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Energy security as an international norm: A normative shift

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Abstract

Key words:

International norms; norm diffusion; energy security; normative order.

This study aims to determine the effect of a shift in energy norms on the diffusion of energy security at the international level and the international normative order of energy. The data were collected using a cross-sectional methodology, and 220 responses were collected successfully. The Partial Least Square – Structural Equation Modeling (PLS-SEM) is utilized for data analysis, and Smart PLS 3.0 is employed. The findings confirmed that a shift in energy norms considerably and positively affects the international spread of energy security. Statistical analysis also confirmed that a shift in energy norms affects the international normative order of energy. The study has contributed novel findings to the body of knowledge, and the policy implications of this research are significant. The limitations and prospective directions of this research are explained.

Introduction

Energy is indispensable to the well-being and efficient operation of contemporary society. Energy empowers daily human, societal, and economic activities. Consequently, energy provides fundamental services and facilitates functionality. As energy is significant across all sectors of human society, it entails many actors at all levels, and its significance permeates time. In contrast, threats to energy would impact everything within its context (Adnan & Shahnin, 2021). Due to its significance in modern society, energy influences domestic and international politics inexorably. As a result of the uneven and unequal global distribution of natural resources, countries with limited energy resources are compelled to interact with other nations to acquire sufficient energy supplies to satisfy the expanding needs of their populations and economies. Historically, valuable resources and minerals were perceived as catalysts for interactions between individuals, social organizations, and political entities.

The valuable resources contributing considerably to world politics shifted from minerals, such as silver and gold, to energy resources, such as coal, crude oil, natural gas, and uranium (Menon & Sujatha, 2020). Countries with abundant energy resources acquire a particular advantage and superiority over those with limited or no energy resources, leaving the latter susceptible to supply disruptions or significant price fluctuations. Energy is, therefore, susceptible to international geopolitical maneuvering (Alves et al., 2019). As energy technology advances, energy norms have transitioned from traditional renewable energy (RE) to fossil fuels and nuclear energy. During the pre-modern era of energy, humans relied on muscular energy and used renewable energy for cooking, heating, and rudimentary automation. As RE use is a public benefit, traditional RE is typically produced and utilized domestically (Qiao-Franco, 2021). Energy and energy security were not discussed explicitly during this period.

After World War II, the secondary use of energy derived from fossil fuels marked the beginning of the modern energy era, in which modern energy services—particularly electricity and automobiles—became the symbol of civilization and industrialization (Yang et al., 2022). In addition, awareness of the adverse effects of fossil fuels on the environment increased progressively. As a result, nuclear energy was viewed as a viable option because nuclear power plants can generate massive quantities of electricity using limited fissile materials without emitting air pollutants (Lopez-Arboleda et al., 2019). Numerous nations are pursuing clean and green energy development in the power and transportation sectors while phasing out nuclear power plants to mitigate climate change, reduce reliance on imported fossil fuels, improve human security, and safeguard the environment for future generations. As previously mentioned, international efforts have been made to encourage a global energy transition toward sustainable, low-CO2 emission RE and advanced energy technology (hydrogen) and unconventional energy resources due to shifting energy norms and rising environmental consciousness. RE development and low-carbon, high-efficiency energy systems have become a priority in nations' energy policies worldwide. They are also supported by several international energy organizations (Sotnyk et al., 2021). Although using renewable energy is a public benefit, the energy-critical elements (ECEs) necessary for the modules to harvest energy and the supporting technology to manage its intermittent nature are not readily available. In other words, although renewable energy (RE) can be generated domestically by all nations to some extent through the harvesting of hydro, solar, and wind energy, the technology and materials required for the generation, such as permanent magnets, advanced batteries, thin-film semiconductors, and phosphors, are still constrained by the geopolitics of resources. RE is not entirely renewable, contrary to its name, because its systems require specific materials that are scarce and less likely to be recycled.

Countries that own territories associated with ECEs can benefit from the irregular geographical distribution of natural resources. For instance, China, the world's primary producer and processor of rare earth materials with abundant resources, processing infrastructure, and human capital, can become a new energy superpower, diminishing the significance of petroleum-exporting nations. A normative shift in energy utilization could alter the international system and influence the perception of energy security and its definition in the following ways. For example, a clash between the current and emerging energy major powers increased political tensions. Former energy major powers employed energy as a political weapon to maintain their power structure. The primary concern of this study is that a global energy transition toward renewable energy and advanced energy technology may result in a shift in global energy politics, thereby granting resource proprietors and their political interest's geopolitical advantage. A shift in global energy norms toward RE would also alter the geopolitics of energy resources, which determine the political powers of states.

In addition to the shifting international energy norms and power structure, the diffusion of international energy norms into domestic practice can be used to examine policy implications. While mainstream energy trends and international energy norms have been developed and evolved over decades, concerns have arisen regarding the policy implications for each country and the influence of international energy norms on the policy agenda. This research seeks to contribute to the limited literature in the interdisciplinary international energy relations and politics field. Understanding global energy politics' current and future landscape and its power structure is crucial, particularly for developing nations. In addition, policymakers who make policy decisions and establish policy orientations according to the dynamics of energy security in international politics could benefit from the research. The policy implications will be investigated via norm diffusion and socialization.

Review of Literature

While the existing literature on energy security covers a wide spectrum of dimensions and approaches (Menon & Sujatha, 2021), there are relatively few studies on normative approaches to energy security. Energy security is more likely to be shaped and driven by rational rather than normative considerations, which is both simple and probable. For instance, the rational choice theory would suggest that a nation-state increases its energy security through energy self-sufficiency because it enables the nation to be less dependent on external energy supply and more in control, not because it is the right thing to do. Based on this premise, the perception and interpretation of energy security are related to the country's particular energy requirements and contexts.

Still, even though energy security is highly context-dependent (Huang et al., 2021) and open to various interpretations, there have been specific types of normative principles that have guided the planning and implementation of policies aimed at addressing energy insecurity and enhancing energy security (Sotnyk et al., 2022). Energy security has become a more complex international norm as a result of the proliferation of increasingly diverse aspects of energy security throughout the international system about the specific kind of 'expected' behaviors and 'gradually more abiding' commitment to energy security practice within the framework of global energy governance (Trencher et al., 2020). Whether among policymakers or epistemic communities, the narrative regarding energy security is that a nation-state must ensure that its energy sector is adequate, accessible, affordable, and environmentally and socially acceptable (Valdes, 2021). Thus, the nation's functionality and economy can continue to operate and expand as intended. Such behavior consistency indicates the existence of an energy security standard. International norms, as independent variables in the study of international relations and foreign policy, are one of the dynamics that influence state behaviors and direct their interactions within the international system. Norm is defined as "a

widespread or usual practice, procedure, or custom" and "a principle of right action binding upon the members of a group and serving to guide, control, or regulate proper and acceptable behavior" (Adnan & Shahrina, 2021). Thus, norms carry two broad connotations: one focusing on uniformities in behavior, i.e., everyday state practice or recurring pattern of policy interactions, and the other focusing on the normativity or obligatory quality/property of norms, "which specifies what is acceptable and what is not within a particular group" (Alves et al., 2019). Scholars have classified international norms into various types, such as constitutive norms, prescriptive norms, prohibitive norms, regulative norms, and meta-norms (Yang et al., 2022). In addition, norms can be differentiated based on relevant actors—universal norms for actors and norms specific to partners (Lopez-Arboleda et al., 2019). Regardless, "norms permeate nearly every form of human interaction, disciplining behavior in the most unexpected ways" (Trencher et al., 2020), and energy security is no exception.

The study of norms about energy security is somewhat controversial; researchers aiming to provide a clear understanding of norms and their function on relevant entities have yet to reach a consensus because norms, particularly social norms, are remarkably dynamic, overlapping, and sometimes ambiguous (Valdes, 2021). On the other hand, several studies, particularly in international relations, have sought to comprehend the effects of international norms on domestic politics (Sotnyk et al., 2021). However, as specified, relatively few studies attempt to comprehend energy security as an international norm. In addition, researchers have investigated the relationship between a normative shift in energy and its impact on international politics, despite the acknowledged effects of a shift in energy resources (from fossil fuels to renewables) and energy transition on global politics (Lawless et al., 2020). To fill the gap and cast light on a potential change in the international system, this study focuses on explaining energy security as an international norm and its effects on perceptions of energy security and subsequent policy directions. This study has two hypotheses regarding relationships;

H1: Shift in energy norms influences the diffusion of energy security internationally.

H2: Shift in energy norms influences the international normative order of energy.

Methodology

Like energy research from a social science perspective, this investigation employs a quantitative methodology and empirical data. As the study's objective is to investigate the normative aspect of energy security and international energy politics, the research methodologies are primarily quantitative. Respondents in the field and policymakers' primary data on the influence of normative shift of energy and changing perception of energy security on world energy politics were analyzed quantitatively.

Regarding the data collection procedure, a formal invitation letter was sent after identifying prospective informants to their affiliated institutions or organizations. The letter described the project, provided the reason they were contacted, and included a list of tentative Likert scale questions. The scale elements used in this study are adapted from previously published research.

The recipients of the invitation letter were free to accept, decline, neglect, or delegate the task to others (each of whom would subsequently receive an invitation letter). Before commencing the survey for data collection, the researcher ensured that critical informants were aware of their consent and reminded them that they might withdraw at any time. The researcher then determined whether the informants wished to remain anonymous. The data were collected using a cross-sectional methodology, and 220 responses were collected successfully. After completing data collection, the researcher summarized critical details provided by informants to verify their accuracy. In addition, once the analysis portion of the research was completed, the researcher sent them a digital copy of the final draft (including any sections in which the informants participated or where their ideas or opinions influenced the manuscript).

Table 1. Normality Test

Items	Missing	Mean	Median	Min	Max	Standard Deviation	Excess Kurtosis	Skewness
DESIL1	0	3.691	4	1	7	1.860	-0.768	0.185
DESIL2	0	3.705	3	1	7	1.875	-0.769	0.314
DESIL3	0	3.695	3	1	7	1.948	-0.817	0.338
DESIL4	0	3.586	3	1	7	1.901	-0.742	0.375
DESIL5	0	3.586	3	1	7	1.855	-0.637	0.357
INOE1	0	3.614	3	1	7	1.909	-0.795	0.331
INOE2	0	3.486	3	1	7	1.780	-0.454	0.449
INOE3	0	3.523	4	1	7	1.925	-0.923	0.216
INOE4	0	3.473	3	1	7	1.823	-0.637	0.307
INOE5	0	3.645	3	1	7	1.774	-0.591	0.282
SEN1	0	3.255	3	1	7	1.519	-0.477	0.095
SEN2	0	3.273	3	1	7	1.811	-0.581	0.434
SEN3	0	3.541	3	1	7	1.879	-0.806	0.294
SEN4	0	3.505	3	1	7	1.920	-0.825	0.365
SEN5	0	3.555	3	1	7	1.743	-0.503	0.300
SEN6	0	3.514	4	1	7	1.833	-0.736	0.232
SEN7	0	3.514	4	1	7	1.835	-0.862	0.154

Data Analysis and Findings

The normality of any research data is evaluated to determine whether the data used in the study is appropriate for obtaining accurate results. This research has determined the missing values, and the results have confirmed no missing value in this investigation. In addition, the study

confirmed the validity of the skewness and kurtosis findings regarding data normality. The skewness values for the collated data did not exceed +1 (Royston, 1992). In contrast, the kurtosis values were more significant than -1. The findings are presented in Table 1, which confirms the normality of the data collected for this study. Thus, the data is deemed suitable for subsequent analyses to determine convergent and discriminant validity. In addition, the convergent validity test is utilized to determine the data's reliability and validity. Before the test of the hypothesis relationship, it is necessary to examine the normality of the data. Valid data are suitable for discovering significant findings. In this manner, the initial findings of factor loadings have been determined. Shevlin and Miles (1998) recommend that factor loadings be above 0.60 for scale items to be considered significant in any study. In addition, the study has determined the results of Cronbach alpha, which are examined to determine the collective validity of scale items. According to Tavakol and Dennick (2011), the Cronbach alpha value should be greater than 0.70. Additionally, the value of composite reliability was evaluated. Raykov (1997) suggests that the composite reliability values must be greater than 0.70 for the research results to be reliable. This investigation has thus determined the average variance extracted findings. Alarcón et al. (2015) recommend that for significant findings, the average variance extracted should be greater than 0.70. The convergent validity results reported in Table 2 confirmed that the desired results were obtained, and that the data in this study are valid and reliable.

Table 2. Convergent Validity

Variables	Items	Factor Loadings	Cronbach's Alpha	Composite Reliability	Average Variance Extracted
Diffusion of Energy Security at the International Level	DESIL1	0.894	0.946	0.959	0.824
	DESIL2	0.909			
	DESIL3	0.929			
	DESIL4	0.922			
	DESIL5	0.883			
International Normative Order of Energy	INOE1	0.893	0.942	0.955	0.811
	INOE2	0.902			
	INOE3	0.911			
	INOE4	0.903			
	INOE5	0.893			
Shift in Energy Norms	SEN1	0.887	0.958	0.966	0.800
	SEN2	0.897			
	SEN3	0.894			
	SEN4	0.874			
	SEN5	0.897			
	SEN6	0.911			
	SEN7	0.901			

The findings of discriminant validity are examined to determine whether the study's data collection elements are distinct. The average variance extracted square root method was used to test the discriminant validity in this study. [Fornell and Larcker \(1981\)](#) recommend that the results of one variable should be greater than those of other correlated variables. The outcome data presented in [Table 3](#) confirmed the discriminant validity of the study's findings.

Table 3. Discriminant Validity

Variables	Diffusion of Energy Security at the International Level	International Normative Order of Energy	Shift in Energy Norms
Diffusion of Energy Security at the International Level	0.958		
International Normative Order of Energy	0.942	0.901	
Shift in Energy Norms	0.931	0.822	0.794

In addition, the cross-loading method was used to examine the discriminant validity. This procedure is recommended for testing the correlation between each item's findings and the other constructs' other items. [Barlat et al. \(2013\)](#) recommend that the findings of one variable's items should be more significant than the correlational findings of other variables' items. [Table 4's](#) data confirmed that the study's cross-loadings are reliable. This test demonstrated conclusively that this research's findings have discriminant validity. Therefore, the data for this study have discriminant validity and are suitable for data analysis.

Table 4. Cross-Loadings

Items	Diffusion of Energy Security at the International Level	International Normative Order of Energy	Shift in Energy Norms
DESIL1	0.894	0.844	0.851
DESIL2	0.909	0.881	0.846
DESIL3	0.929	0.874	0.871
DESIL4	0.922	0.850	0.842
DESIL5	0.883	0.823	0.812
INOE1	0.869	0.893	0.824
INOE2	0.849	0.902	0.815
INOE3	0.876	0.911	0.872
INOE4	0.835	0.903	0.829
INOE5	0.809	0.893	0.810
SEN1	0.827	0.822	0.887
SEN2	0.821	0.820	0.897
SEN3	0.842	0.825	0.894
SEN4	0.844	0.824	0.874
SEN5	0.833	0.837	0.897
SEN6	0.843	0.824	0.911
SEN7	0.817	0.822	0.901

The structural equation modeling test is used to determine the relationships in this study. The study has tested the t-statistics for determining the path. The significance of the paths and their directions are also tested. It is recommended by [Ramayah et al. \(2018\)](#) that the findings of t-statistics should be above 1.96 for the significance of the hypotheses. The findings ($\beta = 0.931$, $t = 4.631$, and $p = 0.000$) of H1 confirmed that the shift in energy norms positively and significantly influences the diffusion of energy security at the international level. Meanwhile, the results ($\beta = 0.922$, $t = 4.656$, and $p = 0.000$) of H2 statistically confirmed that a shift in energy norms influences the international normative order of energy. In this way, both developed hypotheses of this research are statistically accepted for these findings.

Table 4. Path Findings

Relationship	Original Sample	Standard Deviation	T Statistics	P Values
Shift in Energy Norms -> Diffusion of Energy Security at the International Level	0.931	0.201	4.631	0.000
Shift in Energy Norms -> International Normative Order of Energy	0.922	0.198	4.656	0.000

Discussion and Conclusion

This study has statistically demonstrated that both hypotheses are significant. The findings of Hypothesis 1 confirmed that a shift in energy norms positively and substantially influences the international diffusion of energy security. In the meantime, Hypothesis 2 confirmed statistically that a shift in energy norms affects the international normative order of energy. The reliability of these findings is supported by statistical evidence, but they are also examined in the context of the existing literature. According to the findings of [Menon and Sujatha \(2021\)](#), international energy norms consist of standard state practices, policies, or behaviors about energy development, which are influenced to some extent by conventional energy trends and interstate interaction patterns and markets. According to [Lopez-Arboleda et al. \(2019\)](#), conventional energy trends represent the energy norms of any given period. Before the widespread use of conventional RE, essential strategic energy resources included biomass, solar, wind, and hydropower. As traditional RE was primarily used for cooking, lighting (in the traditional sense), and heating ([Yang et al., 2022](#)), energy production was predominantly domestic (regardless of the advent of the modern state system and the concept of delineated territorial areas). In addition, [Sotnyk et al. \(2021\)](#) reported that international energy standards were not notably distinct during this period. The regulations focused on collecting the adequate biomass required to provide fundamental energy services. Territorial expansion and conquests prompted the exchange (through trade and force) of both hydrocarbons

and renewable energy sources. In contrast to other valuable minerals, international energy politics during this period were not precisely driven by energy resources.

However, as energy technology development progressed and evolved, using hydrocarbons or fossil fuel resources altered the global energy landscape regarding geographic locations and political geography (Trencher et al., 2020). In contrast to the previous era of domestically produced traditional renewables, the dispersed yet concentrated fossil fuels divided the international system between the haves and the have-nots (Huang et al., 2021). While energy production from fossil fuels represents industrialization and civilization, rendering traditional renewables obsolete and implying energy poverty, international energy trade transactions, energy diplomacy, and energy-driven foreign policies indicate specific patterns of "normal and proper" state behavior (Trencher et al., 2021). The development of the international political economy (IPE) and the global governance of conventional (fossil) energy resources has been precipitated, according to Torney (2019). These concerns motivate efforts to eliminate fossil fuels and transition to RE. Subsequently, the drive for decarbonizing global energy systems and replacing fossil fuels emphasized using innovative renewables and electrifying several sectors. Concerning the frequent fluctuations in oil and gas markets, Wandera (2021) reported that the decrease in prices of solar PV and advanced renewable technologies increased the proportion of solar, wind, and other renewables in global electricity production. Clean and green energy or unconventional energy became a solution for mitigating climate change and ensuring future generations' energy security.

According to Dhal et al. (2020), norms are significant because they establish the international system's normative order and govern appropriate state practices and behaviors. To comprehend the normative or obligatory nature of practices or behaviors, it is necessary to comprehend norm classification. In addition, according to Palit et al. (2022), regulative norms are further subdivided into prescriptive norms (which prescribe appropriate or expected behaviors or practices), permissive norms (which permit certain behaviors or practices as acceptable within the system or community), restrictive norms (which restrict practices or behaviors and set specific boundaries for acceptable behavior), and prohibitive norms (which prohibit certain behaviors deemed as unacceptable). In addition to the level of normativity, international norms are categorized according to their scope, which includes actor-universal norms (applicable to all actors within a system or community) and partner-specific norms (applicable to the specific role of actors within a system or community). Corbett et al. (2019) reported that international norms for global energy trends and perceptions of energy security, which have been fossil-fuel-centric, have shifted toward RE. The core concepts of RE are solutions to create energy self-sufficiency, improve zero (or neutral) carbon energy systems, and demonstrate moral responsibility by selecting environmentally and socially acceptable energy

options (de Freitas et al., 2020). However, numerous rationales and arguments explain why RE, incorporated into international energy standards, is significant enough to influence the energy security concept (Henderson, 2019). Over the past decade, RE has become increasingly efficient (IEA, 2021). Although RE may not be as efficient as fossil fuels, it requires significantly less energy input or, in some instances, none. The cost-effectiveness of renewable energy generation, particularly for sophisticated RE, has decreased significantly.

Nonetheless, the diffusion and internalization of RE norms into domestic practices is a two-step procedure (Dhal et al., 2020). There is little opposition when contemplating how the internationalization of RE standards contributes to energy security (Liu et al., 2020). Second, the internationalization of RE standards is predicated on efforts to reduce CO2 emissions and mitigate climate change. Due to the technical and economic constraints of advanced RE development and investment, which are less cost-effective than fossil fuels, it faces opposition and requires incentives and persuasion (Le Billon & Kristoffersen, 2020). For the first dimension, once combined with energy security enhancement, countries are less likely to oppose the adoption of RE as a potential energy option, primarily because RE production—especially power generation—occurs domestically (Benabdallah, 2019). This indicates that RE addresses the available/accessible and reliable/uninterrupted dimensions of energy security. Domestic production and generation indicate relative energy independence or self-sufficiency to the extent that it precludes the need to import external energy supplies. Choosing RE reduces or eliminates exposure to energy risks caused by politically unstable trading partners, unsafe transport routes, or assaults on and plundering pipelines.

Therefore, there is little opposition to the adaptation process and strategic negotiation regarding whether RE standards should be internalized into domestic energy policies. States can regain control over the energy flow and supply chain by adhering to international RE standards (Rathore et al., 2019). Adaptation and strategic bargaining may be hindered by the technical and economic barriers of advanced RE production and generation; however, as energy security contributes to national security and interests, states are less hesitant to accommodate the norms (Yang et al., 2022). Regarding the second dimension, the discourse regarding RE norms about the perception of energy security corresponds to the environmental sustainability of energy systems, in addition to having positive effects on energy security. In other words, the socialization process for RE norms includes the demand for "proper" or "expected" energy policy directions that contribute to zero emissions and mitigate climate change (Sotnyk et al., 2021). Climate security unquestionably requires a concerted effort to mitigate climate change issues successfully. Additionally, RE standards have been indexed as the most efficient means of achieving this objective.

The process of raising moral awareness can be used to explain the narrative and discourse surrounding collective efforts to address climate change issues (Le Billon & Kristoffersen, 2020). RE norms aim to promote moral obligations beyond self-interests so that energy security is perceived as mutual security and interests. Similarly, the argumentation process reverberates in the diffusion of RE norms, where the debate over climate justice suggests states' reluctance to internalize RE norms into domestic practices (Qiao-Franco, 2021). Regarding persuasion, international, regional, and local cooperation initiatives have discussed incentives to encourage RE use (Valdes, 2021). The second dimension of RE norm diffusion confronts resistance and requires persuasion due to the individualistic nature of the energy security concept (David et al., 2022). This normative transformation impacts energy policy directions and the definition of energy security. The primary obstacle is the technical and economic constraints of advanced RE development and investment, which are still less cost-effective than fossil fuels. In other words, states would be motivated to make substantial initial investments in RE if fossil fuel technologies were less expensive, more efficient, and, most importantly, more familiar (Torney, 2019).

Regarding policy implications, the normative shift influences the conception and policy direction primarily because of the emergence of novel RE significant powers, who have acquired or own technologies and elements essential to advanced RE production, transmission, and storage, and to create a novel scenario and landscape for global energy politics (Adnan & Shahrina, 2021). Alves et al. (2019) suggest that the energy security concept could be less supply-centric and instead revolve around sophisticated technologies, elements, and minerals. Numerous developing nations have adopted RE standards and are reducing their greenhouse gas emissions through RE (Trencher et al., 2021).

Theoretical and Practical Implications

This research has contributed novel and significant findings to the existing body of knowledge. This study has added two new, statistically-proven relationships to the body of knowledge. First, this study contributed to the literature by demonstrating that a shift in energy norms positively and substantially influences the international diffusion of energy security. Second, this study contributed considerably to the understanding that a shift in energy norms affects the international normative order of energy. From a practical standpoint, many developing nations have adopted RE standards and are in the process of reducing their overall greenhouse gas emissions by utilizing RE. Thus, developing nations should recognize the ramifications of a shifting normative order, commence cautious exploration of potential deposits, and invest in relevant extraction and recycling research and development. In addition, another policy implication relates to the potential for developing nations to rely on the commodities utilized for RE production, transmission, and storage. This can create the illusion of energy self-sufficiency (domestic production of

RE) when energy security is still dependent on imports of raw materials. In addition, the prices of RE commodities ought to be indexed as an independent variable in energy security. The assessment and planning of energy security policies should consider how the normative shift affects energy security; otherwise, these nations would merely replace supply security with commodity security.

Future Directions

Although some studies have attempted to use international relations theories to capture and explain energy security and the geopolitics of energy resources, this study shed a different light on energy security. It used a bottom-up approach to investigate the complex concept of security studies. By conceptualizing energy security as an international standard, this study is a foundation for future research. Future research would include an in-depth examination of global energy governance, focusing on the role of non-state actors. In addition, future research must focus on qualitative data and conduct interviews to contribute to the body of knowledge. In addition, the best way to validate the study's findings is to compile data from various geographic populations.

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