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Indonesia's Sustainable Green Economy Policy in the Energy Sector: Challenges and Expectations

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ABSTRACT

This paper comprehensively analyzes the challenges and prospects for achieving a sustainable green economy in Indonesia's energy sector, where fossil fuels dominate approximately 90.4 percent of the domestic energy supply, making the sector a major contributor to emissions. Despite ambitious targets, renewable energy development has progressed slowly, with only 0.97 GW capacity achieved out of a 3.4 GW target by the fourth quarter of 2023. Employing a normative research approach, this study draws from primary and secondary data sources to explore the obstacles hindering green economic transformation, including limited financing for technological innovation, insufficient long-term environmental policies, human resource constraints, institutional structures, regulatory coherence, and the need to balance economic trade-offs. Key findings highlight that Indonesia must bolster its legal framework, strengthen infrastructure, foster policy alignment, secure financing, enhance technological capabilities, and expand renewable energy capacity. This paper seeks to contribute insights for formulating an integrated, resilient strategy to accelerate Indonesia's transition to a green economy within the energy sector.

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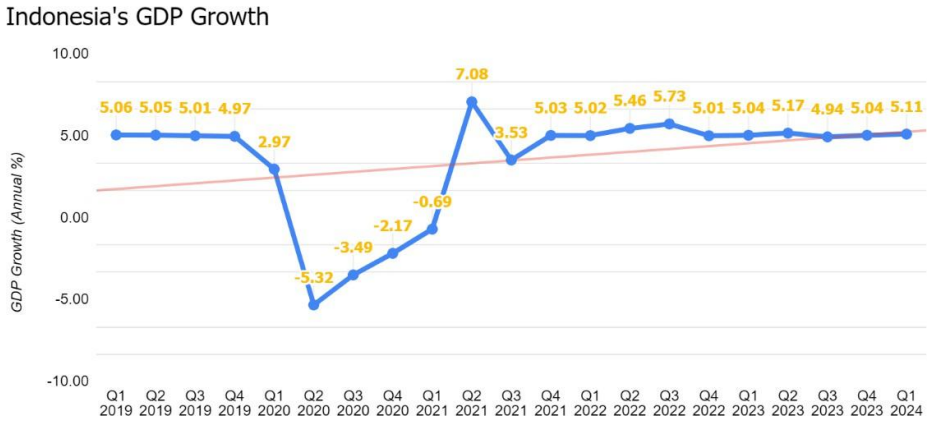
1. Introduction

Climate change has a long-term impact on the real economy, manifesting in decreased production, decreased employment, reduced social coherence, and cultural loss in each country, especially in developing or low-income countries most vulnerable to climate change

risks.[1] Indonesia is one of the countries that is vulnerable to the risk of climate change and is also impacted by economic growth even though, in recent years, from 2019 to 2024, the economic conditions in Indonesia have remained stagnant, as shown in Figure 1.

Figure 1 (Indonesia's GDP Growth 2019 – 2024)



Source: BPS-Statistics Indonesia (www.bps.go.id)

In the first quarter of 2024, Indonesia's economic growth reached 5.11% year-on-year, a modest increase of 0.07%. This steady growth has contributed to a rise in domestic energy demand, particularly for electricity, a fundamental need in modern society. As a signatory to the Paris Agreement, ratified through Law No. 16 of 2016, Indonesia has committed to achieving net-zero emissions by 2060 or earlier. This commitment is reinforced by an enhanced Nationally Determined Contribution (NDC) target of a 31.89% reduction in emissions through domestic efforts and a potential 43.20% reduction with international support. Additionally, the Just Energy Transition Partnership (JETP) between Indonesia and the International Partner Group aims to transition 44% of Indonesia's energy mix to renewable sources by 2030 and phase out 1.7 GW of coal-fired power plants. However, these targets face significant challenges. The JETP, while promising, is criticized for needing more ambition in controlling global temperature rise to the 1.5 degrees Celsius target. This study addresses Indonesia's complex path toward a sustainable green economy, focusing on the main issues hindering its energy transition, such as policy coherence, financial and technological limitations, and the gradual shift from coal dependency. [2]

On the other hand, the demand for national energy for the industrial sector was recorded at 44.21% in 2022, of which 55.79% was fulfilled by coal. Government policies influence this condition through the Domestic Market Obligation (DMO). This policy can support the development of domestic industries that use national natural resources, but the use of coal in the industrial sector also increases greenhouse gas emissions. In the transportation sector, through Ministerial Decree Number 8 of 2023 on the Determination of Climate Change Mitigation Actions in the Transportation Sector to Achieve Nationally Determined Contribution Targets, 38 mitigation action steps have been set to focus on the electrification of land vehicles, including motorcycles, cars, and public vehicles as well as the use of low-carbon

[1] Min Yan, 'Permitting Dual Class Shares in the UK Premium Listing Regime – a Path to Enhance Rather than Compromise Investor Protection', *Legal Studies*, 42.2 (2022), 335–57. https://doi.org/10.1017/lst.2021.50.

[2] Yimin Huang and others, 'Can China Achieve Its 2030 and 2060 CO2 Commitments? Scenario Analysis Based on the Integration of LEAP Model with LMDI Decomposition', *Science of The Total Environment*, 888 (2023), 164151. https://doi.org/10.1016/j.scitotenv.2023.164151.

fuels in sea and air transportation. These various developments show that Indonesia's energy transition is starting to enter the take-off phase to reduce environmental damage.[3]

Although many green growth programs are implemented, such as energy programs, energy landscape programs, special economic zones (SEZs), and climate funds, in their implementation, these green growth programs face many challenges.[4] One of the concerns regarding business activities that cause environmental damage, based on data from the Indonesian Ministry of Environment and Forestry (KLHK), as of August 2023, the activities of four companies that cause air pollution and environmental damage have been stopped in the following Jakarta buffer areas. PT. Wahana Sumber Rezeki and PT. Unitama Makmur Persada allegedly needed a detailed Environmental Management Plan (RKL) and Environmental Monitoring Plan (RPL) during their PT activities. Maju Bersama Sejahtera was said to have committed violations related to the discrepancies between environmental documents and the actual conditions on the site. Meanwhile, for the disposal of coal combustion waste and chimneys of PT, Pindo Deli 3, the problem was the sampling pit that did not meet technical requirements.[5]

The effect of these environmentally friendly activities has left at least 332 mining pits in the mining area that have yet to be closed (reclamation). Some of the voids have become death holes. They have claimed the lives of the people around the mining area because they drowned in the puddle. In general, coal mining business activities are carried out in a non-environmentally friendly manner and are even indicated to damage the environment. This can be seen in the heavy rainy season; in addition to floods and landslides, many agricultural lands are buried in mud from mining waste. One of the most recent cases happened to PT. Timah Tbk (TINS) Bangka Belitung for the 2015-2022 period caused environmental losses of up to Rp271 trillion due to mining business activities that do not have a Mining Business License (IUP). Environmental damage and the impact of climate change have the potential to create significant economic losses that can hinder Indonesia's aspirations to become a developed country.[6]

Indonesia is currently developing and implementing specific measures in public policy for a green economy in the energy sector to reduce the impact of unwanted environmental damage.[7] Therefore, consideration of the main challenges in law, social, economic, and environmental development and the structuring of public policies for the green economy is of particular concern. Indonesia's economic growth to date has been built on the rapid expansion of natural resource-based industries, especially mining, energy, agriculture, and forestry. Progressively

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[3] Sigit D. Sasmito and others, 'Challenges and Opportunities for Achieving Sustainable Development Goals through Restoration of Indonesia's Mangroves,' *Nature Ecology & Evolution*, 7.1 (2023), 62–70. https://doi.org/10.1038/s41559-022-01926-5.

[4] Tonni Agustiono Kurniawan and others, 'Unlocking Synergies between Waste Management and Climate Change Mitigation to Accelerate Decarbonization through Circular-Economy Digitalization in Indonesia', *Sustainable Production and Consumption*, 46 (2024), 522–42. https://doi.org/10.1016/j.spc.2024.03.011.

[5] Yordan Gunawan and Mohammad Hazyar Arumbinang, 'The Climate Change Litigation Based Human Rights Approach in Corporations: Prospects and Challenges', *Journal of Human Rights, Culture and Legal System*, 3.2 (2023), 288–307. https://doi.org/10.53955/jhcls.v3i2.116.

[6] R Jannah and others, 'Climate Change, Villages and Agromaritime: Current Conditions and Future Challenges in Indonesia', *IOP Conference Series: Earth and Environmental Science*, 1359.1 (2024), 012055. https://doi.org/10.1088/1755-1315/1359/1/012055.

[7] Arief Rahman and others, 'Pathways to Reduce Indonesia's Dependence on Oil and Achieve Longer-Term Decarbonization', *Renewable Energy*, 202 (2023), 1305–23. https://doi.org/10.1016/j.renene.2022.11.051.

increasing budget allocation for environmental protection into the readiness of the green economy ecosystem must be supported by clarity of financial sector support in both the State and Non-State Budget schemes. The average climate change budget reaches 4.1% of the state budget annually, and 88.1% of the funds support green infrastructure as the principal capital for green economy transformation. Indonesia's overall climate funding is IDR 3.799 trillion.[8]

This study examines the challenges and expectations of a sustainable green economy in the energy sector in the climate change era in Indonesia. This paper also gives recommendations to mitigate these challenges and expectations. This study provides more specific findings on implementing the green economy, especially in the energy sector. Previously, there were still not many studies that researched the relationship between the green economy and the energy sector. This study provides information on Indonesia's challenges and expectations in implementing the green economy in the energy sector so that it becomes interesting for the authors in conducting this research; it is expected that this paper can provide conferential information and discussion.

2. Research Method

This research uses a normative approach focusing on Indonesia's sustainable green economy policies in the energy sector. This approach helps to understand the challenges and expectations faced by the government and stakeholders in implementing green economy policies in the energy sector. Descriptive-analytical aims to describe existing policies and analyze the challenges and expectations related to the policies. The data sources consist of primary data from in-depth interviews with experts in the energy sector and secondary data, namely from policy documents (laws), government regulations related to the green economy and sustainable energy, reports from international institutions, and relevant scientific journals and articles. Meanwhile, the data analysis technique uses qualitative analysis, where data obtained from interviews and document studies are analyzed using content analysis techniques to find the main themes related to challenges and expectations in green economy policies in the energy sector. Triangulating data is also applied by increasing the validity of the results; data from various sources (interviews, documents, literature) were compared to see the consistency of the findings.

3. Result and Discussion

3.1 Indonesia's Sustainable Green Economy in the Energy Sector

To realize a sustainable green economy, Indonesia has been progressively cooperating in the planning of the Low Carbon Development Initiative (LCD since its initiation at the United Nations Framework on Climate Change Conference of Parties 23 (UNFCC COP-23).[9] The PRK initiative aims to explicitly incorporate environmental considerations, such as greenhouse gas reduction and capacity-bearing targets, into the national development planning framework. Phase 1 of the Indonesian PRK initiative has been adopted into the National Medium-Term Development Plan (RPJMN) 2020-2024. Currently, Indonesia's PRK initiative has entered phase 2, namely the implementation phase. Namely, Sustainable Energy, Sustainable

[8] Sigit Setiawan and others, 'Green Finance In Indonesia's Low Carbon Sustainable Development', *International Journal of Energy Economics and Policy*, 11.5 (2021), 191–203. https://doi.org/10.32479/ijeep.11447.

[9] Moira Moeliono and others, 'REDD+ in Indonesia: A New Mode of Governance or Just Another Project?',*Forest Policy and Economics*, 121 (2020), 102316. https://doi.org/10.1016/j.forpol.2020.102316.

Landscapes, and Sustainable Infrastructure in the context of Special Economic Zones (SEZs) are being carried out and supported to reach the bankable stage.[10]

In the context of implementing the Green Economy Roadmap (PRK), the Ministry of National Development Planning/National Development Planning Agency (BAPPENAS), with support from the United Nations Partnership for Action on Green Economy (UN-PAGE) and the United Nations Institute for Research and Training (UNITAR), conducted the Indonesia Green Economy Learning Assessment (GELA). This study aims to establish a comprehensive training program on the green economy that can be implemented nationwide, targeting civil servants, development planners, and policymakers across various ministries, institutions, local governments, and other key stakeholders. A deeper exploration of the role of law is critical to accelerating the implementation of green energy within this framework. Legal frameworks and policies must align with green economy principles to ensure effective governance, regulatory incentives, and compliance mechanisms that support renewable energy initiatives and facilitate the transition from fossil fuels.[11]

The sustainability of this assessment also has specific objectives, such as first, analyzing learning needs and priorities to advance an inclusive green economy in Indonesia based on the Low Carbon Development Initiative (LCDI) Framework agreed upon with the BAPPENAS, which includes issues relevant to building a sustainable recovery, such as green work and resource efficiency, second, reviewing the existing institutional capacities to carry out learning activities related to the priority components of the LCDI and outline concrete action plans and training strategies based on findings, including the opportunities to strengthen and improve the delivery of green economy learning at BAPPENAS and other relevant institutions at the national and regional levels. In addition, to encourage the green economy, BAPPENAS, in collaboration with the Ministry of Energy and Mineral Resources (MEMR), supports the energy sector, especially the renewable energy and energy efficiency subsectors, through the Green Economy Growth Program.[12]

Planning the green growth approach in energy planning at the national and sub-national levels will create a resilient foundation for realizing national energy priorities, which include strengthening energy security, developing energy infrastructure, increasing the use of renewable energy, and reducing energy subsidies. The National Energy Policy aims to improve the portion of New and Renewable Energy (NRE) to 16% in 2019 and up to 23% in 2025 to meet national energy needs. Indonesia's Green Economic Growth Program develops and provides systematic approaches, including methods, tools, indicators, and best practices, that can drive the realization of green investment. The goal of this green investment with a green growth approach is expected to help Indonesia implement innovative and creative funding schemes to increase investment in renewable energy projects and energy efficiency in promoting a green economy. The Green Economy Growth Program offers investment services, such as arranging funding and bringing together investors with project developers in project development to reduce risks and help projects reach the bankable stage. Potential investors

[10] Novita Putri Rudiany and Keista Puti Yesandi, '"Greening" the National Growth: How Global Green Growth Institute (GGGI) Collaborates with Indonesia in 2014-2020', *Insignia: Journal of International Relations*, 10.2 (2023), 199. https://doi.org/10.20884/1.ins.2023.10.2.9707.

[11] Abdul Kadir Jaelani, Reza Octavia Kusumaningtyas, and Asron Orsantinutsakul, 'The Model of Mining Environment Restoration Regulation Based on Sustainable Development Goals', *Legality : Jurnal Ilmiah Hukum*, 30.1 SE-Journal's Articles (2022), 131–46. https://doi.org/10.22219/ljih.v30i1.20764.

[12] Alfred Boediman, Raden Aswin Rahadi, and Bagus Aditya Nugraha, 'An Overview of Indonesian Renewable Energy Studies and Its Investment Opportunities', *Indonesian Journal of Energy*, 4.2 (2021), 87–100. https://doi.org/10.33116/ije.v4i2.123.

can be connected to the project early, either through funding schemes by independent power producers (IPPs), Energy Service Companies (ESCOs), or other agreements.[13]

Currently, the program's main focuses in Indonesia are the utilization of photovoltaic solar energy systems, the use of palm oil waste for energy, and various bioenergy solutions.[14] However, the activities of this green economy program in the energy sector can be expanded based on market demand and interest. The programs also explore investment opportunities in energy conservation and the development of energy efficiency solutions by implementing energy audits in the industrial sector. The Green Economic Growth Program seeks to create a conducive situation for green investment and capital increase, which is done by helping the government build investor confidence, attract capital, and create sustainable 'green' business models that can generate profits and open up new untapped opportunities.[15]

The Energy Sector estimates total energy demand, with an emphasis on electricity, energy supply, and the cost of energy consumption, as well as the created jobs.[16] The mining sector, the relationship between oil discovery, oil reserves, and electricity production from oil, shows how oil reserves change from discovery to electricity generation.[17] In addition, investment in oil discovery leads to higher oil production costs and energy prices, ultimately lowering energy demand and production and oil discovery efforts (balancing loop). Conversely, investment in solar energy will reduce oil production costs and energy prices, thereby driving demand, and ultimately, solar energy production could experience a reinforcing loop.[18]

In the Indonesia Green Economy Model (I-GEM), it is also essential to pay special attention to hydropower capacity and production, including micro hydro projects and larger projects, as there is an explicit relationship between energy bills (i.e., energy consumption costs) and economic productivity.[19] Biomass, on the other hand, offers a sustainable solution by utilizing organic materials to produce energy. This not only helps reduce waste but can also provide an additional source of income for the agricultural sector. Using biomass can help stabilize energy

[13] Martitah Martitah and others, 'Transformation of the Legislative System in Indonesia Based on the Principles of Good Legislation', *Journal of Indonesian Legal Studies*, 8.2 (2023), 545–94. https://doi.org/10.15294/jils.v8i2.69262.

[14] Syaifuddin Yana and others, 'Biomass Waste as a Renewable Energy in Developing Bio-Based Economies in Indonesia: A Review', *Renewable and Sustainable Energy Reviews*, 160 (2022), 112268. https://doi.org/10.1016/j.rser.2022.112268.

[15] Abdul Matin bin Salman and Eko Asmanto, 'Islamic Environmental Stewardship: A Sociological Approach to Hadith and Legal Frameworks for Ecological Responsibility', *Volksgeist: Jurnal Ilmu Hukum Dan Konstitusi*, 7.2 SE-Articles (2024), 361–78. https://doi.org/10.24090/volksgeist.v7i2.12205.

[16] Rita Lopes and Nuno Videira, 'Modelling Feedback Processes Underpinning Management of Ecosystem Services: The Role of Participatory Systems Mapping', *Ecosystem Services*, 28 (2017), 28–42. https://doi.org/10.1016/j.ecoser.2017.09.012.

[17] Yordan Gunawan and Yovi Cajapa Endyka, 'The Protection of Small and Medium Enterprises in Yogyakarta: The Challenges of ASEAN Economic Community', *Pertanika Journal of Social Sciences and Humanities*, 25.October (2017), 199–206.

[18] D. Guzzo and others, 'Towards a Systemic View on Rebound Effects: Modelling the Feedback Loops of Rebound Mechanisms', *Ecological Economics*, 217 (2024), 108050. https://doi.org/10.1016/j.ecolecon.2023.108050.

[19] Muntasir Murshed and others, 'The Impacts of Renewable Energy, Financial Inclusivity, Globalization, Economic Growth, and Urbanization on Carbon Productivity: Evidence from Net Moderation and Mediation Effects of Energy Efficiency Gains', *Renewable Energy*, 196 (2022), 824–38. https://doi.org/10.1016/j.renene.2022.07.012.

prices and significantly contribute to the diversification of energy sources.[20] In addition, the role of technology in energy efficiency must be addressed. Intelligent technology and smart grids allow for more efficient energy distribution management, reduce energy loss, and ensure a stable and reliable supply. It also aids in integrating renewable energy sources into the primary power grid, which is crucial to achieving long-term sustainability goals.[21]

In the policy context, the government must continue to encourage regulations that support the development of renewable energy and energy efficiency. In addition, tax incentives, subsidies, and research and development (R&D) programs are practical tools to encourage innovation and investment in the energy sector. Collaboration between the public and private sectors is also needed to achieve a sustainable energy transition. It is essential to involve the public in the energy transition process because public education and awareness about the benefits of renewable energy and energy efficiency can accelerate the adoption of green technologies and drive behavioral change towards wiser energy consumption. Active community participation in local energy projects can also strengthen social support and increase the success of renewable energy projects.[22] Considering all these factors, the energy sector can be crucial in achieving economic and environmental sustainability and improving society's overall well-being.

3.2 Indonesia's Challenges and Expectations for a Sustainable Green Economy in the Energy Sector

One way the Indonesian government has fully paid attention to the development of new renewable energy is by signing the Paris Agreement, which has been ratified as one of the policies taken by the Indonesian government as a form of global commitment to face climate change.[23] The policy is contained in Indonesian Law No. 16 of 2016 on the Paris Agreement on the United Nations Framework Convention on Climate Change. In addition to the ratification, the government has also implemented several other policies to address climate change.

These include Government Regulation Number 24 of 2021 on the Procedures for Implementing Strategic Environmental Studies and Presidential Regulation Number 98 of 2021 on Implementing Carbon Economic Value for the Achievement of Nationally Determined Contribution Targets and Controlling Greenhouse Gas Emissions in National Development.[24]

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[20] Md. Golam Kibria and others, 'Current Prospects and Challenges for Biomass Energy Conversion in Bangladesh: Attaining Sustainable Development Goals', *Biomass and Bioenergy*, 183 (2024), 107139. https://doi.org/10.1016/j.biombioe.2024.107139.

[21] Ali Q. Al-Shetwi, 'Sustainable Development of Renewable Energy Integrated Power Sector: Trends, Environmental Impacts, and Recent Challenges', *Science of The Total Environment*, 822 (2022), 153645. https://doi.org/10.1016/j.scitotenv.2022.153645.

[22] Irati Otamendi-Irizar and others, 'How Can Local Energy Communities Promote Sustainable Development in European Cities?', *Energy Research & Social Science*, 84 (2022), 102363. https://doi.org/10.1016/j.erss.2021.102363.

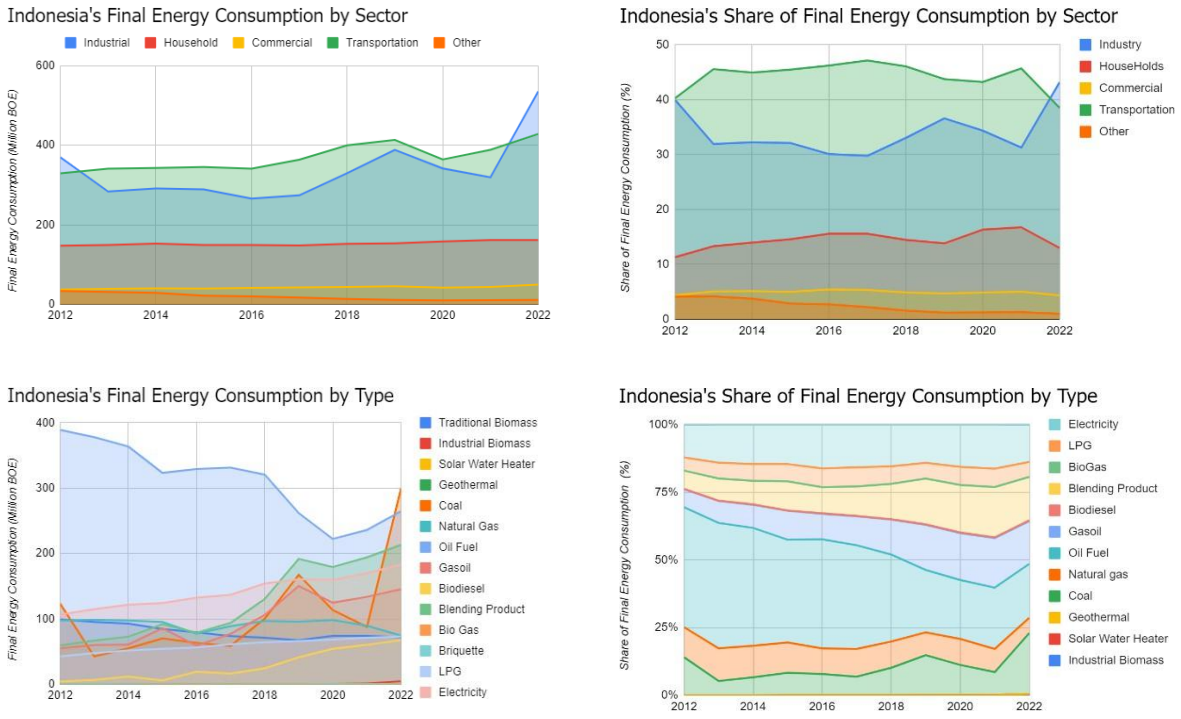
[23] Djoko Santoso Abi Suroso and others, 'Revisiting the Role of International Climate Finance (ICF) towards Achieving the Nationally Determined Contribution (NDC) Target: A Case Study of the Indonesian Energy Sector', *Environmental Science & Policy*, 131 (2022), 188–95. https://doi.org/10.1016/j.envsci.2022.01.022.

[24] Katie K. Arkema and others, 'Evidence-Based Target Setting Informs Blue Carbon Strategies for Nationally Determined Contributions', *Nature Ecology & Evolution*, 7.7 (2023), 1045–59. https://doi.org/10.1038/s41559-023-02081-1.

The Indonesian government has also set the green economy plan as one of the key factors for economic transformation in the medium to long term.[25]

The green economy is the key focus of the government's policies to promote inclusive and sustainable economic development. Implementing the carbon pricing policy and carbon tax scheme in 2024 represents a significant step toward advancing Indonesia's green economy.[26] Challenges and prospects related to realizing a sustainable green economy in Indonesia, aimed at achieving long-term economic and environmental stability, are critical topics for discussion, especially given the increasingly evident negative impacts of climate change on the environment. The country's heavy dependence on fossil fuels and the environmental damage caused by energy companies are central issues that must be addressed.[27]

Figure 2: Energy Consumption in Indonesia



Source: (Handbook of Energy & Economic Statistics of Indonesia 2023)

Indonesia has abundant coal reserves, so it is often used as the primary source to meet its energy needs. Power generation and transportation are the main sectors that use fossil fuels. Many power plants in Indonesia still rely on coal as the primary fuel, while most transportation depends on fuel oil. However, the potential for renewable energy in Indonesia

[25] Luke Swainson and Sango Mahanty, 'Green Economy Meets Political Economy: Lessons from the "Aceh Green" Initiative, Indonesia', *Global Environmental Change*, 53 (2018), 286–95. https://doi.org/10.1016/j.gloenvcha.2018.10.009.

[26] Dian Parluhutan, Satya Arinanto, and Velentina Napitupulu, 'The Green Economy and Decentralization of Natural Resources Management (DNRM) Policy in Indonesia under the International Law Framework: Quo Vadis?', *IOP Conference Series: Earth and Environmental Science*, 1111.1 (2022), 012087. https://doi.org/10.1088/1755-1315/1111/1/012087.

[27] Shuguang Wang, Luang Sun, and Sajid Iqbal, 'Green Financing Role on Renewable Energy Dependence and Energy Transition in E7 Economies', *Renewable Energy*, 200 (2022), 1561–72. https://doi.org/10.1016/j.renene.2022.10.067.

is huge and has not been utilized optimally. Solar, wind, and geothermal energy are some of the renewable energy sources that can be further developed. The Indonesian government has begun to take steps to reduce dependence on fossil fuels by introducing various incentives and policies that encourage investment in renewable energy. By leveraging the potential of existing renewable energy and increasing energy conservation efforts, Indonesia can accelerate the transition to a green economy and achieve sustainability in the energy sector.

The graph above provides a comprehensive overview of final energy consumption in Indonesia from 2012 to 2022 by sector and type of energy. *The first* graph shows that the industrial and transportation sectors are the largest energy consumers, with significant increases in the period. Meanwhile, the household, commercial, and other sectors have relatively stable and lower energy consumption. *The second* graph shows the percentage share of energy consumption by sector, where the industrial sector dominates throughout the period. In contrast, the household and transportation sectors show an increase in the share of energy consumption. *The third* graph, energy consumption by type of energy, shows a significant increase in electricity and natural gas use. Fuel oil and coal consumption also increased, albeit at a slower pace. Types of renewable energy such as biomass, biogas, and biodiesel are starting to show an increase even though their contribution is still small. *The fourth* graph reveals the percentage share of energy consumption by type of energy, with electricity having the largest share and continuing to increase. Fuel oil and natural gas also have a significant share, although the share of fuel oil tends to decrease. The type of renewable energy shows an increasing trend in the share of energy consumption, although it is still relatively small compared to conventional energy.

Applying green economy principles is essential to balance economic growth with environmental protection and social welfare, apart from Indonesia's potential for sustainable and environmentally friendly economic development. There is a need to increase the utilization of renewable energy sources, improve policy coherence, and address economic challenges such as negative trade balance and heavy reliance on extractive sectors that harm the environment. Consistency in planning and implementation, as well as maximizing government stimulus for green economy initiatives, is critical to addressing these challenges and achieving a sustainable green economy in Indonesia's energy sector.

There are challenges in maintaining policy consistency in the long term. Frequent or inconsistent policy changes can disrupt long-term investment and reduce domestic and foreign investor confidence. On the other hand, access to financing is essential for renewable energy projects. Indonesia needs more public budgets to support investment in infrastructure and other sustainable projects.[28] With priorities divided between different sectors and other domestic needs, budget allocation for sustainable projects may become limited. Indonesia often relies on external debt to support green economic development and sustainable programs. Investment in the research and development of renewable energy technologies tailored to Indonesia's geographical and environmental conditions is essential—environmental challenges such as deforestation, air and water pollution, and environmental degradation.[29] Switching to renewable energy can reduce these problems by reducing emissions and minimizing environmental degradation associated with the extraction and burning of fossil fuels.

[28] David Ray and Lili Yan Ing, 'Addressing Indonesia's Infrastructure Deficit', *Bulletin of Indonesian Economic Studies*, 52.1 (2016), 1–25. https://doi.org/10.1080/00074918.2016.1162266.

[29] La Pande Jurumai and others, 'Impact of Population Growth and Housing Development on the Riverine Environment: Identifying Environmental Threat and Solution in the Wanggu River, Indonesia', *Ecological Modelling*, 486 (2023), 110540. https://doi.org/10.1016/j.ecolmodel.2023.110540.

Indonesia has an excellent opportunity to encourage an economic shift towards a more sustainable and environmentally friendly energy sector. Changes towards a green economy can be driven by increased resource efficiency, green technology innovation, increased public awareness and participation, and investment and business opportunities.[30] In the long term, the economic benefits of this transition can be a strong attraction for the business sector and society. In addition, it is necessary to emphasize that supportive, coordinated, and consistent policies are essential. Policies that have clear regulations and incentives can encourage investment and progress in a sustainable green economy. To ensure that the policies and actions taken meet the needs and aspirations of the community, it is essential to have active public participation and involve all stakeholders. The transition to a sustainable green economy requires cooperation from various parties, including governments, industry, communities, and international institutions. The Indonesian government has various expectations regarding the sustainability of the green economy in the energy sector, which are priorities to support sustainable development in the country, such as creating diversification of energy sources, reducing emissions, increasing access to energy, creating new jobs, innovation and technology, energy independence, and environmental protection.

In its national long-term plan for 2025–2045, the Indonesian government transitions to a green economy, encompassing several key focuses. The first focus is the transition to clean and renewable energy, with the renewable energy mix targeted to reach around 60 percent by 2045. Second, environmentally friendly transportation or green transportation should be implemented. Third, applying a circular economy approach to industry and people's daily lives. The implementation of the green economy will be the main focus of the Golden Indonesia vision from 2025 to 2045 and will be an integral part of Indonesia's economic transformation efforts. Ten (10) years in the green economy assessment period, from 2011 to 2020, the Indonesia Green Economy Index showed an increasing trend, indicating that Indonesia is on the right track towards a Green Economy. The composite score of the Green Economy Index grew by 25%, reaching 59.17 in 2020.

Figure 3: Indonesia Green Index

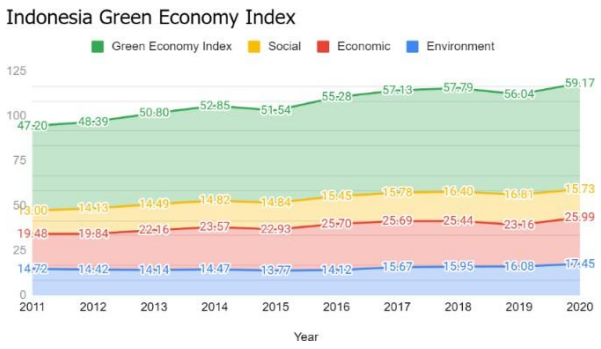
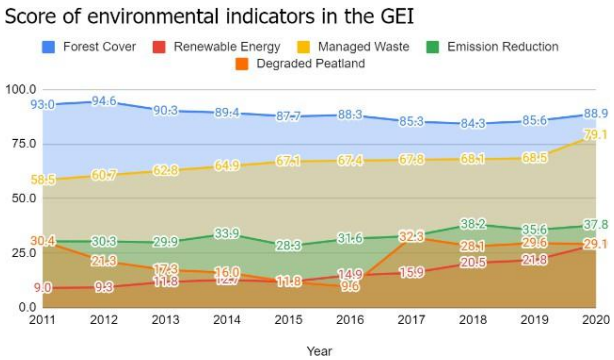


Figure 4: Score of Environmental Indicators in the GEI



Source: (Data Managed from Low Carbon Development Indonesia, https://lcdi-indonesia.id/)

The graph on the left shows Indonesia's Green Economy Index from 2011 to 2020, divided into social, economic, and environmental components. The overall Green Economy Index experienced a steady increase from around 47.20 in 2011 to 59.17 in 2020. The social component

[30] Antonio Licastro and Bruno S. Sergi, 'Drivers and Barriers to a Green Economy. A Review of Selected Balkan Countries', *Cleaner Engineering and Technology*, 4 (2021), 100228. https://doi.org/10.1016/j.clet.2021.100228.

was around 14 to 16 points during this period, indicating a moderate increase. Initially around 19.48 in 2011, the economic component increased significantly to around 25.99 in 2020. The environmental component also increased, from about 14.72 in 2011 to 17.45 in 2020. The graph on the right presents the scores of environmental indicators in the Green Economy Index (GEI) for several aspects of the environment from 2011 to 2020, namely forest cover, renewable energy, waste management, emission reduction, and degraded peatlands. Forest cover indicators were relatively stable in the 90s, slightly declining from 93.0 in 2011 to 88.9 in 2020. Renewables also showed stability with a score of around 60-70, although there was a slight decline from 58.5 in 2011 to 57.8 in 2020. Waste management increased from 30.4 in 2011 to 37.8 in 2020, showing improvements in waste management systems. Emission reductions slightly increased from 9.0 in 2011 to 21.8 in 2020. Meanwhile, degraded peatlands showed a fluctuating score but slightly increased from 12.4 in 2011 to 29.1 in 2020.

Implementing the green economy is not easy; it requires significant changes that must be supported by a good ecosystem and joint efforts to achieve sustainable economic growth in the next decades. Several policies, such as improving energy efficiency,[31] a fair energy transition,[32] the development of smart grids, and the implementation of a circular economy, are the cornerstones of these changes. Therefore, it is necessary to provide fiscal and non-fiscal incentives for environmentally friendly products, such as subsidies for electric vehicles or the elimination of import taxes on renewable energy technologies. In fact, efforts to encourage a green economy are not only limited to the energy transition, but also strengthen other pillars to ensure sustainable economic growth.

The government must also prepare legal infrastructure as part of an integrated and inseparable policy foundation from various other policies to answer the challenge so that the energy sector's sustainable green economy development program has aspects of certainty, justice, and benefits. This is certainly in line with the purpose of the law, as referred to by Gustav Radbruch.[33] The formation of rules and regulations based on the ideal legal objectives by Gustav Radbruch is indeed inseparable from the legal politics of the formation of legislation both in the form of synchronization and harmonization of legal substance, especially those that support the implementation and strengthening of sustainable green economic development programs in the energy sector. Synchronization and harmonization can be carried out hierarchically, from Laws, Government Regulations, and Presidential Regulations to regulations that become technical guidelines in the form of Ministerial Regulations or Ministerial Decrees. In addition, institutional and legal politics from ministries and other institutions involved in formulating and implementing sustainable green economic development policies in the energy sector are another challenge for the Indonesian government.[34]

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[31] Prangan Duarah and others, 'A Review on Global Perspectives of Sustainable Development in Bioenergy Generation', *Bioresource Technology*, 348 (2022), 126791. https://doi.org/10.1016/j.biortech.2022.126791.

[32] Jianling Jiao, Jiangfeng Song, and Tao Ding, 'The Impact of Synergistic Development of Renewable Energy and Digital Economy on Energy Intensity: Evidence from 33 Countries', *Energy*, 295 (2024), 130997. https://doi.org/10.1016/j.energy.2024.130997.

[33] Lars Vinx, 'Pauer-Studer and Radbruch's Second Thesis', *Jurisprudence*, 14.2 (2023), 282–90. https://doi.org/10.1080/20403313.2023.2204689.

[34] Martha Maulidia and others, 'Rethinking Renewable Energy Targets and Electricity Sector Reform in Indonesia: A Private Sector Perspective', *Renewable and Sustainable Energy Reviews*, 101 (2019), 231–47. https://doi.org/10.1016/j.rser.2018.11.005.

The existence of egoism and disharmonized authority owned by various institutions or ministries involved in sustainable green economic development programs in the energy sector is homework that must be completed to be given a formula for its completion.[35] The synergy of cross-ministries and related state institutions in shaping technical policies to realize sustainable green economic development policy programs in the energy sector is undoubtedly part of the proposed policy formulation to answer the challenges of overlapping authority from various institutions or ministries. [36]

Legal and cultural factors are crucial challenges in implementing sustainable green economy programs in the energy sector. Good governance among officials, inter-ministerial synergy, and harmonized legislation are vital to creating an ideal legal system. Lawrence M. Friedman emphasizes that a legal system comprises formal rules, institutional structures, actors' behavior, and community legal culture, all of which affect law enforcement.[37] A robust legal framework with integrated policies, consistent implementation, and effective oversight can ensure certainty, justice, and benefits for all. Indonesia's 2024 State Budget reflects its commitment to accelerating the green economy, including completing priority infrastructure to support this transformation.[38]

3.3 The Future of Indonesia's Sustainable Green Economy Policy in the Energy Sector

The factors driving green economic growth identified in the roadmap include various activities in the energy and extractive industry sectors, manufacturing industries, connectivity, and renewable natural resources, as well as in cross-sectoral regions of emerging markets for natural capital.[39] These driving factors are very diverse and include removing fossil fuel subsidies, investing in research and development of clean technologies, accelerating international certification of sustainable products, increasing community involvement in coral reef management, and providing long-term financing for forestry projects. The key to achieving sustainability and the interaction between aspects, such as social, environmental, economic, and energy, is to go hand in hand and pay attention to each other.[40]

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[35] Enny Agustina, 'Juridical Analysis of Disharmonization between Local Leaders and Deputy Local Leaders in Local Government Systems', *Jurnal Bina Praja*, 12.2 (2020), 181–92. https://doi.org/10.21787/jbp.12.2020.181-192.

[36] Yordan Gunawan and others, 'Does the Protection of Minority Groups in Xinjiang Fail?', *Sriwijaya Law Review*, 4.2 (2020), 205–20. https://doi.org/10.28946/slrev.Vol4.Iss2.432.pp205-220.

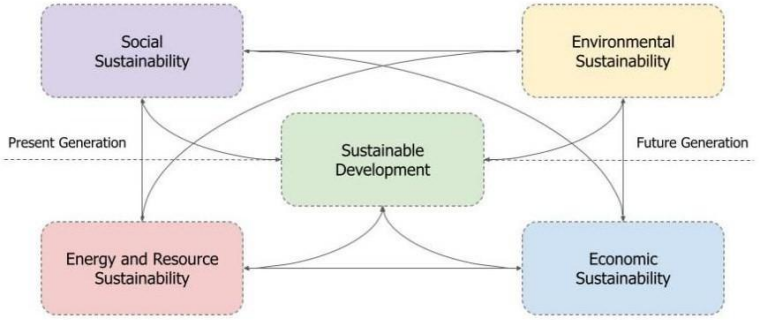
[37] Henny Saida Flora, Mac Thi Hoai Thuong, and Ratna Deliana Erawati, 'The Orientation and Implications of New Criminal Code: An Analysis of Lawrence Friedman's Legal System', *Jurnal IUS Kajian Hukum Dan Keadilan*, 11.1 (2023), 113–25. https://doi.org/10.29303/ius.v11i1.1169.

[38] Baihaqi Ashar and others, 'Dampak Kebijakan Hilirisasi Nikel Terhadap Peningkatan Pendapatan Negara Bukan Pajak (Minerba)', *Journal of Law, Administration, and Social Science*, 4.5 (2024), 798–808. https://doi.org/10.54957/jolas.v4i5.890.

[39] Zeeshan Khan and others, 'Aggregate and Disaggregate Impact of Natural Resources on Economic Performance: Role of Green Growth and Human Capital', *Resources Policy*, 80 (2023), 103103. https://doi.org/10.1016/j.resourpol.2022.103103.

[40] Ben Purvis, Yong Mao, and Darren Robinson, 'Three Pillars of Sustainability: In Search of Conceptual Origins', *Sustainability Science*, 14.3 (2019), 681–95. https://doi.org/10.1007/s11625-018-0627-5.

Figure 4: Sustainability Development Concept



Source: Ruggerio, 2021

The chart above illustrates the concept of sustainable development, which includes four main aspects: social, environmental, economic, and energy and resource sustainability. In the middle of the chart, there is a box labeled 'Sustainable Development,' which shows that sustainable development is a key goal that includes meeting the needs of current generations without sacrificing the ability of future generations to meet their own needs[41]. At the top left, social sustainability focuses on improving social well-being, justice, education, health, and community participation. On the top right side, environmental sustainability includes efforts to protect and restore the natural environment, including natural resource management and climate change mitigation, to ensure that ecosystems remain healthy for future generations. At the bottom right, economic sustainability focuses on equitable and stable economic development, which can survive in the long term without sacrificing resources or social and environmental well-being. Energy and resource sustainability, at the bottom left, includes the efficient and sustainable management of energy resources, emphasizing the use of renewable energy and the reduction of fossil energy. The interrelationships between the four aspects of sustainability show that each element affects and supports sustainable development. Therefore, it can be concluded that sustainability efforts must consider their impact on the current and future generations; achieving a harmonious balance between all aspects ensures comprehensive sustainability.

The sustainability pillar depicts sustainability as a roof supported by three pillars. This representation emphasizes that these three aspects must be solid and balanced to achieve stable sustainability. In the context of green economy and green energy, the diagram shows that initiatives such as the Green New Deal play an essential role as a catalyst for sustainable development. The Green New Deal encourages policy and investment in renewable energy and energy efficiency, part of green energy. Green energy uses renewable and environmentally friendly energy resources to reduce negative impacts on ecosystems. Therefore, to achieve comprehensive sustainability, a harmonious integration of social, environmental, and economic aspects is needed, with support from the green economy and green energy to ensure sustainable and environmentally friendly development.[42]

[41] Carlos Alberto Ruggerio, 'Sustainability and Sustainable Development: A Review of Principles and Definitions', *Science of The Total Environment*, 786 (2021), 147481. https://doi.org/10.1016/j.scitotenv.2021.147481.

[42] Liang Chen and others, 'How Do Natural and Socio-Economic Factors Influence the Sustainable Development of the Ecological Environment in the World Natural Heritage Sites? Evidence from the Jiuzhaigou, China', *Journal of Cleaner Production*, 428 (2023), 139238. https://doi.org/10.1016/j.jclepro.2023.139238.

In the energy sector, it is essential to consider long-term considerations, as minimizing energy use and energy independence can also support the concept of a green economy. This is certainly a tremendous opportunity to transform the future spaces where we will live and work—that is, to improve indoor air quality and sunlight exposure while reducing the environmental impact of fossil waste.[43] Energy inevitably has to be used, even if nothing is wasted. With consideration of climate change and other economic, social, and environmental challenges, energy must increasingly come from renewable energy sources. Byrne revealed that 'the new policy context of energy productivity conservation and renewable energy represents a paradigm shift from the principle of 'more is better' to a foundation built based on enjoying less".[44] This paradigm shift fundamentally reorganizes the relationship between energy, the environment, and society by establishing a policy framework that meets human needs and desires. In addition, it prioritizes the needs of community energy services and strives to meet them fairly and sustainably. Similarly, efforts to build community-scale solar systems can offer a path to harnessing the potential of the green energy economy by repositioning the dynamics of consumer-producer relationships to community-producer-user relationships.[45]

Indonesia's abundant renewable energy supply can play a pivotal role in this effort, ensuring a more sustainable energy future by enhancing energy security for the entire population, minimizing negative impacts on humans and the environment, and reducing conflicts between nations over energy reserves. Therefore, to preserve global sustainability, reducing energy use is a must from fossil fuels and replacing it with green energy with the principles of the green economy concept.[46] The vital role of green energy in mitigating the global crisis and achieving sustainability is that the state must drive the transition to green energy. Indonesia still has many green economic opportunities that can be achieved using renewable energy. Therefore, by looking at the existing challenges, the Indonesian government must be more proactive in encouraging investment and development of renewable energy through various policies. This also requires synergy between the government, the private sector, and the community to enable Indonesia to achieve its target of becoming a sustainable and inclusive green economy. [47]

Improving energy management is crucial, starting with decision-making and adopting an integrated approach.[48] In their research results, Midili, Dincer, and Ay give the view that the sectoral impact ratio is more critical and must be maintained to remain constant in the

[43] Frank J. Kelly and Julia C. Fussell, 'Improving Indoor Air Quality, Health and Performance within Environments Where People Live, Travel, Learn and Work', *Atmospheric Environment*, 200 (2019), 90–109. https://doi.org/10.1016/j.atmosenv.2018.11.058.

[44] Solange Garcia and others, 'Corporate Sustainability Management: A Proposed Multi-Criteria Model to Support Balanced Decision-Making', *Journal of Cleaner Production*, 136 (2016), 181–96. https://doi.org/10.1016/j.jclepro.2016.01.110.

[45] Muhamad Haris Aulawi and others, 'Governing Indonesia's Plan to Halt Bauxite Ore Exports: Is Indonesia Ready to Fight Lawsuit at the WTO?', *Bestuur*, 11.1 (2023), 26–42. https://doi.org/10.20961/bestuur.v11i1.69178.

[46] Lucien Georgeson, Mark Maslin, and Martyn Poessinouw, 'The Global Green Economy: A Review of Concepts, Definitions, Measurement Methodologies and Their Interactions', *Geo: Geography and Environment*, 4.1 (2017). https://doi.org/10.1002/geo2.36.

[47] Tika Maidasari, Lukman Yudho Prakoso, and Sri Murtiana, 'Renewable Energy As A Green Economy Stimulus In Indonesia', *Jurnal Energi Baru Dan Terbarukan*, 4.3 (2023), 183–91. https://doi.org/10.14710/jebt.2023.18496.

[48] Chiranjib Bhowmik and others, 'Optimal Green Energy Planning for Sustainable Development: A Review', *Renewable and Sustainable Energy Reviews*, 71 (2017), 796–813. https://doi.org/10.1016/j.rser.2016.12.105.

implementation of green energy policies. Furthermore, the sustainability ratio based on green energy tends to increase alongside improvements in technological advancements and sectoral impact ratios. This means that all negative impacts on industrial, technological, sectoral, and social development are partially and/or wholly reduced during the transition and utilization of green energy and technologies when sustainable energy strategies are implemented. Sustainable energy strategies can contribute to countries' economies where green energy (e.g., wind, solar, tides, biomass) is produced in abundance. Therefore, governments and other authorities must encourage investment in providing and advancing green energy to replace fossil fuels with green energy for a greener and more sustainable future.

Transitioning to renewable energy is challenging but critical to meeting the IPCC's 1.5°C global warming target and cutting emissions in the energy sector. Indonesia faces significant financing gaps in its energy transition. Webb highlights that renewable energy, not Small Modular Reactors (SMRs), is the most viable short-term solution. To address financing challenges, Indonesia should create favorable investment conditions through tax incentives, subsidies, and regulatory reforms. Green bonds, public-private partnerships, and streamlined licensing can attract private and foreign investment. Establishing a renewable energy fund with public and international contributions can further mobilize resources. While the transition is complex, with obstacles to financing, capacity, and policy alignment, periodic evaluations and strategic efforts are essential for achieving a sustainable, green energy future.[49]

4. Conclusion

The results of this study reveal that Indonesia faces considerable challenges in achieving a sustainable green economy in the energy sector. These challenges include a heavy reliance on fossil fuels, which significantly contributes to carbon emissions, slow progress in renewable energy development, and limited financing for environmental technology innovations. Environmental issues, such as ongoing deforestation, air and water pollution, and general environmental degradation, further complicate the transition. However, there are also positive expectations, including renewable energy's economic and environmental benefits, sustainable transportation, and effective waste management. The authors propose strategies to address these challenges, including transitioning to renewable energy sources, infrastructure development, policy coherence, financing, technological innovation, and capacity building. An essential component of this transition is the provision of legal infrastructure, which requires strengthening and updating regulations to support green economy goals.

Strengthening regulatory frameworks can ensure that green energy policies are enforceable, create incentives for investment in renewable technologies, and establish accountability for environmental impacts. For example, introducing stricter emissions standards, revising subsidy structures to favor renewable over fossil energy, and implementing clear, binding targets for emissions reduction can drive sustainable practices. Additionally, aligning national laws with international agreements, such as the Paris Agreement, and incorporating green economy principles into local government regulations will enhance policy coherence across governance levels. Through these regulatory improvements, Indonesia can create a supportive legal environment that encourages compliance, fosters innovation, and accelerates the transition to a green economy.

[49] Jeremy Webb and others, 'The Application of Green Finance to the Production of Blue and Green Hydrogen: A Comparative Study', *Renewable Energy*, 219 (2023), 119236. https://doi.org/10.1016/j.renene.2023.119236.

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