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Policy Analysis and Implications for Sustainable Development Goals of Carbon Tax Implementation in Indonesia

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Abstract

The continuous increase in carbon emissions in Indonesia over the past three decades has prompted the need for effective policy instruments to mitigate the impact of global warming. This study aims to analyze the implementation of the carbon tax in Indonesia and its relationship to the achievement of the Sustainable Development Goals (SDGs). The method used is descriptive qualitative with a public policy study approach through analysis of documents, regulations, and official national and international reports. The results show that the energy sector, especially coal-fired power plants, is the largest contributor to emissions, making it the initial target for the implementation of a carbon tax starting in 2022 at a rate of IDR 30/kg CO₂e through a cap and tax mechanism. This policy has the potential to reduce emissions while increasing fiscal revenue to support the energy transition, green development, and social protection. However, its effectiveness is still influenced by challenges such as limited sector coverage, industry readiness, and regulatory strengthening.

Keywords

Carbon Emissions, Carbon Tax, Energy Sector, Global Warming, SDGs.

1. Introduction

Air pollution is an increasingly critical environmental issue as carbon emissions from various human activities in the industrial, energy, transportation, and land-use change sectors increase (Ferrer & Thome, 2023; Huang et al., 2023; Ling et al., 2024). The impacts of climate change and global warming are increasingly apparent, with global warming experiencing a significant increase since the mid-20th century. According to the Global Climate Report, in August 2024 was recorded as the warmest period and is projected to continue until March 2025, while 2023 was the hottest year on record, with an average global temperature increase of 1.18°C (Global Climate Report, 2024). Carbon emissions, the main contributor to the greenhouse effect, are produced through the combustion of fossil fuels, industrial activities, motor vehicles, and deforestation, with CO₂ being the dominant component that is increasing rapidly due to anthropogenic activities (Boer et al., 2012; Nayak et al., 2020; Pusparini et al., 2023; Siswati & Sumayyah, 2025).

The IEA (2025) explains that total global CO₂ emissions increased again by 1.1% in 2023, reaching a record high of 37.3 Gt, and rising again to 37.6 Gt in 2024, far from the emission reduction target set in the Paris Agreement. This condition has encouraged various countries to implement environmentally friendly economic policies, one of which is through a carbon tax instrument. The OECD (2021) emphasizes that carbon tax policies not only function to control emissions but also provide a double dividend in the form of increased state fiscal revenues. The carbon tax also aims to internalize environmental costs so that they are reflected in the prices of goods and services and encourage the transformation towards a green economy and the use of new and renewable energy (Maghfirani et al., 2022). Globally, 40 national jurisdictions and 25 sub-national jurisdictions have set carbon prices, covering 15% of global Greenhouse Gas (GHG) emissions, with Uruguay being the country with the highest tax rate at 167 USD/tCO₂e.

Indonesia, as one of the countries with the highest carbon emissions globally, has experienced a significant increase in recent years. Global Carbon Project (2023) noted that Indonesia is among the top ten carbon emitters in the world, with emissions increasing by 18.3% in 2022, the highest among other major emitting countries. Worldometers (2024) data shows that Indonesia's carbon emissions rose again after the pandemic, from 594 million tons of CO₂e in 2020 to 674.5 million tons of CO₂e in 2023, driven by coal use, industrial recovery, and deforestation. The Indonesian government responded by implementing a carbon tax based on the HPP Law with an initial rate of IDR 30/kg CO₂e starting in 2022 in the coal-fired power plant sector as an initial step towards achieving the 2030 Nationally Determined Contribution (NDC) target (Meila et al., 2024).

The implementation of a carbon tax in Indonesia has strategic potential for increasing fiscal revenue, accelerating the energy transition, and achieving the SDGs. However, it faces challenges such as industry readiness, low policy literacy, and weak regulatory enforcement (Hanafi et al., 2024; Mokhtar et al., 2024). Several previous studies have shown that a carbon tax has the potential to increase state revenue and reduce emissions and that the policy's success requires the involvement of all stakeholders (Malihah, 2022; Fandira et al., 2022; Meila et al., 2024; Rahmasari et al., 2024). However, research findings in the Indonesian context still show variation, so a more comprehensive study is needed.

Based on this phenomenon, this study focuses on the implementation of the carbon tax in Indonesia, policy analysis, and its implications for sustainable development goals. This study aims to analyze the effectiveness of the policy, opportunities and challenges of implementation, and its contribution to the national sustainable development agenda.

2. Literature Review

2.1. Externality Theory

Externality theory by Pigou (1920) explains that market failure arises when economic activities generate costs not reflected in market prices, creating a gap between marginal private and social costs. In negative externalities such as air pollution, social costs exceed those borne by producers or consumers, necessitating government intervention through Pigouvian taxes to internalize these externalities (Sarie et al., 2022). In this context, a carbon tax functions as a Pigouvian instrument that increases the cost of carbon-intensive activities, encouraging shifts toward cleaner and more efficient production and consumption. Beyond controlling emissions, carbon taxes also promote clean-energy innovation and behavioral change, thereby supporting the transition to a low-carbon and environmentally sustainable economy.

Environmental economics views natural resources as economic assets whose utilization must consider long-term ecological balance, a perspective reinforced by the Stern Review, which found that the future costs of climate change exceed current mitigation costs. Within this framework, carbon taxes function as price-based policy instruments that discourage polluting activities and encourage shifts toward cleaner energy, providing a theoretical justification for government intervention in controlling carbon emissions (Köppl & Schratzenstaller, 2023).

The Brundtland Commission initially defined sustainable development in its 1987 report, "Our Common Future." Development that satisfies current demands without endangering the capacity of future generations to satisfy their own needs is known as sustainable development. This theory emphasizes a balance between economic, social, and environmental aspects, known as the triple bottom line (Hammer & Pivo, 2017; Nogueira et al., 2025; Asih et al., 2025). The implementation of a carbon tax is one strategy for achieving sustainable development, particularly in maintaining environmental sustainability and promoting a low-carbon economy. By integrating a carbon tax into fiscal policy, it is hoped that it will encourage innovation in environmentally friendly technologies and create new jobs in the renewable energy sector, as well as create positive synergies in achieving sustainable development goals.

2.2. Carbon Emissions

The discharge of carbon dioxide (CO₂) gas into the Earth's atmosphere is referred to as carbon emissions. This emission can be caused by human activity, such as burning fossil fuels, deforestation, and industrial processes, or it can happen naturally, such as through respiration and decomposition. One of the primary causes of global climate change is carbon emissions. Greenhouse gases (GHGs) released from carbon emissions can absorb and retain heat energy from the Sun, which in turn causes an increase in average global temperatures (Jogdand, 2020; Yoro & Daramola, 2020; Letcher, 2022). The carbon footprint must be measured in order to calculate the quantity of carbon emissions generated. The GHG emissions resulting from human or organizational activity are referred to as a carbon footprint (PNG Forest Environment).

Global carbon emissions continue to increase, and Indonesia is one of the countries with a significant increase in carbon emissions. In 2022, Indonesia's carbon emissions increased by 18.3 percent, even higher than other countries, making it one of the countries with the highest increase in carbon emissions in the world. The Indonesian government has implemented a number of initiatives to lower carbon emissions, such as energy conservation, energy transition, and improved energy efficiency. The community, the commercial sector, and the government must all work together to cut carbon emissions.

Hanafiyah et al. (2024) found that the implementation of a carbon tax is effective in reducing negative environmental externalities, particularly those associated with carbon emissions. Their study emphasizes the role of carbon taxation as a regulatory instrument to mitigate emission-intensive economic activities. Similarly, Rahmasari et al. (2024) concluded that carbon taxes have significant potential to reduce carbon emissions while simultaneously contributing to national economic performance.

2.3. Carbon Tax

A carbon tax is a levy imposed on carbon emissions resulting from the combustion of fossil fuels such as coal, oil, and natural gas used to generate energy, which can have a negative impact on the environment (Yüksel & Mikhaylov, 2022; Melia et al., 2024). The strategy implemented to achieve net-zero emissions is to implement a Pigouvian tax. According to the Tax Foundation, a Pigouvian tax is designed to account for the social costs arising from negative externalities, which can be considered by decision-makers. This tax is imposed on goods whose production or consumption has the potential to damage environmental quality (Bakker).

The purpose of implementing a carbon tax is to reduce greenhouse gas emissions that have negative impacts by requiring companies and the public to pay compensation for goods and services that are not yet fully carbon-free (Melia et al., 2024). Revenue from the carbon tax can be used to control climate change, provide social assistance to poor households affected by the carbon tax, and subsidize renewable energy (Ministry of Finance, 2021). Meila et al. (2024) demonstrated that the implementation of a carbon tax in Indonesia could generate substantial state revenue from the energy sector, estimated to reach IDR 23.280 trillion by 2025. Supporting this finding, Udin et al. (2024) revealed that carbon tax policies not only increase government revenue but also drive behavioral changes among businesses and consumers toward emission reduction and the adoption of environmentally friendly energy and technologies.

2.4. Sustainable Development Goals (SDGs)

A global commitment to attaining shared prosperity and a better living is known as the Sustainable Development Goals (SDGs). The United Nations (UN) created the SDGs in 2015 as a component of the 2030 Agenda. According to Malilah (2022), the SDGs are a continuation of the Millennium Development Goals (MDGs), which is a sustainable development agenda with 17 main goals, further divided into 169 targets. All of these targets are planned to be achieved by 2030, and they are interconnected and influence each other.

The 17 Sustainable Development Goals (SDGs) include eradicating poverty, reducing hunger, promoting healthy and prosperous lives, high-quality education, gender equality, clean water and adequate sanitation, affordable and clean energy, decent work and economic growth, industry, innovation, and infrastructure, reducing inequality, sustainable cities and settlements, responsible consumption and production, addressing climate change, marine ecosystems, terrestrial ecosystems, peace, justice, and partnerships to achieve these goals. This demonstrates that the carbon tax plays a significant part in helping Indonesia attain the Sustainable Development Goals.

Udin et al. (2024) emphasized that carbon taxation supports the balance between economic, social, and environmental dimensions within the triple bottom line framework, making it highly relevant to the achievement of the SDGs. Meila et al. (2024) further indicated that carbon taxes contribute to sustainable development by strengthening fiscal capacity. In addition, Rahmasari et al. (2024) highlighted that carbon taxes function as a strategic policy instrument to support the SDGs by

integrating economic growth with emission reduction efforts. Meanwhile, Malihah (2022) noted that although policies such as carbon taxes and the circular economy have been introduced, effective progress toward sustainable development still requires strong collaboration among all stakeholders.

3. Methods

This study uses a descriptive qualitative method with a public policy study approach to analyze the implementation of the carbon tax in Indonesia and its implications for the achievement of the SDGs. The research location focuses on national policies issued by the Ministry of Finance, the Ministry of Environment, and the Fiscal Policy Agency, and refers to secondary data from international institutions such as the World Bank and UNDP. The research population includes all policy documents, government reports, and publications related to carbon tax and sustainable development, while the sample was selected purposively from relevant documents such as carbon tax regulations, ministerial reports, scientific publications, and international reports for 2020–2024. The data used are secondary data obtained from official government documents, international institution reports, academic literature, credible media, and carbon emission data, with data collection techniques through documentary studies, searching, and reviewing official documents and reliable publications according to research needs.

According to Sugiyono (2016), an operational definition is a comprehensive set of instructions regarding what needs to be observed to measure or test something in the context of perfection testing. Operational variables serve to establish rules and procedures for researchers in conducting research, so that data collection and analysis can be carried out in a more directed, focused, efficient, and consistent manner. Carbon emissions refer to the release of carbon dioxide (CO₂) into the atmosphere, measured through initiatives such as renewable energy programs, energy efficiency efforts, and public awareness campaigns. Carbon tax implementation, as defined by Melia et al. (2024), is a fee levied on CO₂ emissions by individuals, companies, or specific sectors, operationalized through tax rates, generated tax revenue, overall state revenue, and compliance levels. Achievement of SDGs, according to Malihah (2022), reflects progress toward the UN's sustainable development goals, assessed across environmental, social, and economic dimensions.

The data analysis method in this study focuses on unsystematic data obtained through literature review and document analysis. The data were analyzed using content analysis to examine policy content, fiscal direction, and its impact on SDG indicators. Findings were grouped into the themes of regulation, effectiveness, challenges, and impact on SDGs. The analysis was conducted qualitatively and descriptively through two stages. First, data reduction, which entails sorting and selecting relevant information on carbon tax implementation, emission reduction strategies, and SDG achievement to create a more organized and structured dataset. Second, data presentation, which compiles the results of data reduction into narratives, tables, or diagrams, providing a clear and comprehensive view of carbon tax policies, carbon emissions, and their relationship to the Sustainable Development Goals.

4. Results

This section presents the findings of the study regarding global carbon emissions, carbon tax implementation, and their relationship to the achievement of Sustainable Development Goals (SDGs). The results are organized to provide a comprehensive overview of historical trends, sectoral contributions, and the potential impacts of carbon taxation on emission reduction and sustainable development. Data are presented through tables, figures, and narrative summaries to facilitate a clear

understanding of the observed patterns and their implications for policy and environmental management.

4.1. Effectiveness, Opportunities, and Challenges of Carbon Tax Policy

According to data in Figure 1, industrialization and the use of fossil fuels contributed to an increase in global carbon emissions between 1990 and 2023. According to the data, the energy sector contributes the most to global emissions, followed by transportation and industry.

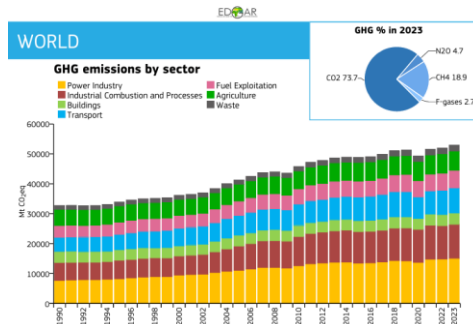


Figure 1. GHG Emissions World Sector

Table 1. GHG Emissions Global

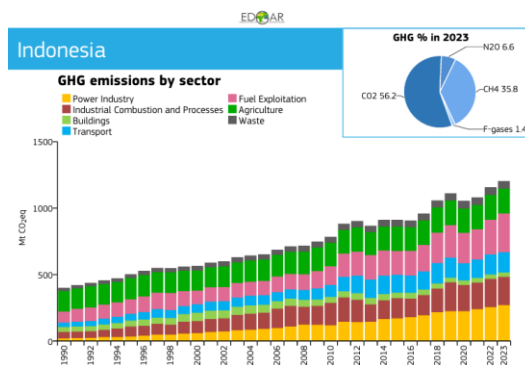
Year	GHG emissions Mt CO ₂ e/yr	GHG emissions per capita t CO ₂ e/cap/yr	GHG emissions per unit of GDP PPP t CO ₂ e/kUSD/yr	Population
2023	52962.901	6.594	0.320	8.032G
2015	48808.767	6.613	0.369	7.381G
2005	41296.885	6.314	0.437	6.540G
1990	32726.228	6.140	0.543	5.330G

Table 1 shows the increase in total emissions from 32.7 GtCO₂e in 1990 to 52.9 GtCO₂e in 2023, while per capita emissions are relatively stable, and emission intensity per unit of GDP.



Figure 2. Comparison of Global Emissions in Various Sectors

Figure 2 confirms the dominance of the energy sector in contributing to emissions, so that policy interventions such as carbon taxes are globally focused on sectors with the highest emission intensity.



Source: EDGAR (2025)

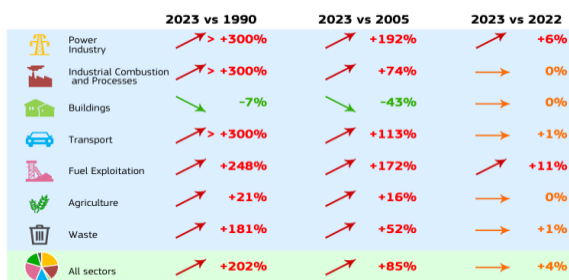
Figure 3. Indonesia’s GHG Emissions (Sector)

Based on Figure 3, data show that Indonesia’s carbon emissions have continued to increase since 1990 due to industrialization and the use of fossil fuels. Figure IV.3 shows that the energy and forestry sectors are the largest contributors to national emissions, while agriculture, waste, and IPPU contribute less.

Table 2. GHG Emission

Year	GHG emissions Mt CO ₂ e/yr	GHG emissions per capita t CO ₂ e/cap/yr	GHG emissions per unit of GDP PPP t CO ₂ e/kUSD/yr	Population
2023	1200.200	4.287	0.307	279.934M
2015	907.315	3.515	0.318	258.162M
2005	649.499	2.865	0.394	226.713M
1990	397.099	2.189	0.444	181.437M

Table 2 shows an increase in emissions from 397 MtCO₂e in 1990 to 1,200 MtCO₂e in 2023, with per capita emissions increasing from 2.1 to 4.3 tCO₂e. Although emissions intensity per unit of GDP is decreasing, total emissions continue to increase, driven by economic and population growth.



Source: EDGAR (2025)

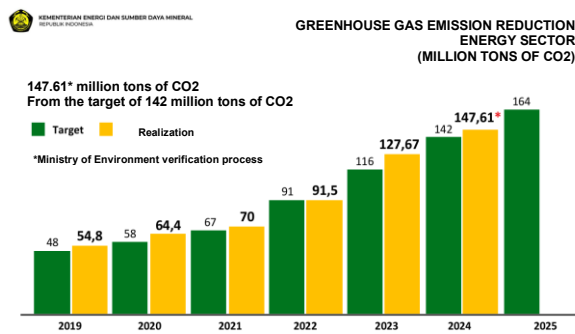
Figure 4. Comparison of Indonesia’s Emissions in Various Sectors

Figure 4 confirms the dominance of emissions from the energy sector, especially coal-fired power plants and transportation, and the high contribution of the forestry sector due to deforestation.

Table 3 shows fluctuations in emissions from 2019–2023, particularly in the forestry sector, while the energy sector consistently remains the largest source of emissions. This underscores the need for cross-sectoral control policies and fiscal interventions such as carbon taxes.

Table 3. Total Emissions from Various Sectors

No.	Item	2019	2020	2021	2022	2023
1.	Energy	20,682.03	17,790.05	17,749.87	17,197.77	18,227.37
2.	IPPU	50,878.11	49,890.83	52,068.74	59,451.89	59,854.23
3.	Agriculture	105,300.85	107,849.59	111,935.17	109,350.65	92,016.01
4.	Forestry	821,201.67	317,235.91	253,347.85	219,554.01	306,897.69
5.	Waste	123,017.79	125,748.50	128,714.28	130,227.17	136,334.68
	Total	1,121,080.45	618,514.86	563,815.91	535,781.48	613,329.97



Source: *Energy and Mineral Resources Sector Performance Achievements (2024)*

Figure 5. Realization of GHG Reduction in the Energy Sector in 2024

Meanwhile, the ESDM report (2024) noted that Indonesia succeeded in reducing energy sector emissions by 147.61 million tons of CO₂, exceeding the target of 142 million tons of CO₂ as shown in Figure 5.

A carbon tax is an economic instrument used to reduce CO₂ emissions while supporting the achievement of the Nationally Determined Contribution (NDC) targets under the Paris Agreement. Additionally, this legislation increases state cash that may be used for social initiatives and development. Law Number 7 of 2021 concerning the Harmonization of Tax Regulations (HPP Law) established the carbon tax in Indonesia, and it went into force on April 1, 2022. As the industry with the highest emissions, coal-fired power plants (*Pembangkit Listrik Tenaga Uap/PLTU*) were initially subject to a tax of IDR 30/kilogram of CO₂e through a cap-and-tax system in which businesses are penalized if their emissions over the predetermined threshold.

4.2. Contribution to National Sustainable Development Goals (SDGs)

Based on Figure 6, Carbon taxes have direct relevance to the achievement of the Sustainable Development Goals (SDGs), particularly in the environmental and energy transition aspects. Of the 17 SDGs, the four most relevant are SDG 13, SDG 7, SDG 9, and SDG 12. Carbon taxes support SDG 13 by reducing greenhouse gas emissions; accelerating the transition to clean energy in SDG 7; encouraging low-carbon technology innovation for SDG 9; and promoting sustainable production and consumption patterns in SDG 12. Thus, the implementation of carbon taxes is an important instrument in strengthening the national and global sustainable development agenda.



Figure 6. 17 SDGs

The potential state revenue from the carbon tax is estimated from 2019 to 2027 in the coal-fired power plant energy sector, as shown in Table 4.

Table 4. Potential State Revenue from Coal-Fired Power Plants 2019-2027

Year	Total Carbon Emissions(kg)	Minimum Carbon Tax Rate(IDR/CO ₂)	Potential State Revenue
2019	315,400,000,000	30	IDR 9,462
2020	300,520,000,000	30	IDR 9,015.6
2021	303,150,000,000	30	IDR 9,094.5
2022	404,520,000,000	30	IDR 12,135.6
2023	399,050,000,000	30	IDR 11,971.5
2024	365,500,000,000	30	IDR 10,965
2025	288,800,000,000	30	IDR 8,664
2026	311,900,000,000	30	IDR 9,357
2027	336,400,000,000	30	IDR 10,092

Table 4 shows projected state revenues, with the highest revenue range projected in 2022 (IDR 12.14 trillion) when emissions peak, then declining in 2025 (IDR 8.66 trillion) as emissions decrease, before rising again in 2027 (IDR 10.09 trillion). This revenue can be used to support the energy transition, green infrastructure development, renewable energy subsidies, and social protection, so the carbon tax serves a dual function as both an environmental and fiscal instrument.

5. Discussion

The implementation of a carbon tax since 2022 is the first step towards controlling emissions in Indonesia, although it is still limited to coal-fired power plants, the sector with the largest emission contribution. This policy provides economic incentives for companies to reduce emissions through energy efficiency and low-carbon technology (Hanafiyah et al., 2024; Meila et al., 2024). However, to achieve the 2030 NDC target, expanding the tax to other industrial sectors is necessary.

Some of the main challenges in implementing a carbon tax include uneven industrial readiness, the high need for investment in low-emission technology, and limited policy dissemination. Furthermore, strengthening regulations and oversight is needed to prevent tax evasion. Social risks such as rising energy prices also need to be addressed through compensation programs for vulnerable groups (Rahmasari et al., 2024). In addition, a more critical evaluation is needed regarding policy trade-

offs and distributional impacts, such as the potential burden on low-income households, small businesses, and energy-intensive industries (Udin et al., 2024). Addressing these distributional concerns is essential to ensure the policy is both effective and socially equitable.

The carbon tax has the potential to become a new source of revenue for the state. In 2023, PT PLN (Persero) produced 323,320.62 GWh of electricity, of which only 3.15% came from renewable energy, 43% from other sources, and 53.78% still relied on sources that produce carbon emissions (Cozzi & Goodson, 2021; Ferrer & Thome, 2023). The carbon tax is imposed in accordance with Article 13 of the HPP Law, and the initial target of the carbon tax in Indonesia is coal-fired power plants (PLTU). The carbon tax is calculated based on carbon emissions that negatively impact the environment, with a minimum rate of IDR 30.00 per kilogram of CO₂e. The implementation of a carbon tax directly supports SDG 13 (Addressing Climate Change) by reducing GHG emissions. The resulting revenue can support SDG 7 (Affordable and Clean Energy) through subsidies for renewable energy and clean technology innovation. Furthermore, the carbon tax contributes to SDG 9 (Industry, Innovation, and Infrastructure) by encouraging the development of environmentally friendly infrastructure and sustainable technologies, and SDG 12 (Responsible Consumption and Production) by encouraging more sustainable production practices. Furthermore, SDG 1 (No Poverty) supports social assistance through funding, and SDG 8 (Decent Work and Economic Growth) through the creation of green jobs. With a transparent, inclusive, and critically evaluated policy approach that considers trade-offs and distributional impacts, the carbon tax can be an integrated instrument for achieving sustainable development in Indonesia (Udin et al., 2024).

The researchers recommend expanding the scope of sectors subject to the carbon tax, so that it is not limited to coal-fired power plants but also includes transportation, manufacturing, and other sectors that contribute significantly to carbon emissions. Public awareness and education about the benefits and mechanisms of the carbon tax should be increased among industry players and the general public to enhance understanding, support, and compliance. Institutional capacity and law enforcement need to be strengthened to ensure the transparent, fair, and effective implementation of the carbon tax, including measures to prevent tax avoidance (Maghfirani et al., 2022). Furthermore, revenues from the carbon tax should be utilized transparently and effectively, particularly to fund renewable energy subsidies, investments in clean technology, compensation for vulnerable groups affected by rising energy prices, and the development of green infrastructure. Finally, cross-sector partnerships between government, industry, civil society, and international institutions should be developed to support the successful implementation of the carbon tax as a key instrument for the transition to a green economy and the achievement of the SDGs.

6. Conclusion

Based on the research results and discussions outlined above, it can be concluded that carbon emissions in Indonesia continue to increase throughout the 1990–2023 period, with total emissions increasing from 397 million tons of CO₂e to more than 1,200 million tons of CO₂e in 2023. Per capita emissions also increased from approximately 2.1 to 4.3 tons of CO₂e per person; however, improvements in emissions efficiency per unit of GDP have not been able to stem the overall rate of increase in emissions due to population growth and economic activity. In addition, the energy sector, particularly coal-fired power plants, remains the largest source of emissions, followed by the forestry, industrial, agricultural, and waste sectors. In the 2019–2023 period, the energy sector contributed more than 17 thousand Gg CO₂e

per year, while emissions from forestry experienced significant fluctuations due to changes in land use. In line with these conditions, the government has implemented a carbon tax since 2022 through a Cap and Tax mechanism with an initial rate of IDR 30/kg CO₂e, initially focused on coal-fired power plants (PLTUs) as the largest contributors to emissions.

On the other hand, the carbon tax policy has the potential to generate substantial state revenue, approximately IDR 8.6 trillion to IDR 12.1 trillion per year based on projections for 2019–2027. This revenue can then be directed to accelerate the transition to clean energy, provide subsidies for renewable energy, build green infrastructure, and provide social support for vulnerable groups. Furthermore, the implementation of the carbon tax has made a positive contribution to achieving various sustainable development goals, particularly SDG 13, SDG 7, SDG 9, and SDG 12. However, the implementation of this policy still faces several challenges, ranging from limited sector coverage, uneven industrial readiness, the need for significant investment in low-carbon technology, to social risks in the form of potential energy price increases, which require fair and targeted compensation policies.

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Data Disclosure Statement

The data that support the findings of this study are available from the corresponding author upon reasonable request.



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