

## Comparative Study Across Countries: Analysis Of Carbon Tax Implementation Toward The Net Zero Emission Commitment

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### Abstract

This study aims to analyze the implementation of carbon taxes and their role in supporting the Net Zero Emission (NZE) commitment, especially in the context of Indonesia's sustainable development vision towards Indonesia Emas 2045. Using a qualitative descriptive method with a comparative approach, this paper reviews how countries such as Sweden, Japan, Singapore, and Indonesia apply carbon tax policies in different economic and political settings. The study finds that a carbon tax can be an effective fiscal tool to internalize the negative externalities of carbon emissions, especially when supported by clear policy designs, political commitment, and well-targeted revenue utilization. Sweden's success lies in its long-term consistency and transparent reinvestment in public services, while Japan emphasizes integration with technological innovation. Singapore leads in Southeast Asia through regulatory clarity and international offset mechanisms. Indonesia, in contrast, is still in the early stages of implementation, with relatively low tax rates, undefined revenue allocation, and institutional constraints. The findings suggest that carbon taxation holds significant potential to advance NZE goals in developing countries, but its effectiveness depends on domestic readiness, structural reform, and policy coherence

**Keywords** : carbon tax, negative externality, net zero emission.

JEL Codes : H23, Q54, F64

### INTRODUCTION

Global warming is a crucial issue triggered by the increasing concentration of greenhouse gases in the atmosphere, particularly carbon dioxide (CO<sub>2</sub>) originating from human activities such as industrial production, transportation, and consumption of goods with carbon footprints. The accumulation of these emissions has caused extreme climate change with widespread impacts on the environment, public health, and global economic stability.

In response to this condition, the Paris Agreement was established in 2015, urging countries to limit the rise of global temperatures to well below 2°C, with an ideal target of not exceeding 1.5°C compared to pre-industrial levels. To achieve this, many countries have adopted clean energy transition policies, one of which is the imposition of a carbon tax as a fiscal instrument aimed at reducing emissions while internalizing the social costs of environmental pollution. (World Bank, 2021; Jonsson et al., 2019).

As a signatory to the Paris Agreement, Indonesia has set its Net Zero Emission (NZE) target for 2060 or earlier. This commitment demands major transformations in various sectors, particularly energy, industry, and fiscal policy. In this context, the carbon tax was introduced through Law Number 7 of 2021 concerning the Harmonization of Tax Regulations, reflecting the country's effort to adopt a market-based approach to control emissions. (World Bank, 2021; Jonsson et al., 2019).

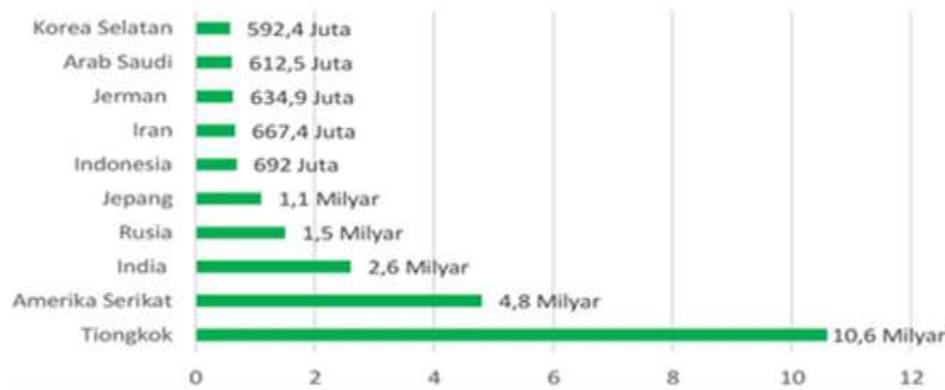


Figure 1. Top 10 Carbon Emitting Countries in the World  
Source: Energy Institute (2022)

According to the Emission Database for Global Atmospheric Research (EDGAR), Indonesia is among the world's top ten carbon-emitting countries, with annual emissions reaching approximately 692 million tons. This number is projected to continue increasing in line with economic growth, technological progress, and intensified societal activities. This indicates that emission reduction efforts need to be complemented by stronger and more integrated fiscal policies. Carbon tax, as part of Pigouvian taxation, functions not only as a state revenue source but also as a tool to shift household and corporate behavior toward more sustainable activities.

Carbon tax is imposed on parties consuming fossil fuel-based energy as a measure to reduce excessive consumption. This is crucial because uncontrolled fossil fuel use is a major contributor to the rising concentration of greenhouse gases, which directly drives global warming and climate change. Without effective control instruments such as a carbon tax, the social and environmental costs of pollution remain unaccounted for in market prices, leading to market failure.

Although carbon taxation has been recognized as a strategic step for emission reduction, its implementation in Indonesia still faces various structural and operational challenges. The government initially planned to enforce the carbon tax in April 2022, but its implementation was postponed until 2025 due to economic recovery concerns and global political uncertainty following Russia's invasion of Ukraine, which caused sharp increases in energy prices. This situation raises concerns regarding Indonesia's consistency and credibility in achieving its long-term Net Zero Emission target as outlined in its national development agenda.

Several countries such as Sweden, Canada, and Japan have already implemented carbon taxes, with results showing success in reducing emissions while accelerating the transition to clean energy. For instance, Japan has imposed a carbon tax since 2012 with rates based on fossil fuel emissions, with revenues allocated directly to renewable energy development. These country practices can serve as important benchmarks for Indonesia in developing a contextual and adaptive carbon tax policy.

Therefore, the objective of this research is to describe and compare carbon tax implementation across countries in order to assess its relevance and adaptation potential for Indonesia's Net Zero Emission commitment. This study also seeks to explore how carbon tax policies can be optimized not only as a revenue source but also as an environmental control instrument.

## LITERATURE REVIEW

### Pigouvian Tax

Pigouvian tax is a type of tax designed by considering the social impacts of negative externalities, thus serving as a reference for policymakers in formulating regulations (Pratama et al., 2022). In this context, the imposition of a carbon tax as a form of Pigouvian tax is expected to reduce negative externalities such as carbon emissions, by charging additional costs on emission-generating activities.

### **Carbon Tax**

A carbon tax is a levy imposed on the use of carbon-based fuels. The taxpayers are individuals or entities that purchase carbon-containing goods and/or conduct activities generating carbon emissions. The constitutional basis for introducing new taxes lies in the 1945 Constitution, Article 23 Paragraph (1). Fossil fuels—hydrocarbon-based resources such as petroleum, coal, and natural gas—are non-renewable and serve as major sources of carbon emissions.

From a microeconomic perspective, an increase in the price of carbon-based fuels through instruments like carbon tax will lower demand for these fuels while reducing the negative externalities they cause. The emergence of carbon taxation reflects the rising global concern over increasing carbon emissions. Research on carbon taxation has developed significantly over the past three decades, with empirical evidence showing that carbon pricing is an effective instrument for reducing emissions when supported by consistent policy design (Jonsson et al., 2019; Martinsson & Rezessy, 2024).

### **Net Zero Emission**

Net Zero Emission (NZE) is a condition where the amount of greenhouse gases released into the atmosphere is balanced by the amount absorbed back by nature or ecosystems (Hermawan & Prabhawati, 2022). Achieving NZE involves emission reduction, enhanced carbon absorption capacity either through natural or technological processes, and balancing emissions by removing carbon from the atmosphere.

### **Negative Externalities**

Negative externalities refer to harmful effects generated by economic activities on third parties who are not directly involved in the activity, and such effects are not reflected in market prices. In environmental contexts, negative externalities occur when activities such as fossil fuel combustion generate air pollution or greenhouse gas emissions, causing social costs including environmental damage, public health risks, and climate change.

Since economic actors do not directly bear these social costs, incentives to reduce polluting activities remain low. Therefore, government intervention through policies such as carbon taxation is necessary to internalize these negative externalities.

## **RESEARCH METHOD**

This study employs a qualitative approach with a descriptive-comparative method aimed at analyzing carbon tax implementation in several countries and its implications for achieving Net Zero Emission (NZE). The research relies on secondary data obtained from national and international journals, books, online sources, news reports, and government documents concerning potential revenues and challenges in implementing carbon taxation.

## **RESULTS AND DISCUSSION**

This study uses a qualitative descriptive approach with cross-country comparative analysis to understand the implementation of carbon taxes and their contribution to the Net Zero Emission (NZE) commitment. The countries analyzed were selected based on policy diversity and levels of economic development, namely Sweden, Japan, Singapore, and Indonesia. The analysis covers policy structure, technical implementation, and the resulting environmental and fiscal impacts.

### **Carbon Tax Implementation in Sweden**

According to Jonsson et al. (2020), Sweden has been successful in implementing carbon taxation. The country managed to design its carbon tax provisions in a way that effectively reduced emissions without harming the economy. This was possible because Sweden also enacted tax reform in 1991, whereby the government not only introduced the carbon tax but also drastically reduced other existing tax rates (Jonsson et al., 2020). Among the reduced taxes were income tax rates for both individuals and corporations. This ensured that citizens would not bear an excessive tax burden, allowing the economy to continue functioning smoothly.

As income tax revenues decreased, Sweden allocated all revenues from carbon taxation to cover the shortfall, enabling the government to sustain its fiscal functions. Sweden's success demonstrates that

long-term policy consistency, transparency in tax revenue utilization, and strong clean energy infrastructure are key to achieving NZE. Sweden is often cited as a successful case study where the carbon tax, introduced in 1991, contributed to a significant reduction in emissions while maintaining stable economic growth (World Bank, 2021).

### **Carbon Tax Implementation in Japan**

Japan was the first country in Asia to implement a carbon tax in 2012. The tax was imposed on the consumption of fossil fuels such as coal, petroleum, natural gas, and their derivatives. Revenue generated from this tax was directly allocated to renewable energy development and lowering energy costs. The tax rates vary according to the carbon emission content of each fuel.

Compared to European countries, Japan's carbon tax rate is relatively low, around 295 yen per ton of carbon, equivalent to approximately IDR 38,000. Despite the low rate, Japan's approach is preventive and integrated into its national industrial policy. Japan is committed to achieving NZE by 2050, progressively increasing its energy mix from solar, nuclear, and hydrogen sources. However, the country's limited domestic resources make its transition more gradual.

Japan's carbon tax, on the other hand, has faced criticism due to its relatively low rate and limited coverage, although it is complemented by technological innovation policies (Gokhale, 2021; Kawakatsu, 2017).

### **Carbon Tax Implementation in Singapore**

Singapore is the pioneer in Southeast Asia in adopting carbon taxation, as stipulated in the Carbon Pricing Act (Sutanto et al., 2023). The policy was introduced in 2018 and officially enforced in 2019 (Low et al., 2023). The carbon tax is part of Singapore's strategy to reduce greenhouse gas (GHG) emissions. Under this regulation, companies emitting 25,000 tons or more of GHG annually are required to pay a carbon tax.

Singapore's carbon tax system is considered innovative, being the first in the region to allow the use of high-quality international carbon credits as emission offset mechanisms. Since 2024, large emitters are permitted to reduce up to 5% of their tax liabilities using such credits, provided they meet international quality standards. As a geographically small nation, Singapore focuses its policies on energy efficiency, low-carbon technology development, and transport electrification. Carbon tax revenues are directed toward research and development rather than fiscal income alone. Singapore has committed to achieving NZE by 2050.

### **Carbon Tax Implementation in Indonesia**

The Government of Indonesia has introduced Law Number 7 of 2021 on the Harmonization of Tax Regulations, which includes provisions on carbon tax. Initially planned for enforcement on April 1, 2022, implementation was scheduled to begin in the coal-fired power plant (CFPP) sector. The rate was set at IDR 30 per kilogram of carbon dioxide equivalent (CO<sub>2e</sub>), lower than the IDR 75/kg CO<sub>2e</sub> rate initially proposed in the draft bill. This rate is considered suboptimal since it falls short of recommendations from the World Bank and the International Monetary Fund (IMF).

Indonesia targets NZE by 2060 or earlier, but success will largely depend on political will, reform of energy subsidies, and effective redistribution of tax revenues to affected sectors. Unlike developed countries, Indonesia remains in the early stages of policy design and requires stronger impact studies and public communication strategies. Indonesia has only recently introduced a carbon tax through the Harmonization of Tax Regulations Law No. 7 of 2021. Studies suggest that while the potential is significant, challenges include institutional capacity and the clarity of revenue allocation (Meila, Dianty, & Veronica, 2024).

**Comparison Across Countries****Table 1. Countries Implementing Carbon Tax**

Country	Year Implementation	Initial Rate	NZE Commitment	Allocation of Tax Revenue	Emission Impact
Sweden	1991	USD 30 → 130	2045	Transportation subsidies & income tax reduction	Stable, downward trend
Japan	2012	JPY 289	2050	Energy R&D & efficiency improvement	Stable, downward trend
Singapore	2019	SGD 5	2050	Low-carbon technology R&D	Still gradual
Indonesia	2025 (planned)	Rp 30.000	2060	Not yet defined	Not yet significant

Source: Data processed by the researcher, 2025.

The comparative analysis across Sweden, Japan, Singapore, and Indonesia highlights important lessons regarding carbon tax design and implementation. Sweden demonstrates that long-term consistency and relatively high tax rates can effectively reduce emissions while maintaining competitiveness.

Sweden has implemented a carbon tax since 1991, starting at USD 30 and now increasing to USD 130 per ton of CO<sub>2</sub>. The tax revenue is allocated to transportation subsidies and income tax reductions. According to the American Economic Association (2019), this policy has successfully reduced CO<sub>2</sub> emissions in the transportation sector significantly while maintaining economic growth. Its impact is described as stable with a downward trend, consistent with findings from Deutsche Welle (2024), which emphasize the consistency of Sweden's climate policy.

Japan introduced a carbon tax in 2012 with an initial rate of JPY 289 per ton of CO<sub>2</sub>. The tax revenue is directed toward energy research and development as well as improving energy efficiency. According to Waseda University (n.d.), this tax has proven effective in reducing non-CO<sub>2</sub> greenhouse gases such as SO<sub>2</sub> and NO<sub>x</sub>, although the reduction of CO<sub>2</sub> emissions has been gradual. This supports the description of being stable with a downward trend in the table. Japan's experience reveals the limitations of setting a low tax rate without strong complementary policies. While the tax itself had limited impact, Japan's integration with technological innovation has helped advance decarbonization in industrial sectors (Sugino et al., 2013).

Singapore began implementing a carbon tax in 2019 at an initial rate of SGD 5 per ton of CO<sub>2</sub>, covering around 80% of total national emissions. The tax revenue is used for low-carbon technology research. According to the Climate Governance Initiative (2023), while this policy demonstrates a strong commitment toward NZE, the emission reductions achieved so far are not yet significant in the short term, thus categorized as still gradual. Singapore's approach illustrates how carbon taxation can be aligned with international carbon markets, positioning the country as a hub for carbon trading in Asia. Its sectoral focus, particularly in energy-intensive industries, shows that targeted design is possible (Li, 2023a; Li, 2023b).

Indonesia plans to fully implement a carbon tax in 2025 with an initial rate of IDR 30,000 per ton of CO<sub>2</sub> and a target of NZE by 2060. According to Wikipedia (2024), although the legal framework has been established through the Law on Harmonization of Tax Regulations, the allocation of tax revenue remains unclear, and its impact on emission reduction has not been significant. In contrast, Indonesia remains in the early stages, with a tax rate significantly below international benchmarks. This raises questions about the effectiveness of the policy in achieving meaningful emissions reduction in the short term (Meila, Dianty, & Veronica, 2024).

A recurring theme in the literature is the importance of revenue recycling. Studies show that revenues from carbon taxes can be reinvested in renewable energy, infrastructure, or returned to households to offset distributional impacts (Muth et al., 2023; Dugstad et al., 2024). Furthermore, political economy factors play a critical role. Public acceptance is shaped by perceptions of fairness, transparency, and tangible benefits (Bulut et al., 2025). Without addressing these aspects, resistance to carbon taxation is likely to persist, particularly in developing countries. Overall, the discussion suggests that Indonesia must not only raise its carbon tax rate but also clarify its strategy for revenue allocation, ensure institutional capacity, and strengthen communication strategies to enhance public trust.

## CONCLUSION AND SUGGESTION

### Conclusion

This study analyzed the implementation of carbon tax policies in Sweden, Japan, Singapore, and Indonesia using a qualitative descriptive approach to evaluate their effectiveness in supporting the achievement of Net Zero Emission (NZE). The comparative findings highlight that carbon taxation has strong potential as a fiscal instrument to internalize the negative externalities of carbon emissions, provided it is accompanied by consistent political commitment, transparent revenue utilization, and alignment with clean energy transition strategies.

Sweden serves as a best-practice example of sustainable carbon taxation, where ambitious pricing combined with revenue recycling—such as transport subsidies and income tax reductions—has significantly reduced emissions while maintaining economic competitiveness. Japan's case illustrates that a relatively low tax rate yields limited impact unless integrated with complementary policies, particularly technological innovation and industrial decarbonization. Singapore demonstrates the importance of regulatory clarity and integration with international carbon markets to enhance both policy effectiveness and credibility. In contrast, Indonesia remains at an early stage of implementation, with relatively low rates, unclear revenue allocation, and institutional challenges that may hinder its effectiveness in the short term. Overall, the study concludes that carbon taxation is a crucial instrument to accelerate the energy transition and the achievement of NZE targets. However, its effectiveness is context-specific and depends on tax rate ambition, policy coherence, institutional capacity, and public trust.

### Sugesstion

To strengthen Indonesia's carbon taxation framework and maximize its contribution to emission reduction and sustainable development goals, the following policy recommendations are proposed:

1. **Gradually increase the carbon tax rate** to align with international benchmarks and provide a stronger price signal to emitters.
2. **Establish a transparent revenue recycling framework** that directs tax proceeds toward renewable energy, energy efficiency programs, and low-carbon infrastructure development.
3. **Design complementary policies** to stimulate technological innovation, while offering targeted support for vulnerable industries and households to mitigate distributional impacts.
4. **Strengthen communication and public engagement strategies** to build trust, enhance acceptance, and ensure the perceived fairness of the policy.

By adopting these measures, Indonesia can ensure that its carbon tax policy not only reduces emissions but also contributes to broader sustainable development objectives, supporting the vision of *Indonesia Emas 2045*.

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