e-ISSN: 3109-6425
p-ISSN: 3109-6433

Proceeding Jakarta Geopolitical Forum
Lembaga Ketahanan Nasional Republik Indonesia (LEMHANNAS RI)
Volume 9 | 2025
WEB : https://proceeding.lemhannas.com/index.php/jgf
DOI : https://doi.org/10.55960/jgf.v9i1.295

Conference Paper

STRATEGIC PATHWAYS FOR INDONESIA'S RENEWABLE ENERGY TRANSITION: GEOPOLITICAL POSITIONING, CRITICAL MINERALS, AND NET-ZERO AMBITIONS

Eko Supriyanto
Universiti Teknologi Malaysia, Johor Bahru, Malaysia

Abstract.

Renewables are now playing a major role in shaping global energy security and climate diplomacy, as well as economic resilience. The energy transition of the world is accelerating under the influence of market changes, competition for critical resources and rapid technology development, the transition is presenting both opportunities and challenges. Through the lens of legislation, future electricity generation mix and the role of critical minerals, this study undertakes a qualitative content analysis to assess Indonesia's strategic position in the renewable energy transition. Indonesia has a significant comparative advantage since the nation has a plentiful nickel, cobalt, and potentially lithium reserves and abundant renewable resources. By 2050, under the projected energy scenarios, the contribution of solar power generation will rise to more than 30%, while the use of coal will have fallen dramatically to 5-10%. But the country has structural problems, that are geopolitically vulnerable supply chains, expensive storage, regulatory hurdles, reliance on foreign technology. Faster downstream mineral processing, local technical capacity R&D, regional energy integration, and regional technical partnerships of this kind need to take place in order to avoid these pitfalls. Indonesia can establish itself as the regional leader in sustainable energy and critical mineral supply, seize on the energy transition to cost-effectively work towards net zero emissions by 2045 with early strategic action.

Keywords:; climate diplomacy; critical minerals; energy security; net-zero emissions; renewable energy transition

Corresponding Author:
Eko Supriyanto
Email: ekosupriyanto@isi-ska.ac.id

Article History:
Received : 12-04-2025
Revised : 24-05-2025
Accepted : 28-06-2025

Published by Lemhannas Press.

Introduction

Renewable energy has been widely believed to have played an influential role in the global energy security, diplomacy, and economic development (1,2). Opportunities and challenges are emerging from the global energy transition as new technologies and market forces redefine the strategic landscape, but the trajectory away from carbon is also an environmental imperative. The geopolitical shake-up determine which countries will dominate in the decades to come (3,4). Renewable energy provide a smart strategy for Indonesia to enhance economic resilience, contribute to climate diplomacy and gain energy sovereignty (5). As countries make energy through solar, wind, hydrogen and new-generation energy sources like fusion and space-based solar power, the global picture is evolving rapidly. From a cost perspective, solar photovoltaic power will even outpace nuclear and fossil fuels by 2045 and can be earlier if supplemented by battery storage (4,6). In this momentum, Indonesia has a unique opportunity to use critical minerals and abundant renewables to become a major player in the energy economy of the 21st century.

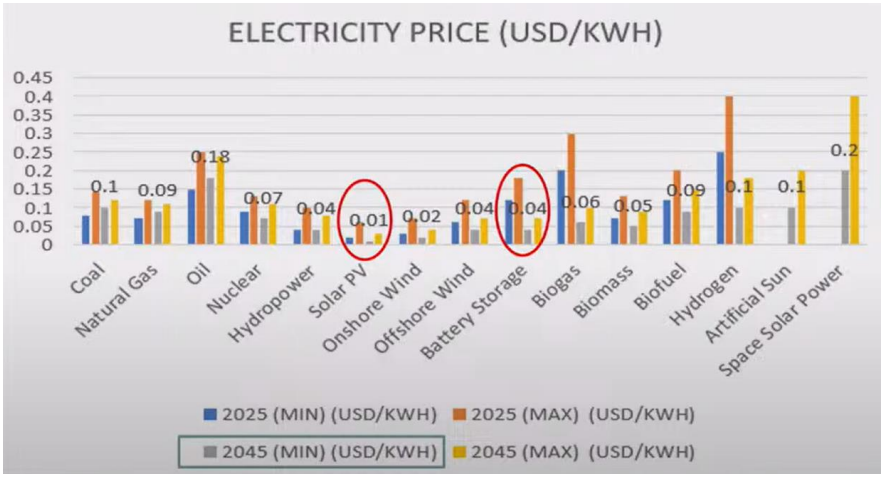

Figure 1. Electricity Price (USD/KWH)
Source: Supriyanto (2025)

Literature Review

Theoretical Studies

The energy transition follows a global framework in which many countries aim to achieve net-zero emissions by the mid-century (7). The demand for fossil fuel will be in high position before 2050, after adoption of renewable energy between 2030 and 2060. A lot of countries also pursuing different strategies to reduce dependence on fossil fuel imports, diversify energy sources, and improve system resilience (8). Renewable energy enhances diversification, reduces vulnerability to supply

disruptions, and contributes to decarbonization and economic growth. Renewable energy attracts investment, stimulates technological innovation, and strengthens human capital (9–11). Climate diplomacy has become an important dimension of the renewable energy transition, with initiatives like the “Just Energy Transition Partnership” mobilizing significant funding for coal retirement and renewable energy expansion (3,4). Countries also use renewable energy leadership to build soft power through mechanisms like green hydrogen trade corridors and carbon border adjustment measures.

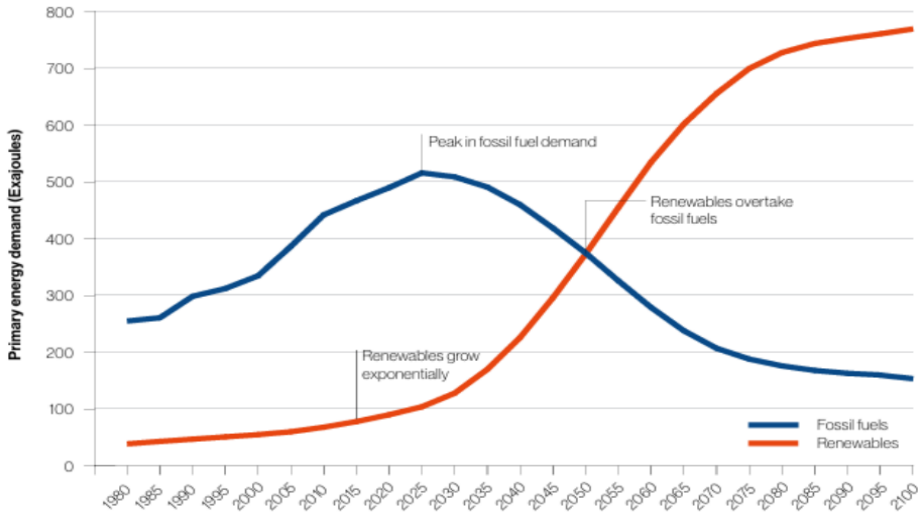

Figure 2. Energi Transition Framework
Source: Supriyanto (2025)

The economics of renewables depends on access to critical minerals (12). Electric vehicles, wind turbines and solar panels all need lithium, nickel, cobalt and rare earth metals are expected to multiply fourfold by 2030. Indonesia is positioned as one of the important suppliers because the country has been proved to have large copper, nickel, cobalt, and other key mineral reserves (13,14). Yet, as the Chinese domination of battery, solar panel and hydrogen electrolyser capacity proves, relying on a concentrated supply chain has risks. These condition underscore the importance of regional production, diversified sourcing, and technical autonomy (3,4).

Empirical Studies

Global trends indicate diverse national pathways in the implementation of renewable energy (15,16). Germany is on target to reach net zero by 2045, thanks to its leadership on climate change. China's goal is 2060, and they are focusing on their industrial strategy and manufacturing capacity. Indonesia wants to have 23% of its energy come from renewable sources by 2060 (17). The US, India, Saudi Arabia, and Russia all have distinct

schedules based on what is important to them. In 2023, solar and wind power overtook gas generation for the first time, showing that renewable energy might become the biggest source of electricity in the European Union. (3,4).

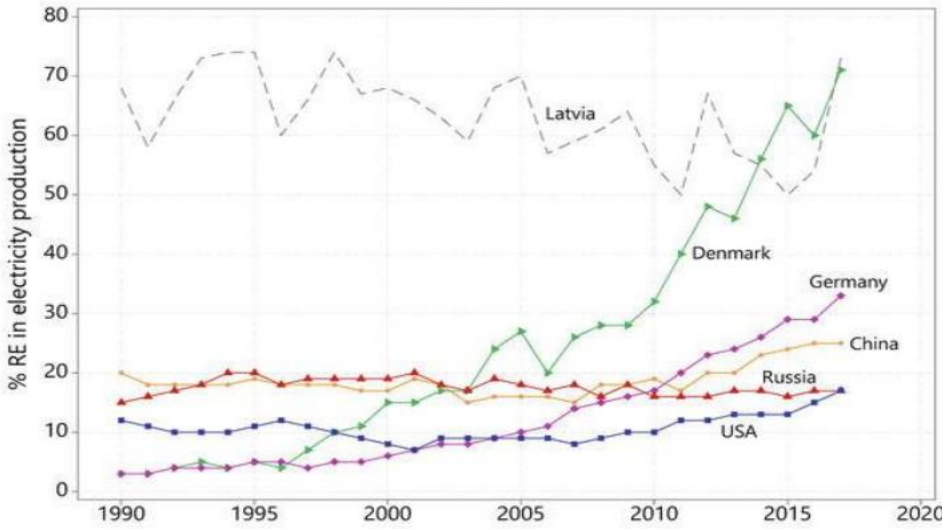

Figure 3. Percent Renewable Energy in Electricity production
Source: Supriyanto (2025)

Efforts from local community is needed for renewable energy initiatives to work (18,19). In Indonesia, projects that give distant villages solar mini-grids and water pumps have given communities more control over their own lives, expanded access to electricity for more than 14,000 people, and created new business opportunities (3,4). There are several similar initiatives on Denmark's Samsø Island that show the possibilitiy to make renewable energy systems that are 100% owned by the community. Community-based programs garner increased public support, alleviate energy poverty, and empower marginalized groups through training and employment (20).

However there are challenges remain. High storage costs, limited green financing, permitting delays, and inadequate public awareness hinder renewable energy expansion (3,4,21–23). Geopolitical risks comprise of concentration of supply chains, price volatility in critical minerals, trade tensions, and environmental concerns from resource extraction and manufacturing processes.

Methods

The study use a qualitative content analysis approach, defined as a research method for deriving replicable and valid inferences from textual data (24,25). The paper addresses Indonesia’s strategic positioning in the global perspective of transition power plant as well as by reviewing regulatory frameworks, national energy roadmaps, anticipated generation

mixes, and mineral resource mapping. All of the secondary studies, as well as government energy plans, ASEAN regional integration documents, international agency reports, and comparison country case studies conducted during the last 20 years would be considered primary sources. The selection criteria focus on how relevant something is to deploying renewable energy, ensuring that there is a stable supply of crucial minerals, and the geopolitical implications of diversifying sources of energy, with an emphasis on Indonesia's aspirations to achieve net-zero emissions. The unit of analysis centres on state-led strategies, infrastructure development plans, and technology adoption measures in balancing declining fossil fuel reliance with renewable energy expansion. Data credibility is maintained through triangulation of official statistics, scenario projections, and cross-referencing with peer-reviewed and institutional sources.

Results and Discussion

Evaluation of projected mixes of electricity generation has led to an intense decrease in the use of coal in numerous countries where coal use is intended to be phased out completely by 2050. Coal's share is predicted to drop to 5-10% by 2050 and solar will increase from less than 1 per cent in 2000 to more than 30%. Malaysia has only a small share of coal, Singapore goes for nil, and Germany gets rid of it all. The comparative data confirm that renewable energy adoption is accelerating globally, but the pace varies by national level (3,4).

Table 1. Projected Electric Power Mix (% of Total Generation)
Source: Supriyanto (2025)

Country / Year	Coal	Gas	Oil	Nuclear	Hydro	Solar/Wind	Other Renewables
Indonesia 2000	55–60%	20–25%	10–12%	0%	10–12%	<1%	<1%
Indonesia 2025	40–45%	20–25%	2–3%	<1%	15–20%	10–12%	2–3%
Indonesia 2030	35–40%	20–25%	2–3%	<1%	15–20%	10–15%	2–3%
Indonesia 2050	5–10%	15–20%	<1%	2–5%	25–30%	30–35%	10–15%
Malaysia 2000	40–45%	35–40%	10–12%	0%	10–12%	<1%	<1%
Malaysia 2025	35–40%	35–40%	2–3%	<5%	10–15%	8–10%	2–3%
Malaysia 2030	30–35%	35–40%	2–3%	<5%	10–15%	10–15%	2–3%
Malaysia 2050	5–10%	30–35%	<1%	10–15%	15–20%	25–30%	5–10%
Singapore 2000	<5%	85–90%	5–10%	0%	<1%	<1%	<1%
Singapore 2025	0%	95%	<1%	0%	<1%	3–5%	1–2%
Singapore 2030	0%	90–95%	<1%	0–5%	<1%	5–10%	2–3%
Singapore 2050	0%	60–70%	<1%	10–15%	<5%	20–25%	5–10%
China 2000	70–75%	1–2%	<1%	2–3%	15–18%	<1%	<1%
China 2025	55–60%	10–15%	<1%	5–10%	10–15%	15–20%	2–3%
China 2030	45–50%	10–15%	<1%	5–10%	10–15%	20–25%	2–3%
China 2050	5–10%	10–15%	<1%	15–20%	15–20%	35–40%	5–10%
India 2000	65–70%	2–3%	2–3%	2–3%	20–25%	<1%	<1%
India 2025	60–65%	5–10%	<1%	3–5%	10–15%	12–15%	2–3%
India 2030	55–60%	5–10%	<1%	3–5%	10–15%	15–20%	2–3%
India 2050	10–15%	10–15%	<1%	10–15%	20–25%	30–35%	5–10%
USA 2000	50–55%	15–20%	2–3%	18–20%	7–9%	<1%	<1%
USA 2025	18–22%	35–40%	<1%	18–20%	5–10%	25–30%	2–3%
USA 2030	15–20%	35–40%	<1%	15–20%	5–10%	30–35%	2–3%
USA 2050	5–10%	20–25%	<1%	20–25%	10–15%	30–35%	5–10%
Germany 2000	50–55%	10–15%	5–7%	25–30%	5–7%	<1%	<1%
Germany 2025	15–20%	20–25%	<1%	0%	5–10%	40–45%	5–10%
GERMANY 2030	5–10%	20–25%	<1%	0%	5–10%	50–55%	10–15%
GERMANY 2050	0%	15–20%	<1%	0%	10–15%	55–60%	15–20%

Indonesia's strategic advantage lies in combination of abundant renewable energy resources and critical minerals essential for clean technology production (13,14). Indonesia is already the world's top producer of nickel and could become even more so if the nation finds more lithium sources. However, relying on foreign technology and industrial skills is less safe. Technology is still occurring mainly in countries such as China, the United States, Germany and Japan, where the number of publications and the amount of state funding is several times greater than in Indonesia. If Indonesia want to alter this trajectory, the nation must invest in research and development here in the United States, train our workers, and work with others to share technology (15–17).

Table 2. Countries Holds the Strongest Strategic Position
Source: Supriyanto (2025)

Factor	Leading Countries
Materials	China, Australia, Chile, DRC, Indonesia
Technology	China, Germany, USA
Market Size	China, USA, India, Indonesia
Human Capital	Germany, USA, India
Financing Power	USA, EU, Japan, UAE

Geopolitical positioning will depend on how well we can diversify our energy sources and partners, make sure that vital minerals are always available, and connect renewable energy to regional power systems. ASEAN linkages can make energy security stronger for everyone and let Indonesia be both a provider and a transit centre for renewable electricity and green hydrogen. (3,4).

Conclusion

Renewable energy is not only a means to reduce carbon emissions, however also helps make countries more energy independent, gain greater geopolitical power and drive inclusive development. Nations that act firmly can shape the power of the future, capture wealth and enhance their position in the world. To accomplish the net-zero emissions milestone in 2045, Indonesia must accelerate the downstream processing of minerals, rely more heavily on renewable energy, develop new technologies and have robust financial systems in place. By working with international partners and making things in Indonesia, while also going digital, Indonesia can lead in the global renewable energy economy. Decisive strategy will impact Indonesia's ability to realize vision for a sustainable, innovative, and prosperous energy future.

Acknowledgments
The author extends sincere gratitude to Universiti Teknologi Malaysia and Lembaga Ketahanan Nasional Republik Indonesia for their invaluable support throughout the various stages of developing this article

References

1. Mangla A. Geopolitics of Renewable Energy: Shaping the Global Power Landscape. Gyan Manag J. 2023;17(2):75–80.
2. Scholten D, Bazilian M, Overland I, Westphal K. The Geopolitics of Renewables: New board, New Game. Energy Policy. 2020;138(1):111059.
3. Supriyanto E. Jakarta Geopolitical Forum IX/2025. 2025 [cited 2025 Aug 10]. Strategic Pathways for Indonesia's Renewable Energy Transition: Geopolitical Positioning, Critical Minerals, and Net-Zero Ambitions. Available from: https://www.youtube.com/watch?v=9VSWkAXLb4U&t=3424s
4. Supriyanto E. The Relevance of Renewable Energy in the Changing Global Geopolitics and Economics. Johor Bahru; 2025.
5. Nasution EB, Rolliansyah DA, Roring HA, Rino MR, Lanjari RNW. Mempromosikan Energi Terbarukan: Diplomasi Lingkungan Indonesia dalam Menanggulangi Perubahan Iklim. Verit J Ilm Hub Int (International Relations Journal). 2023;15(30):15–28.
6. He G, Lin J, Sifuentes F, Liu X, Abhyankar N, Phadke A. Rapid Cost Decrease of Renewables and Storage Accelerates the Decarbonization of China's Power System. Nat Commun. 2020;11(1):2486.
7. Jacobs T. BP's Energy Outlook Foresees Big Shift for Oil Demand. J Pet Technol. 2020 Oct 1;72(10):42–4.
8. Ikevuje AH, Kwakye JM, Ekechukwu DE, Ogundipe OB, Esiri AE. Optimizing the Energy Mix: Strategies for Reducing Energy Dependence. Open Access Res J Multidiscip Stud. 2024;8(1):94–104.
9. Wen J, Okolo CV, Ugwuoke IC, Kolani K. Research on Influencing Factors of Renewable Energy, Energy Efficiency, on Technological Innovation. Does Trade, Investment and Human Capital Development Matter? Energy Policy [Internet]. 2022;160(1):112718. Available from: https://www.sciencedirect.com/science/article/pii/S0301421521005838
10. Yang C, Song X. Assessing the Determinants of Renewable Energy and Energy Efficiency on Technological Innovation: Role of Human Capital Development and Investement. Environ Sci Pollut Res. 2023;30(13):39055–75.
11. Esquivias MA, Sugiharti L, Rohmawati H, Rojas O, Sethi N. Nexus between Technological Innovation, Renewable Energy, and Human Capital on the Environmental Sustainability in Emerging Asian Economies: A Panel Quantile Regression Approach. Vol. 15, Energies. 2022. p. 1–16.
12. Han S, Zhenghao M, Meilin L, Xiaohui Y, Xiaoxue W. Global Supply Sustainability Assessment of Critical Metals for Clean Energy Technology. Resour Policy. 2023;85(1):103994.
13. Dini Putri Saraswati, Shanti Darmastuti, Nurfarah Nidatya, Dinda Jasmine. Peran Strategis Indonesia dalam Geopolitik Transisi Energi di Bidang Sumber Daya Mineral. Khatulistiwa J Pendidik dan Sos Hum. 2025 May 19;5(2):599–615.

14. Pasaribu NT, Tama AA, Azzari MK, Gautama I. Green Arms Race: Indonesia's Critical Minerals and its Sprint for Renewable Energy Sovereignty. Secur Intell Terror J. 2025 Mar 7;2(1):27–47.
15. Hassan Q, Viktor P, J. Al-Musawi T, Mahmood Ali B, Algburi S, Alzoubi HM, et al. The Renewable Energy Role in the Global Energy Transformations. Renew Energy Focus. 2024;48(1):100545.
16. Gajdzik B, Nagaj R, Wolniak R, Bałaga D, Žuromskaitė B, Grebski WW. Renewable Energy Share in European Industry: Analysis and Extrapolation of Trends in EU Countries. Vol. 17, Energies. 2024. p. 1–38.
17. Syabriyana M. Progress and Challenges of Renewable Energy Transition in Indonesia's Energy Mix Towards Net Zero Emissions. JURUTERA - J Umum Tek Terap [Internet]. 2024 Dec 30;11(02):76–82. Available from: https://ejurnalunsam.id/index.php/jurutera/article/view/11141
18. Hussain S, Xuetong W, Maqbool R, Hussain M, Shahnawaz M. The Influence of Government Support, Organizational Innovativeness and Community Participation in Renewable Energy Project Success: A Case of Pakistan. Energy. 2022;239(1):122172.
19. Uzorka A, Olatide Olaniyan A, Olubusayo VF. Engaging Communities in Renewable Energy Projects For Sustainable Development. J Appl Sci Inf Comput. 2024;4(2):57–67.
20. Busch H, Radtke J, Islar M. Safe Havens for Energy Democracy? Analysing the Low-Carbon Transitions of Danish Energy Islands. Zeitschrift für Polit. 2023;33(2):227–51.
21. Krane J, Idel R. More Transitions, Less Risk: How Renewable Energy Reduces Risks from Mining, Trade and Political Dependence. Energy Res Soc Sci. 2021;82(1):102311.
22. Vakulchuk R, Overland I, Scholten D. Renewable Energy and Geopolitics: A Review. Renew Sustain Energy Rev [Internet]. 2020;122(1):109547. Available from: https://www.sciencedirect.com/science/article/pii/S1364032119307555
23. Islam MM, Sohag K, Mariev O. Geopolitical Risks and Mineral-Driven Renewable Energy Generation in China: A Decomposed Analysis. Resour Policy. 2023;80(1):103229.
24. Saunders M, Lewis P, Thornhill A. Research Methods for Business Students by Mark Saunders, Philip Lewis and Adrian Thornhill 8th edition. [Internet]. Research Methods For Business Students. 2015. 768 p. Available from: https://www.google.co.id/books/edition/Research_Methods_for_Business_Students/0DHFsgEACAAJ?hl=en
25. Krippendorff K. Content Analysis: An Introduction to Its Methodology [Internet]. SAGE Publications; 2018. 472 p. Available from: https://methods.sagepub.com/book/mono/content-analysis-4e/toc