An Examination of The Factors Enhancing Sustainable Renewable Energy Consumption in Thailand During 2000-2020

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Abstract

This paper examines the key factors influencing sustainable renewable energy consumption in Thailand from 2000 to 2020. This study is a mixed-methods design. The study employed multiple linear regression analysis (MLRA) in the quantitative phase to assess the impacts of the factors, while the qualitative phase included interviews with 23 interviewees from different organizations involved in Thailand's renewable energy development. For the quantitative results, this study explored the relationships between twelve independent variables and sustainable renewable energy consumption (SREC) in Thailand from 2000 to 2020, using Pearson's correlation analysis. The findings revealed complex and sometimes counter-intuitive relationships. Several variables exhibited strong and statistically significant negative correlations with SREC, including technology evolution (X1 = TE, $r = -0.791$, $p < 0.01$) and policy and regulatory changes for the commercial sector (X10 = PRCCS, $r = -0.856$, $p < 0.01$), industrial sector (X11 = PRCIS, $r = -0.766$, $p < 0.01$), and transportation sector (X12 = PRCTS, $r = -0.749$, $p < 0.01$), as well as the residential sector (X9 = PRCRS, $r = -0.643$, $p < 0.01$). These negative associations suggest that although such factors are often assumed to facilitate renewable energy adoption, they may in fact reflect cost-driven implementation strategies, technological transitions, or regulatory uncertainty that inhibit consumption. A moderate negative correlation was also found with government effectiveness (X6 = GE, $r = 0.497$, $p < 0.05$), indicating that institutional efficiency does not automatically translate into enhanced energy sustainability outcomes. In contrast, the democracy index (X8 = DI, $r = 0.527$, $p < 0.01$) demonstrated a significant positive correlation with SREC, emphasizing the role of participatory governance and political openness in promoting renewable energy use. Importantly, no statistically significant correlations were found between SREC and power generation costs (X2 = PGC,

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r = -0.192, p = 0.203), global crude oil price (X3 = GCOP, r = 0.208, p = 0.183), number of investment projects (X4 = NIP, r = -0.192, p = 0.203), political stability (X5 = PS, r = -0.323, p = 0.077), and regulatory quality (X7 = RQ, r = 0.053, p = 0.409), indicating limited or negligible direct effects. While the qualitative results indicate that interviewees agreed both entirely and partially, those factors are the most crucial in increasing sustainable renewable energy consumption in Thailand during that period. The study reveals a complicated network of factors that affect renewable energy consumption, which is essential for creating effective policies. It proposes five theoretical contributions to public administration and public policy, emphasizing the need for a multi-faceted approach to fully comprehend the transition to renewable energy development and policy.

Keywords: Sustainable Development, Sustainable Renewable Energy Consumption

Introduction

Governments worldwide are increasingly focusing on strategies to secure a sustainable future for their citizens by implementing measures such as restrictions on fossil fuel investments (The United Nations, 2019). Energy is a crucial driver of economic growth, facilitating both industrial and consumer activities, and is essential for modern economies. However, the energy sector significantly contributes to climate change, accounting for over two-thirds of global greenhouse gas emissions (Walton, 2020). Consequently, energy represents both a major opportunity and a significant challenge in addressing environmental concerns.

In 2015, the United Nations established the 2030 Agenda for Sustainable Development, which includes 17 Sustainable Development Goals (SDGs), notably SDG 7, which promotes access to affordable, reliable, and sustainable energy for all by 2030 to advance renewable energy and enhance energy efficiency. Additionally, the Paris Agreement seeks to combat climate change by limiting global temperature rise to between 1.5 and 2 degrees Celsius, requiring countries to set nationally determined contributions (NDCs) aimed at reducing greenhouse gas emissions. At the 26th Conference of the Parties (COP26) in 2021, the Glasgow Climate Pact was adopted, with over 120 countries announcing new emissions reduction targets for 2030 and committing to achieve net zero emissions by 2050 or shortly thereafter (The United Nations, 2022).

ASEAN aims to increase its reliance on renewable energy to reach 23% of total primary energy supply (TPES) by 2025, up from 14% in 2020. This aligns with Sustainable Development Goal 7, but progress has been slow. Projections suggest limited growth in renewables by 2040, indicating that ASEAN may not meet its targets. Significant work is needed at both national and regional levels in the energy sector to achieve these goals within the next 5-6 years. (ASEAN Centre for Energy, 2020).

In Thailand, it is clearly observed that the proportion of renewable energy consumption exhibited a steady increase from 2000 to 2020. Nevertheless, the period between 2011 and 2020 was characterized by fluctuations in consumption growth. Specifically, a 5 percent decline was recorded between 2010 and 2020 as show in Figure 1. This observation has prompted scholars to re-examine the developments over the past decade—particularly from 2010 to 2020—with the aim of identifying the key determinants that contributed to both the increase and decrease in renewable energy consumption throughout the period from 2000 to 2020 (Energy Policy and Planning Office, 2024).

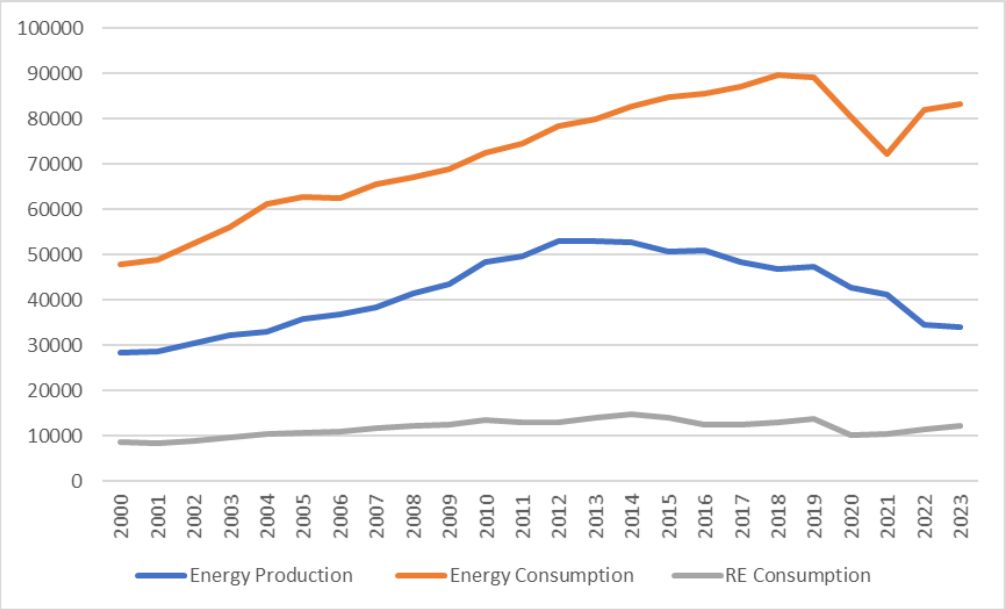

Figure 1. Energy Production and Consumption in Thailand 2000-2023

Source: Energy Policy and Planning Office (EPPO), Thailand, 2024

Thailand is actively promoting renewable energy through comprehensive policies, starting with the Thailand Integrated Energy Blueprint (TIEB) launched in 2014. This blueprint (2015-2036) focuses on energy security, economic viability, and ecological sustainability, encompassing five key master plans, including the Alternative Energy Development Plan (AEDP2015), which aims to maximize domestic renewable energy resources while considering social and environmental impacts (Department of Alternative Energy Development and Energy Efficiency, 2015). Currently, Thailand is implementing the National Energy Plan (NEP), a new holistic plan to achieve carbon neutrality by 2050 and net-zero emissions by 2065. The latest draft of the Power Development Plan (PDP2024) is crucial to this, targeting a significant increase in renewable energy's share in electricity generation to 51 percent by 2037, up from 20 percent in 2023 (Chanwong, 2025). Furthermore, the AEDP 2018-2037 aims for 30 percent of final energy consumption from renewable energy by 2037, including electricity, heat, and transportation. Within the electricity sector, the AEDP 2018 targets approximately 30,000 MW of renewable energy capacity by 2037, contributing to roughly 34 percent of net national electrical energy demand (Grantham Research Institute, 2020; The US International Trade Administration, 2021).

Therefore, the study investigates the consumption of renewable energy in Thailand from 2000 to 2020, concentrating on the factors that impact its adoption. Although Thailand is a frontrunner in renewable resources within ASEAN, its development targets have varied. Previous studies have examined economic factors and carbon emissions, yet there exists a gap in research concerning developing

countries like Thailand (Hussain et. al., 2021; Wall, Khalid, Urbaski, & Kot, 2021). The study aims to identify critical determinants, including energy economic and technology factors (e.g., technological advancements, renewable power generation costs, crude oil prices, and renewable energy investment projects) and public administration factors (e.g., political stability, government effectiveness, regulatory quality, democracy index, and policy alterations across residential, commercial, industrial, and transportation sectors). It also underscores renewable energy's importance for national progress and global sustainability, highlighting stakeholder roles in shaping energy policy. Promoting renewable energy is crucial for energy security, economic growth, and climate change mitigation. The study offers insights to inform future development strategies in Thailand's renewable energy sector. The objectives of the study are to investigate the key factors for enhancing sustainable renewable energy consumption in Thailand from 2000 to 2020. Additionally, to analyze the connection between the key factors and sustainable renewable energy consumption in Thailand from 2000 to 2020. Furthermore, to suggest guideline frameworks for the long-term enhancement of renewable energy development in Thailand.

Literature Review

This section reviews current literature to pinpoint the crucial factors that promote the adoption of sustainable renewable energy, specifically in Thailand during the years 2000 to 2020. The objective is to find the key factors that can create a conceptual framework that assists in analyzing these factors and improving the sustainable utilization of renewable energy.

The factor of renewable energy technology evolution plays an important role in boosting renewable energy consumption. Research by Xin (2022) and Ahuja and Tatsutani (Ahuja & Tatsutani, 2009) affirms that technological advancements not only offer immediate benefits but are also critical for promoting the use of renewable resources. Assi, Zhakanoval, and Tursoy (2021) discovered that offering financial assistance for technological advancement further promotes renewable energy utilization and aids in alleviating environmental problems. The factor of renewable power generation costs pertains to the declining costs, especially in solar energy technologies such as solar modules, which are key motivators for renewable energy adoption. Taghizadeh-Hesary, Yoshino, and Inagaki (2018) indicated that reduced generation costs lead to higher usage. Wall et al. (2021) and Knez, Simic, Milovanovic, Starikova, and Zupanic (2022) confirmed that the global reduction in solar photovoltaic (PV) prices has had a considerable effect. The Factor of Global Crude Oil Prices explained by Mukhtarov, Mikayilov, Maharramov, Aliyev, and Suleymanov (2020) and others found that the connection between global crude oil prices and renewable energy consumption is intricate. Research highlights that increasing oil prices can stimulate renewable energy use, as supported by various studies. These studies cumulatively suggest that variations in oil prices affect renewable energy developments in different countries. While the factor of the number of renewable energy investment projects pertains to the

amount of investment in renewable energy projects, which is essential for the sector's growth. Several researchers, including Maqbool and Sudong (2018) and Zhang, Liu, and Baloch (2022) confirm that both private and public investments are crucial for the progress of renewable energy initiatives.

The factors related to public administration include the factor of political stability, which is another significant factor that can promote renewable energy adoption. Mahmood, Tanveer, and Furqan (2021) noted that stable political conditions encourage economic growth through increased use of renewable energy, particularly in Asian countries. And the factor of government effectiveness highlights the actions that significantly influence renewable energy consumption. Research by Mahmood et al. (2021), Akhtaruzzaman (2022), and Hussain et al. (2021) suggests that strong government policies can foster investment and growth in the renewable energy sector. Regarding the Factor of Regulatory Quality, scholars like Mahmood et al., (2021) and others have found that high regulatory quality encourages the development of renewable energy by enabling effective governance. Researchers have identified that robust regulations positively affect renewable energy consumption. And for the Factor of Democracy Index, the investigation by Sakolsatayatorn (2018) and Chou and Zhang (2020) emphasized that the degree of democracy influences renewable energy development. Studies suggest that democratic governance can facilitate the execution of renewable energy policies, while military governments may hinder stakeholder participation and impede advancement. In addition to the aforementioned factors, sector-specific policy and regulatory changes—particularly in the residential, commercial, industrial, and transportation sectors—play a significant role in influencing renewable energy consumption. Scholars such as Inderberg, Tews, and Turner (2018) and Fais, Sabio, and Strachan (2016) underscore that comprehensive and supportive policy frameworks substantially contribute to increased adoption of renewable energy technologies across these domains.

Therefore, it can be concluded that the adoption of sustainable renewable energy is influenced by three key dimensions: renewable energy technology evolution, public administration, and policies and regulatory changes across sectors. The evolution of renewable energy technology reflects advancements and economic viability, where lower renewable power generation costs enhance competitiveness over fossil fuels, encouraging broader adoption; fluctuations in global crude oil prices affect the relative attractiveness of renewables, with higher oil prices often prompting investment in alternative sources; and the number of renewable energy investment projects indicates market confidence and sectoral momentum, directly impacting infrastructure development. In terms of public administration, factors such as political stability contribute to a predictable environment that supports long-term planning and investment, while government effectiveness ensures policy design and enforcement that encourage innovation and private sector engagement. Regulatory quality underpins transparent and efficient governance, essential for attracting investment, and a higher democracy index is associated with public participation and policy responsiveness, which facilitate renewable energy policy implementation. Lastly, sector-specific policy and regulatory changes—particularly in the

residential, commercial, industrial, and transportation sectors—play a pivotal role in shaping renewable energy demand and supply, with targeted measures like rooftop solar subsidies, industrial tax incentives, and vehicle emission standards significantly accelerating the deployment and integration of renewable technologies across diverse energy-consuming sectors. Understanding these factors can help in formulating effective strategies to promote renewable energy and achieve sustainability goals. Then, the research conceptual framework can be created as shown in the next page in Figure 2.

Research Conceptual Framework

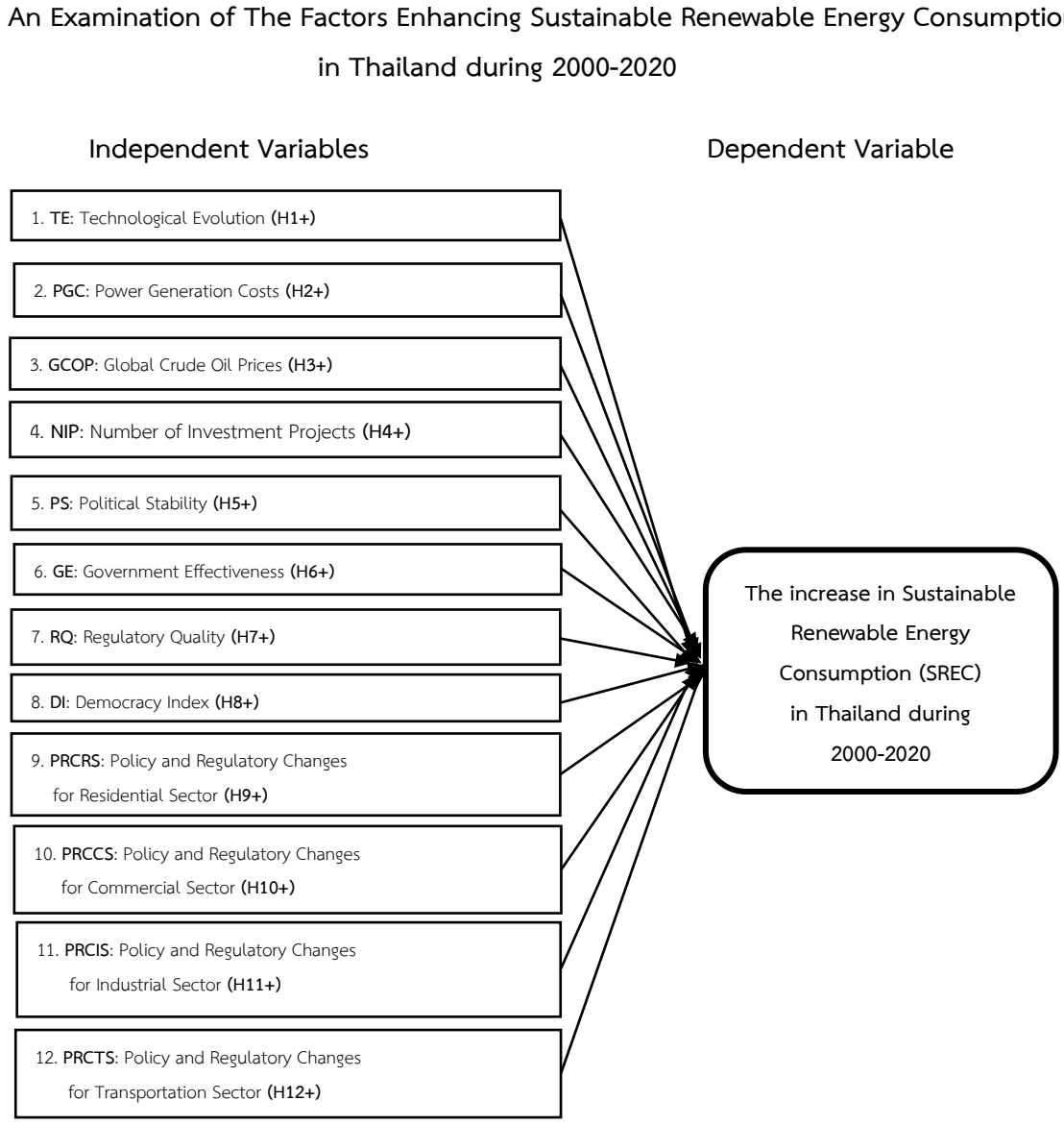

Figure 2. Diagram for Research Conceptual Framework

Methodology

This study employed a mixed-methods approach to analyzes the factors influencing the sustainable renewable energy consumption in Thailand from 2000 to 2020. This study is divided into two phases.

In the initial phase of the quantitative research, Multiple Linear Regression Analysis (MLRA) was employed to investigate the statistical relationships and significance between independent and dependent variables. The study utilized time-series data spanning from 2000 to 2020, compiled from credible national and international sources. Domestic data were gathered from governmental bodies such as the Ministry of Energy of Thailand, the Energy Policy and Planning Office (EPPO), the Department of Alternative Energy Development and Efficiency (DEDE), and the Energy Regulatory Commission (ERC). Complementary data were obtained from internationally recognized institutions, including the International Energy Agency (IEA), the International Renewable Energy Agency (IRENA), the Worldwide Governance Indicators (WGI), the World Bank, and The Economist Intelligence Unit (EIU). All data were processed and analyzed using the SPSS software package, with MLRA conducted through the Entry Method, wherein all independent variables were entered simultaneously into the regression model. This approach enabled a comprehensive assessment of each variable's contribution to variations in sustainable renewable energy consumption.

Model

$$ySREC=\beta_0+\beta_1\,(TE)+\beta_2\,(PGC)+\beta_3\,(GCOP)+\beta_4\,(NIP)+\beta_5\,(PS)+\beta_6\,(GE)+$$
$$\beta_7\,(RQ)+\beta_8\,(DI)+\beta_9\,(PRCRS)+\beta_{10}\,(PRCCS)+\beta_{11}\,(PRCIS)+\beta_{12}\,(PRCTS)+\varepsilon i$$

where y = SREC represents the sustainable renewable energy consumption. TE represents technological evolution through advancements in renewable energy; PGC captures the power generation costs associated with renewable sources; GCOP refers to global crude oil prices; and NIP indicates the number of investment projects, reflecting the scale of sectoral engagement. In terms of governance indicators, PS denotes political stability, GE represents government effectiveness, RQ stands for regulatory quality, and DI corresponds to the democracy index. Furthermore, policy and regulatory variables are disaggregated across four sectors: PRCRS represents policy and regulatory changes in the residential sector; PRCCS captures changes in the commercial sector; PRCIS relates to the industrial sector; and PRCTS pertains to the transportation sector in the context of renewable energy. The analysis, conducted using SPSS, includes a Pearson correlation matrix to evaluate the relationships between the independent variables and their contribution to the dependent variable.

In the second phase of qualitative analysis, 23 executives and experts were interviewed regarding renewable energy development in Thailand. The study utilized semi-structured interviews for adaptability and more in-depth conversations, carried out both face-to-face and through Zoom or Microsoft Teams program. The information gathered encompassed perspectives from different stakeholders. The researcher subsequently employed thematic analysis to pinpoint key themes and trends in the participants' thoughts and emotions.

Results and Discussion

The content examines the outcomes of both quantitative and qualitative analyses performed. The analysis included assessing the connections among variables by computing correlation coefficients and applying multiple linear regression with 12 independent variables to comprehend their effect on the dependent variable. The results are shown in Table 1and Table 2. The qualitative findings from interviews with a diverse set of interviewees from various governments will be integrated with the quantitative results from 23 interviewees to collectively discuss in order to reach the conclusion of the study together.

Table 1. Pearson Correlation Matrix of the Variables Used to Test the Factors Enhancing Sustainable Renewable Energy Consumption in Thailand During 2000-2020

Variable	Statistics	Y=SREC	X1=TE	X2=PGC	X3=GCOP	X4=NIP	X5=PS	X6=GE	X7=RQ	X8=DI	X9=PRCPS	X10=PRCCS	X11=PRCIS	X12=PRCTS
Y=SREC	Pearson Correlation	1.000												
	Sig. (1-tailed)													
X1=TE	Pearson Correlation	-.791**	1.000											
	Sig. (1-tailed)	.000												
X2=PGC	Pearson Correlation	-.192	.499*	1.000										
	Sig. (1-tailed)	.203	.011											
X3=GCOP	Pearson Correlation	.208	.277	.438*	1.000									
	Sig. (1-tailed)	.183	.112	.024										
X4=NIP	Pearson Correlation	-.192	.499*	1.000**	.438*	1.000								
	Sig. (1-tailed)	.203	.011	.000	.024									
X5=PS	Pearson Correlation	-.323	-.024	-.421*	-.602**	-.421*	1.000							
	Sig. (1-tailed)	.077	.459	.029	.002	.029								
X6=GE	Pearson Correlation	-.497*	.249	-.083	-.513**	-.083	.113	1.000						
	Sig. (1-tailed)	.011	.138	.361	.009	.361	.314							
X7=RQ	Pearson Correlation	.053	-.277	-.208	-.618**	-.208	.472*	.247	1.000					
	Sig. (1-tailed)	.409	.112	.183	.001	.183	.015	.141						

Table 1. Pearson Correlation Matrix of the Variables Used to Test the Factors Enhancing Sustainable Renewable Energy Consumption in Thailand During 2000-2020 (continue)

Variable	Statistics	Y=SREC	X1=TE	X2=PGC	X3=GCOP	X4=NIP	X5=PS	X6=GE	X7=RQ	X8=DI	X9=PRCRS	X10=PRCCS	X11=PRCISI	X12=PRCTS
X8=DI	Pearson Correlation	.527**	-.400*	-.327	.349	-.327	-.120	-.700**	-.312	1.000				
	Sig. (1-tailed)	.007	.036	.074	.061	.074	.302	.000	.084					
X9=PRCRS	Pearson Correlation	.643**	-.206	.311	.518**	.311	-.699**	-.357	-.332	.172	1.000			
	Sig. (1-tailed)	.001	.185	.085	.008	.085	.000	.056	.071	.228				
X10=PRCCS	Pearson Correlation	-.856**	.977**	.402*	.141	.402*	.106	.357	-.147	-.507**	-.327	1.000		
	Sig. (1-tailed)	.000	.000	.035	.272	.035	.323	.056	.262	.009	.074			
X11=PRCISI	Pearson Correlation	-.766**	.870**	.390*	.040	.390*	-.083	.554**	-.059	-.599**	-.218	.899**	1.000	
	Sig. (1-tailed)	.000	.000	.040	.431	.040	.360	.005	.399	.002	.171	.000		
X12=PRCTS	Pearson Correlation	-.749**	.984**	.550**	.236	.550**	-.040	.290	-.233	-.487*	-.131	.963**	.874**	1.000
	Sig. (1-tailed)	.000	.000	.005	.151	.005	.432	.101	.155	.013	.286	.000	.000	

Source: Pearson correlation is the values from -1 (negative correlation) to +1 (positive correlation) and 0 is no correlation between independent variables and dependent variable.

**. Correlation is significant at the 0.01 level (1-tailed). *. Correlation is significant at the 0.05 level (1-tailed). c. Listwise N=21

Table 2. The Multiple Linear Regression Analysis

Coefficients

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95.0% Confidence Interval for B		Correlations			Collinearity Statistics	
	B	Std. Error	Beta			Lower Bound	Upper Bound	Zero-order	Partial	Part	Tolerance	VIF
1 Constant	2.803	9.429		.297	.773	-18.527	24.133					
X1=TE	-3.735E-6	.000	-1.550	-1.534	.159	.000	.000	-.791	-.455	-.101	.004	235.528
X2=PGC	.022	.008	.404	2.721	.024	.004	.040	.208	.672	.179	.196	5.093
X3=GCOP	-.003	.004	-.088	-.647	.533	-.012	.007	-.192	-.211	-.043	.235	4.264
X4=NIP	.006	.012	.070	.465	.653	-.022	.034	-.323	.153	.031	.194	5.166
X5=PS	.011	.096	.016	.111	.914	-.207	.228	-.497	.037	.007	.206	4.844
X6=GE	.099	.049	.211	2.042	.072	-.011	.209	.053	.563	.134	.405	2.470
X7=RQ	.543	.429	.229	1.266	.237	-.427	1.513	.527	.389	.083	.133	7.507
X8=DI	.001	.000	.247	1.566	.152	.000	.002	.643	.463	.103	.174	5.741
X9=PRCRS	-.216	.303	-.565	-.711	.495	-.902	.471	-.856	-.231	-.047	.007	145.556

Table 2. The Multiple Linear Regression Analysis (continue)

Coefficients												
Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95.0% Confidence Interval for B		Correlations			Collinearity Statistics	
	B	Std. Error	Beta			Lower Bound	Upper Bound	Zero-order	Partial	Part	Tolerance	VIF
X10=PRCCS	.000	.000	.127	.504	.626	.000	.001	-.766	.166	.033	.068	14.731
X11=PRCIS	.004	.002	1.352	2.041	.072	.000	.009	-.749	.563	.134	.010	101.151
X12=PRCTS	2.803	9.429	-1.550	.297	.773	-18.527	24.133	-.791	-.455	-.101	.004	235.528

Adjusted R2 = .913

Dependent Variable: Y=SREC

The details of research findings and discussion of each factor as follow.

1. Renewable energy technology evolution

Hypothesis 1 (H1+) *The more RE technological evolution leads to the more RE consumption in Thailand during 2000 to 2020.*

Based on the quantitative results, the strong negative correlation of -.791 (r= -.791) between the renewable energy technological evolution (X1) and sustainable renewable energy consumption in Thailand (Y) from 2000 to 2020 indicates an unexpected relationship. The significant value of .000 (commonly referred to as p-value) is remarkably low. It was necessary to accept the hypothesis. Even though technological advancements generally facilitate renewable energy growth, this data suggests that as X1 increases, Y is likely to decrease. Factors such as the time lag in the adoption of new technologies and the impact of government policies may complicate this relationship. This finding challenge exist assumptions that technological progress is crucial for renewable energy development, emphasizing the need for further investigation into the underlying influences and interactions within this sector.

Based on the interviews carried out, it was concurred that the advancement of renewable energy technology significantly influenced the rise of renewable energy usage in Thailand from 2000 to 2020. This progress was fueled by the global community's worries regarding the environment and climate change. The Thai government has also been proactively endorsing renewable energy implementation through diverse methods and policies. Thai residents have the freedom to select the most appropriate renewable energy technology for their individual location or situations. The advancement of renewable energy has resulted in greater efficiency and user-friendliness. Solar energy technology, especially, has become increasingly popular among producers and consumers because of its reduced size and enhanced efficiency compared to previous times. Although the expenses related to renewable energy

technology have fallen, they might still exceed those of fossil fuel energy, which could hinder its further progress. Nevertheless, if renewable energy technology continues to improve in the proper manner, it is anticipated that renewable energy development will speed up.

In summary, a significant negative relationship exists between the development of renewable energy technology and the consumption of renewable energy in Thailand during the period from 2000 to 2020. This indicates that advancements in technology may result in lower consumption, which goes against widespread assumptions. Multiple elements, such as governmental policies and delays in adopting technology, influence this connection. Discussions indicate that the progress of renewable energy technology has a beneficial effect on consumption owing to environmental issues and government initiatives. Solar energy technology has gained popularity because of its efficiency and compactness, even though it is more expensive than fossil fuels. Ongoing advancements in renewable energy technology could enhance its further development. However, ongoing innovation may support long-term development. These findings align with Jin and Tang (2018), who showed that in China, technological innovation increases energy consumption in the short run but fosters mutual growth with energy consumption in the long run, aiding sustainability through improved efficiency and energy structure.

2. Renewable power generation costs

Hypothesis 2 (H2+) *The lower RE power generation costs lead to the more RE consumption in Thailand during 2000 to 2020.*

Based on the quantitative findings, the renewable power generation costs (X2) show a weak negative association with sustainable renewable energy consumption in Thailand from 2000 to 2020 (Y), as evidenced by a correlation coefficient of -.192. The significant value of .203 (p-value) is relatively elevated. It was to reject the hypothesis. This implies that although reduced renewable energy generation expenses may slightly promote consumption, the correlation is not robust. Other elements are likely to exert a more substantial influence on encouraging renewable energy utilization in Thailand. Even though the decreasing costs could potentially boost consumption, this outcome aligns with scholars' views that production costs impede growth in renewable energy. Reduced technology expenses, particularly for solar photovoltaic systems, have been essential in propelling global progress in renewable energy. The connection between these costs and variables such as economic growth and energy security further reinforces the potential for achieving sustainable renewable energy consumption in the long run (Taghizadeh-Hesary. F. et al, 2018).

Based on the statement, all 23 interviewees concurred that the cost of producing renewable energy electricity is a key factor in boosting its consumption. This is attributed to technological advancements, leading to greater competition and mass production, which ultimately reduces prices

and production costs. Consequently, consumers might transition to renewable energy as it becomes increasingly accessible and budget-friendly. Solar cells are cited as an instance of dropped renewable energy costs, and their adoption is on the rise. It is also recommended that government policies align with the production costs of private sector electricity, as stable policies can foster more investment and reduce production expenses further. Policies that advocate for net connection can additionally stimulate the use of renewable energy. Nonetheless, it is essential to recognize that the total cost of renewable energy production cannot be definitively connected to its increased use. The sourcing of raw materials for renewable energy is a vital aspect, as the production costs still remain elevated when compared to primary energy sources. Nevertheless, the cost of renewable energy electricity production is not as critical as the escalating global crude oil prices. Individuals are searching for alternative energy solutions that could be less expensive than primary energy at the current moment, and consumers typically favor utilizing more economical energy options.

In summary, the cost of renewable energy generation in Thailand has a weak negative correlation with sustainable energy use from 2000 to 2020, indicating that lower costs could potentially promote usage slightly, yet additional factors are more influential. All 23 respondents concurred that decreased production expenses, primarily resulting from technological improvements, boost consumption. Policies from the government ought to back these developments. Nevertheless, the relationship between production costs and consumption is not straightforward, since the costs of raw materials continue to be elevated in comparison to conventional energy sources. Increasing global oil prices further stimulate the demand for more affordable alternatives. These results are consistent with the findings of Apostoleris, Sgouridis, Stefancich, and Chiesa (2018), who reported that the decreasing cost of solar photovoltaic systems in the Middle East led to increased adoption of renewable energy, demonstrating how cost competitiveness can drive sustainable energy transitions.

3. Global crude oil prices

Hypothesis 3 (H3+) *The more global oil prices lead to the more RE consumption in Thailand during 2000 to 2020.*

Based on the quantitative result, global crude oil prices (X3) exhibited a weak positive correlation (.208) with sustainable renewable energy consumption in Thailand during 2000-2020 (Y), indicating a slight impact of oil prices on renewable energy usage. The important value of .183 (p-value) is quite high. It was to reject the hypothesis. This correlation points to a nearly insignificant relationship, suggesting that other factors have a more substantial influence on Thailand's renewable energy growth. While increasing oil prices might logically promote the shift to renewables, the data indicates a minimal effect. Scholars emphasize differing opinions on this relationship, pointing out that

higher oil prices can negatively impact renewable energy consumption, complicating the expected transition to cleaner energy sources (Murshed & Tanha, 2021).

Based on the 23 interviewees, it was determined that changes in global crude oil prices influence the consumption of renewable energy in Thailand from 2000 to 2020. When crude oil prices rise, consumers are likely to utilize more renewable energy, whereas they use less when crude oil prices drop. This occurs because consumers evaluate the costs of fossil fuels and renewable energy and select the less expensive option. The interviewees also concur that the growth in renewable energy consumption is motivated by worldwide environmental concerns. Nonetheless, one interviewee holds a differing view, proposing that the increase in renewable energy usage is associated with the petroleum industry instead of the power sector.

In summary, global crude oil prices exhibit a weak positive correlation with renewable energy consumption in Thailand from 2000 to 2020. Although increased oil prices might promote renewable energy adoption, the impact is minor. Interviews suggest that consumers opt for renewables when oil prices increase based on cost evaluations and worldwide environmental issues. One interviewee believes that the growth in renewables is more associated with the petroleum sector than with the energy industry. This outcome aligns with the findings of Mikayilov, Galeotti, and Hasanov (2022), who concluded that increases in crude oil prices are expected to promote renewable energy adoption, as such price shifts significantly influence the pace of the renewable energy transition.

4. Number of renewable energy projects

Hypothesis 4 (H4+) *The more number of RE projects leads to the more RE consumption in Thailand during 2000 to 2020.*

Based on the quantitative findings, the number of renewable energy investment projects (X4) in Thailand from 2000 to 2020 shows a weak negative correlation with sustainable renewable energy consumption (Y), which is evidenced by a correlation coefficient of -.192. The significant value of .203 (p-value) is comparatively high. This led to the rejection of the hypothesis. This indicates an unanticipated trend where a rise in investment projects might be associated with a minor reduction in energy consumption. Factors such as time lag, type of investment, and external conditions like government policies and consumer awareness likely have important roles in influencing this connection. These results differ from earlier studies that claimed a positive relationship between the number of projects and renewable energy adoption, underscoring the complexity of the influencing factors (Maqbool & Sudong, 2018).

Based on the 23 interviewees, 4 of them affirm that investment projects in renewable energy have favorably influenced the increase of renewable energy usage in Thailand from 2000 to 2020. This is attributed to the greater availability of renewable energy resources and the market's competitiveness,

which has made renewable energy more reachable for the public. The majority of interviewees also concur that the government's supportive measures, like the Adder and FiT scheme, have significantly aided in the advancement of renewable energy projects. These measures have served as incentives for investments from the private sector in renewable energy in Thailand. Furthermore, the global tendency towards renewable energy development has aided in the rise of investment projects, in line with the government's efforts to assist investors in this field. Nonetheless, it is important to mention that previously, the government did not sufficiently monitor or assess the results and value of these investments regarding their effect on renewable energy consumption.

In summary, renewable energy investment initiatives in Thailand from 2000 to 2020 demonstrated a weak negative correlation with renewable energy consumption. Elements such as time delay and government policies affected this connection. Interviews revealed that certain projects had a beneficial effect on energy consumption, supported by favorable government policies. Nevertheless, previous government oversight concerning the effects of investment was inadequate. These findings are consistent with Zhang et al. (2022), who emphasized that private sector participation in renewable energy investments plays a critical role in enhancing both production and consumption. This implies that for investments to be truly effective, they must be strategically directed and supported by both public and private sectors.

5. Political stability

Hypothesis 5 (H5+) *The more political stability leads to the more RE consumption in Thailand during 2000 to 2020.*

Based on the quantitative findings, the analysis indicates a moderate negative relationship between political stability (X5) and sustainable renewable energy consumption (Y) in Thailand from 2000 to 2020, with a correlation coefficient of -.323. The significant value of .077 (p-value) is near the established threshold of .05. This led to the rejection of the hypothesis. This implies that higher political stability might result in a slight reduction in renewable energy consumption, potentially because of a focus on economic growth or policy changes that divert attention from renewable sources. This result contrasts with earlier studies suggesting that political stability promotes renewable energy development. Researchers contend that while political stability is crucial for drawing investments into renewable energy, it can occasionally hinder its progress due to changing priorities (Sohail, Majeed, Shaikh, & Andlib, 2021).

Based on the interviews with 23 individuals revealed varied perspectives on political stability's impact on Thailand's renewable energy growth from 2000-2020. Most interviewees believed political stability had minimal influence, citing renewable energy's alignment with global trends and its integration

into the National Plan Strategy. This strategy mandates government bodies to incorporate renewable energy, limiting political alterations. However, political instability was acknowledged as a potential cause for project approval delays, potentially deterring private investment. Furthermore, Thailand's single energy buyer model, where the government controls energy sources, diminishes public influence on consumption, negating any direct impact from political stability. While not a primary driver, political stability's influence on investment confidence and project timelines remains a factor in renewable energy development.

In summary, the examination indicates a moderate negative relationship between political stability and renewable energy usage in Thailand from 2000 to 2020. This implies that increased political stability might result in a small reduction in renewable energy consumption, potentially due to an emphasis on economic development. Conversations with 23 individuals uncovered that the majority believe political stability does not influence renewable energy expansion since it is in line with global patterns and is incorporated in the National Plan Strategy. However, political stability can influence the endorsement process for renewable initiatives, leading to setbacks and diminishing investor trust. Furthermore, the government's regulation of energy sources within a single buyer system restricts public awareness and engagement in renewable energy usage. These findings align with the research by Hussain et al. (2021), which demonstrated that political stability significantly impacts renewable energy investment decisions in various countries, highlighting how stable political environments can influence both the pace and nature of renewable energy development.

6. Government effectiveness

Hypothesis 6 (H6+) *The more government effectiveness leads to the more RE consumption in Thailand during 2000 to 2020.*

Based on the quantitative findings, the relationship between government effectiveness (X6) and sustainable renewable energy consumption (Y) in Thailand from 2000 to 2020 is moderately negative, reflected by a coefficient of -. 497. The significant value of. 011 (p-value) is notably low. This led to the acceptance of the hypothesis. This indicates that as the effectiveness of the government rises, renewable energy consumption tends to diminish slightly. This unexpected outcome could suggest that more capable governments focus on sectors other than renewable energy. Furthermore, research indicates that effective governance has a positive effect on the advancement of renewable energy, emphasizing its vital importance in sustainable energy investments and climate change alleviation (Mahmood et al., 2021; Akhtaruzzaman, 2022).

Based on the 23 interviewees (excluding one without a viewpoint), it has been established that the effectiveness of government was essential in impacting renewable energy usage in Thailand between 2000 and 2020. Government effectiveness pertains to the formulation of policies that endorse,

encourage, oversee, and govern the growth of renewable energy. This nurtures investor assurance, leading to heightened investment and ongoing development in renewable energy. Nonetheless, erratic or interrupted policies from specific governments have hindered the progress of renewable energy. Hence, it is critical for the government to implement robust and stable policies.

In summary, the research discovers a moderately negative relationship between government effectiveness and renewable energy consumption in Thailand from 2000 to 2020. This implies that as government efficiency rises, the usage of renewable energy might decrease a little. Interview participants verified the significance of efficient governance in promoting renewable energy through robust policies that enhance investor trust. Inconsistent policies have obstructed progress, highlighting the necessity for consistent government backing in renewable energy advancement. These findings align with Hussain et al. (2021) found that government effectiveness significantly influences renewable energy investment decisions across multiple countries, reinforcing the idea that good governance plays a key role in enabling or constraining renewable energy growth, depending on how effectively it is directed.

7. Regulatory quality

Hypothesis 7 (H7+) *The more regulatory quality leads to the more RE consumption in Thailand during 2000 to 2020.*

Based on the quantitative findings, the regulatory quality (X7) of the governmental in Thailand shows a weak positive correlation (coefficient of .053) with the expansion of sustainable renewable energy consumption from 2000 to 2020 (Y). The noteworthy value of. 409 (p-value) is comparatively high. It was to reject the hypothesis. This implies that, although improved regulatory conditions might marginally promote renewable energy usage, the association is insignificant, as other elements likely exert a more substantial influence. Researchers contended that elevated regulatory quality is typically associated with heightened investment in renewable energy, indicating effective governance that motivates private sector participation in sustainable energy efforts (Hussain et al., 2021).

Based on the results, 22 of the 23 people interviewed affirmed that quality regulation has notably impacted the rise in renewable energy usage in Thailand from 2000 to 2020. The primary reason for this impact is the government's successful administration of both public agencies and the private sector, guaranteeing compliance with laws and regulations. This strategy fosters fairness, efficiency, and transparency throughout all phases of auctions and the execution of appropriate programs for renewable energy initiatives. Nevertheless, if regulations fail to evolve with contemporary standards and become obsolete, it might obstruct the future development of renewable energy in Thailand.

In summary, the quality of government regulations in Thailand has a weak positive connection with the increase in renewable energy usage from 2000 to 2020. The association is not robust, suggesting that other elements hold greater importance. Although the majority of respondents concur that the quality of regulation has notably impacted renewable energy consumption, primarily because of efficient government oversight ensuring equity and clarity. Nonetheless, obsolete regulations might obstruct future advancement in this area. These findings are consistent with the work of Hussain et al. (2021), who found that regulatory quality is a statistically significant determinant of renewable energy investment across various countries. Their study highlights how well-designed regulations can stimulate economic growth and provide strong incentives for the private sector to support renewable energy initiatives. This alignment reinforces the idea that while regulation alone may not drive major increases in renewable energy use, it remains a critical enabler when combined with other supportive policies and market conditions.

8. Democracy index

Hypothesis 8 (H8+) *The more democracy Index leads to the more RE consumption in Thailand during 2000 to 2020.*

Based on the quantitative findings, the democracy index (X8) displays a strong positive relationship with sustainable renewable energy consumption (Y) in Thailand from 2000 to 2020, showing a correlation coefficient of .527. The significant value of .007 (p-value) is relatively low. This was to accept the hypothesis. This suggests that higher levels of democracy might encourage renewable energy expansion, as democracies usually emphasize sustainability due to public pressure. Transparent governance and community-based decision-making further improve environmental policies. Research indicates that elevated democracy levels favor renewable energy growth, whereas military regimes may obstruct such efforts. In general, democratic frameworks facilitate effective policies for renewable energy consumption (Adams & Asante, 2019; Chou & Zhang, 2020).

Based on the interviews with 23 individuals revealed diverse opinions on government type's influence on Thailand's renewable energy progress. Some argued that Thailand's energy strategy, aligned with global trends, minimizes the impact of democratic or authoritarian rule. Others believed government type significantly impacts investment confidence and policy promotion. Authoritarian regimes offer faster approvals but less competition, while democracies prioritize bureaucratic processes and global investment. However, some interviewees noted that democratic governance doesn't guarantee faster implementation, citing failed renewable energy projects. They also argued that the democracy index is less important than cost and other factors in driving renewable energy development. This highlights a complex interplay between governance, policy implementation, and economic considerations in Thailand's renewable energy sector.

In summary, the democracy index indicates a strong positive correlation with the use of renewable energy in Thailand between 2000 and 2020, implying that increased levels of democracy may enhance sustainability. Interviews indicate varied opinions on the government's influence on energy development, with some contending that an all-encompassing energy strategy reduces the effects of governance type. Others argue that democracy and authoritarianism influence investment confidence and the pace of policy implementation, with authoritarianism facilitating swifter approvals but resulting in less market competition. Detractors assert that democratic governance does not consistently guarantee expedited policies and emphasize that other factors, such as costs, have a more significant impact on renewable energy development. These findings align with Chen, Pinar, and Stengos (2021), who emphasized the importance of democratic institutions in promoting renewable energy use. Similarly, Yahya and Rafiq (2019) found that both full and flawed democratic systems significantly influence renewable energy consumption. Their research also suggests that elements of democracy and authoritarianism can work together to shape effective public policies that support clean energy adoption and production. This underscores that while democracy can be a strong driver of renewable energy growth, its effectiveness depends on how it interacts with institutional capacity, economic factors, and governance structures.

9. Renewable energy policy and regulatory changes in the residential sector

Hypothesis 9 (H9+) *The more RE policy and regulatory change for residential sector leads to the more RE consumption in Thailand during 2000 to 2020.*

Based on the quantitative findings, the renewable energy policy and regulatory alterations for the residential sector (X9) in Thailand exhibit a robust positive correlation (.643) with the rise in sustainable renewable energy consumption from 2000 to 2020 (Y). The significant figure of .001 (p-value) is exceedingly low. Thus, the hypothesis was accepted. Researchers have shown that facilitating policies like net metering, feed-in tariffs, and tax incentives substantially motivate homeowners to implement renewable energy options, such as solar panels. Although economic and technological aspects are crucial in energy consumption, different policy effects are noticeable around the world, with variations in solar energy development depending on the available support systems. In spite of households' readiness to transition to renewable technologies, financial obstacles and insufficient infrastructure impede adoption, resulting in challenges for distributed generation in the residential sector (Hidayatno et al., 2020; Sotnyk, Kurbatova, Blumberga, & Kubatko, 2022).

Based on the 23 interviewees concurred that residential renewable energy consumption is significantly affected by policy and regulatory changes. Streamlined permit applications and incentive programs, like electricity buy-back schemes, have spurred growth. However, some argued social factors

and cost-saving motives drive adoption more than direct government policies. To further promote household renewable energy, reliable transmission lines are crucial for electricity sales to the grid. Simplifying administrative processes and regulations would enhance accessibility. Adequate budget allocation is also vital for future initiatives. While policies play a role, cost-effectiveness and practical implementation are key to wider residential adoption.

In summary, the changes in renewable energy policy and regulation in the residential sector in Thailand have a strong positive correlation with the rise in renewable energy usage in households from 2000 to 2020. Supportive policies like tax benefits and net metering motivate homeowners to embrace renewable options. However, financial obstacles and infrastructure challenges hinder widespread adoption. Interviewees concurred that policy adjustments have enhanced renewable energy consumption. Government incentives, such as buy-back programs, also contribute to increased usage. Nevertheless, some feel that social factors are more influential in driving the transition than governmental measures. To enhance renewable energy consumption in homes, improved transmission reliability and more straightforward regulations are necessary, along with effective budget planning for upcoming initiatives. These results are consistent with the findings of Štreimikienė, Lekavičius, Stankūnienė, and Pažėraitė (2022) and Coria, Penizzotto, and Pringles (2019), who observed that while many households are open to adopting renewable technologies, practical barriers—particularly financial constraints and inadequate infrastructure—limit their ability to do so. Moreover, they noted that distributed renewable generation remains economically unviable in many residential settings due to high capital investment costs, uncompetitive energy pricing structures, and national policies that often prioritize profitability for energy enterprises over consumer-level adoption. This alignment underscores the shared conclusion that while policy support is vital, its effectiveness depends heavily on overcoming structural and economic limitations within the residential energy market.

10. Renewable energy policy and regulatory changes in the commercial sector

Hypothesis 10 (H10+) The more RE policy and regulatory change for commercial sector leads to the more RE consumption in Thailand during 2000 to 2020.

Based on the quantitative findings, the research shows a very strong negative correlation (-.856) between changes in renewable energy policy and regulatory in Thailand's commercial sector (X10) and the increase of renewable energy usage from 2000 to 2020 (Y). The significant value of .000 (p-value) is remarkably low. This allowed for the acceptance of the hypothesis. This indicates that, in spite of initiatives such as net metering and tax breaks designed to assist the commercial sector, the overall consumption of renewable energy has decreased. The surprising connection suggests that such policies might unintentionally impede residential adoption, prioritize larger projects, and lessen energy diversity,

thereby making the sector more susceptible. Conversely, other researchers contend that beneficial policy changes promote renewable energy advancement (Alola & Yildirim, 2019).

Based on the interviews with 23 participants highlighted the pervasive impact of policy development across sectors, but identified a regulatory gap in commercial renewable energy. Participants advocated for comprehensive regulations covering generation and usage, including installation standards, mains-rate electricity charging, market liberalization, electric vehicle import policies, tax reductions, and streamlined procedures. These regulations aim to ensure oversight and promote competitive pricing, driving commercial adoption. There's a growing trend towards solar thermal, biomass, and waste energy utilization in businesses and government enterprises. Globalization and renewable energy marketization are accelerating this integration, as businesses prioritize cost reduction. The participants emphasized the need for a robust regulatory framework to foster sustainable renewable energy adoption in the commercial sector. This framework should focus on both incentivizing businesses and ensuring fair market competition, leading to a more efficient and sustainable energy landscape.

In summary, the research demonstrates a significant negative correlation between changes in renewable energy policies and the increase of renewable energy usage in Thailand's commercial sector from 2000 to 2020. Although there have been initiatives such as tax incentives, consumption has decreased. Those interviewed believe that policy development impacts all sectors but consider regulations for the business sector to be insufficient. Suggestions for enhancement consist of creating regulations for production and consumption, conducting inspections for standards, and encouraging renewable energy sources such as solar and biomass. The business sector is slowly transitioning to renewable energy as a result of reduced costs and market dynamics. These findings are consistent with those of Golmohamadi (2022) highlighted that policy subsidies are essential for advancing renewable energy in the commercial sector, especially as climate change concerns prompt many businesses to invest in sustainable energy solutions. This study underline that while market forces play a role, proactive and well-structured policy frameworks are critical for driving commercial sector engagement in renewable energy—something currently lacking in Thailand’s approach, according to the research.

11. Renewable energy policy and regulatory changes in the industrial sector

Hypothesis 11 (H11+)The more RE policy and regulatory change for industrial sector leads to the more RE consumption in Thailand during 2000 to 2020.

Based on the quantitative findings, the connection between renewable energy policies and regulatory changes for the industrial sector (X11) and sustainable renewable energy consumption in Thailand from 2000 to 2020 (Y) has indicated a very strong negative relationship (-.766). The significant value of .000 (p-value) is notably low. It was to accept the hypothesis. This signifies that while supportive policies, like net metering and tax benefits, are intended to boost renewable energy usage, they might unintentionally result in decreased renewable energy consumption in the industrial sector. This paradox implies that policy initiatives might produce unintended adverse effects. Even though other elements also affect energy consumption results, the scholars disagree with perspectives that suggest increasing industrial policies results in enhanced renewable energy development. The scholars stress the significance of appropriate renewable energy policies in balancing trade-offs within green industrial strategies to foster low-carbon industrial advancement. (Lund, 2009; Zhang et al., 2013).

Based on interviews with 23 individuals, it was discovered that policy-making significantly influences every sector. Nevertheless, there is currently an absence of regulations specifically aimed at the industrial sector. In spite of this, the industry itself has begun to focus on renewable energy because of cost-saving strategies and growing worldwide demand for environmentally friendly practices. To guarantee the effective execution of renewable energy in the industrial sector, a number of suggestions were proposed: carefully monitor installation standards, enforce regulations, allocate resources for the advancement of renewable energy, coordinate projects across various levels, create a competitive market for renewable electricity, and offer tax incentives. It is also recommended to implement policies that motivate the industrial sector to enhance their procurement of electricity from renewable sources. Some interviewees noted that the government has already enacted certain policies, such as assigning budgets for the acquisition of electricity from the industrial sector, promoting biomass electricity generation through tax incentives linked to corporate social responsibility initiatives, and offering guidance and audits to aid in energy conservation and the incorporation of renewable energy in the industrial sector.

In summary, changes in renewable energy policy and regulatory for the industrial sector in Thailand from 2000 to 2020 demonstrated a significant negative relationship with the consumption of sustainable renewable energy. Although encouraging policies are intended to enhance renewable energy, they might diminish its consumption in this sector. Discussions highlighted the requirement for targeted regulations. The industry is transitioning to renewable energy due to cost and demand factors. Suggestions for effective implementation encompass overseeing standards, enforcing regulations, distributing resources, coordinating initiatives, developing a competitive marketplace, and offering tax incentives. Several government policies encourage the adoption of renewable energy within the industrial sector. These findings are consistent with Matsuo and Schmidt (2019), who argued that renewable energy policies should be carefully structured to balance trade-offs in green industrial strategies, especially in emerging economies. Their research underscores the importance of aligning

renewable energy initiatives with industrial policy to support low-carbon industrialization. Similarly, Fais et al. (2016) highlighted the critical role of the industrial sector in achieving long-term energy efficiency, emission reductions, and renewable energy targets, particularly in Europe. Both studies support the notion that policy design and execution must be strategically aligned with industrial dynamics to effectively accelerate the sector's transition toward sustainability—something the current Thai policy landscape has yet to fully realize.

12. Renewable energy policy and regulatory changes in the transport sector

Hypothesis 12 (H12+)The more RE policy and regulatory change for transportation sector leads to the more RE consumption in Thailand during 2000 to 2020.

Based on the quantitative findings, the connection between renewable energy policy and regulatory changes for the transportation sector (X12) demonstrates a very strong negative correlation with sustainable renewable energy consumption in Thailand from 2000 to 2020 (Y), as shown by a correlation coefficient of -.749. The significant value of .000 (p-value) is exceptionally low. It was to accept the hypothesis. This indicates that supportive policies, such as electric vehicle incentives and charging infrastructure, might unexpectedly result in a decline in overall renewable energy usage. Elements that lead to this negative correlation include data limitations that impede effective policy evaluation and unforeseen consequences affecting renewable initiatives. Although researchers have typically reported a positive relationship between transportation policies and renewable energy expansion, the findings underscore the difficulties in incorporating renewables in transportation, especially in fuel-dependent countries. Thus, regulatory frameworks that motivate renewable energy adoption in transportation are suggested to lower emissions and improve sustainability (Batlle, 2011; Lorenzia & Baptista, 2018).

Based on the insights provided by 23 interviewees, the execution of policies greatly affects multiple sectors. In the transportation sector, a policy has been established by the government to enhance the use of biodiesel and ethanol, allocating specific proportions to boost the uptake of alternative energy sources. A partnership between fuel station operators and automobile manufacturers is necessary to synchronize their services and vehicles with government policies. Furthermore, the government provides reduced import taxes for electric vehicles, which promotes their importation. Numerous private sector organizations have created their own electric transportation systems that run on solar energy, which are more economical. The government levies taxes on fuel to support the production of alternative energy by providing subsidies. Nonetheless, the government does not adequately regulate policies in the transportation sector, leading to a decline in public interest in the use of alternative energy. To remedy these challenges, it is advised that the government adopt proactive

strategies to oversee and manage the ratios of biodiesel and ethanol over the long term. Sufficient planning and supply of electricity are also critical to support the rising number of electric vehicles.

In summary, the connection between renewable energy policy and regulatory changes for the transportation sector in Thailand from 2000 to 2020 exhibits a significant negative correlation with the consumption of renewable energy. Limitations in data and unforeseen results add to this dilemma. While policies typically advocate for renewable energy, there are obstacles in nations reliant on fuel. Insights from 23 interviewees suggest that governmental policies heavily influence different sectors, fostering the use of biodiesel and ethanol while promoting electric vehicle imports through tax incentives. Cooperation between fuel stations and automobile manufacturers is vital. Nevertheless, insufficient regulation results in a decline in public interest in alternative energy. Active government initiatives are necessary for improved management and backing of electric vehicle infrastructure. These results align with the findings of Amin et al. (2020), who noted that although increased renewable energy usage can significantly reduce carbon emissions in the transportation sector—by up to 12 percent—urbanization alone has a minimal positive effect on pollution reduction. Their research emphasizes the need for energy-efficient and environmentally friendly transport systems, alongside increased public awareness, to address transportation-related environmental challenges. The study suggests that while policy mechanisms are essential, their effectiveness relies on coordinated implementation, regulatory clarity, and public engagement to successfully drive the transition to renewable energy in transportation.

Conclusion

This study examined factors influencing Thailand's sustainable renewable energy consumption from 2000-2020, revealing both positive and negative correlations. Positive correlations were observed with: residential renewable energy policy changes, strongly associated with increased household consumption; the democracy index, showing a significant link, though interviewees had mixed views on government influence; global crude oil prices, weakly positively correlated, as rising prices spurred renewable energy adoption; and regulatory quality, also weakly positively linked, acknowledged for its impact on consumption.

Conversely, a significantly strong to very strong negative correlation was observed with changes in renewable energy policy in the business sector ($r = -.856$, $p = .000$), despite the acknowledged influence of such policies, indicating that adoption is primarily cost-driven. The evolution of renewable energy technology ($r = -.791$, $p = .000$) also demonstrated a strong negative correlation, contrary to expectations, even though respondents recognized its positive effects. Policy changes in the industrial sector ($r = –.766$, $p = .000$) and the transportation sector ($r = -.749$, $p = .000$) revealed similarly strong negative correlations, highlighting the complexity of government effectiveness and efficiency, despite the acknowledged importance of such policies in enhancing investor confidence. Political stability ($r =$

-.323, p = .077) showed a weak negative correlation, likely due to the relatively minimal influence of such policies, attributed to the overarching national energy strategy. The cost of renewable energy production (r = -.192, p = .203) presented a slight negative correlation, even though cost reduction was recognized as a driving factor. Similarly, the number of renewable energy investment projects (r = .192, p = .203) also showed a slight negative correlation, despite some projects demonstrating positive impact.

The study highlighted the intricate interplay of policy, economics, and governance in shaping renewable energy consumption. While residential policies and global oil prices positively influenced adoption, regulatory challenges in commercial, industrial, and transportation sectors, alongside government effectiveness and political stability, presented obstacles. The research also revealed that technological advancements and cost reductions, while expected to boost consumption, showed negative correlations, indicating potential complexities in their implementation.

The findings underscore the need for targeted policy interventions and a comprehensive understanding of the factors driving renewable energy consumption in Thailand. The mixed results suggest that while certain policies are effective, others require refinement to address sector-specific challenges. Furthermore, the study emphasizes the importance of considering both quantitative data and qualitative insights from stakeholders to develop effective strategies for promoting sustainable renewable energy adoption.

Recommendations

The findings of this study offer valuable insights for shaping new policy recommendations and theoretical contributions aimed at guiding renewable energy development in Thailand toward sustainable growth. To support this goal, the research puts forward a six-strategy framework designed to effectively manage the country's renewable energy progress.

1. Establish Clear Regulations: Implement new rules and guidelines specifically for renewable energy use. This creates a stable and predictable environment for its growth and adoption.

2. Enhance Government Efficiency: Streamline bureaucratic processes to speed up the installation of renewable energy projects. Reducing delays can significantly boost deployment rates.

3. Promote Research in Renewable Technologies: Invest in and encourage research and development (R&D) within Thailand to foster innovation in renewable energy technologies. This can lead to more efficient and cost-effective solutions tailored to local needs.

4. Encourage Investment: Create attractive incentives and conditions to draw both domestic and foreign investment into Thailand's renewable energy sector. Financial backing is crucial for large-scale development.

5. Facilitate Residential Adoption: Support and incentivize homeowners to adopt renewable energy solutions, such as rooftop solar. This helps reduce individual energy costs and decentralizes energy production.

6. Promote Renewable Energy in Transportation: Develop and implement policies and regulations that encourage the use of renewable energy sources within the transportation sector, such as electric vehicles powered by renewable grids or biofuels.

Additionally, the study also contributes to academic understanding within Public Administration and Public Policy through five key areas:

1. Optimizing Policy Mixes: This involves researching how different policy tools (e.g., regulations, incentives, public awareness campaigns) can be combined most effectively to encourage the adoption of renewable energy.

2. Analyzing Governance and Regulatory Capacity: Understanding the ability of government institutions and regulatory bodies to manage the shift towards renewable energy. This includes their structure, resources, and decision-making processes during energy transitions.

3. Understanding Political and Economic Influences: Examining how political dynamics (e.g., special interest groups, public opinion) and economic factors (e.g., market forces, financial incentives) shape and impact energy policy decisions.

4. Examining Intergovernmental Coordination: Researching how different levels of government (national, provincial, local) and various government agencies work together to promote renewable energy. Effective coordination is vital for successful implementation.

5. Ensuring Social Equity and Justice: Investigating how renewable energy policies can be designed and implemented to ensure fair distribution of benefits and burdens across all segments of society, avoiding disproportionate impacts on vulnerable populations.

This study essentially recommends that Thailand adopt a comprehensive strategy for its renewable energy transition. This means blending actionable policies from the National Energy Plan

(NEP), Power Development Plan (PDP), and Alternative Energy Development Plan (AEDP) with strong theoretical foundations to achieve sustainable development goals.

Future research should investigate other influences like economic growth and climate change while considering regional renewable energy development, particularly in relation to ASEAN countries, to broaden the understanding of public administration in the renewable sector and reduce energy costs for local communities.

Furthermore, this research uncovered a notable difference between quantitative and qualitative analyses while investigating factors influencing sustainable renewable energy consumption in Thailand from 2000 to 2020. Factors such as the renewable energy technology evolution, global crude oil prices, the number of renewable energy investment projects, political stability, government effectiveness, regulatory quality, and the democracy index displayed differing effects based on the analytical method used. Consequently, it is essential to undertake more in-depth research into each of these factors to comprehend why these factors have differing impacts on sustainable renewable energy consumption within the context of Thailand.

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