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Leveraging System Thinking: Diplomatic Strategies for Nuclear Power Plant Development to Support Indonesia's Net Zero Emission 2060

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Abstract

Indonesia's energy sector faces pressing issues related to emissions and sustainability, such as greenhouse gas emissions in 2023 reaching 1.24 Gigatons and the New and Renewable Energy mix is still 13.09% far from the target of 31,89% in 2030. On the other hand, Indonesia has international commitments to require an energy transition to Net Zero Emission (NZE) by 2060, including building a Nuclear Power Plant (NPPs). This research explores the transformative of multitrack diplomacy through Track 1. Government, Track 2. professional conflict resolution, and Track 4. private citizens in reshaping Indonesia's energy landscape of nuclear power plant development, which aims to achieve NZE by 2060. This research method uses a descriptive qualitative approach with a Systems Thinking Analysis to help make sense of complex and hard-to-understand situations by examining the interconnected components of a diplomatic strategy to complete energy resources domestically. The expected results of this research will provide insight into how energy diplomacy can effectively promote the growth of nuclear power for electrical energy to various countries so that Indonesia can become a significant player in the world as a pioneer of the first nuclear power plant in ASEAN. This research concludes that based on multitrack diplomacy, it has successfully encouraged government investment, predicted intervention from other parties, and increased public acceptance of the construction of Nuclear Power Plants in Indonesia in 2040 by the 2060 Net Zero Emission target.

Keywords: **Syste*m thinking, Diplomacy Strategy, NPPs***

INTRODUCTION

Amidst the complexity of global dynamics in the energy sector, Indonesia is in the spotlight as it bears the brunt of pressing issues related to emissions and sustainability. Energy diplomacy is crucial to increasing the renewable energy mix to reduce environmental problems and lower emissions. Carbon emissions and other pollutants from energy production and consumption have become a significant cause of climate change and environmental degradation. For information, according to European Commission data (2022), the volume of greenhouse gas emissions in 2022 reached 1.24 gigatons of carbon dioxide equivalent (Gt CO2e), an increase of 10% over the previous year (year-on-year). It accounted for about 2.3% of total global greenhouse gas emissions (Bastori and Birmano 2018).

The use of energy that is still dominated by fossil energy has left a detrimental trace in increasing Greenhouse Gas Emissions in Indonesia, and this is evidenced by the primary energy mix in 2023 consisting of Coal (40.46%), petroleum (30.18%), natural gas (18.28%), and New Renewable Energy (13.09%). Due to the low level of renewable energy in Indonesia, the government has set a target of renewable energy mix, which is contained in the Enhanced Nationally Determined Contribution (ENDC) document. The emission reduction target was raised to 31.89% unconditionally and 43.20% conditionally by 2030. The hope is that Indonesia will achieve net zero emissions by 2060 or sooner (Arindya 2017; Susiati 2014).

The determination of the target is one part of Indonesia's commitment to realizing net zero emissions in the Paris Agreement, followed by 195 countries combating climate change by reducing gas emissions. To achieve this, Indonesia has discussed the use of nuclear for electricity starting in 2039. Nuclear energy is one of the sources with the lowest carbon emissions after

hydro energy. In the Conference of the Parties (COP26) on climate change, nuclear energy began to attract attention as a solution to reduce carbon emissions. Some countries, such as the United States, France, South Korea, and Japan, have used nuclear power as the main electric power generator for industries, households, schools, and others (Ariana, Wijaya, and Hidayah 2021; Wauran 2009).

In addition to its significant benefits, Nuclear Power Plants in Indonesia can potentially cause security concerns in other countries related to radioactive leaks or accidents that can have an inter-state impact and misuse of nuclear technology for other purposes. Given all this, energy diplomacy plays a central role and is a crucial element in international efforts to design strategies for nuclear power plant development. Diplomacy, in this case, not only involves bilateral or multilateral negotiations but also pays attention to and maps the complexity of the political, technical, and social factors involved. Furthermore, in answering the complexity of the development of Nuclear Power Plants, a deep understanding of the system thinking approach is needed, which leads to a thorough study in analyzing the existing potential and formulating policies in realizing the development of Nuclear Power Plants through diplomacy strategies (Bukhari 2021; Wauran 2009)

The purpose of this paper is to present an analysis of a comprehensive understanding based on System thinking in the development of diplomacy strategies towards the involved and interrelated aspects such as Government, Society, and potential tensions between countries so that all of these can be put together in an effective diplomacy strategy. This analysis is expected to identify concrete steps that can be taken to facilitate Indonesia's transition to cleaner and more sustainable energy sources, achieve the 41% energy mix target in 2050, and realize the Net Zero Emission goal in 2060 or sooner (Anggoro et al. 2013; Hussein et al. 2020).

RESEARCH METHODS

This article is compiled using descriptive qualitative research methods to explain the analysis of Indonesia's achievement of net zero emission 2060 through the diplomatic strategy of building Nuclear Power Plants. In addition, this article is based on system thinking, which is poured into a depiction or modeling of system dynamics using depiction through Causal Loop Diagrams using the Vensim PLE x64 application (Creswell 2008, 2009) .

Accordint to (Wardito, Purba, and Purba 2021), System thinking is an approach that tries to see a phenomenon by looking at components that appear to be isolated and independent as an element that is connected in a particular pattern. System thinking is holistic, where in examining a phenomenon, system thinking will track the cause and effect of a phenomenon that has interrelationships and is often cross-disciplinary. System thinking is an essential analytical tool because of its ability to dissect complex problems. Analysis through system thinking will produce a high-impact and sustainable solution.

Experts equate system thinking with non-linear thinking because, in system thinking, the mindset used to see a phenomenon is not in the form of a straight line but in the form of a loop or circle. System thinking will map phenomena based on their cause and effect. This mapping is done through causal loop diagram (CLD) modeling. A causal loop diagram is a representation of reality. In CLD, there is feedback. The essence of this feedback is that something must cause something else, and something else must eventually impact something that causes it, either directly or indirectly. The philosophy behind causal loop diagrams is that whatever we do will not just disappear but will have an impact on the system, which will feed back, impacting us over time. A CLD comprises three components: variables, connectors, and labels. Here in Figure 1. is an example of a simple CLD:

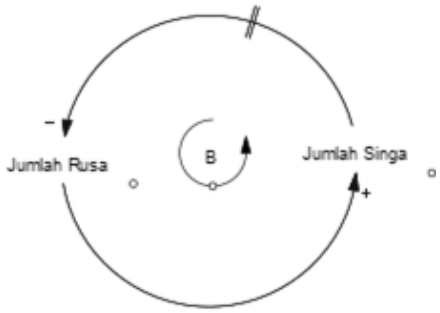

Figure 1. Cause & Effect from Causal Loop Diagram

As mentioned earlier, there is feedback in CLD. In a CLD, you will also find (+) and (-) signs that indicate the nature of the relationship, whether it is positive (+) (an increase in A causes an increase in B) or negative (-) (an increase in A causes a decrease in B). There is also a ≠ sign that indicates a delay. A CLD can represent growth or reinforcing (R), or it can represent balancing (B). In the simple CLD example above, the CLD can be read as follows:

- The more the number of deer, the more the number of lions (+)
- The more the number of lions, the less the number of deer (-), but it will not happen directly ≠
- The CLD property is balancing.

In international relations studies, the use of systems thinking as a research method is still relatively small. In fact, International relations is very complex and often crosses the boundaries of other disciplines and across various national boundaries. This complexity is very suitable if examined using system thinking, which can dissect the complexity by mapping causes and effects through causal loop diagrams. In order to find a diplomacy strategy for the construction of Nuclear Power Plants to achieve net zero emission by 2060, authors have successfully utilized system thinking in revealing the variables connected with CLD mapping through Vensim PLE x64 software.

In this research, the data analysis process is divided into several stages: data collection, interpreting and describing data, analyzing data, and drawing conclusions. Analyzing and interpreting data in this article is assisted by the Vensim PLE x64 application to map the Causal Loop Diagram of system thinking. In terms of the validity of the data obtained is done through data collection from various sources in order to obtain valid data

RESULT AND DISCUSSION

Dynamics and potential of Nuclear Energy for electric power in the world and Indonesia through System thinking

The development of Nuclear Power Plants (NPPs) in Indonesia has always been one of the exciting topics that is often discussed in various forums by various government sectors and academics because it is one of the new renewable energy sources. The primary fuel in this plant is uranium, a weak radioactive metal generally formed in the earth's crust layer. Besides Uranium, Thorium can also be an alternative fuel for Nuclear Power Plants. Thorium is a fertile material, and when absorbing neutrons, it becomes fissile material U-233, which, in a nuclear reactor, can produce a chain reaction and be used as a nuclear power plant fuel.

The potential for the development of Nuclear Power Plants in Indonesia can be seen from the uranium reserves owned by around 70,000 tons of U3O8 (yellow cake), most of which are located in West Kalimantan, Papua, Bangka Belitung, and West Sulawesi. Of the 70,000 tons of

uranium, 1,608 tons are in the measured category, 6,456 tons are in the indicated category, 2,648 tons are inferred, and the rest are in the hypothetical category. The existence of nuclear minerals in Indonesia is spread over 26 locations in Sumatra, Kalimantan, Sulawesi, Maluku, and Papua. The uranium and thorium resources have been estimated at nine deposit locations. In 2021, the amount of uranium resources is 89,483 tons of U3O8 (the heat generation value for uranium this amount is equivalent to heat generation by 1.85 Trillion tons of coal), while the amount of thorium resources is 143,234 tons. Details of radioactive mineral resources in Indonesia can be seen in Table 1.

Table 1. Indonesian Radio Active Mineral Resources in 2021

No	Potential Sector	Resources								
		Measurable		Indicated	Inferred		Hypothetical		Speculative	
		U3O8	Th	U3O8	U3O8	Th	U3O8	Th	U3O8	Th
1	Aloban, Sibolga - Sumatera Utara				490*					
2	Singkep - Riau						1.298*	433*		
3	Bangka Belitung	2.840*	4.729*				1.224*	10.361*	25.715*	111.298*
4	Ketapang - Kalimantan Barat						736*	4.767*		
5	Kalan, Melawai - Kalimantan Barat	2.394*		5.903*	2.914*		5.058*			
6	Mentawa dan Darab, Seruyan - Kalimantan Tengah				623*		9.669*			
7	Katingan - Kalimantan Tengah						572*	2.261*		
8	Kawat, Mahakam Hulu - Kalimantan Timur						17.861*			
9	Mamuju - Sulawesi Barat				769*	3.424*	3.023*	3.138*	8.393*	2.823*
Total Amount		**5.234***	**4.729****	**5.903***	**4.796***	**3.424****	**39.441***	**20.960****	**34.108***	**114.121****
		Measurable	**Measurable Th**	**Indicated U**	**Inferred U**	**Inferred Th**	**Hypo-thetical U**	**Hypoth-etical Th**	**Speculative U**	**Speculative Th**
Total U3O8		**89.483***								
Total Th		**143.234****								

Note: (*) U3O8 Ton unit
(**) Unit of Ton tTh

Source: Data Processed by Authors

Furthermore from Figure 2, The largest uranium reserves globally are found primarily in Australia (29%), followed by Kazakhstan (9%), Russia (9%), Canada (9%), South Africa (6%), Namibia (5%), Nigeria (5%), Brazil (5%), China (5%), Ukraine (2%), Mongolia (2%), Uzbekistan (1%), Botswana (1%), and the United States (1%).In the geographical aspect, to see the supply of new renewable energy from 95% of the total accumulation, the remaining 5% includes Indonesia.

Figure 2. Uranium Reserves in The World

In the Conference of the Parties (COP26) on climate change, nuclear energy is one of the best options because it is a low-emission energy source that benefits various sectors ranging from agriculture and households to medicine. This development has received attention from the Government of Indonesia through regulation in Law No.10 of 1997 concerning Nuclear.

Then, in the institutional sector, the Government established the Nuclear Power Supervisory Agency through Presidential Decree No.103 of 2001 with the task of carrying out nuclear power supervision through regulations, licensing, and inspections and the establishment of the Indonesian Nuclear Energy Agency through Presidential Regulation No.46 of 2013 which functions for research, development, and utilization of nuclear science and technology.

At least four essential principles must be considered for this development: security, safety, safeguards, and nuclear liability. For countries that do not yet have a nuclear power plant and intend to develop a nuclear power plant, it is strongly recommended by the International Atomic Energy Agency (IAEA) to establish a Nuclear Energy Program Implementing Organization (NEPIO) as part of the Government's commitment to nuclear energy development. Therefore, in 2021, a Decree of the Minister of Energy and Mineral Resources Number 250.K/HK.02/MEM/202 was issued concerning the Preparation Team for establishing the Nuclear Energy Program Implementing Organization. Currently, the Nuclear Energy Program Implementing Committee (KPPEN) organizational form is being proposed to the Ministry of Administrative and Bureaucratic Reform of The Republic of Indonesia regarding the draft KPPEN Presidential Decree.

Diplomacy has a central role in developing Nuclear Power Plants in Indonesia, considering that nuclear energy still needs to be utilized to provide electricity to support industry or household needs in Indonesia. Diplomacy can be a link between countries that are advanced in the use of nuclear energy and countries that are in the development stage so that it is possible to transfer knowledge in the form of cooperation between government to government, government to private, or private to private.

However, the development of nuclear technology is not free from controversy because it can threaten various countries if a reactor leak occurs at a nuclear power plant. This leak occurred in three reactors at the Fukushima NPPs, Japan, in 2011 due to a giant tsunami triggered by an earthquake. These conditions can cause international conflict in the Southeast Asian region because no single country has a nuclear power plant.

On the other hand, the government must also face the side of public acceptance and perception of the dangers of developing this nuclear power plant. Prior research indicates that the strong resistance against nuclear energy primarily stems from two main factors. Firstly, nuclear energy is perceived as a high-risk technology due to concerns regarding potential dangers related to radioactivity, nuclear accidents, and the potential proliferation of nuclear weapons. After identifying most of the variables relevant to the development of NPPs, Authors represent the relationships between various factors or variables in a causal loop diagram, as depicted in Figure 3 below (Sari, Alfiaturrohmah, and Sudarti 2023; Susiati et al. 2023).

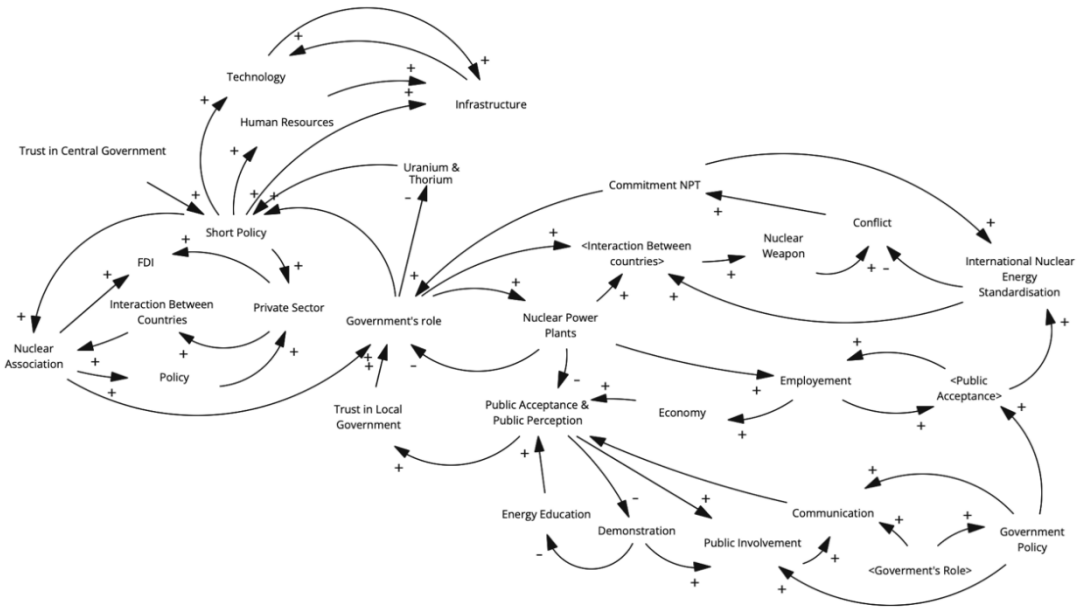

Figure 3. Causal Loop Diagram of Diplomacy Strategy for Nuclear Power Plant

Government's role of Diplomacy in Nuclear Power Plants (NPPs)

In the Causal loop in Figure 3, the government's active role in the development of Nuclear Power Plants (NPPs) will also facilitate the utilization of nuclear fuel in the form of uranium and thorium found in Indonesia. The existence of uranium and thorium as potential nuclear fuel provides an opportunity to formulate policies that support the use of nuclear energy. With a clear policy, the government can provide the incentives and facilities needed to mobilize investment in nuclear infrastructure development. In addition, the existence of supportive policies will also open up opportunities for the private sector to play an active role in developing nuclear infrastructure. Collaboration between the government and the private sector in nuclear infrastructure development can increase the efficiency and effectiveness of the project, as well as accelerate the construction of the required infrastructure. Thus, there will be an increase in foreign direct investment (FDI) in Indonesia's nuclear energy sector (Mudjiono, Alimah, and Susiati 2020).

Increased FDI will create a conducive environment to formulate further policies that support the development of nuclear energy. With the existence of short policies, the government can more easily encourage investment and establish interactions between countries, which will impact cooperation with nuclear associations. Cooperation with nuclear associations will assist in exchanging knowledge, technology, and best practices in developing nuclear energy in Indonesia.

Thus, a positive loop is formed between the role of government, private sector, FDI, short-term policies, and cooperation with nuclear associations. This shows the importance of

collaboration between the government, private sector, and nuclear associations in developing the nuclear energy industry in Indonesia. With a developed infrastructure, there will be an increase in human resources and available technology. Good infrastructure can improve accessibility to education and training needed to develop skills and knowledge in nuclear energy. This will positively impact Indonesia's ability to formulate more effective short-term policies in support of nuclear energy development (Darmawan 2023).

With the increase of skilled and trained human resources in nuclear energy, implementing short policies becomes more efficient and can be better executed. Technological improvements in nuclear energy development will enable more innovative and effective short-policy implementation. In this context, a positive loop is formed between infrastructure, human resources, technology, and short policy. Adequate infrastructure will improve human resources and technological capabilities, influencing better policymaking. On the other hand, short policies will also encourage improvements in technological development and strengthening of human resources, creating a mutually reinforcing positive loop between the three elements.

With the development of Nuclear Power Plants (NPPs), Indonesia will increasingly become an important actor in the interaction between countries regarding nuclear energy. International collaboration and cooperation in the development of nuclear technology can enhance Indonesia's reputation in the international world. In addition, this cooperation can also open opportunities for Indonesia to expand its diplomatic network and improve bilateral relations with other countries with similar interests in nuclear energy development. The positive impact of interactions between these countries will then have an impact back on the role of the government. Through international cooperation, the Indonesian government can obtain the technical, financial, and political support needed to accelerate the development of NPPs. In addition, this cooperation can help Indonesia overcome technical and regulatory challenges that may arise in developing NPPs.

In this context, a positive loop is formed between the development of Nuclear Power Plants (NPPs), interactions between countries, and the role of the government. The development of NPPs increases the interaction between countries, which will strengthen the government's role in developing nuclear energy in Indonesia. A more detailed discussion of the interaction between countries in the development of nuclear energy and its impact on the role of the government will be described in the next sub-chapter. In addition, discussions related to public acceptance of NPPs and efforts that can be made to increase this acceptance will be discussed in the following sub-chapters (Bastori and Sriyana 2020; Lumbanraja and Dewi 2017).

3.3 Strengthening Interactions Between Countries for Nuclear Power Plant development

The development of nuclear energy in Indonesia requires a comprehensive approach involving various parties. In the Causal loop in Figure 3, the role of diplomacy is as an approach involving various actors other than the government in international relations. Through this diplomacy, Indonesia can build cooperation and gain support from various parties in developing nuclear energy. This is important to overcome various challenges and encourage progress in this field. The development of NPPs has a complex impact on inter-state interactions, with potential benefits and risks, as shown in Table 2 below.

Table 2. Positive and Negative Impacts of Nuclear Power Plant (Data Process by Authors)

Impact Explanation	
Positive Impact	**Negative Impact**
Energy Security: NPPs can help Indonesia achieve energy independence, reduce dependence on fossil fuel imports, and improve national energy security.	Nuclear Proliferation: The existence of Nuclear Power Plants can increase the risk of nuclear proliferation, which is the spread of nuclear weapons to irresponsible countries. This can jeopardize regional and global stability.

International cooperation: NPPs can encourage international cooperation in the fields of nuclear technology, nuclear safety, and radioactive waste management. This can improve relations between countries and build trust.	Terrorism Threat: NPPs can be the target of terrorist attacks, which can lead to significant damage and radioactive contamination.
Reduced Greenhouse Gas Emissions: NPPs produce lower greenhouse gas emissions than fossil fuel power plants. This can help Indonesia achieve its emissions targets and combat climate change.	Radioactive Waste Management: Radioactive waste from Nuclear Power Plants requires safe and long-term management. Failure to manage radioactive waste can lead to environmental contamination and jeopardize public health.
Technology Development: Nuclear Power Plants can encourage innovation and development of valuable nuclear technology for various sectors, such as medicine, industry, and agriculture.	International Disputes: The construction of Nuclear Power Plants can lead to international disputes, especially with neighbouring countries concerned about safety and environmental risks.

The development of Nuclear Power Plants is not directly linked to nuclear weapons. However, some countries are concerned that nuclear technology used for Nuclear Power Plants could be misused to develop nuclear weapons. This can increase tensions and mistrust between countries, especially countries with non-transparent nuclear programs.

Indonesia has collaborated with several other countries to obtain support and expertise in developing Nuclear Power Plants. Russia: Technical assistance, funding, feasibility studies, cooperation in constructing Nuclear Power Plants. South Korea: Nuclear information and technology exchange, design, construction, operation, floating nuclear power plant cooperation. United States: Exchange of nuclear information and technology, safety regulation, radioactive waste management, and cooperation in developing safe and clean nuclear energy. Japan: Exchange of nuclear information and technology, training of experts, radioactive waste management, and cooperation in developing fourth-generation nuclear technology. China: Information exchange, nuclear technology application, environmental protection, nuclear fuel, health care, and financial investment (Suhaemi 2016).

In addition to bilateral cooperation with other countries, Indonesia is also active in various international organizations related to nuclear energy, such as the International Atomic Energy Agency (IAEA) and the Asian Nuclear Energy Forum (NEAF). These organizations provide a forum for exchanging information and experience and assist Indonesia in developing regulations and safety standards for Nuclear Power Plants. International cooperation in the development of Nuclear Power Plants in Indonesia faces several challenges, such as Public concerns about the safety and security of Nuclear Power Plants, Nuclear non-proliferation issue, High cost of nuclear power plant construction, Lack of human resources experts in the nuclear field, and Radioactive waste management.

Diplomacy in interactions between countries, as well as international cooperation, play an important role in the development of Nuclear Power Plants (NPPs) in Indonesia. By addressing the challenges and maximizing the benefits of nuclear energy, Indonesia can achieve its energy security goals and contribute to sustainable development.

3.4 Strengthening Public Acceptance and Perception of Nuclear Power Plant Development

Public trust has a very strategic and important position in strengthening state policies and the implementation process of the Nuclear Power Plant program. In this case, the public has three main functions. The first is advocacy, which ensures their aspirations are heard in the implementation and policy process. Second, as empowerment, actively empower the public to

improve the ability and potential of the public. Third, as a social control to ensure the norms and safety standards in the NPPs development operation and process run smoothly and safely.

In causal loop of Figure.3 public acceptance and public perception are closely interconnected, a survey conducted by the National Nuclear Energy Agency (NNEA) on 4000 respondents in 34 Provinces showed that as many as 77.53%, or around 200,573,986.5 Indonesians in 2016, supported the construction of Nuclear Power Plants (NPPs) in Indonesia. Although the majority of people support this development, 22.47%, or around 58,131,013.5 Indonesians show, disagree with the existence of Nuclear Power Plants. Given the potential damage that is quite dangerous to society, the government must be careful of attacks from within by strengthening regulations and increasing communication with the public through energy education in the nuclear sector (Herawati and Sudagung 2020; Yuniarto and Septiadi 2019).

Furthermore, the level of public acceptance of Nuclear Power Plants can vary depending on the region and other factors. Based on the region from the results of research in Bangka Belitung Province, which is one of the locations where a nuclear power plant will be built, it shows that the acceptance of the community there is 73.73%, which is supported by 94.27% agreeing to the benefits of Nuclear Power Plants. However, the research also shows that 70.93% of the risks are related to Nuclear Power Plants. On the other hand, in Gorontalo Province, based on a NNEA survey in 2016, only 46.7% of Gorontalo residents agreed with constructing a nuclear power plant. On the other hand from public perception, the rejection of the nuclear energy program is due to concerns about nuclear reactor accidents (64.9%). In addition, the public is also worried that the existence of nuclear reactors is expected to cause radioactive pollution (78.8%) and radioactive waste problems (83.9%), which are still considered unsolvable by nuclear experts .

In this loop in Figure 3, the lack of maximum acceptance and poor public perception provide the potential for demonstrations against development that can hurt the sustainability of this development. The Indonesian movement organization WALHI in 2023 demonstrated against the government's plan to build a nuclear power plant in West Kalimantan. Usually, the movement against nuclear energy is triggered by fear of the potential for nuclear accidents; these accidents are often used as material for campaigns against the use of nuclear energy.

That is why public involvement is significant to make this loop positive. In every decision-making process and management of Nuclear Power Plants, public participation must be included so that it is in accordance with the needs and interests of the community. This community involvement is undoubtedly the role of the government. Hence, it needs to be actively communicated to the community. In reality, the communication carried out is still one-way from the government to the community through social media, socialization, and others, especially since there is still no clear policy on the concept of community involvement in developing Nuclear Power Plants in Indonesia.

Furthermore, this also requires that this government policy guarantee community rights through transparency and accountability. This can be in the form of regular public consultation forums in the development of Nuclear Power Plants, community-based approaches, and participating in community empowerment, this empowerment in principle must be accompanied by increasing community income from Nuclear Power Plants so that it can open up fields to improve the individual economy in the form of employment so that it has a positive impact on future community acceptance.

CONCLUSION

This research explains the various factors that contribute to conducting nuclear power plant (NPPs) development in Indonesia, especially as a cause of problems related to energy diplomacy. The authors conduct a system thinking assessment of the government and interactions between states and society based on the Track in Multitrack Diplomacy. By identifying some of the complex and interrelated variables, The authors then summarise these variables in a cause-and-effect circle diagram and, based on this diagram, map out the concept of a road strategy for solving problems related to the construction of Nuclear Power Plants.

The authors considers that to overcome systemic problems, as illustrated in the causal loop diagram, the government's active role is crucial in providing a clear direction for nuclear energy development policies to present and strengthen human resources, technology, and supporting infrastructure. These incentives spur foreign direct investment from other countries and the private sector by utilizing thorium and uranium in Indonesia to build trust at the government level.

Then, the author argues that Nuclear Power Plants are not only a technical problem but also a complex geopolitical and social issue. The role of diplomacy is very important in garnering support from within the country (society) and abroad (Southeast Asia). In this causal loop, this development will increase tensions both within the community and between countries, so the government must invite various actors to be involved in the process of international peace cooperation related to nuclear energy for power generation and effective and transparent communication from the government is the key to educating the public about the benefits and safety of nuclear energy, to overcome concerns that may arise.

Finally, the author argues that realizing the ideals of Net Zero Emission 2060 or faster with efforts to develop Nuclear Power Plants by the road map that the Indonesian government has prepared can be carried out by applying energy diplomacy between the government, private sector, state, and society based on answering the problems of international cooperation between the government and the private sector that are sustainable, conflicts between countries, and public acceptance & perceptions of the development of this nuclear power plant. With this system thinking, Indonesia can become the first significant player to succeed in utilizing nuclear energy to generate electricity.

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