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The role of carbon tax in the integration of environmental economy and green economy in Indonesia

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ABSTRACT

Indonesia's rapid economic growth over the past two decades has had a significant impact on the increase of greenhouse gas (GHG) emissions, creating an urgency to integrate environmental dimensions into national economic policies. This study aims to analyze the role of carbon taxes as an instrument connecting environmental economics and the green economy framework in Indonesia. The method used is descriptive quantitative combined with policy analysis, allowing for the mapping of carbon emission conditions, energy structure, and the evaluation of carbon tax implementation in the context of sustainable development. Secondary data were obtained from BPS, KLHK, the Ministry of Energy and Mineral Resources, as well as official policy documents related to carbon taxes and green fiscal measures. Research results show that the energy sector remains the main contributor to GHG emissions, with a high dependence on coal, resulting in relatively high carbon intensity. The initial imposition of a carbon tax rate of IDR 30,000 per ton of CO_2e provides only a limited price signal in driving changes in industrial behavior. Integrative analysis confirms that carbon taxes have strategic potential to promote green investment, energy efficiency, and structural transformation towards a low-carbon economy. However, their effectiveness depends on progressive policy design, institutional readiness, and fair revenue allocation. Compared to the current situation, the implementation of a carbon tax still faces socio economic and technical challenges, including a limited MRV system and the potential regressive impact on low income households.

Keywords: carbon tax; environmental economics; green economy; ghg emissions.

1. INTRODUCTION

Indonesia's economic development over the past two decades has shown strong dynamics, but at the same time, it has left increasingly complex environmental issues. The pace of industrial growth, energy consumption, and urban expansion has led to a significant increase in greenhouse gas (GHG) emissions, creating an urgent need to integrate environmental dimensions into national economic policy (Eko et al., 2022). As a developing country, Indonesia has made a substantial commitment under the Paris Agreement to reduce emissions by up to 31.89% independently or 43.20% with international support by 2030. In this context, market-based fiscal instruments such as carbon taxes are seen as one approach expected to align economic growth with environmental sustainability goals through the application of price signals to high-emission activities (BPS Indonesia, 2025) (See Figure 1).

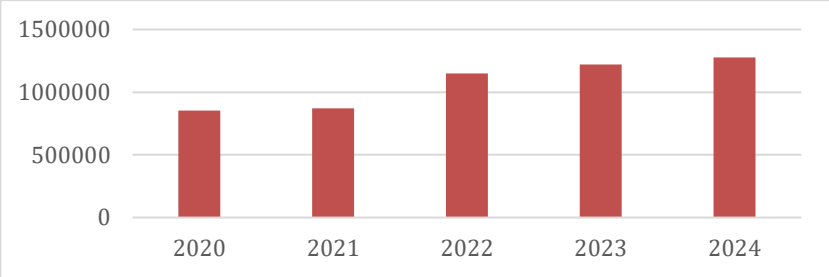

Figure 1. Final Energy Comsumption (per thousand BOE)

Source: Handbook of Energy and Economic Statistics of Indonesia, Ministry of Energy and Mineral Resources (2025)

As a new fiscal policy, the carbon tax in Indonesia has gained legal standing through the Harmonization of Tax Regulations Law (Law No. 7 of 2021), which stipulates that carbon emissions can be subject to taxation. The government set an initial rate of IDR 30 per kilogram of CO_2e, equivalent to IDR 30,000 per ton of CO_2e, as an initial step toward a more comprehensive emission control mechanism. On the other hand, technical ministries such as the Ministry of Environment and Forestry and the Ministry of Energy and Mineral Resources are preparing supporting systems such as MRV (monitoring, reporting, verification), emission inventories, and the development of a domestic carbon market (Sadewo et al., 2025). The presence of this regulation not only signals the country's seriousness in achieving decarbonization targets but also opens up space for integrating environmental economics within the framework of a green economy, where growth is directed to support energy efficiency, pollution reduction, and the strengthening of the green economy.

To examine the effectiveness of carbon taxes in promoting a green economy, this study utilizes various data sources sourced from official institutions. Greenhouse gas (GHG) emissions data by sector are taken from the Indonesia Energy Flow Accounts and the Greenhouse Gas Emissions Accounts published by the Central Statistics Agency (BPS) (BPS Indonesia, 2025), which provide a comprehensive overview of emissions distribution from the energy, manufacturing, agriculture, and land-use change sectors. Energy and fossil fuel consumption data are obtained from the Handbook of Energy and Economic Statistics of Indonesia released by the Ministry of Energy and Mineral Resources (ESDM) (M. of energy and mineral resources republik of Indonesia, 2024), while information on carbon tax policies and roadmaps is referenced from publications by the Directorate General of Taxes and the Ministry of Finance. Macroeconomic data such as sectoral GDP, industrial structure, and energy intensity are also used to assess the long-term economic impact of the policy.

Previous research provides an important empirical basis for explaining the potential and challenges of implementing carbon taxes in Indonesia. Rokhmawati et al., (2024) show that carbon taxes have the potential to gradually reduce emissions if accompanied by an energy transition toward renewable sources.

Carbon taxes tend to be regressive, where low-income households are proportionally more affected than high-income households. However, appropriate income redistribution schemes, such as direct cash transfers or clean energy subsidies, can mitigate these negative impacts.

Based on this context, this study aims to explain the role of carbon taxes as a bridging mechanism between environmental economics and the green economy framework in Indonesia. By integrating emissions data, energy statistics, economic indicators, and policy reviews, this research is oriented toward assessing how carbon taxes can drive changes in production and consumption behavior, improve environmental quality, while still maintaining national economic stability. It is hoped that this study can provide evidence-based recommendations and serve as a scientific contribution to enrich the literature on the implementation of green fiscal policies in developing countries, particularly Indonesia, which is currently at a crucial stage toward a low-carbon economy.

2. LITERATURE REVIEWS

2.1. Carbon Tax

Carbon tax is a fiscal policy instrument imposed on the carbon content or the amount of greenhouse gas (GHG) emissions generated from an economic activity. Theoretically, carbon tax is rooted in the concept of a Pigouvian tax, which is designed to internalize negative externalities so that the social costs of an activity are reflected in market prices (Febrianti & Karlinah, 2025). Thus, economic actors are encouraged to reduce emissions or switch to cleaner technologies due to the carbon price signal. In the context of Indonesia, the carbon tax is intended not only as an emission control instrument but also as part of a green fiscal reform that supports the national emission reduction commitment (NDC) and the transition to a green economy (Hardini & Rosdiana, 2025).

Carbon tax in Indonesia has been given a legal basis through Law Number 7 of 2021 concerning the Harmonization of Tax Regulations (UU HPP). The government set an initial rate of IDR 30 per kilogram of CO_2e, or equivalent to IDR 30,000 per ton of CO_2e, designed as a minimum rate that can be adjusted according to the domestic carbon market price (Anasta et al., 2025). The initial implementation focuses on coal-fired power plant (PLTU) sectors through a cap and tax approach, which is a combination of emission limits (cap) and taxes on emissions exceeding the threshold. Theoretically, this approach reflects efforts to combine market instruments and fiscal instruments to increase policy effectiveness while minimizing negative impacts on industrial competitiveness (Santoso, 2025).

Empirical literature shows that the effectiveness of carbon taxes is greatly influenced by the tax rate, sector coverage, and the availability of supporting policies such as carbon markets, MRV systems, and renewable energy incentives. Scenario studies of carbon taxes in Indonesia indicate that relatively low rates in the initial stage function more as a policy signal, while significant emission reductions require gradually and consistently increasing rates (Sunanda et al., 2025).

2.2. Greenhouse Gas Emitterns

Greenhouse gas emitters refer to entities or economic sectors that produce GHG emissions, such as carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O). In environmental economics studies, GHG emitters are generally classified by sector, including the energy sector, manufacturing industry, transportation, agriculture, and land use change and forestry. In Indonesia, the energy sector, particularly fossil fuel-powered electricity generation, is the main contributor to GHG emissions, followed by the LULUCF sector, which has fluctuating characteristics due to deforestation and forest fires (Lingkungan et al., 2024).

Measuring GHG emissions plays an important role in the implementation of carbon tax policies. The Monitoring, Reporting, and Verification (MRV) system serves as the main framework to ensure the accuracy and credibility of emission data. From a theoretical perspective, MRV functions to reduce information asymmetry between regulators and businesses and to enhance policy compliance. Indonesia has developed a national emissions inventory and GHG emission accounts compiled by the Central Statistics Agency (BPS). This data provides information on nominal emissions (in tons of CO_2e) by sector

and serves as an important reference for evidence-based policy formulation (BPS Indonesia, 2025) (See Table 1).

Table 1. CO_2 Emission Intensity by Industry (tonnes CO e per billion IDR), 2023

No	Industries	Total
1	Agriculture, Forestry, and Fishing	6,49
2	Mining and Quarrying	15,23
3	Manufacturing	118,51
4	Electricity and Gas Supply	2.202,70
5	Water Supply, Sewerage, Waste Management and Remediation Activities	304,82
6	transportation	143,70
7	Other industries	4,03

Source: Indonesia Energy Flows Accounts and Greenhouse Gas Emissions Acoounts 2019-2023, BPS Indonesia (2025)

2.3. Enviromental Economics

Environmental economics is a branch of economics that studies the relationship between economic activities and environmental quality. Its main focus is on how economic systems can be managed so that the use of natural resources and waste disposal are at socially optimal levels. In environmental economic theory, environmental issues are seen as market failures due to externalities, public goods, and unclear property rights (Graves, 2020). Therefore, policy interventions are necessary to achieve a balance between economic growth and environmental sustainability (Rauf et al., 2025).

Policy instruments in environmental economics include environmental taxes, green subsidies, direct regulation, as well as market-based mechanisms such as emissions trading. Carbon taxes are a concrete example of applying environmental economic theory in public policy, as they function to internalize the social costs of emissions into production and consumption decisions. Various empirical studies in Indonesia show a long-term relationship between economic growth, energy consumption, and carbon emissions, which affirms the relevance of the environmental economics framework in formulating national development policy (Jihannisa et al., 2024).

2.4. Green Economics

The green economy is defined as an economic system aimed at improving human well-being and social equity, while significantly reducing environmental risks and ecological scarcities. This concept emphasizes low-carbon growth, resource efficiency, and social inclusiveness. In a theoretical framework, the green economy is an evolution of the sustainable development concept that is more operational, as it places economic, fiscal, and investment policies as the main instruments of structural transformation (Vochit & Manda, 2022). In Indonesia, the green economy is seen as a strategy to achieve sustainable development targets and emission reduction commitments. Empirical studies show that green economy variables such as renewable energy investment and energy efficiency have a positive influence on long-term economic growth. Carbon taxes, in this context, serve as a fiscal instrument that supports the green economy by redirecting economic incentives from high-emission activities to environmentally friendly activities (Fadillah et al., 2025).

Conceptually, carbon tax is the practical implementation of environmental economic theory and at the same time serves as an important pillar in the green economy strategy. Environmental economics provides the theoretical and analytical foundation, the carbon tax functions as a policy instrument, while the green economy serves as the framework for long-term development goals (Halizah & Furqon, 2024).

3. METHOD

This study uses a quantitative descriptive approach supported by policy analysis to examine the role of carbon taxes in environmental-economic integration and the development of the green economy in Indonesia. This approach was chosen because it can provide an empirical overview of carbon emission conditions, energy sector dynamics, and the implications of environmental fiscal policies on the national economic structure. In addition, this approach is relevant for explaining the relationship between carbon tax instruments and sustainable development goals within the framework of a green economy.

3.1. Data Collection Techniques

The data used in this study are secondary data obtained from various official and credible sources. Greenhouse gas emissions data were collected from the Greenhouse Gas Emissions Accounts published by the Central Statistics Agency (BPS), as well as greenhouse gas inventory reports from the Ministry of Environment and Forestry (KLHK). This data is used to illustrate national emission trends and the contribution of key sectors to total carbon emissions. In addition, data related to energy consumption and structure were obtained from the publication Handbook of Energy and Economic Statistics of Indonesia, issued by the Ministry of Energy and Mineral Resources (ESDM). This data provides information on the energy mix, dependence on fossil fuels, and the potential for transitioning to renewable energy. Macroeconomic data, such as sectoral Gross Domestic Product (GDP) and economic growth indicators, were obtained from BPS publications and the annual reports of Bank Indonesia. For policy aspects, this study uses official government documents, including Law Number 7 of 2021 concerning the Harmonization of Tax Regulations, derivative regulations related to carbon taxes, as well as green fiscal policy documents issued by the Ministry of Finance.

3.2. Data Analysis Techniques

Data analysis in this study was carried out through several stages. The first stage is descriptive analysis, which aims to depict the actual conditions of carbon emissions, energy consumption structure, as well as the development of carbon tax policy in Indonesia. This analysis is used to identify patterns, trends, and key sectors that contribute to national carbon emissions. The second stage is policy analysis, which is used to evaluate the design and implementation of the carbon tax in Indonesia. This analysis includes assessing the rate, sector coverage, and implementation mechanisms of the carbon tax, by comparing them with international practices and recommendations in environmental economics literature. Through this approach, the research can evaluate the extent to which Indonesia's carbon tax aligns with environmental economic principles and the green economy. The third stage is integrative analysis, which involves connecting the results of descriptive analysis and policy with the framework of environmental economics and green economics. At this stage, researchers interpret how carbon taxes could potentially influence the behavior of economic actors, encourage energy efficiency, and contribute to structural transformation toward a low-carbon economy. This analysis is also used to identify implementation challenges and formulate policy recommendations to ensure that carbon taxes can function optimally in supporting the green economy in Indonesia. To maintain data validity and reliability, this study applies source triangulation, which involves comparing data from BPS, relevant ministries, and previous research findings. This approach is expected to minimize bias and enhance the accuracy of research result interpretations.

4. RESULT & DISCUSSION

The results of this study indicate that a carbon tax has strategic potential as a key instrument in integrating environmental economic approaches with the green economy agenda in Indonesia. However, the research findings also emphasize that the effectiveness of a carbon tax is not automatic; it highly depends on the quality of policy design, the level of institutional capacity readiness, and the clarity of how the generated tax revenue will be utilized. In this context, a carbon tax functions not only as a fiscal tool

for emission control but also as a mechanism guiding structural transformation towards a low-carbon and sustainable economic system.

4.1. Carbon Emission Conditions and Fossil Energy Dependence in Indonesia

Descriptive analysis of emission data shows that the energy sector remains the largest contributor to greenhouse gas emissions in Indonesia. Dependence on coal as the main energy source results in relatively high carbon intensity, especially in the electricity generation and manufacturing industry sectors. These findings are in line with reports from BPS and KLHK, which state that the energy transition in Indonesia still faces structural barriers in the form of limited renewable energy infrastructure and fiscal dependence on the fossil energy sector (BPS Indonesia, 2025; Lingkungan et al., 2024).

Theoretically, this condition reflects a market failure due to negative externalities that have not been fully internalized in the production cost structure. Environmental economics literature emphasizes that without price policy intervention, economic actors tend to continue using cheap fossil-based energy despite its harmful impact on the environment (Dilasari et al., 2023). Researchers argue that a carbon tax in Indonesia cannot be positioned merely as an emissions control instrument but must be understood as a structural correction instrument. In the context of a developing country with high dependence on fossil energy, a carbon tax functions as a trigger for gradual changes in the structure of energy production and consumption, rather than as a shock policy. This approach requires adaptive and gradual policies to avoid disrupting economic stability.

4.2. Implementation of Carbon Tax and Price Signal Effectiveness

Policy studies indicate that Indonesia's relatively low carbon tax rate (IDR 30,000 per ton of CO_2e) still does not provide a strong enough price signal to significantly drive changes in industrial behavior. Empirical studies in various countries show that an effective carbon price must be at a certain level to stimulate technological innovation and energy substitution (Siregar et al., 2025).

Nevertheless, the implementation of a low initial tariff can be understood as a political-economic strategy to avoid industrial resistance and inflationary pressures. This approach aligns with the findings of Pamungkas & Hapsari (2022) who emphasize the importance of social acceptance and the readiness of the industrial sector in environmental fiscal policy in Indonesia. Researchers view that the effectiveness of a carbon tax is not only determined by the tariff amount, but also by the long-term expectations of economic actors regarding the policy. Therefore, the government needs to build a credible commitment through a clear and scheduled tariff increase roadmap. This policy certainty is believed to have a greater impact on green investment decisions compared to a high tariff implemented suddenly.

4.3. Carbon Tax as an Instrument for Integrating Environmental Economics and the Green Economy

Integrative analysis results indicate that the carbon tax has the potential to become a key link between environmental economics and the green economy (Halizah & Furqon, 2024). Within the green economy framework, environmental fiscal policies are not only aimed at reducing emissions but also at promoting green investments, creating environmentally friendly jobs, and fostering sustainable economic growth. The study of Rokhmawati et al. (2024) using the STIRPAT model shows that a carbon tax in Indonesia could significantly reduce emissions if accompanied by increased renewable energy and other supporting policies. These findings reinforce the results of this research that a carbon tax cannot stand alone but must be part of a broader green policy ecosystem.

Researchers put forward the view that carbon taxes should be constructed as a development instrument, not merely a fiscal instrument. This means that carbon tax revenues should be explicitly directed to fund strategic green economy sectors, such as renewable energy industries, low-emission transportation, and green SMEs. In this way, the carbon tax functions as a reinvestment policy mechanism that accelerates the transformation of the national economy.

4.4. Institutional Challenges and Social Justice

Research results also identify that the main challenge of carbon taxation in Indonesia lies in institutional aspects and social justice. Limitations in the MRV system, inter-agency coordination, as well as the potential regressive impact on low-income households are critical issues (Tjoanto & Tambunan, 2022). The study of Kumar & Stauvermann (2024) shows that environmental taxes without compensation mechanisms have the potential to increase social inequality and emphasizes the importance of revenue recycling to maintain the social legitimacy of carbon tax policies. This underscores that the success of a carbon tax largely depends on how the tax revenue is used and communicated to the public.

Researchers argue that social justice must be the foundation of carbon tax policy in Indonesia. Direct compensation schemes, clean energy subsidies for poor households, and the enhancement of green public services are important strategies to ensure that the carbon tax is not perceived as a burden, but rather as a tool for future protection.

4.5. Synthesis of Research Findings and Contributions

Overall, the results and discussion indicate that carbon taxes have great potential in supporting the green economy in Indonesia, but their effectiveness heavily depends on progressive policy design, cross-sector integration, and social equity orientation. This study contributes by positioning the carbon tax not only as an environmental economic instrument but also as a tool for sustainable and inclusive development transformation. The main contribution of this study is reinforcing the perspective that carbon taxes in developing countries like Indonesia should be designed as transformative-adaptive policies, rather than simply adopting models from developed countries. This approach emphasizes gradualism, policy integration, and green reinvestment as key to success.

5. CONCLUSION

Carbon taxes have strategic potential to accelerate Indonesia's transition to a green economy by internalizing the social costs of emissions, encouraging investment in low-carbon technologies, and providing a source of funding for green programs. However, this potential will only be realized if policies are designed comprehensively: credible and gradual rates, adequate sectoral coverage, a reliable MRV system, and transparent, pro-inclusive revenue allocation mechanisms. Carbon taxes are not merely fiscal instruments; they can also serve as tools for economic transformation. With careful, transparent, and equitable design, carbon taxes can become a pillar for financing and directing investment towards an inclusive and competitive green economy.

Ethical Approval

Not Applicable

Informed Consent Statement

Not Applicable

Author Contributions

RAP contributed to the formulation of the research concept and design, the determination of the research approach and methods, as well as the collection and analysis of data. She was also responsible for writing the initial draft of the article, including the introduction, methodology, discussion, and conclusion sections, as well as coordinating the entire research process and communication among authors until the manuscript refinement stage. MAANA contributed to strengthening the theoretical framework and literature review, supporting data analysis, and sharpening the arguments in the discussion section. He was also involved in the critical review process of the article's content and provided academic input to improve the quality and

scientific consistency of the manuscript. SWM contributed to the processing and presentation of data, including the preparation of tables, figures, and supporting research documentation. In addition, she assisted with language and editorial editing, as well as ensuring the technical completeness of the manuscript in accordance with journal writing guidelines before submission for publication.

Disclosure Statement

This study was conducted to support and strengthen attention to environmental issues and nature conservation. The author declares that there are no conflicts of interest, either financial or non-financial, in the conduct and publication of this research.

Data Availability Statement

The data used in this study are publicly available and can be accessed by the public through relevant open sources as listed in the article.

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Resty Abdillah Paryanda is a master's student in the Sharia Economics Study Program at the State Islamic University Sayyid Ali Rahmatullah Tulungagung. Her academic interests focus on sharia economics, Islamic finance, and sustainable economic development, particularly the integration of sharia values into economic policies and practices. She is actively involved in academic research and scientific writing.

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