy in Thailand.*

3.6. Risk and Trust Perception of Renewable Energy

Risk perception refers to the ability of the concerned individual to discern the amount of risk involved or associated with a particular activity [43]. With reference to the renewable energy, this implies the evaluation of an individual regarding the risk perceptions associated with the renewable energy use. This brings in another concept, risk tolerance. The adoption of a particular technology is strategically dependent on the individual's perception of risk, as well as his/her risk tolerance levels. If an individual perceives that the risk associated with the use of renewable energy is quite low as compared to other sources of energy, then that individual will likely adopt renewable energy and vice-versa [44]. Trust is considered as the willingness of an individual to be vulnerable to the actions taken by another individual or party, with the expectation that the trusted individual will perform particular actions in favor of the trusting individual [45]. From the perspective of renewable energy, trust in renewable energy implies the expectation of an individual the using the renewable energy resources will result in acceptable to favorable outcomes in terms of its benefits [46]. Trust is considered a critical aspect in ascertaining the prevailing situations, which incorporates the associated risks as well as the susceptibility to the trusted party. Trust has been considered as a catalyst towards the adoption of new technology and carrying out transactions involving the provision of services with the expectation of a fruitful exchange relationship between the parties involved. From this literature, the following hypothesis was developed:

Hypothesis 6 (H6). *Risk/trust perception of renewable energy negatively influences consumer adoption of renewable energy in Thailand.*

Summary of Hypothesis

H1: Perception of self-effectiveness (SP) positively influences consumer adoption of renewable energy in Thailand

H2: Environmental concern (EC) positively influences consumer adoption of renewable energy in Thailand

H3: Cost of renewable energy (REC) generation negatively influences consumer adoption of renewable energy in Thailand

H4: Awareness (REA) positively influences consumer adoption of renewable energy in Thailand

H5: Beliefs about renewable energy benefits (BRE) positively influence consumer adoption of renewable energy in Thailand

H6: Risk/trust perception (RTP) of renewable energy negatively influences consume adoption of renewable energy in Thailand.

4. Research Methods

4.1. Research Instrument

Renewable energy in Thailand is an essential element in the development of high-efficiency energy to meet the increasing energy demands. The government works towards promoting the use of renewable energies by developing infrastructural and technological capabilities to support the use of clean energy. However, the improvement towards the use of renewable energies also involves the consumer's willingness to adopt renewable energies. Analysis of the consumer's willingness to adopt renewable energies indicates various determinants that influence renewable energy in Thailand. A structured and closed ended questionnaire was used to collect the data from respondents in five major cities in Thailand, namely Bangkok, Pattaya, Khon Kaen, Chiang Mai, and Phuket. The cities were purposively selected because they are seen as technological hubs in Thailand, among the largest consumers of residential electricity [47], and thus they should be inclined to adopt renewable energy sources. The data was collected between September 2020–March 2021. The convenient random sampling was used to select the respondents. A comprehensive explanation of the research questionnaire and purpose was necessary to ensure the respondents understood the research questions and for their answers to accurately mirror the data collected. A total of 536 responses were received, but after cleaning the data, a total of 388 responses were used for the study.

4.2. Measurement Scale and Data Collection

To develop the research constructs used in the study, various previous works were consulted. Regarding the measurement of the awareness of renewable energy, the work of [48] was adopted, while the work [49] was adopted as a reference to develop the scale for neighbors' participation and perception of self-effectiveness. The scale used in the measurement of the residents' beliefs in renewable energy and the consumer's intention to adopt renewable energy were obtained from [49]. All the item scales were measured using the 5-point Likert scale, which ranged from 1 "strongly disagree" to 5 "strongly agree".

4.3. Data Analysis

The first step in data analysis was evaluating the data collected. The data was evaluated by conducting descriptive statistics of the demographic characteristics of the respondents. The second step involved evaluating the reliability and validity of the data using techniques such as Cronbach's alpha, convergent reliability (CR) and average variance extracted (AVE). Among the statistical analyses conducted was confirmatory factor analysis (CFA) which evaluated the model fitness. Structural equation modeling (SEM) was applied to evaluate the hypothesis of the study, which depicted the relationship between the variables of the study. SEM was considered a suitable model for the study because it provides accurate and meaningful outcomes regarding the study constructs [50].

5. Results and Analysis

5.1. Respondents Descriptive Statistics

Table 1 shows the demographic characteristics of the respondents in the study. The results show that the age group with the highest representation in the sample was the middle aged (36–55 years) comprising 71%, followed by the youths (below 35 years) comprising 22%. Considering the gender, females comprised the highest gender represented by 65%, while male gender was represented by 35%. Regarding the education variable, most of the respondents (69%) indicated to have a diploma level of education, followed by the graduate level (20%). With regard to the employment variable, 80% of the respondents

indicated that they were self-employed, making the largest representation of the study sample, followed by those that were company employees comprising 8%. The last study variable was the monthly income of the respondents, which comprised of those earning 10,000 Baht and less per month comprising the highest proportion, approximately 54.6%. They were followed by those making 20,000–30,000 Baht per month, comprising 24% of the total respondents.

Table 1. Demographics of the Study Respondents.

	Age	Frequency	Percent
Age	18–35 years	87	22.4
	36–55 years	276	71.1
	56 and above	25	6.4
Gender	Male	137	35.3
	Female	251	64.7
Education	High school or lower	9	2.3
	Diploma	268	69.1
	Graduate	78	20.1
	Post Graduate	33	8.5
Occupation	self employed	312	80.4
	company employee	29	7.5
	government officer	24	6.2
	technical personnel	13	3.4
	other	10	2.6
Monthly Income	<=10,000 Baht	212	54.6
	10,000–20,000 Baht	91	23.5
	20,000–30,000 Baht	47	12.1
	30,000–40,000 Baht	7	1.8
	>=40,000 Baht	31	8
Residence	Urban	242	62.3
	Rural	146	37.7
Citizenship	Thai National	322	82.9
	Expatriate/Foreigner	66	17.1

Table 1 also reveals that 62.3% of the respondents are urban dwellers compared to 37.7% who say they reside in rural areas. The fact that the study was conducted in mainly urban areas may have contributed to this finding. In addition, the majority of the respondents are Thai citizens (82,9%) compared to those who consider themselves expatriates/foreigners (17.1%).

5.2. Measureing Model Fitness

Before conducting the actual statistical analysis to evaluate the study hypothesis, the proposed model was evaluated for its fitness. The evaluation techniques applied included the measurement of the reliability, measurement of the validity and confirmatory factor analysis. The reliability analysis was evaluated using two metrics, the Cronbach's alpha and convergent reliability (CR), while the validity of the model was evaluated using the average variance extracted (AVE). The results of the CFA revealed that the chi-square statistic for the model was significant (χ^2 [593] = 1315.745, $p < 0.01$), the check of CMIN/df = 2.128 was considered acceptable since it was below the threshold of 3.0 [51,52]. Additional

statistics included NFI = 0.901, IFI = 0.945, TLI = 0.938, CFI = 0.944, and RMSEA = 0.048. RMSEA was below the threshold of 0.80 and verified the suitability of the model [53], while the variables were above 0.9 thresholds as recommended by [54,55].

The factor loadings of the constructs of each variable are presented in the Table 2 below, which expressed the effects of the observed variables on the latent variables. Convergent reliability (CR) of all the constructs was also calculated. The CR ranged from 0.839–0.897. Following the [56] criteria that the convergent reliability (CR) of every construct should be equal to or higher than 0.70, the threshold was met. This satisfied satisfies the fact that all the items were able to accurately measure the factors. The reliability of each latent variable was also measured using Cronbach's alpha, which ranged between 0.837 and 0.985, which indicates a "very high" reliability level of the constructs. The validity of the study constructs was evaluated using average variance extracted (AVE), which ranged from 0.511 to 0.636. According to [57], the average variance extracted (AVE) should be equal to or higher than 0.50, a satisfied threshold.

Table 2. Reliability and validity analysis of the hypotheses.

	Constructs Items	Std. Loadings	CR	AVE	Cronbach's Alpha
	Renewable Energy Awareness (REA)		0.839	0.511	0.837
REA1	I have interacted with renewable energy resources in the past	0.714			
REA2	I am aware of renewable energy use and needs	0.736			
REA3	I know different types of renewable energy that can be used	0.671			
REA4	I know that renewable energy-based solutions are available in Thailand market	0.701			
REA5	I am aware of the benefits of renewable energy utilization	0.748			
	Self-effectiveness Perception (SP)		0.872	0.578	0.870
SP1	I possess the required knowledge to adopt renewable energy and its resources	0.745			
SP2	I possess full control of consuming renewable energy resources	0.787			
SP3	I know the experts to consults regarding renewable energy	0.77			
SP4	I possess all resources of consuming renewable energy	0.819			
SP5	I know where to find renewable energy products if I need them	0.673			
	Environmental concern (EC)		0.897	0.636	0.985
EC1	I am anxious about pollution in the environment	0.757			
EC2	Environmental pollution caused by energy is not good	0.809			
EC3	I am anxious about environmental problems caused by energy sources	0.833			
EC4	I am anxious about climate change and the associated hazardous effects	0.774			
EC5	Utilization of renewable energy can improve the environment	0.811			

Table 2. *Cont.*

Constructs Items		Std. Loadings	CR	AVE	Cronbach's Alpha
Renewable energy generation cost (REC)			0.854	0.595	0.852
REC1	The generation of renewable energy may cause additional cost	0.761			
REC2	Renewable electricity is expensive as renewable energy projects need a heavy initial investment	0.717			
REC3	Renewable energy consumption needs a high installation cost	0.847			
REC4	The Recurrent cost of renewable energy may be quite high	0.754			
Belief about Renewable Energy benefits (BRE)			0.886	0.608	0.885
BRE1	The utilization of renewable energy reduces carbon emissions and improve energy structure	0.766			
BRE2	Renewable energy would avail new environmental opportunities	0.767			
BRE3	The utilization of renewable energy would improve public surroundings	0.788			
BRE4	Energy supply would become improved with the utilization of RE	0.813			
BRE5	Employment opportunities will be increased with the installation of new RE projects	0.763			
Intention to adopt renewable energy (IARE)			0.890	0.618	0.889
IARE1	I have the intention to adopt renewable energy	0.78			
IARE2	The Energy-saving behavior encourage me to adopt renewable energy	0.786			
IARE3	I am willing to be renewable energy adoption ambassador	0.823			
IARE4	I have the intention to spend more on renewable energy than other sources of energy	0.805			
IARE5	I strongly recommend others to adopt renewable energy	0.734			
Risk Perception of Renewable Energy (RTP)			0.862	0.556	0.859
RTP1	I believe that renewable energy is a risk-free source of energy	0.724			
RTP2	I am aware of the risks associated with renewable energy	0.719			
RTP3	I don't think I am at risk when using renewable energy	0.772			
RTP4	I trust renewable energy because it can provide for my best interests in mind	0.823			
RTP5	I trust that using renewable energy would be a quick service	0.684			

5.3. Structural Equation Modelling

The structural equation modeling was calculated to evaluate the six hypotheses of the study, which represented the relationship between the study variables. The output of the SEM model is presented in the Figure 2.

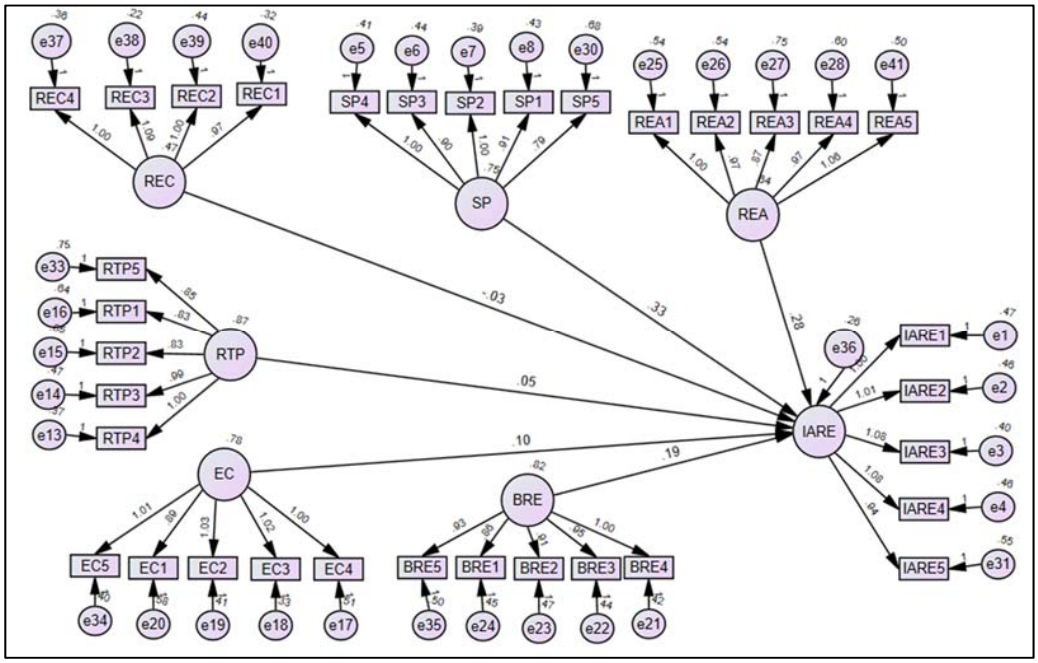

Figure 2. Evaluation of the SEM Model.

The SEM model was evaluated for its fitness and the results were obtained were as follows. The chi-square statistic for the model was significant (χ^2 [593] = 1315.745, $p < 0.01$). The χ^2/df ratio = 2.128 was below 3.0 and was influenced by the sample size [45,47]. The CFI was 0.944; TLI was 0.938; IFI was 0.945, and NFI was 0.901, which provided an excellent fit since the values were greater than 0.9 or close to 1.0. Additionally, the RMSEA was 0.048 (below the threshold of 0.80) [51]. These findings clarify that the model fitted well with the data and was suitable for evaluating the hypothesis of the study. The findings of the study are summarised in Table 3 below.

Table 3. Evaluation of Study Hypotheses.

Hypothesis	Relationship			β	Accept
H1	SP	→	IARE	0.327 ***	Yes
H2	EC	→	IARE	0.100 ***	Yes
H3	REC	→	IARE	−0.025	No
H4	REA	→	IARE	0.283 ***	Yes
H5	BRE	→	IARE	0.191 ***	Yes
H6	RTP	→	IARE	0.050	No

Note: *** = p <0.01. Source: research data.

From the results, four hypotheses were accepted as discussed below. The path coefficients of "Perception of self-effectiveness (SP)" H1 (β = 0.327, $p < 0.01$) indicated that the consumer's perception of self-effectiveness (SP) positively and significantly influences consumer adoption of renewable energy in Thailand. Therefore, H1 was accepted. The path coefficients for "Environmental concern (EC)" H2 (β = 0.100, $p < 0.01$). The results indicated that environmental concern positively and significantly influences consumer adoption of renewable energy in Thailand, which led to accepting H2. The study also accepted H4 on the path coefficients of "Renewable Energy Awareness" (β = 0.283, $p < 0.01$). Therefore, we accepted H4, that renewable energy awareness positively influences consumer adoption of renewable energy in Thailand. Additionally, the path coefficients of "Beliefs about Renewable Energy Benefits (BRE)" H5 (β = 0.191, $p < 0.01$) indicated that beliefs about renewable energy benefits positively influence consume adoption of renewable energy in Thailand.

However, two path coefficients were rejected because they were not significant, "Cost of Renewable Energy (REC)" H3 ($\beta = -0.025$, $p > 0.01$) and "Risk/Trust Perception (RTP)" H6 ($\beta = 0.050$, $p > 0.01$). Therefore, hypotheses 3 and 6 were rejected with the conclusion that the cost of renewable energy and risk/trust perception (RTP) do not significantly influence the adoption of renewable energy.

6. Discussions

6.1. Association between Perception of Self-Effectiveness and Consumer Adoption of RE

The results of this study indicated that there is a significant and positive association between perception of self-effectiveness and the consumers' intention to adopt renewable energy in Thailand. This implied that the aspects of self-effectiveness, such as 'possession of required knowledge', 'full control of renewable energy resources', 'knowing the renewable energy experts to consult', 'possession of the renewable energy resources', and 'knowing where to find renewable energy products' influenced the consumers' intention to adopt renewable energy in Thailand. This agrees with the position of some of the literature. These results were supported by [48,58], whose findings indicated that the self-effectiveness factors that influence the adoption of renewable energy include the aspects of environmental friendliness, energy saving, and energy security. A higher level of perceived effectiveness of the energy leads to its intended adoption.

6.2. Association between Environmental Concern and Consumer Adoption of RE

Environmental concern is considered as a significant influencer of the consumer behavior, in terms of the products and services they use. Environmental polluting activities are discouraged in society. This study found a significant association between the environmental concern and the intention of the customers to adopt renewable energy technologies. The findings of this study were supported by those of [59], who indicated that environmental concerns affect the choices the consumers make in purchasing green energy. Moreover, it is a major consideration as far as the adoption and consumption of renewable energy are concerned. Environmental concern contributes towards encouraging positive behavior in the consumption of energy. From this research, the aspects of environmental concern that influence adoption of renewable energy include anxiety about pollution and associated environmental problems, as well as the enhancement of the environment derived from using renewable energy. The literature [20,23,25] identified the importance of tackling environmental pollution by turning to renewable energy sources, which necessitated the PDP of Thailand increasing its renewable energy consumption to 30% by 2036. A synergy of all stakeholders will make this achievable as Thailand joins other nations in the gradual phasing out of the use of fossil fuel because of environmental concerns.

6.3. Association between Cost of Renewable Energy and Consumer Adoption of RE

This study found that though there was a negative effect of the cost of renewable energy on the consumer's intention towards adoption. The cost did not significantly influence adoption. The aspects of cost considered in this study included 'additional cost of generating renewable energy', 'heavy investment required in renewable energy projects', 'high cost of installations for renewable energy', and 'the general high cost of renewable energy'. The study of the cost of renewable energy was supported by the findings of [2], while [60] indicate that cost is the major challenge and hindrance as far as the adoption of renewable energy is concerned. Azhgaliyeva et al. [16] note that government support is an important component in reducing the cost of renewable energy in order to increase adoption and encourage private sector participation. Regulations and policies that lower costs should be encouraged to attract private and public sector investments, which in turn will lead to greater adoption of renewable energy.

6.4. Association between Awareness of Renewable Energy and Consumer Adoption of RE

In the adoption of any particular renewable energy, awareness is the first step that the concerned individual should have. This implies the knowledge that a consumer has regarding the renewable energy and the understanding of its various aspects, such as cost, efficiency, and other associated concerns [43]. The findings of this study indicated that renewable energy awareness positively influences consumer adoption of renewable energy in Thailand. These findings were supported by those of [61] who indicated that awareness plays a critical role in the decision process of consumers' adoption of renewable energy. Further, this result is in line with that of [48], who indicated that the adoption of renewable energy is positively associated with awareness.

6.5. Association between Beliefs about Renewable Energy and Consumer Adoption of RE

The findings of this study indicated that beliefs about renewable energy benefits positively influence consumer adoption of renewable energy in Thailand. The aspects of beliefs that were considered included expectations of the benefits from renewable energy, employment opportunities generated, improved energy supplies, and new environmental opportunities. The findings of this study were in line with those of [16,19,26], who indicated that consumer knowledge influences beliefs about renewable energy, and the consequent reactions. Therefore, it is noble to make efforts to expand the consumers' knowledge regarding the benefits associated with renewable energy, such as the improvement of the air quality, reducing harmful gas emissions, and the negative consequences associated with consumption of other energies. Awareness of renewable energy can be created through ads, publicity, and with increasing adoption, word of mouth. Awareness is critical to knowledge about renewable energy and adoption.

6.6. Association between Risk/Trust Perception of Renewable Energy and Consumer Adoption of RE

The risk and trust of a consumer regarding particular products have a significant influence on the behavior of the concerned individual, as far as adoption is concerned. This study found out that risk/trust perception does not significantly influence the adoption of renewable energy in Thailand. The perception of associated risk is critical in the process of renewable energy transformation, as well as the level of risk tolerance of the concerned individual [44]. Trust is also critical, as it determines prevailing conditions affecting the adoption of a particular renewable energy, e.g., [46] considered trust as a catalyst towards the adoption of renewable energy technology. According to [22], the most probable direction towards minimizing risk and fixing trust issues associated with the adoption of renewable energy sources is to introduce policies to resolve the reward and penalty value for a product or a service, e.g., with a feed-in-tariff (FiT) or carbon tax. However, the value of a feed-in-tariff or carbon tax is usually different according to location, which has been of great concern to the government, researchers, academics, and other relevant stakeholders. It is expected that the modeling of sustainable energy policy will be strategic towards advocacy for renewable energy to thrive and change the energy trajectory and narrative in Thailand.

7. Conclusions and Recommendations

The purpose of this research was to investigate the factors influencing the consumer adoption of renewable energy in Thailand. This involved an evaluation of various factors to determine those that have a positive and significant influence on the consumer adoption of renewable energy and those that have a negative and insignificant influence. The study adopted the Theory of Planned Behavior (TPB) and extended it by adding three variables. Therefore, the variables considered for the study were renewable energy awareness, self-effectiveness perception, environmental concern, renewable energy generation cost, belief about renewable energy benefits, and risk/trust perception of renewable energy. The study adopted a quantitative analysis whereby the data were collected from five main cities in Thailand. The CFA and SEM techniques were applied in analyzing the data.

The findings of the study indicated that perception of self-effectiveness, environmental concern, renewable energy awareness, and beliefs about renewable energy benefits have a significant and positive effect on consumers' intention to adopt renewable energy. The cost of renewable energy was found to have a negative but non-significant influence on consumer adoption of renewable energy, while risk/trust perception was found to have a positive but non-significant influence on consumer adoption of renewable energy.

7.1. Implications

This study provides important insights towards the adoption of renewable energy to various stakeholders, government agencies, and organizations which are concerned by the adoption and use of renewable energy technologies among consumers. Stakeholders should take into account the aspects of perception of self-effectiveness, environmental concern, renewable energy awareness, and beliefs about renewable energy benefits when running campaigns to promote consumers' adoption of renewable energy in Thailand. The study recognizes that there is a great trend globally towards the adoption of renewable energy, and Thailand should not consider being left behind. This study has developed implications for Thailand. First, from the fact that Thailand is a fast-growing economy with a rising demand for energy, the adoption of strategically evaluated renewable energy would help compensate for the rising energy demand. Secondly, as Thailand works towards achieving the set objective of obtaining 30% of its total energy consumption from renewable energy by 2036, the energy sources that should be enhanced include solar, hydropower, wind, as well as biomass.

7.2. Policy Recommendations

Based on the findings of this research, and with reference to the prevailing conditions in Thailand as far as renewable energy adoption and use are concerned, several policy recommendations were developed.

Energy sources are a major contributor to the environmental issues experienced today, including climate change and pollution issues. The government and concerned stakeholders should consider increasing public awareness of the hazards emanating from consumption of other unsuitable energy sources. This would cultivate a positive attitude towards the adoption of renewable energy [39] and a willingness to promote the use of renewable energy resources. This is based on the fact that the adoption of new technology by consumers is highly influenced by the socioeconomic benefits emanating from it. Hence, knowledge of environmental benefits would be paramount.

Raising public awareness should be two-fold, highlighting the importance and benefits that the consumers would obtain from the use of renewable energy, such as conservation of energy and environmentally friendly energy sources, and the need for reducing hazards of using non-renewable sources of energy, e.g., carbon emissions. All the involved stakeholders, including the government authorities, non-governmental organizations, entrepreneurs, and leaders at every level should participate in educating the public regarding the benefits of adopting renewable energy, addressing their community and the nation as a whole.

7.3. Limitations of the Study

A few limitations of the study could be highlighted. First, this study was carried out in Thailand, with considerations of Thailand's cultural and traditional aspects. These are different from other countries, and therefore the applications of the findings to other regions should be approached with caution. Another limitation is that the sample size was relatively small, considering that it was collected from five major cities in Thailand. As a result, the generalizability of the outcomes may be affected. The third limitation is that the study relied on the TPB which only has three variables. Three variables were added to the theory to develop the study model. Future studies should consider using a combination of several theories so as to explore several factors around the study problem. Moreover, this study was conducted in mainly urban cities, thereby affecting the number of respondents

residing in rural areas as seen in the demographic results. The smaller number of rural dwellers identified may have been people in the city for a short business or personal visit. Future studies should be performed to understand the dynamics involving rural renewable energy users and factors that may affect their adoption of renewable energy.

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References

1. Sirasoontorn, P.; Koomsup, P. *Energy Transition in Thailand: Challenges and Opportunities*; Friedrich Ebert Stiftung: Bangkok, Thailand, 2017.
2. Irfan, M.; Zhao, Z.-Y.; Li, H.; Rehman, A. The influence of consumers' intention factors on willingness to pay for renewable energy: A structural equation modeling approach. *Environ. Sci. Pollut. Res.* **2020**, *27*, 21747–21761. [CrossRef]
3. Smirnova, E.; Kot, S.; Kolpak, E.; Shestak, V. Governmental support and renewable energy production: A cross-country review. *Energy* **2021**, *230*, 120903. [CrossRef]
4. Nate, S.; Bilan, Y.; Cherevatskyi, D.; Kharlamova, G.; Lyakh, O.; Wosiak, A. The Impact of Energy Consumption on the Three Pillars of Sustainable Development. *Energies* **2021**, *14*, 1372. [CrossRef]
5. Trifonov, I.; Trukhan, D.; Koshlich, Y.; Prasolov, V.; Ślusarczyk, B. Influence of the Share of Renewable Energy Sources on the Level of Energy Security in EECCA Countries. *Energies* **2021**, *14*, 903. [CrossRef]
6. Nate, S.; Bilan, Y.; Kurylo, M.; Lyashenko, O.; Napieralski, P.; Kharlamova, G. Mineral Policy within the Framework of Limited Critical Resources and a Green Energy Transition. *Energies* **2021**, *14*, 2688. [CrossRef]
7. Kiprop, E.; Matsui, K.; Maundu, N. The Role of Household Consumers in Adopting Renewable Energy Technologies in Kenya. *Environments* **2019**, *6*, 95. [CrossRef]
8. Chaiyasoonthorn, W.; Khalid, B.; Chaveesuk, S. Success of Smart Cities Development with Community's Acceptance of New Technologies. In Proceedings of the 9th International Conference on Information Communication and Management, Prague, Czech Republic, 23–26 August 2019; pp. 106–111. [CrossRef]
9. Chaveesuk, S.; Khalid, B.; Chaiyasoonthorn, W. Emergence of New Business Environment with Big Data and Artificial Intelligence. In Proceedings of the 9th International Conference on Information Communication and Management, Prague, Czech Republic, 23–26 August 2019; pp. 181–185. [CrossRef]
10. Haseeb, M.; Kot, S.; Hussain, H.I.; Kamarudin, F. The natural resources curse-economic growth hypotheses: Quantile–on–Quantile evidence from top Asian economies. *J. Clean. Prod.* **2021**, *279*, 123596. [CrossRef]
11. Hussain, H.; Haseeb, M.; Kamarudin, F.; Dacko-Pikiewicz, Z.; Szczepańska-Woszczyna, K. The Role of Globalization, Economic Growth and Natural Resources on the Ecological Footprint in Thailand: Evidence from Nonlinear Causal Estimations. *Processes* **2021**, *9*, 1103. [CrossRef]
12. Thailand—Renewable Energy. Available online: https://www.trade.gov/energy-resource-guide-thailand-renewable-energy#:~{}:text=According%20to%20the%20Department%20of,16.5%25%20of%20total%20energy%20consumption (accessed on 2 August 2021).
13. Muangmee, C.; Dacko-Pikiewicz, Z.; Meekaewkunchorn, N.; Kassakorn, N.; Khalid, B. Green Entrepreneurial Orientation and Green Innovation in Small and Medium-Sized Enterprises (SMEs). *Soc. Sci.* **2021**, *10*, 136. [CrossRef]
14. Majid, M.A. Renewable energy for sustainable development in India: Current status, future prospects, challenges, employment, and investment opportunities. *Energy Sustain. Soc.* **2020**, *10*, 1–36. [CrossRef]
15. Sestino, A. *Review About Consumers' Perception on Renewable Energy Market*; SSRN: Amsterdam, The Netherlands, 2018.
16. Azhgaliyeva, D.; Beirne, J.; Mishra, R. *What Matters for Private Investment Financing in Renewable Energy Globally and in Asia? ADBI Working Paper 1246*; Asian Development Bank Institute: Tokyo, Japan, 2021; Available online: https://www.adb.org/publications/what-mattersprivate-investment-financing-renewable-energy-globally-asia (accessed on 2 August 2021).
17. Ndebele, T. Assessing the potential for consumer-driven renewable energy development in deregulated electricity markets dominated by renewables. *Energy Policy* **2020**, *136*, 111057. [CrossRef]
18. Quirapas, M.; Taeihagh, A. Ocean renewable energy development in Southeast Asia: Opportunities, risks and unintended consequences. *Renew. Sustain. Energy Rev.* **2021**, *137*, 110403. [CrossRef]

19. Senpong, C.; Wiwattanadate, D. Challenge of Renewable Energy Transition towards Krabi's Sustainable Energy City. In *IOP Conference Series: Earth and Environmental Science*; IOP Publishing: Bangkok, Thailand, 2019; Volume 385, p. 012060.
20. Nakapreecha, N.; Pongthanaisawan, J.; Wangjiraniran, W. Plausible Scenarios for Thai Energy Businesses in the Next 30 Years. *Front. Energy Res.* **2021**, *8*, 372. [CrossRef]
21. Hu, M. The Transfer of Renewable Energy Policy Instrument from Europe to Southeast Asia: A Case Study of Thailand's Feed-in Tariff Policy. Master's Thesis, KTH Royal Institute of Technology, School of Architecture and Built Environment, Department of Sustainable Development, Environmental Science and Engineering, Stockholm, Sweden, 2021. Available online: https://www.diva-portal.org/smash/get/diva2:1424777/FULLTEXT01.pdf (accessed on 2 August 2021).
22. Lu, Y.; Khan, Z.A.; Alvarez-Alvarado, M.S.; Zhang, Y.; Huang, Z.; Imran, M. A Critical Review of Sustainable Energy Policies for the Promotion of Renewable Energy Sources. *Sustainability* **2020**, *12*, 5078. [CrossRef]
23. Siala, K.; Chowdhury, A.K.; Dang, T.D.; Galelli, S. Solar energy and regional coordination as a feasible alternative to large hydropower in Southeast Asia. *Nat. Commun.* **2021**, *12*, 4159. [CrossRef] [PubMed]
24. Sriprapakhan, P.; Artkla, R.; Nuanual, S.; Maneechot, P. Economic and ecological assessment of integrated agricultural bio-energy and conventional agricultural energy frameworks for agriculture sustainability. *J. Saudi Soc. Agric. Sci.* **2021**, *20*, 227–234. [CrossRef]
25. Sugsaisakon, S.; Kittipongvises, S. Citywide Energy-Related CO_2 Emissions and Sustainability Assessment of the Development of Low-Carbon Policy in Chiang Mai, Thailand. *Sustainability* **2021**, *13*, 6789. [CrossRef]
26. Junlakarn, S.; Kittner, N.; Tongsopit, S.; Saelim, S. A cross-country comparison of compensation mechanisms for distributed photovoltaics in the Philippines, Thailand, and Vietnam. *Renew. Sustain. Energy Rev.* **2021**, *145*, 110820. [CrossRef]
27. Kot, M.; Kamiński, B. Agent Based Model of Cross Media Reach of Advertising. In *First Complex Systems Digital Campus World E-Conference 2015*; Springer Science and Business Media LLC: Mainz, Germany, 2021; pp. 45–57.
28. Khalid, B.; Chaveesuk, S.; Chaiyasoonthorn, W. MOOCs Adoption in Higher education: A management perspective. *Pol. J. Manag. Stud.* **2021**, *23*, 239–256. [CrossRef]
29. Muangmee, C.; Kot, S.; Meekaewkunchorn, N.; Kassakorn, N.; Khalid, B. Factors Determining the Behavioral Intention of Using Food Delivery Apps during COVID-19 Pandemics. *J. Theor. Appl. Electron. Commer. Res.* **2021**, *16*, 1297–1310. [CrossRef]
30. Wall, W.P. Determinants of SMES' performance—from business strategy to innovation. *Pol. J. Manag. Stud.* **2021**, *23*, 537–554. [CrossRef]
31. Ślusarczyk, B.; Tvaronavičienė, M.; Haque, A.U.; Oláh, J. Predictors of industry 4.0 technologies affecting logistic enterprises' performance: International perspective from economic lens. *Technol. Econ. Dev. Econ.* **2020**, *26*, 1263–1283. [CrossRef]
32. Khalid, B.; Lis, M.; Chaiyasoonthorn, W.; Chaveesuk, S. Factors influencing behavioural intention to use MOOCs. *Eng. Manag. Prod. Serv.* **2021**, *13*, 83–95. [CrossRef]
33. Meekaewkunchorn, N.; SzczepańskaWoszczyna, K.; Muangmee, C.; Kassakorn, N.; Khalid, B. Entrepreneurial orientation and SME performance: The mediating role of learning orientation. *Econ. Sociol.* **2021**, *14*, 294–312. [CrossRef]
34. Wall, W.P. The comparison of the TQM practices and quality performance between manufacturing and service sectors. *Pol. J. Manag. Stud.* **2021**, *23*, 436–452. [CrossRef]
35. Irfan, M.; Zhao, Z.-Y.; Rehman, A.; Ozturk, I.; Li, H. Consumers' intention-based influence factors of renewable energy adoption in Pakistan: A structural equation modeling approach. *Environ. Sci. Pollut. Res.* **2021**, *28*, 432–445. [CrossRef] [PubMed]
36. Zainudin, N.; Lau, J.L.; Munusami, C. Modelling household behavioural changes as an opportunity for sustainable home energy. *Environ. Econ. Policy Stud.* **2021**, *23*, 1–25. [CrossRef]
37. Makki, A.A.; Mosly, I. Factors Affecting Public Willingness to Adopt Renewable Energy Technologies: An Exploratory Analysis. *Sustainability* **2020**, *12*, 845. [CrossRef]
38. Thiangtam, S. An analysis of factors influencing consumers' intention to install solar power system with reference to evidence from Thailand. *Int. J. Technol. Manag. Sustain. Dev.* **2016**, *15*, 239–252. [CrossRef]
39. Jabeen, G.; Yan, Q.; Ahmad, M.; Fatima, N.; Qamar, S. Consumers' intention-based influence factors of renewable power generation technology utilization: A structural equation modeling approach. *J. Clean. Prod.* **2019**, *237*, 117737. [CrossRef]
40. Joshi, Y.; Rahman, Z. Factors Affecting Green Purchase Behaviour and Future Research Directions. *Int. Strat. Manag. Rev.* **2015**, *3*, 128–143. [CrossRef]
41. Cruz, S.M.; Manata, B. Measurement of Environmental Concern: A Review and Analysis. *Front. Psychol.* **2020**, *11*, 363. [CrossRef] [PubMed]
42. Ntanos, S.; Kyriakopoulos, G.; Chalikias, M.; Arabatzis, G.; Skordoulis, M. Public Perceptions and Willingness to Pay for Renewable Energy: A Case Study from Greece. *Sustainability* **2018**, *10*, 687. [CrossRef]
43. Komendantova, N.; Patt, A.; Barras, L.; Battaglini, A. Perception of risks in renewable energy projects: The case of concentrated solar power in North Africa. *Energy Policy* **2012**, *40*, 103–109. [CrossRef]
44. Dóci, G.; Gotchev, B. When energy policy meets community: Rethinking risk perceptions of renewable energy in Germany and the Netherlands. *Energy Res. Soc. Sci.* **2016**, *22*, 26–35. [CrossRef]
45. Dhagarra, D.; Goswami, M.; Kumar, G. Impact of Trust and Privacy Concerns on Technology Acceptance in Healthcare: An Indian Perspective. *Int. J. Med. Inform.* **2020**, *141*, 104164. [CrossRef] [PubMed]
46. Wu, K.; Zhao, Y.; Zhu, Q.; Tan, X.; Zheng, H. A meta-analysis of the impact of trust on technology acceptance model: Investigation of moderating influence of subject and context type. *Int. J. Inf. Manag.* **2011**, *31*, 572–581. [CrossRef]

47. Chapter 9. Social Imbalances and Spatial Organization. In *Atlas of Thailand*; Open Edition; 2004; pp. 175–187. Available online: https://books.openedition.org/irdeditions/32597?lang=en (accessed on 30 August 2021).
48. Alam, S.S.; Hashim, N.H.N.; Rashid, M.; Omar, N.A.; Ahsan, N.; Ismail, D. Small-scale households renewable energy usage intention: Theoretical development and empirical settings. *Renew. Energy* **2014**, *68*, 255–263. [CrossRef]
49. Liu, W.; Wang, C.; Mol, A. Rural public acceptance of renewable energy deployment: The case of Shandong in China. *Appl. Energy* **2013**, *102*, 1187–1196. [CrossRef]
50. Steenkamp, J.-B.E.; Baumgartner, H. On the use of structural equation models for marketing modeling. *Int. J. Res. Mark.* **2000**, *17*, 195–202. [CrossRef]
51. Wall, W.P. Strategic management and evaluation of the performance of family firms using management control system. *Transnatl. Corp. Rev.* **2021**, 1–16. [CrossRef]
52. Schumacker, R.E.; Lomax, R.G. *A Beginner's Guide to Structural Equation Modeling*, 3rd ed.; Routledge: New York, NY, USA, 2010.
53. Hu, L.T.; Bentler, P.M. Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. *Struct. Equ. Model. Multidiscip. J.* **1999**, *6*, 1–55. [CrossRef]
54. Kline, R.B. *Principles and Practice of Structural Equation Modeling*, 3rd ed.; The Guildford Press: New York, NY, USA, 2011; ISBN 9781606238776.
55. Thompson, B. *Exploratory and Confirmatory Factor Analysis: Understanding Concepts and Applications*; American Psychological Association (APA): Washington, DC, USA, 2004.
56. Fornell, C.; Larcker, D.F. Evaluating structural equation models with unobservable variables and measurement error. *J. Mark. Res.* **1981**, *18*, 39–50. [CrossRef]
57. Segars, A. Assessing the unidimensionality of measurement: A paradigm and illustration within the context of information systems research. *Omega* **1997**, *25*, 107–121. [CrossRef]
58. 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]
59. Dienes, C. Actions and intentions to pay for climate change mitigation: Environmental concern and the role of economic factors. *Ecol. Econ.* **2015**, *109*, 122–129. [CrossRef]
60. Ghosh, A.; Ghosh, D. *Investments in Clean Energy in South Asia: Visiting Barriers and Gaps from the Perspective of Policies and Politics in Sustainable Energy and Transportation 2018*; Springer: Singapore, 2018; pp. 115–135.
61. Zografakis, N.; Sifaki, E.; Pagalou, M.; Nikitaki, G.; Psarakis, V.; Tsagarakis, K. Assessment of public acceptance and willingness to pay for renewable energy sources in Crete. *Renew. Sustain. Energy Rev.* **2010**, *14*, 1088–1095. [CrossRef]