Nuclear Engineering and Technology 54 (2022) 741–748

Contents lists available at ScienceDirect

Nuclear Engineering and Technology

journal homepage: www.elsevier.com/locate/net

Original article

Study on the policy literacy of the Republic of Korea regarding nuclear and new-renewable energy

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ARTICLE INFO

Article history:
Received 29 March 2021
Received in revised form
13 August 2021
Accepted 13 August 2021
Available online 14 August 2021

Keywords:
Nuclear energy policy
Policy literacy
Trust
Transparency
Policy PR

ABSTRACT

Policy literacy plays a critical role in enhancing deliberative communication among the public, policy-makers, and experts. It also helps develop a positive view of policy by the public, which facilitates public acceptance. Despite its importance, however, policy literacy has received little attention in energy policy practice. Therefore, this study explores factors affecting the public's understanding and knowledge (i.e., policy literacy) of nuclear and new-renewable energy policies. Accordingly, we analyzed data from an online survey of 790 laypeople in Korea. Specifically, we examined the effects of trust, transparency, and policy public relations (PR) on the policy literacy of the public regarding the two alternative energy sources. The analysis revealed that people showed higher policy literacy about the alternative sources when provided with more transparent information and exposed to more policy PR activities. However, we found that trust in energy plant operators played a negligible role in improving policy literacy for both energy sources. Based on these findings, we developed some policy suggestions to secure the energy policy literacy of the public.

1. Introduction

The continuous increase in energy consumption is increasing energy and electricity demand worldwide. In China, the energy capacity of nuclear power plants has and will continue to increase [1]. In contrast, Germany declared a nuclear phase-out after the Fukushima Daiichi nuclear disaster. Similarly, President Jae-In Moon of the Republic of Korea (ROK) promised to phase out the energy program that depended on nuclear power plants [2]. However, the anti-nuclear movement of the Moon administration has also been opposed. According to Richardson's paper, one of the reasons for this opposition toward the anti-nuclear energy policy of the ROK is the movement's insufficient strategies, for example, the lack of feasible alternative energy sources [3]. In this regard, the public is interested in not only nuclear energy, but also renewable energy sources such as solar, wind, and geothermal energy.

Policy literacy might require improvement to narrow the viewpoints of the public, decision makers, and experts in order to encourage public participation and enhance public acceptance. In particular, since the pros and cons of each energy source vary dramatically, people could compromise on energy issues based on mutual understanding and trust between groups by understanding the benefits and risks of each energy source. Therefore, we would like to claim the necessity of policy literacy for decision-makers and the public, because it can strengthen the modern democratic system.

Nevertheless, policy literacy has not received much attention in the field of energy policy because this field has focused on research on public acceptability. Policy literacy has been mainly discussed in the field of public relations. Based on this observation, the policy literacy of the public regarding nuclear and new-renewable energy was measured, and factors that can contribute toward encouraging policy literacy were suggested in this study. To this end, three tasks were planned. First, factors affecting policy literacy were found through literature reviews. Second, a survey was conducted among 790 members of the public. Third, the relationship between the abovementioned factors and policy literacy was empirically analyzed and verified.

This paper consists of six sections. Section 2 deals with the ROK's

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https://doi.org/10.1016/j.net.2021.08.018

current energy policy of nuclear and renewable energy, and Section 3 reviews the literature of policy literacy and factors affecting it such as trust, transparency, and policy public relations (PR) and develops hypotheses. Section 4 explains our research model, survey method and questionnaire, and the empirical analysis method, while Section 5 presents the results of hypothesis testing. Finally, Section 6 summarizes this study and provides policy implications based on the research.

2. Energy policy of the ROK

2.1. Nuclear energy

The government of the ROK announced 100 policy tasks for a five-year plan in 2017 [4]. This report stated that "*Nuclear power plants will be phased out on the basis of a nuclear phase-out roadmap, and the energy price system will undergo reforms to provide safe and clean energy*" [4]. The three remarkable energy policy roadmaps, which are presented in "The 8th Basic Plan for Long-term Electricity Supply and Demand (2017–2031)" [5] and "The 3rd Basic Plan for Energy" [6], are listed below:

1. Number of nuclear power plants in the ROK will be gradually reduced as follows: 24 nuclear power plants in 2017 → 28 nuclear power plants in 2022 → 18 nuclear power plants in 2031 → 14 nuclear power plants in 2038.
2. New-renewable energy accounted for 7% of the electricity produced in 2017, but it will increase to 20% by 2030.
3. Necessary technologies and selected regions will be appropriately developed for this energy plan. Moreover, this plan will attempt to push for the decommissioning of nuclear power plants in international markets.

Among other relevant policies, this study attends to the government projects designed to support the neighborhoods of nuclear power plants. Typical neighborhood support projects hand over the government's (particularly, Ministry of Trade, Industry and Energy) access to the electric power industry fund to the head of a local government or an electric power generation company. They try to enhance the understanding of local residents by improving the welfare and income of residents residing near nuclear power plants during the nuclear power plant construction period (temporary) or the nuclear power plant operation period (annual). The target of this support project is the region (town, township, or neighborhood) or islands located within a 5 km radius of a nuclear power plant. The support project is categorized into the basic support project, the special support project, and the extra support project. The basic support project is detailed in Table 1 [7].

2.2. New-renewable energy

According to Article 2 of the Act on the Promotion of the Development, Use and Diffusion of New and Renewable Energy, new-renewable energy in the ROK can be defined as energy from converting fossil fuels or converting renewable energy including geothermal energy and energy from sunlight, water, precipitation, and living organisms. In general, new-renewable energy has three categories of new energy and nine categories of renewable energy. New energy consists of hydrogen energy, fuel cells, and coal liquefaction gasification and vacuum residue gasification. Renewable energy includes solar photovoltaic power, solar heat, and bio, wind, hydro, marine, waste, geothermal, and hydrothermal energy.

In current, there are various supporting programs to supply the new-renewable energy system to the public. For example, the government financially supports people who would like to install the devices or system to use new-renewable energy in their house. Moreover, the regional support, solar power rental, and feed in tariff programs are available. The detail information for support programs is shown in Table 2 [8].

3. Theoretical discussion and set of hypotheses

3.1. Literature review

3.1.1. Definition of policy literacy

Literally, the term "literacy" means the ability of language use. Academics in diverse disciplines apply and expand the original meaning to refer to the knowledge and understanding of basic concepts and theories in their fields. For example, political literacy is defined as "the potential for informed political participation" and indicated as "knowledge of basic political concepts and facts" [9]. Milner calls it "civic literacy" which he defines as political knowledge and measures as the degree of political involvement [10]. In the area of public policy, the term "policy literacy," or "literacy in policy," is defined as the ability to understand the contents of government policies and their policy-making process [11].

Some scholars consider policy literacy a critical thinking ability regarding policy, which may lead to constructive suggestions for policy improvement, reaching beyond the level of the mechanical acquisition and retention of knowledge and skill [12,13]. In this vein, Yoon and Yoon include the ability to evaluate policy process and its contents at individual and collective levels in policy literacy [14]. According to Jung, it consists of three dimensions: traditional, functional, and critical literacy [15]. First, traditional literacy

Table 1
Support projects for the nuclear energy.

Project type	Content
Income increase	A project for regional development and income increase of residents by establishing and operating agriculture, forestry, fishery, and tourism industry facilities.
Public social welfare	A project to expand facilities related to social welfare and manage supporting programs by establishing a welfare hall or business to establish or operate medical, road, harbor, water management, environmental sanitary, radioactive disaster prevention, sports entertainment, and electric communication facilities, among others.
Educational work	A project to support the education of local residents by supporting educational equipment, board, lodging, and attending school, providing school expenses and scholarships, and establishing facilities for education and culture.
Resident welfare support	A project to assist with funds required for necessary projects to improve local safety and living environment of regional residents. A project to improve resident welfare by assisting with funds for their health examination fees, information, and communication charges.
Support to invite business companies	A project to increase local profits and jobs by assisting with the funds required to invite, establish, and manage business companies.
Assistance with electric charges	A project to assist with funds for residential and industrial power, as provided in the provision of Article 16 of the Electric Utility Act.
Extra support	A project to enhance the cooperation of regional residents for the purpose of supporting the area around the nuclear power plant.

Table 2
Support projects for the new-renewable energy.

Project type	Content
Residence Support	Financial supporting that the installation of devices or system to use new-renewable energy in a house
Regional Support	Support to install or establish the new-renewable energy system in facilities owned or managed by local governments
Solar Power Rental Project	A lender for the solar light power generation system installs that system in a house and requests a rental fee to the house holder
Feed in Tariff	If the electricity price supplied by the new-renewable energy is higher than the standard price announced by the government due to the large initial investment of the new-renewable energy system, the difference between two prices is supported to a resident.

pertains to the acquisition and retention of knowledge about a policy. Second, functional literacy is about the ability to utilize the knowledge in daily life. Third, critical literacy requires insight to understand the effects of a policy. Given the distinction, critical literacy may be understood as the literacy of the most sophisticated skill, while traditional literacy requires the foundational skill.

Among the literacy skills of different levels and forms, we attend to traditional literacy, measuring literacy with individuals' knowledge and understanding of a policy. We see that the type of literacy represents a fundamental aspect of policy literacy and forms the foundation on which other sophisticated skills can be developed.[1] In this regard, we define policy literacy in the context of policies of nuclear and new-renewable energy sources, limiting our interest to the level of knowledge of policy contents and policy-making process related to each energy source.

3.1.2. Factors affecting policy literacy

The public can develop their understanding of a policy based on the information of its contents and policy-making processes. While the government and its agencies form the primary information channel, other information channels exist as well [16]. When exploring factors influencing policy literacy, it is important to understand the channels through which individual citizens acquire information and knowledge regarding a policy. For example, Woo showed that media communication activities (e.g., newspapers) and participation in private conversations regarding public issues can improve people's understanding of policies [17]. Similarly, Wolbring, Leopatra, and Yumakulov reported that the online and offline media use of the participants in a policy increases policy literacy [18]. In addition, according to Choi and Park, increased contact with local and central governments on their e-government platform or more frequent offline face-to-face meetings are associated with a higher level of public knowledge about the central government's policies [11]. Mu, Li and Fu found that government communication including prior consultation and policy training can facilitate policy understanding regarding energy conservation in China [19]. As such, prior literature suggests that frequent and effective interactions between participants in policy governance may improve policy literacy. It is understood that people's active engagement in private conversion or policy deliberation processes in both online and offline channels leads to better policy understanding and specialized policy knowledge [11,15,17,20].

Extending the prior literature, this study explores the potential determinants of policy literacy. They include trust in government agencies operating power plants (i.e., power plant operators), transparency in the policy-making process, and policy PR. Trust in policy makers and a transparent policy-making process can facilitate interactive communication between the government and the general public [16], which, in turn, improves policy literacy. Transparency, which contributes to increasing information flow between energy providers and households [21], can improve policy literacy. More policy PR activities involve more information exchanges between information providers (i.e., policy makers) and recipients (i.e., the public) and, therefore, increase awareness of a policy of interest. The next section develops hypotheses regarding the relationship between each factor and policy literacy.

3.2. Hypothesis development

3.2.1. Trust

Trust is a variously defined multidimensional construct. Across many academic disciplines, trust means "that the probability that he will perform an action that is beneficial or at least not detrimental to us is high enough for us to consider engaging in some form of cooperation with him" [22]. In other words, trust can be defined as an expectation or belief that one will behave in a favorable manner toward another. In social capital theory, trust is understood as a network among individuals and it is seen as social capital underlying socio-economic development and democracy formation [23]. Extending the general definition provided in the literature to nuclear energy policy, trust involves predictability based on firm belief in others, which can reduce uncertainty and risk factors of nuclear power [24,25].

In this study, we conjecture that trust in government agencies increases the public's effective acquisition of the information that the government delivers. The literature on collaborative governance suggests that "thick communication" through face-to-face dialogue between stakeholders establishes trust among them, which then helps with developing a shared view of what they collectively pursue [26]. In other words, a collaborative learning process based on trust can facilitate more frequent and effective interactions between the relevant parties. Thus, it leads to better understanding of the other's stand and, if identified, common goals. Policy research generally agrees that trust in government agencies plays a positive role in developing civic engagement in policy deliberation and narrowing the gap in policy literacy among the public [15]. Accordingly, a high level of trust in government agencies that operate alternative energy source power plants can help unite relevant interest groups in the energy policy deliberation process. The opinion-sharing process opens up opportunities for (previously) uninformed parties to learn more about and understand the government's position over a policy. The discussion leads to the following hypothesis:

H1. Trust in energy plant operators[2] is positively associated with policy literacy.

[1] It is also noted that despite the notable expansion of literacy concept, prior empirical studies in the area have made little progress in developing reliable and robust indicators for the high-level literacy, i.e., functional and critical literacy. Even Jung [15], who distinguishes the three types of literacy, uses a single policy literacy measure only for the level of understanding of a policy.

[2] In Korea, state-owned enterprises, specifically Korea Hydro & Nuclear Power and Korea Energy Agency, operate the nuclear plants and new-renewable power plants, respectively. They develop and implement nuclear energy policies in consultation with and on behalf of the government. For this reason, we equate the trust for energy plant operators with the trust for general policy makers.

H1-1. Trust in nuclear energy plant operators is positively associated with policy literacy.

H1-2. Trust in new-renewable energy plant operators is positively associated with policy literacy.

3.2.2. Transparency

Transparency is defined as "the process through which public authorities make decisions, (which) should be understandable and open; the decisions themselves should be reasoned; as far as possible, information on which the decisions are based should be available to the public" [27]. In other words, transparency involves (ideally) full disclosure of information across the entire policy-making process; it is the degree of openness and truthfulness of information to the public in the bureaucratic process. This study measures transparency as the extent to which power plant operators disclose information related to their plant's operation, safety conditions, and community support programs to the public.

The government would be willing to provide information on energy policies through PR activities across diverse channels, including the public media and the e-government platform. While the quantity of information delivered to the public matters, higher quality information in terms of transparency also likely leads to greater acceptance of the information and improvement of policy literacy. Since power plants are recognized as dangerous facilities, it is crucial to the public that they are managed properly. In this regard, transparent disclosure of their operation offers a critical means for the public to scrutinize their operation and secure their safety. Moreover, another important dimension of information quality relates to timeliness. In other words, information regarding effective management and safe operation should be disclosed to all stakeholders in a timely manner or immediately after all relevant events occur. Timely disclosure would also help the public understand the energy policy. This discussion leads to the following hypothesis:

H2. Transparent disclosure of information is positively associated with policy literacy.

H2-1. Transparent disclosure of information on nuclear energy is positively associated with policy literacy.

H2-2. Transparent disclosure of information on new-renewable energy is positively associated with policy literacy.

3.2.3. Policy public relations

Policy PR refers to the activities of deliberately providing the public with information about a policy, which leads to the public's positive view of the policy. It includes not only providing policy information delivered unilaterally to the public, but also providing an interactive exchange of information and opinion between the government and the public. Lee, Lee, and Oh investigated attitudes toward tourism crisis management policy and found that policy literacy mediates the relationship between policy PR activities and policy support [13]. In other words, policy PR not only improves the policy understanding of the public, but also leads to a more favorable and supportive attitude toward the policy.

Any energy source, even a promising new-renewable source, has both advantages and disadvantages and, therefore, is subject to criticism. For this reason, when facing stakeholders opposing an energy source, the government is keen to expand its PR effort to promote energy source policies [28]. Focusing on the information provided to the public, this study measures policy PR as the extent to which power plant operators provide information about the goals, contents, effects, and needs of energy policies. Policy PR can contribute toward improving people's policy literacy by helping them understand the policy's goals and contents. In addition, it can lead to the positive evaluation of policies and enhance public policy support and acceptance. This leads to the following hypothesis:

H3. Policy PR is positively associated with policy literacy.

H3-1. Policy PR for nuclear energy is positively associated with policy literacy.

H3-2. Policy PR for new-renewable energy is positively associated with policy literacy.

4. Designing research

4.1. Data collection and analysis method

For this study, an expert company conducted a survey from May 20, 2018 to June 7, 2018 (two weeks). An internet-based survey method was used. Survey data were collected from 790 people who were over 19 years of age. They were selected using stratified random sampling proportional to population size. In terms of the demographic characteristics of the respondents, 394 (49.9%) were women and 396 (50.1%) were men. Academically, 527 respondents (66.7%) were university graduates. The largest respondent group was over 50 years of age, with 206 people. Other age groups were evenly distributed between 22% and 23%. Detailed information of the respondents is shown in Table 3.

In this study, a social science statistical analysis software (SPSS 22.0, Stata14) was used for the empirical analysis such as the character analysis, reliability analysis, and factor analysis to determine the common factors between variables. Finally, multiple regression analysis was performed to verify the causal relationship between variables.

4.2. Research model

The purpose of this study was to measure the public's perception of policy literacy, i.e., perceived policy literacy, regarding nuclear and new-renewable energy and determine the factors that affect perceived energy policy literacy. Moreover, the perceptions of nuclear energy and new-renewable energy were separately analyzed to compare and analyze whether the factors affecting the perceived policy literacy of nuclear and new-renewable energy were identical. A trust factor, a transparency factor, and a policy PR factor were independent in the analysis of the factors influencing perceived policy literacy. The analysis was intended to empirically derive and analyze the causal relationship and influence factors between the independent and dependent variables by setting the perceived policy literacy of energy as the dependent variable, as shown in Fig. 1.

4.3. Measurement and analysis method for variables

The independent and dependent variables used in this study were measured using a 5-point Likert scale (5 = very positive, 4 = somewhat positive, 3 = neither positive nor negative, 2 = somewhat negative, and 1 = very negative). The trust, transparency, and policy PR factors as the independent variables consisted of 7, 5, and 5 questions, respectively. The perceived policy literacy factor used as the dependent variable was composed of 5 questions based on the concept of traditional literacy. Table 4 summarizes the questions for each variable. Identical questions were used for both nuclear and new-renewable energy.

Table 3
Demographic characteristics of the sample.

Variable		Number of people	%
Gender	Men	396	50.1
	Women	394	49.9
Academic background	MSG	4	0.5
	HSG	138	17.5
	US	65	8.2
	UG	527	66.7
	GG	56	7.1
Age	20s	174	22
	30s	173	21.9
	40s	186	23.5
	≥50s	257	32.5

MSG: Middle school graduates, HSG: High school graduates, US: University student, UG: University graduates, GG: Graduate school graduates.

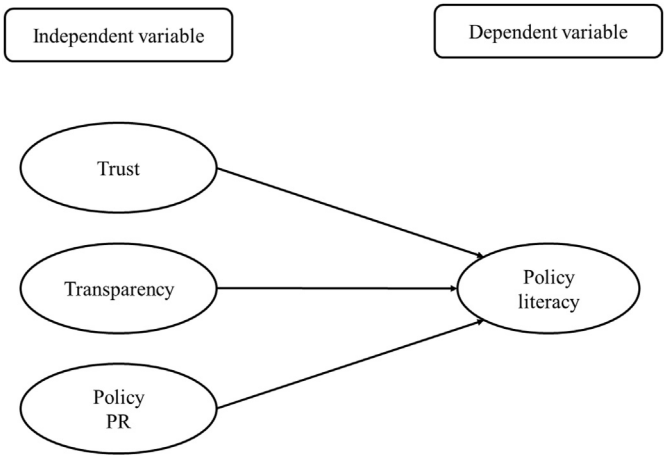

Fig. 1. Research model to analyze policy literacy impact factors.

5. Results

5.1. Reliability verification and exploratory factor analysis

Feasibility and exploratory factor analyses were conducted to verify the reliability and validity of the assessment tool. In the exploratory factor analysis, i) a varimax rotation was performed and ii) factors with an eigenvalue greater than one were extracted. The results of the reliability verification showed that the Cronbach's α values for nuclear and new-renewable energy were equal to or greater than 0.9, as shown in Table 5. Reliability is a concept that indicates the degree of consistency between measured variables. It refers to the variance in values that are repeatedly measured for an identical concept. In general, if the Cronbach's α value is equal to or greater than 0.8, it can be said that reliability is secured. Therefore, we can claim the reliability of this study.

The results of the exploratory factor analysis on nuclear and new-renewable energy showed that the factor loading, perceived

Table 4
Survey questions.

	Variable	Question
Dependent variable	Perceived policy literacy	A1 I have knowledge of nuclear (new-renewable) energy.
		A2 I know the system of law for nuclear (new-renewable) energy.
		A3 I know an organization related to nuclear (new-renewable) energy
		A4 I know the government's supporting programs for the residents living near nuclear power (new-renewable) plants.
		A5 I understand the nuclear (new-renewable) energy policy.
Independent variable	Trust	B1 Nuclear power (New-renewable energy) plant operators are reliable.
		B2 Nuclear power (New-renewable energy) plant operators strive for local development.
		B3 Nuclear power (New-renewable energy) plant operators can safely operate a nuclear power (new-renewable energy) plant.
		B4 Nuclear power (New-renewable energy) plant operators fulfill their promises to the residents.
		B5 Nuclear power (New-renewable energy) plant operators strive to strengthen community ties.
		B6 Nuclear power (New-renewable energy) plant operators are willing to resolve conflicts through dialogue.
		B7 Nuclear power (New-renewable energy) plant operators are concerned about the safety of their residents.
	Transparency	C1 Nuclear power (New-renewable energy) plant operators transparently disclose information about power plant operations.
		C2 The government transparently discloses information about the operation of nuclear power (new-renewable energy) plants.
		C3 Information on the safety status of the nuclear power (new-renewable energy) plants currently in operation is completely provided.
		C4 I have heard of nuclear power (new-renewable energy) plant operators explaining nuclear (new-renewable energy) safety.
		C5 Information on the regional cooperation and support projects of nuclear power (new-renewable energy) plant regions and their progress are provided in detail.
	Policy PR	D1 Nuclear power (new-renewable energy) plant operators are providing information about the goals of the nuclear (new-renewable) energy policy.
		D2 Nuclear power (new-renewable energy) plant operators are providing detailed information on the nuclear (new-renewable) energy policy.
		D3 Nuclear power (new-renewable energy) plant operators are providing detailed information on the effects of the nuclear (new-renewable) energy policy.
		D4 Nuclear power (new-renewable energy) plant operators are promoting the nuclear (new-renewable) energy policy via various media.
		D5 Nuclear power (new-renewable energy) plant operators are explaining the need for the nuclear (new-renewable) energy policy comprehensively to the public.

Table 5
Results of reliability verification for measured variables.

	Nuclear energy		New-renewable energy	
	Variable	Cronbach's α value	Variable	Cronbach's α value
Dependent variable	Perceived policy literacy	0.906	Perceived policy literacy	0.936
Independent variable	Trust	0.951	Trust	0.951
	Transparency	0.926	Transparency	0.935
	Policy PR	0.925	Policy PR	0.937

policy literacy, policy PR, and transparency for nuclear energy were 0.763–0.836, 0.755–0.839, 0.802–0.855, and 0.740–0.766, respectively. In the case of new-renewable energy, the factor loading, perceived policy literacy, policy PR, and transparency were 0.744–0.845, 0.795–0.888, 0.784–0.816, and 0.724–0.800, respectively, as shown in Table 6. Therefore, we can say that validity for nuclear and new-renewable energy was secured.

5.2. Hypothesis testing

The results of the empirical analysis examining the factors affecting perceived policy literacy are as follows. First, the effect of the trust factor on perceived policy literacy was insignificant for nuclear energy. In contrast, the effects of the transparency ($\beta = 0.202$, $p < 0.001$) and policy PR factors ($\beta = 0.159$, $p < 0.001$)

Table 6
Results of exploratory factor analysis on measured values.

	Nuclear energy				New-renewable energy			
	T	PL	PP	TY	T	PL	PP	TY
T7	.836	.212	.088	.214	.845	.101	.244	.195
T5	.834	.196	.117	.246	.842	.110	.182	.214
T6	.831	.179	.108	.222	.835	.128	.234	.226
T2	.822	.239	.125	.239	.829	.116	.183	.198
T4	.816	.221	.055	.148	.828	.127	.151	.279
T3	.814	.217	.070	.245	.789	.139	.247	.201
T1	.763	.187	.101	.295	.744	.136	.202	.265
PL4	.229	.838	.143	.223	.144	.888	.163	.172
PL3	.238	.792	.145	.156	.102	.884	.130	.186
PL5	.252	.786	.129	.288	.154	.874	.187	.068
PL2	.267	.769	.152	.246	.110	.846	.057	.260
PL1	.261	.755	.155	.365	.110	.795	.206	.037
PP4	.119	.099	.855	.084	.232	.167	.816	.196
PP1	.116	.096	.846	.139	.261	.173	.807	.239
PP3	.113	.152	.846	.080	.256	.159	.807	.281
PP2	.042	.128	.809	.044	.258	.179	.785	.318
PP5	.057	.103	.802	.241	.240	.205	.784	.241
TY5	.256	.337	.211	.766	.277	.204	.272	.800
TY3	.376	.288	.129	.755	.316	.181	.293	.793
TY4	.250	.301	.203	.745	.280	.216	.210	.784
TY2	.321	.267	.112	.743	.309	.161	.315	.738
TY1	.422	.204	.131	.740	.354	.114	.317	.724
Eigenvalue	5.578	3.882	3.765	3.637	5.536	4.104	4.034	3.785
Variance Ratio	25.356	17.647	17.115	16.533	25.163	18.656	18.334	17.206
Cumulative variance	25.356	43.003	60.118	76.651	25.163	43.819	62.153	79.360

T: Trust, PL: Perceived policy literacy, PP: Policy PR, TY: Transparency.

Table 7
Comparison of empirical analysis results for nuclear and new-renewable energy.

	Nuclear energy					New- renewable energy				
	unstandardized coefficient		t	p	VIF	unstandardized coefficient		t	p	VIF****
	β	Std. Err				β	Std. Err			
Constant	1.476	0.089	16.636	0.000***		0.900	0.116	7.748	0.000***	
Trust	−0.001	0.036	−0.016	0.987	1.862	0.060	0.045	1.327	0.185	1.804
Transparency	0.205	0.040	5.147	0.000***	2.269	0.227	0.043	5.283	0.000***	2.154
Policy PR	0.154	0.038	4.106	0.000***	1.905	0.220	0.041	5.353	0.000***	1.889
Number of obs = 790						Number of obs = 790				
R-squared = 0.161						R-squared = 0.223				
Adj R-squared = 0.158						Adj R-squared = 0.220				

*p < 0.05, **p < 0.01, ***p < 0.001.
****VIF is a value to determine the multicollinearity between variables. If VIF is equal to and less than 10, we can see that there is no strong correlation between independent variables.

were significant. This result could be explained as follows. The trust of a power plant operator could not impact on improving perceived policy literacy of nuclear energy. In contrast, enhancing the transparency of information and providing the information related to the safety issues could improve perceived policy literacy. Moreover, the policy PR via various media and opening detailed information for nuclear energy could enhance perceived policy literacy.

Second, similar to nuclear energy, the effect of the trust factor on perceived policy literacy was insignificant with new-renewable energy. However, transparency ($\beta = 0.229$, $p < 0.001$) and policy PR ($\beta = 0.214$, $p < 0.001$) had significant effects. The trust to an operator of a new-renewable energy system could not improve perceived policy literacy. Similar to the nuclear energy case, the transparency of information and the active policy PR can enhance perceived policy literacy.

The verification of the research hypothesis based on the above results was as follows: 1) hypotheses 1-1 and 1−2 based on trust having a positive effect on perceived policy literacy were rejected; 2) hypotheses 2-1 and 2-2 assuming that transparency affected perceived policy literacy positively were accepted; 3) hypotheses 3-1 and 3-2, which stated that policy PR had a positive effect on perceived policy literacy were accepted.

According to the β values of the empirical analysis shown in Table 7, it was shown that both transparency and policy PR had a statistically significant effect. Transparency in the nuclear energy business had a greater effect than the policy PR factor, while those two factors had similar influence in the new-renewable energy business as shown in Table 7. Therefore, we can claim that transparency in information disclosure is more important than the policy PR in the case of nuclear energy.

6. Conclusions and policy implications

This study set perceived policy literacy as a dependent variable and set trust, transparency, and policy PR as independent variables and used multiple regression analysis for nuclear and new-renewable energy. The results of the empirical analysis showed that the trust factor did not have a significant effect on perceived policy literacy for either nuclear or new-renewable energy. However, the transparency and policy PR factors had a significant effect on perceived policy literacy for nuclear and new-renewable energy.

These results have the following policy implications. First, the result shows that trust in government agencies that operate nuclear plants and new-renewable energy plants does not improve policy literacy. We hypothesized that trust would facilitate more frequent and effective interactions between the public and government agencies, develop civic engagement in policy deliberation process and, accordingly, enhance the public's understanding and knowledge of relevant energy policies. Our finding, however, suggests that while trust-based communication would help information sharing among relevant parties, it may not necessarily lead to more knowledge. It is because knowledge acquisition requires additional cognitive efforts and capabilities than simply having more opportunities to get to know the other party's standing. A potential future study would consider other factors such as policy acceptance [29] as a mediating factor that may bridge the relationship between trust and policy literacy.

Second, the transparency of information not only for the nuclear energy system but also the new-renewable energy system was a crucial parameter to enhance the perceived policy literacy. Therefore, more innovative methods for the disclosure of information are necessary. For example, when nuclear power plant operators or nuclear commissions release information, a system that notifies all processes of information generation and processing such as the US Nuclear Regulatory Commission is required. If nuclear power plant operators or nuclear commissions provided only results, people would often suspect the results due to lack of information. Therefore, nuclear power plant operators or nuclear commissions should have a system that can show at least a part of the formation generation process within an appropriate range.

Third, this study showed that the policy PR was a factor positively influenced on the perceived policy literacy. We could insist that continuously providing easily understandable information of nuclear energy and new-renewable energy to public could enhance perceived policy literacy of public. Promotion of each energy system via various media could increase not only perceived policy literacy but also knowledge of the energy system and understanding that system. In this regards, power plant operators should not only expand roles of the PR department, but also develop methodologies to promote their policy through various media such as YouTube and blog, etc.

Since this study focused only on the factors influencing policy literacy, the empirical analysis of the relationship between policy literacy and public acceptance was limited. In the future, it will be necessary to analyze how trust, transparency, and policy PR, which are independent variables, affect policy literacy via public acceptance using structural equation models. Furthermore, this study was based on the survey from public excluding experts. In

measuring policy literacy, we did not use structured knowledge competency as a measurement index. Therefore, it will be meaningful to include the advice and comments from relevant experts for a specific strategy to secure policy literacy about nuclear and new-renewable energy in the future.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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