



## Indonesia's Energy Diplomacy to Promote Nuclear Energy as an Alternative to Energy Security

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### Abstract

Indonesia faces significant challenges in meeting its growing energy demand while seeking clean, sustainable, and safe energy sources. Nuclear energy is emerging as a potential alternative, supported by the country's substantial uranium reserves. However, nuclear energy development in Indonesia faces various obstacles, including public concerns regarding safety, nuclear non-proliferation issues, and high construction costs. This research aims to analyze the role of Indonesia's energy diplomacy in promoting nuclear energy to the public and internal stakeholders as a solution to improve national energy security. Qualitative research methods were used to evaluate Indonesia's internal diplomatic and promotional efforts, including document analysis and content analysis. The study examined Indonesia's bilateral and multilateral cooperation strategies, as well as its participation in international forums such as the International Atomic Energy Agency (IAEA), while focusing on domestic education and socialization efforts. A key focus was identifying challenges, opportunities, and best practices in nuclear energy diplomacy and internal promotional campaigns. The research findings highlighted the importance of comprehensive public education, strengthening international cooperation, and implementing strict safety standards in nuclear energy development. Strategic measures identified include strengthening diplomatic capacity, improving transparency and communication with domestic stakeholders, and developing national nuclear technology and regulation capacity. The research concludes that by addressing these challenges through effective energy diplomacy and structured internal promotion, Indonesia can improve its public acceptance and nuclear energy development prospects. This has the potential to ensure the safe, responsible, and sustainable utilization of nuclear energy to meet the country's long-term energy needs and contribute to global efforts in climate change mitigation.

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## INTRODUCTION

The International Atomic Energy Agency (IAEA) has significantly increased its global nuclear power capacity projections by 2050. A substantial increase in new nuclear power plants and extending existing reactor lifespans are necessary to achieve these ambitious goals. Several countries are expressing renewed interest in nuclear power, with many actively pursuing development plans, as shown in Table 1 (Laue et al., 2022). The IAEA supports these countries through guidance and technical assistance. Additionally, the agency fosters international collaboration on nuclear innovation and promotes public understanding of the technology.

**Table 1.** Nuclear Power Reactors in Operation and Under Construction Around the World (Laue et al., 2022)

Country	Reactors in operation		Reactors in suspended operation		Reactors under construction		Nuclear electricity supplied TW(e).h	Nuclear share %
	No. of units	Total MW(e)	No. of units	Total MW(e)	No. of units	Total MW(e)		
Argentina	3	1 641			1	25	9.0	6.3
Armenia	1	416					2.5	31.1
Bangladesh					2	2 160		
Belarus	2	2 220					11.0	28.6
Belgium	5	3 908					31.3	41.2
Brazil	2	1 884			1	1 340	13.7	2.2
Bulgaria	2	2 006					15.5	40.5
Canada	19	13 699					83.5	13.7
China	55	53 152			24	24 948	406.5	4.9
Czech Republic	6	3 934					28.7	40.0
Egypt					3	3 300		
Finland	5	4 394					32.8	42.0
France	56	61 370			1	1 630	323.8	64.8
Hungary	4	1 916					15.1	48.8
India	19	6 290	4	639	8	6 028	44.6	3.1
Iran, Islamic Republic of	1	915			1	974	6.1	1.7
Japan	12	11 046	21	20 633	2	2 653	77.5	5.5
Korea, Republic of	26	25 825			2	2 680	171.6	31.5
Mexico	2	1 552					12.0	4.9
Netherlands, Kingdom of the	1	482					3.8	3.4
Pakistan	6	3 262					22.4	17.4
Romania	2	1 300					10.3	18.9
Russian Federation	37	27 727			3	2 700	204.0	18.4
Slovakia	5	2 308			1	440	17.0	61.3
Slovenia	1	688					5.3	36.8
South Africa	2	1 854					8.2	4.4
Spain	7	7 123					54.4	20.3
Sweden	6	6 944					46.6	28.6
Switzerland	4	2 973					23.4	32.4
Türkiye					4	4 456		

United Arab Emirates	3	4 011			1	1 310	31.2	19.7
United Kingdom	9	5 883			2	3 260	37.3	12.5
Ukraine	15	13 107			2	2 070	NA	NA
United States of America	93	95 835			1	1 117	742.4	18.5
<b>Worldwide</b>	<b>413</b>	<b>371 539</b>	<b>25</b>	<b>21 272</b>	<b>59</b>	<b>61 091</b>	<b>2 508.7<sup>c</sup></b>	<b>N/A</b>

Note: NA — Not Available, N/A — Not Applicable.

- Source: The agency's Power Reactor Information System (PRIS) ([www.iaea.org/pris](http://www.iaea.org/pris)), based on data provided by Member States by 16 June 2024.
- The figures include the following data from Taiwan and China: 2 units, 1 874 MW(e) in operation, and 17.2 TW·h of electricity supplied, accounting for 6.9% of the total electricity mix.
- The total electricity production does not include Ukraine, as operational data must still be submitted for 2023.

With its growing population and increasing energy needs, Indonesia faces the dilemma of finding clean, sustainable, and safe energy sources. Nuclear energy comes as one of the potential alternatives, but it is still shrouded in pros and cons, as well as various challenges that need to be considered (Laue et al., 2022). According to Indonesia's National Energy Council (DEN), Indonesia's primary energy consumption is predicted to reach 2,867 MTOE (million tons of oil equivalent) in 2030 and 4,326 MTOE in 2040. Coal still dominates the national energy mix, with consumption reaching 64.3% in 2022. This excessive use of fossil energy is feared to exacerbate climate change and air pollution. On the other hand, solar power plants (*Pembangkit Listrik Tenaga Surya* or PLTS) and wind power plants (*Pembangkit Listrik Tenaga Bayu* or PLTB) are still in the development stage. They cannot meet all energy needs (Firmansyah et al., 2023). According to the report 50 Years of Uranium Exploration in Indonesia published by BRIN, Indonesia has considerable uranium resource potential, around 90,000 tons (Ngadenin et al., 2022).

Indonesia has considerable uranium reserves, estimated at around 70,000 tons of U3O8 (yellow cake). These reserves are mainly located in West Kalimantan, Papua, Bangka Belitung, and West Sulawesi. Of the total 70,000 tons, 1,608 tons are categorized as measured, 6,456 tons as indicated, 2,648 tons as inferred, and the rest are included in the hypothetical category. Nuclear minerals in Indonesia are spread across 26 locations in Sumatra, Kalimantan, Sulawesi, Maluku, and Papua, with uranium and thorium resources estimated to be in nine deposit locations. In 2021, uranium resources in Indonesia reached 89,483 tons of U3O8, equivalent to a thermal power plant generated by 1.85 trillion tons of coal. In addition, Indonesia also has thorium resources of 143,234 tons. These sizable reserves demonstrate Indonesia's potential for the development of nuclear power plants in the future (International Renewable Energy Agency, 2022)

This potential makes Indonesia one of the countries with the most significant uranium resources in the world. Nuclear energy can be a clean and reliable source to reduce Indonesia's dependence on fossil energy (Ngadenin et al., 2022). However, the development of nuclear energy in Indonesia is also faced with several challenges, such as public fear of radiation hazards and nuclear non-proliferation. Public fear of radiation hazards can hinder the development of nuclear power plants in Indonesia. Details of radioactive mineral resources in Indonesia can be seen in Table 2.

**Table 2.** Details of Radioactive Mineral Resources in Indonesia  
(International Renewable Energy Agency, 2022)

No	Potential Sector	Resources									
		Measurable		Indicated	Inferred		Hypothetical		Speculative		
		U308	Th	U308	U308	Th	U308	Th	U308	Th	
1	Aloban, Sibolga–North Sumatra				490*						
2	Singkep-Riau						1.298*	433*			
3	Bangka Belitung	2.840*	4.729*				1.224*	10.361*	25.715*	111.298*	
4	Ketapang-West Kalimantan						736*	4.767*			
5	Kalan, Melawai-West Kalimantan	2.394*		5.903*	2.914*		5.058*				
6	Mentawa and Darab, Seruyan – Central Kalimantan				623*		9.669*				
7	Katingan – Central Kalimantan						572*	2.261*			
8	Kawat, Mahakam Hulu – East Kalimantan						17.861*				
9	Mamuju – West Sulawesi				769*	3.424*	3.023*	3.138*	8.393*	2.823*	
<b>Total Amount</b>		<b>5.234*</b>	<b>4.729**</b>	<b>5.903*</b>	<b>4.796*</b>	<b>3.424**</b>	<b>39.441*</b>	<b>20.960**</b>	<b>34.108*</b>	<b>114.121*</b>	
		<b>Measurable</b>	<b>Measurable Th</b>	<b>Indicated U</b>	<b>Inferred U</b>	<b>Inferred Th</b>	<b>Hypothetical U</b>	<b>Hypothetical Th</b>	<b>Speculative U</b>	<b>Speculative Th</b>	
<b>Total U308</b>						<b>89.483*</b>					
<b>Total Th</b>						<b>143.234**</b>					

Note: (\*) U308 Ton unit; (\*\*) Unit of Ton tT,  
Indonesia Energy Outlook 2023

Meanwhile, nuclear non-proliferation is an essential global issue in developing nuclear energy. Energy diplomacy can be one of the instruments to overcome these challenges. Energy diplomacy is using diplomatic tools and instruments to achieve national energy goals. It can also build public trust and international cooperation related to nuclear energy development (Rudiany, 2020). The Indonesian government has committed to developing nuclear energy as an alternative energy source. This is stated in the 2021-2035 National Energy General Plan (*Rencana Umum Energi Nasional* or RUEN).

RUEN targets constructing the first nuclear power plant in Indonesia in 2029, with a capacity of 1,000 MW. Furthermore, other nuclear power plants will be built with a total capacity of 10,000 MW by 2045. To realize this program, the government has established

Indonesia's National Nuclear Energy Agency (BATAN), which is tasked with conducting research, development, and utilization of nuclear energy in Indonesia. The Indonesian government has also cooperated with several other countries, such as Russia, South Korea, and France, to construct technology transfer and nuclear power plant (Taryo and Subekti, 2020). However, the nuclear energy program in Indonesia is still characterized by various challenges. For example, in nuclear security and proliferation, the government must ensure that nuclear power plants are built and operated with high safety standards to prevent accidents and misuse of nuclear technology. Nuclear waste management certainly requires a safe and permanent solution for radioactive nuclear waste storage. A massive education campaign is essential to increase public acceptance of nuclear energy. Furthermore, the substantial financial burden of building nuclear power plants necessitates creative funding models that engage multiple parties (Han & Choi, 2022).

The pros and cons of nuclear energy in Indonesia are a hot topic of debate (Setiawan, 2022). On the one hand, nuclear energy can meet increasing energy needs, support industrialization, and replace fossil fuel power plants in short supply. Nuclear power plants also offer clean energy that can reduce greenhouse gas emissions, helping to achieve net zero emission targets. In addition, mastery of nuclear technology opens up research and development opportunities in various fields, such as health, agriculture, and industry, with relatively low operating costs compared to other power plants. However, there are significant concerns regarding safety and the risk of nuclear accidents, such as those in Chernobyl and Fukushima (Ezra, 2023), as well as the handling of radioactive waste that requires specialized long-term management. Other challenges include a need for more nuclear experts in Indonesia, a long time to prepare infrastructure and regulations related to nuclear power plants, and public skepticism about the safety of nuclear power plants that could hinder their implementation. Alternative energy sources, such as renewable energy, are also considered safer.

Regulations governing the utilization of nuclear energy in Indonesia include Law No. 10 of 1997 and Government Regulation No. 2 of 2014, with oversight by the Nuclear Energy Regulatory Agency (BAPETEN) (Josia, 2023). To promote nuclear energy as an alternative to energy security, Indonesia is active in energy diplomacy, establishing relationships with Russia, South Korea, and the United States for collaborative nuclear projects. Indonesia also participates in international forums such as the IAEA, demonstrating its commitment to developing peaceful nuclear energy (International Renewable Energy Agency, 2022). Energy diplomacy is conducted through bilateral, regional, and multilateral cooperation, aiming to diversify energy sources and reduce dependence on imported fossil fuels (Rudiany, 2020). These efforts are essential to ensuring the stability and sustainability of Indonesia's energy sector and achieving long-term goals in energy diversification and greenhouse gas emission reduction.

Several previous studies have discussed aspects of energy diplomacy and nuclear energy development in Indonesia. Anhar (2020) examined the role of energy diplomacy in overcoming nuclear development challenges, while Taryo and Subekti (2020) examined Indonesia's international cooperation in nuclear technology transfer. Han & Choi (2022) discussed innovative funding models for nuclear power plant construction, and Ezra (2023) analyzed public perceptions of nuclear safety after the Chernobyl and Fukushima incidents. However, there is a gap in the literature regarding the integration between energy diplomacy and internal promotion efforts in the context of nuclear energy development in Indonesia. This study fills that gap by comprehensively analyzing how energy diplomacy can be used not only for international cooperation but also to increase domestic acceptance and support for nuclear energy. The purpose of this study

is to analyze the role and effectiveness of Indonesia's energy diplomacy in promoting nuclear energy, identify the challenges faced, and formulate strategies to increase public acceptance and stakeholder support for nuclear energy development in Indonesia. The urgency of this study lies in Indonesia's pressing need to diversify energy sources to meet growing demand, reduce dependence on fossil fuels, and achieve net-zero emission targets. With significant uranium reserves, nuclear energy development becomes a strategic option that requires an effective diplomatic approach, both internationally and domestically, to overcome existing technical, regulatory, and social challenges.

## **METHODS**

This study will employ a qualitative approach, focusing on discourse analysis and case studies to comprehend the dynamics of Indonesia's nuclear energy diplomacy (Morgan, 2019). Data will be collected from various sources, including official documents and media. Data analysis will be conducted systematically by identifying key themes and categories and developing central themes (Djamba & Neuman, 2002). A qualitative approach will be employed in this study, with a focus on policy document analysis and case studies to comprehend the dynamics of Indonesia's nuclear energy diplomacy. Data will be collected from various sources, including official government documents, international agency reports, and media publications. The analysis will be conducted systematically by identifying key themes related to Indonesia's energy diplomacy strategy, particularly in nuclear energy development. The analytical framework will include an analysis of Indonesia's national energy policies, especially the National Energy General Plan (RUEN) and National Energy Policy (KEN). An evaluation of Indonesia's energy diplomacy strategy in the context of nuclear energy development will be carried out. Challenges and opportunities in nuclear energy development in Indonesia will be identified. Indonesia's role in international cooperation related to nuclear energy, including participation in the IAEA's INIR program, will be analyzed. Brief comparative case studies with other countries, such as the United Arab Emirates and Vietnam, will be conducted to provide additional perspectives. The research questions to be addressed will include Indonesia's energy diplomacy strategy for nuclear energy development, the challenges and opportunities faced by Indonesia in nuclear energy development, and the role of energy diplomacy in enhancing Indonesia's energy security. Through this approach, it is expected that the study will contribute to understanding the dynamics of Indonesia's nuclear energy diplomacy and its implications for national energy security.

## **RESULT AND DISCUSSION**

### **Indonesia's Energy Diplomacy Strategy**

Indonesia's energy diplomacy strategy, particularly concerning nuclear energy development, must be viewed within the broader context of Indonesia's National Energy General Plan (RUEN) and Indonesia's National Energy Policy (KEN). RUEN 2021-2035 targets the construction of the first nuclear power plant (NPP) by 2029, with a capacity of 1,000 MW and a total capacity of 10,000 MW by 2045 (Directorate General EBTKE, 2021). However, these targets face various challenges that require a comprehensive energy diplomacy strategy. Analysis of RUEN reveals several weaknesses in Indonesia's approach to nuclear energy. Firstly, a lack of details on the implementation is evident, as RUEN does not elaborate on how Indonesia will overcome technical, financial, and social barriers in NPP development. Secondly, the nuclear energy targets in RUEN are considered too ambitious given the global trend towards renewable energies such as solar and wind. Lastly, the limited public acceptance strategy is also a concern, as RUEN

has not outlined a comprehensive strategy to enhance public acceptance of nuclear energy.

To overcome these weaknesses, Indonesia needs to develop a more integrated energy diplomacy strategy. This includes deepening bilateral cooperation with countries such as Japan and South Korea, which includes more intensive technology transfer and capacity building. For example, the joint training program between BATAN and Korea Hydro and Nuclear Power Co LTD (KHNP) starting in 2022 needs to be expanded in scope (Kusumawardhana, 2023). In addition, strengthening multilateral diplomacy through Indonesia's membership in the IAEA Board of Governors for the 2023-2025 period needs to be utilized to strengthen Indonesia's position in global nuclear energy governance. Indonesia can initiate programs that support developing countries in the development of safe and sustainable nuclear energy. Public diplomacy also needs to be improved through more effective communication strategies to increase public understanding and acceptance of nuclear energy. This can be done through national education campaigns, public dialogues, and media engagement to deliver accurate information about the benefits and risks of nuclear energy. Integration with climate change policy is also key, where nuclear energy development needs to be linked to national climate change commitments, including Indonesia's Nationally Determined Contribution (NDC) targets. Finally, there is a need to develop a stronger legal and regulatory framework related to nuclear energy, including ratification of international treaties such as the Treaty on the Prohibition of Nuclear Weapons (TPNW), which was ratified by the Indonesian Parliament in November 2023

Indonesia has been actively participating in the IAEA's International Nuclear Infrastructure Review (INIR) program since 2009. The most recent INIR mission to Indonesia in 2021 acknowledged significant advancements in the country's nuclear infrastructure development. However, the mission also identified areas that require further attention, such as strengthening the legal and regulatory framework, enhancing coordination among government agencies, developing a more effective public communication strategy, and conducting more comprehensive feasibility studies for potential NPP sites. The recommendations from this INIR mission should be incorporated into Indonesia's future energy diplomacy strategy to ensure a successful and sustainable nuclear energy program (Laue et al., 2022). A comparison of Indonesia's nuclear energy diplomacy strategy with those of countries such as the United Arab Emirates (UAE) and Vietnam can offer valuable lessons. The UAE, for example, successfully developed a nuclear program through strong international cooperation and effective public communication. Indonesia can learn from the UAE's approach to fostering trust both domestically and internationally (Brears, 2021). Although Vietnam ultimately postponed its nuclear program, it demonstrated the importance of flexibility in long-term energy planning. Indonesia should consider alternative scenarios in its energy strategy to ensure resilience and adaptability. By adopting a more comprehensive and strategic approach to energy diplomacy, Indonesia can improve its prospects for success in nuclear energy development while aligning its efforts with national sustainability and energy security objectives (Nian & Chou, 2014).

### **The Role of Energy Diplomacy in Energy Security**

The role of energy diplomacy in energy security is to build cooperation with other countries to meet a country's energy needs. Energy diplomacy can help countries improve energy security, i.e., the availability of sufficient, safe, and affordable energy;

maintain energy stability, i.e., the certainty of energy supply and prices; and improve energy efficiency, i.e., the efficient and sustainable use of energy (Laue et al., 2022).

Energy security is a crucial component of a country's overall security strategy. Energy security can be defined as the availability of sufficient, safe, and affordable energy. With energy diplomacy, a country can build cooperation with energy-producing countries to secure its energy supply. Energy stability is also an essential aspect of energy security. Energy stability can be defined as certainty of energy supply and price. With energy diplomacy, a country can help maintain global energy price stability, which can impact the national economy. Energy efficiency is also an essential aspect of energy security. Energy efficiency can be defined as the efficient and sustainable use of energy. With energy diplomacy, a country can increase cooperation in new and renewable energy development, which can help reduce dependence on fossil energy (Blazquez et al., 2018).

### **Nuclear Energy as an Alternative for Energy Security**

Nuclear energy has been proposed as a potential solution to achieve energy security due to its reliability and potential in large-scale power generation. Nuclear power plants have a high capacity factor, which means they can operate at a high percentage of rated capacity over long periods (Sriyana, 2023). This reliability ensures a stable electricity supply, which is crucial for countries seeking energy security. In addition, nuclear power plants can generate significant amounts of electricity from a relatively small footprint, suitable for densely populated countries with limited land availability.

Nuclear energy also has the advantage of reducing dependence on fossil fuels, thereby reducing the risks associated with volatile oil and gas markets. Countries can increase their energy security by including nuclear power in the energy mix and reduce vulnerability to supply disruptions or price fluctuations in global energy markets. This diversification helps countries to maintain their economic stability from unexpected outside influences on energy supply (Laue et al., 2022). However, despite its great potential, nuclear energy development in Indonesia faces several challenges (Humas BRIN, 2023). The limited availability of uranium resources requires Indonesia to import fuel, which can be challenging in terms of cost and supply chain reliability. The construction and operation of nuclear power plants require significant capital investment, expertise, a robust regulatory framework, and a trained workforce. In addition, public acceptance of nuclear energy remains a challenge due to concerns about safety and nuclear waste disposal. Therefore, the government needs to conduct rigorous research and public outreach efforts to demonstrate the benefits and address concerns related to nuclear energy so that this potential can be optimized (Matar & Shabaneh, 2020).

### **Challenges and Opportunities**

Nuclear energy development is a controversial issue. On the one hand, nuclear energy has the potential to be a clean and efficient energy source that can help address the energy crisis and climate change. On the other hand, its development raises safety, security, and nuclear waste management issues. Public fear of radiation hazards is one of the main concerns, given that nuclear radiation can be harmful to human health, even in small doses. Nuclear accidents such as in Chernobyl and Fukushima have exacerbated these fears, thus affecting public acceptance of nuclear energy (Ezra, 2023).

The issue of nuclear non-proliferation is also an essential concern in developing nuclear energy. Nuclear fuel has the potential to be used in the manufacture of nuclear weapons, so efforts are needed to prevent the proliferation of nuclear weapons. In



Indonesia, nuclear waste management is regulated by Government Regulation Number 61 of 2013, which covers the classification, licensing, processing, transportation, storage, and handling of nuclear or radiation accidents. The National Research and Innovation Agency (BRIN), formerly known as BATAN, is responsible for nuclear waste management and has various facilities to safely treat and store the waste (Ministry of Foreign Affairs Republic of Indonesia, 2019).

Although Indonesia has adequate regulations and infrastructure, nuclear waste management must overcome various challenges. The volume of nuclear waste is expected to increase along with the planned construction of Nuclear Power Plants and nuclear utilization in other fields. Waste management efficiency also requires a more centralized facility arrangement, especially in the Serpong nuclear area. In addition, unique technology and infrastructure are needed to handle radioactive waste from mining activities. Developing competent human resources in nuclear waste management is essential to ensure professional management and compliance with international standards. Public acceptance of nuclear waste management facilities must also be improved through intensive education and communication to increase public understanding and trust in facility safety.

## CONCLUSIONS AND RECOMMENDATIONS

Indonesia's energy diplomacy strategy for nuclear energy development faces significant challenges but also presents opportunities for enhancing the country's energy security. The analysis of RUEN reveals ambitious targets for nuclear power plant construction yet highlights weaknesses in implementation details, public acceptance strategies, and alignment with global energy trends. To address these challenges, Indonesia needs to pursue a more integrated energy diplomacy approach. This includes strengthening bilateral cooperation for technology transfer and capacity building, leveraging multilateral platforms like the IAEA, improving public diplomacy to increase acceptance of nuclear energy, and aligning nuclear development with climate change commitments. The recent INIR mission recommendations provide a roadmap for areas requiring attention, particularly in legal frameworks, inter-agency coordination, and public communication.

While nuclear energy offers potential benefits for energy security, including reliability and reduced fossil fuel dependence, Indonesia must navigate challenges such as uranium resource limitations, high capital costs, and public safety concerns. The government's commitment to rigorous research and public outreach will be crucial in optimizing nuclear energy's potential. Successful implementation of nuclear energy development in Indonesia will require a balanced approach that addresses safety, security, and waste management concerns while leveraging international cooperation and best practices. By refining its energy diplomacy strategy and addressing identified weaknesses, Indonesia can work towards achieving its nuclear energy goals within the broader context of national energy security and sustainability objectives.

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