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Evaluative Study on the Impact of Carbon Tax Implementation in Promoting Environmentally Friendly Industries in Indonesia

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Abstract: This study evaluates the implementation of Indonesia's carbon tax policy and its role in promoting the transformation toward environmentally friendly industries. Using a qualitative literature review approach, the research synthesizes evidence from academic publications, policy reports, and institutional documents to assess policy effectiveness, institutional readiness, and industry responses. The findings indicate that the current carbon tax—characterized by low pricing levels, limited sectoral coverage, and weak enforcement—has not yet functioned as a significant driver of green innovation or sustainable investment. The analysis shows that many firms perceive the tax primarily as a regulatory formality rather than a strategic market signal, largely due to policy ambiguity, insufficient integration with green finance mechanisms, and weak inter-institutional coordination. The study underscores the importance of aligning fiscal instruments with complementary policies and robust institutional frameworks to enhance their effectiveness in developing country contexts. It also highlights the need for future empirical research focusing on firm-level behavioral responses and the long-term effects of carbon pricing on industrial sustainability.

Keywords: carbon tax; environmental fiscal policy; green industrial transformation; Indonesia; climate policy implementation.

对印度尼西亚实施碳税在促进环境友好型产业发展中的影响的评估研究

摘要：本研究评估了印度尼西亚碳税政策的实施情况及其在推动产业向环境友好型方向转型中的作用。研究采用定性文献综述方法，综合分析学术文献、政策报告和相关机构文件，以评估该政策的有效性、制度准备程度以及产业界的响应情况。研究结果表明，当前的碳税制度由于税率水平较低、行业覆盖范围有限以及执法力度不足，尚未成为推动绿色创新和可持续投资的重要驱动力。分析发现，许多企业主要将碳税视为一种合规性的监管要求，而非具有战略意义的市场信号，这在很大程度上源于政策不明确、与绿色金融机制的融合不足以及跨机构协调薄弱。本研究强调，在发展中国家背景下，应将财政工具与配套政策及稳健的制度框架相结合，以提升其政策效果。同时，研究指出，未来有必要开展以企业层面行为反应为重点的实证研究，并系统评估碳定价对产业可持续发展的长期影响。

关键词：碳税；环境财政政策；绿色产业转型；印度尼西亚；气候政策实施

1. Introduction

The rise in global greenhouse gas emissions over the past decades has underscored the urgent necessity for policy instruments aimed at mitigating climate change. Among the various strategies adopted worldwide, carbon taxation has emerged as a central mechanism in many countries seeking to shift industrial practices toward sustainability [1]. The implementation of carbon taxes, which places a direct price on emissions, is designed to internalize the external costs of carbon dioxide and other greenhouse gases, thereby incentivizing industries to reduce their carbon footprint. Indonesia, as one of the world's top ten greenhouse gas emitters and a rapidly developing economy with a strong reliance on fossil fuels, introduced a carbon tax scheme in 2022 as part of its broader fiscal and environmental reform strategy [2]. This policy development represents a significant shift in the nation's climate governance, aiming to promote green investment and accelerate the transition toward environmentally friendly industries.

The Indonesian carbon tax policy was initiated through Law No. 7/2021 on Harmonization of Tax Regulations, with implementation beginning at a modest rate of IDR 30 per kilogram of CO_2 equivalent, initially targeting coal-fired power plants [3]. The government plans to gradually expand the scope and rate of the tax to cover broader sectors and emitters . However, the practical outcomes of this policy remain largely unexplored, particularly concerning its influence on industrial transformation and the actual behavioral response of companies subjected to the tax. Data from the Ministry of Finance shows that within the first year of implementation, tax revenue from carbon taxation contributed only 0.03% of total state revenue, raising concerns about its current effectiveness as both a fiscal and environmental tool [4]. While countries such as Sweden, Canada, and Japan have demonstrated varied levels of success in leveraging carbon taxes to steer industrial behavior, the Indonesian context marked by institutional, political, and infrastructural complexities presents unique challenges that warrant contextualized examination [5].

Industries in Indonesia face an evolving regulatory environment that increasingly prioritizes

environmental accountability. At the same time, industrial players express concerns over policy unpredictability, technological readiness, and compliance costs. PT Bukit Asam and PLN, two state-owned enterprises involved in energy production, have publicly stated the difficulties in adjusting operations to meet emission targets under the carbon pricing mechanism [6]. These cases exemplify the tension between regulatory ambition and implementation feasibility. Moreover, the policy is situated within a broader landscape of climate financing mechanisms, including green bonds and renewable energy subsidies, further complicating the assessment of its isolated impact [7]. Understanding how carbon tax implementation translates into concrete changes in industrial behavior and whether it drives investment in cleaner technologies remains crucial for evaluating its policy efficacy.

This study is timely not only because of Indonesia's growing commitment to meet its Nationally Determined Contributions (NDCs) under the Paris Agreement, but also because the empirical evidence regarding the interplay between fiscal tools and environmental innovation in emerging economies remains limited. Scholarly discourse on carbon taxation has predominantly focused on high-income countries, leaving gaps in the literature concerning how such mechanisms function within lower-middle-income contexts where industrial dependence on fossil fuels is higher [8]. Furthermore, most existing studies tend to model theoretical cost-benefit analyses or carbon pricing elasticities, rather than empirically assessing the behavioral and structural changes within industries following policy enforcement [9]. As a result, our understanding of how carbon taxes influence real-world business practices, technological adoption, and investment patterns remains fragmented, especially in regions with limited regulatory maturity and infrastructural constraints.

This research addresses these limitations by focusing on the Indonesian industrial sector and evaluating the tangible outcomes of carbon tax implementation on the promotion of environmentally friendly industries. It aims to explore how industries respond in terms of investment in clean technologies, shifts in production processes, and compliance strategies. In doing so, the study also investigates to what extent carbon tax acts as a catalyst for green innovation and industrial decarbonization in the Indonesian context. The goal is not merely to measure emissions reductions but to uncover the mechanisms through which fiscal policy can influence corporate environmental performance.

The research objective is to evaluate the actual impact of carbon tax policy on industrial transformation in Indonesia, with a focus on identifying key factors that enable or hinder progress toward environmentally sustainable operations. It also seeks to assess the role of fiscal policy in shaping corporate behavior and facilitating a transition to low-carbon economic models. The findings are intended to inform both policy refinement and strategic planning among industrial actors, offering practical insights for governments, regulators, and business leaders navigating the intersection of economic development and climate responsibility.

This investigation builds upon and dialogues with existing scholarship on environmental taxation, regulatory compliance, and industrial sustainability. For instance, [10] noted the effectiveness of carbon tax in OECD countries, while [11] highlighted the role of complementary policies in maximizing its impact. Yet, few studies have examined how such instruments operate within structurally different economies such as Indonesia. Moreover, the research draws on frameworks from policy evaluation [12] and innovation systems theory [13] to conceptualize the institutional and technological dynamics involved. The study contributes to closing a significant conceptual and empirical gap by offering a context-specific analysis of carbon tax effects on green industrial transformation, something that is largely underrepresented in the literature.

2. Methods

2.1 Research Design

This study adopts a qualitative research approach through an in-depth literature review method. The research is evaluative and analytical in nature, aiming to critically assess the implementation of carbon tax

policies and their impact on the promotion of environmentally friendly industries in Indonesia. This method is selected due to its strength in synthesizing existing theoretical and empirical knowledge, enabling the identification of thematic patterns, contradictions, and research gaps across previous studies.

2.2 Data Sources and Inclusion Criteria

The data used in this study consist of secondary sources from scientific publications, government documents, and institutional reports. These include peer-reviewed journal articles indexed in Scopus and Google Scholar, policy reports from international organizations such as the World Bank, OECD, and IMF, as well as official documents from the Ministry of Finance and the Ministry of Energy and Mineral Resources (ESDM) of Indonesia. Inclusion criteria for selected literature are as follows: (1) studies discussing carbon tax and/or environmental fiscal policies; (2) research focusing on industrial responses to environmental taxation; (3) studies with contextual relevance to emerging economies, particularly Indonesia or Southeast Asia; and (4) publications dated between 2020-2025. Non-scholarly articles or opinion pieces without rigorous methodological grounding are excluded.

2.3 Literature Search Strategy

The literature collection process was conducted using structured keyword searches across academic databases, including Scopus, ScienceDirect, JSTOR, and Google Scholar, as well as official government portals. Search terms included: carbon tax, carbon pricing in Indonesia, fiscal environmental policy, green industry transformation, and industrial decarbonization strategies. Each document was cataloged and categorized based on publication type, date, geographical focus, and analytical content.

2.4 Analytical Method

To analyze the collected literature, this study applied thematic content analysis, identifying recurring themes related to the effectiveness of carbon taxation, policy implementation barriers, behavioral responses of industries, and incentives for green innovation. These themes were examined critically by comparing the arguments, findings, and methodologies of each study. Particular attention was given to juxtaposing international experiences with the Indonesian case to assess contextual congruencies and divergences. This process allowed the research to produce a nuanced synthesis of existing knowledge and to explore how fiscal mechanisms can drive industrial decarbonization.

2.5 Data Triangulation and Reliability

Comparisons between academic studies and institutional reports. Cross-verification of data from different types of publications helped reduce bias and improved the comprehensiveness of the review. In addition, contradictory findings were included to maintain objectivity and present a balanced assessment of the existing body of knowledge, thereby increasing the robustness of the conclusions drawn from this study.

3. Results and Discussion

3.1 Results

3.1.1 Carbon Tax Implementation Framework in Indonesia

Indonesia introduced a carbon tax under Law No. 7/2021 as part of its broader fiscal and climate policy reforms. The implementation began in April 2022 with a relatively low rate of IDR 30 per kilogram of CO_2 equivalent, initially targeting coal The validity and reliability of the findings were ensured through triangulation of sources, including -fired power plants. The design includes a gradual expansion plan, aiming to extend to other sectors and align with the development of a domestic carbon market [14]. Despite these intentions, limitations in institutional capacity and regulatory clarity have reduced the policy's initial effectiveness as a carbon pricing instrument.

The carbon tax framework reflects a hybrid mechanism, combining fixed taxation with a future emissions trading scheme. However, several studies highlight a lack of comprehensive monitoring, reporting, and verification systems. Industrial actors often report uncertainty about compliance rules, offset

eligibility, and how tax rates will evolve. Without clear operational guidance, the carbon tax fails to function as a strong price signal for investment and innovation in lower-carbon alternatives [11].

Legal ambiguities and limited cross-sectoral coordination create inconsistencies in policy enforcement. Sectoral carbon budgets have not been established, and regulatory agencies operate without synchronized frameworks. While the carbon tax marks a significant policy milestone, analysts caution that it could become largely symbolic unless the institutional framework is strengthened and enforcement capacity is improved [15].

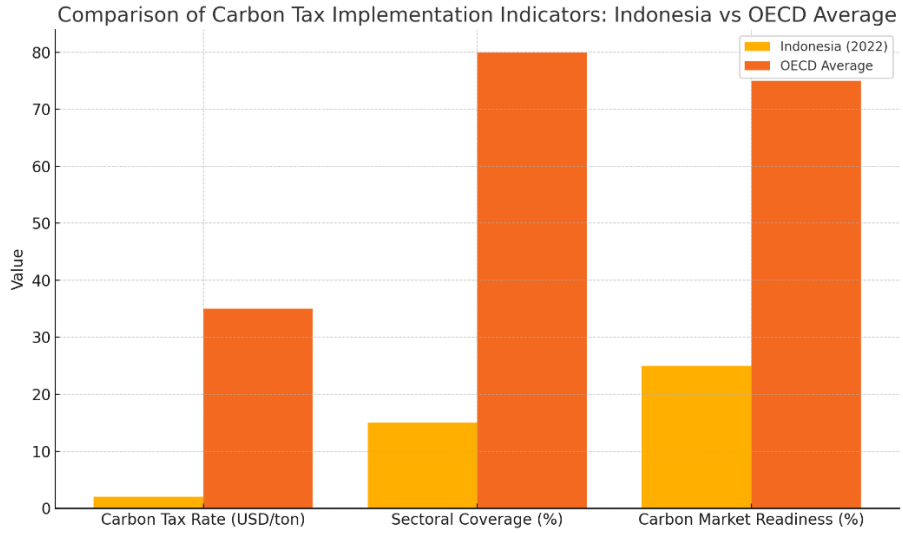

Figure 1. Comparison of Carbon Tax Implementation Indicators: Indonesia vs OECD Average

The chart above illustrates a comparative overview of three key indicators reflecting the status of carbon tax implementation in Indonesia relative to the OECD average:

- Carbon Tax Rate (USD/ton):
  Indonesia introduced a carbon tax with a relatively low rate of approximately USD 2 per ton, significantly below the OECD average of USD 35 per ton. This low price signal is unlikely to influence major shifts in industrial emissions behavior.
- Sectoral Coverage (%):
  As of 2022, the Indonesian carbon tax covered only around 15% of emitting sectors, mainly coal-fired power plants. In contrast, OECD countries have implemented carbon pricing mechanisms that cover up to 80% of emission-intensive sectors, enhancing their environmental impact.
- Carbon Market Readiness (%):
  Indonesia's readiness for a comprehensive carbon market remains limited, estimated at 25%, reflecting early-stage infrastructure and regulatory development. OECD countries demonstrate higher institutional preparedness, averaging 75%, due to mature emissions trading systems and cross-sectoral coordination.

3.1.2 Industrial Response and Behavioral Change

Studies reviewed in this research show that many industrial actors in Indonesia have yet to respond significantly to the carbon tax. With the tax rate set low and its coverage still narrow, most companies perceive the policy as an additional compliance cost rather than a transformative economic signal. Reports from large industrial firms suggest that adaptation efforts are minimal and largely reactive, with little evidence of strategic decarbonization planning [16].

Research from other jurisdictions demonstrates that impactful behavioral shifts occur when carbon pricing is supported by robust regulatory ecosystems and reinforced by complementary measures. Tax levels above US$30 per ton, coupled with subsidies and environmental mandates, have influenced significant changes in production practices [17]. In Indonesia, the lack of integration between fiscal tools

and long-term industrial strategies appears to limit the behavioral impact of the carbon tax.

Some firms with exposure to international markets have initiated steps toward carbon accounting and cleaner technologies. These are typically companies facing pressure from global supply chains or ESG-driven investors. The broader industrial sector, however, has not shown widespread movement toward green transformation, indicating that policy support remains insufficient to stimulate meaningful behavioral change [12].

Table 1. Industry Response to Carbon Tax Implementation in Indonesia

Key Observation	Supporting Source / Context
Limited response from most industrial actors in Indonesia	Indonesia, Literature Review
Carbon tax perceived as compliance cost, not economic signal	Indonesia, Policy Perception
Minimal and reactive adaptation efforts by large firms	Indonesia, Industry Reports
Effective carbon pricing elsewhere requires >US$30/ton + complementary policies	OECD countries, Comparative Research
Indonesia lacks integration between carbon tax and industrial strategies	Indonesia, Policy Analysis
Some international-facing firms started carbon accounting and cleaner tech	Multinational firms, ESG pressures
Most firms show no strategic move toward green transformation	Indonesia, Sector-wide Observations

3.1.3 Investment Trends in Green Technologies

Investment trends indicate that most Indonesian industries have not yet shifted significantly toward green technologies in response to the carbon tax. Financial barriers and low environmental awareness persist, particularly among small and medium-sized enterprises. Industrial production continues to rely on conventional fossil-fuel-based technologies, with little evidence of a structural transition in investment patterns [18].

National data reveal limited uptake of financial mechanisms such as green bonds or sustainability-linked loans among energy-intensive sectors. Strict eligibility criteria, low institutional readiness, and technical complexity contribute to the underutilization of these tools [19]. Without accessible financial incentives or clear regulatory direction, firms often lack the motivation or resources to pursue cleaner technologies.

In certain segments, including renewable energy and export-oriented manufacturing, a gradual shift toward low-emission practices is emerging. These trends are influenced by international regulations, buyer standards, and reputational concerns. Yet this momentum remains isolated and has not translated into broader structural changes across Indonesia's industrial base.

3.1.4 Policy Synergies and Institutional Constraints

A review of policy literature reveals that carbon taxes achieve greater effectiveness when integrated with broader environmental and industrial strategies. Successful models in other countries have combined carbon pricing with innovation support, energy efficiency programs, and sector-specific transition plans [19]. In the Indonesian context, such integration remains limited, and key policies often operate in isolation.

Institutional fragmentation further constrains the effectiveness of carbon taxation. Different ministries and agencies maintain overlapping jurisdictions, with minimal coordination in planning or implementation. Climate-related data systems are underdeveloped, and policy documents often lack operational consistency [20]. As a result, industries face confusion and unpredictability regarding environmental compliance and fiscal responsibilities.

Weak governance at the regional level also undermines policy execution. Capacity gaps in regulatory agencies hinder the enforcement of

monitoring standards, and companies report inconsistent treatment across jurisdictions [21]. Without reliable enforcement, the carbon tax lacks the credibility needed to guide long-term planning and investment decisions in the industrial sector.

3.2 Discussion

3.2.1 Carbon Tax Effectiveness in Developing Country Contexts

In many developing countries, the effectiveness of carbon tax policies is significantly constrained by structural limitations such as institutional fragility, limited market maturity, and insufficient environmental governance. Indonesia's current carbon tax framework demonstrates these issues. The tax rate of approximately USD 2 per ton is not only far below the average rate observed in OECD countries but also too low to create a meaningful economic signal for emissions reduction. This condition aligns with [22] assertion that carbon pricing is unlikely to alter industrial behavior without institutional integrity and supportive regulatory mechanisms.

Carbon taxes in advanced economies are often embedded within a larger climate policy framework that includes well-functioning carbon markets, enforcement systems, and public acceptance. In contrast, Indonesia's fragmented policy architecture and low public awareness diminish the potential impact of the tax [23]. The tax is seen by industries as an administrative formality rather than a transformative tool. Without deeper institutional readiness and multi-stakeholder engagement, the fiscal instrument cannot fulfill its role in catalyzing industrial decarbonization or environmental accountability.

3.2.2 Policy Implementation Gaps and Institutional Constraints

The implementation challenges associated with Indonesia's carbon tax reveal a misalignment between policy design and operational capacity. According to [24] model of policy evaluation, effective public policies require coherence between inputs, processes, outputs, and outcomes. In the Indonesian context, the absence of clear sectoral guidelines, weak monitoring infrastructure, and lack of sanctions for non-compliance illustrate a broken feedback loop. Industries lack regulatory certainty, which reduces compliance motivation and undermines policy credibility.

Administrative fragmentation further compounds the issue. Responsibilities related to carbon pricing are split across multiple ministries and agencies without strong coordination mechanisms. This siloed governance undermines strategic alignment and contributes to overlapping, sometimes contradictory, policy instruments [25]. As a result, industries are exposed to regulatory ambiguity, which discourages them from investing in long-term climate strategies or aligning their production systems with low-carbon objectives.

3.2.3 Industrial Behavior and Innovation System Dynamics

The behavioral response of firms to carbon taxation is closely tied to how they interpret the risks and opportunities presented by environmental policy. [26] argue that innovation is likely to emerge when firms perceive consistent and credible regulatory signals. However, the review indicates that many firms in Indonesia view the carbon tax as a weak and temporary intervention, especially due to the absence of long-term pricing signals and limited enforcement. This perception reduces the tax's potential to stimulate innovation in cleaner technologies or processes.

Without a minimum threshold of policy salience, as noted by [27], carbon taxation tends to be absorbed as a cost of doing business rather than a trigger for strategic transformation. The relatively low financial burden imposed by Indonesia's carbon tax fails to shift production incentives or encourage research and development. In such environments, only firms already oriented toward sustainability usually due to external investor pressure or export requirements pursue innovation, leaving most of the domestic industrial base unaffected by the policy [28].

3.2.4 Complementary Instruments and Policy Architecture

Fiscal tools like carbon taxes achieve greater effectiveness when combined with complementary instruments that address structural barriers to low-carbon investment. [29] that supportive policy mechanisms such as green financing, technology subsidies, and public infrastructure are critical to enable firms to transition. In Indonesia, such complementary policies are either weakly implemented or not clearly linked to the carbon tax framework. This fragmentation results in a policy environment where firms lack both the incentive and capacity to shift toward cleaner operations.

Data showing that less than 8% of industrial firms access green finance reflects the disconnection between environmental fiscal tools and financial systems. Carbon pricing alone is insufficient to change investment flows if capital markets do not align with climate objectives. The absence of strong linkages between fiscal policy and industrial strategy creates a gap where the carbon tax floats without institutional support, rendering it ineffective in influencing long-term investment decisions.

3.2.5 Regulatory Legitimacy and Multi-Level Governance

The perceived legitimacy of environmental regulation strongly influences compliance behavior and long-term planning. [13] suggest that firms are more responsive to regulatory frameworks they consider stable, transparent, and aligned with national development goals. In Indonesia, the carbon tax lacks legitimacy in the eyes of many industrial actors. Regulatory ambiguity, shifting implementation timelines, and limited stakeholder consultation have eroded trust in the policy's durability and intent.

Multi-level governance issues further weaken the regulatory landscape. Climate-related responsibilities are dispersed across central and regional authorities, often leading to inconsistent enforcement. This undermines vertical coordination and causes firms to encounter different regulatory expectations depending on their geographic location [30]. Such inconsistencies not only discourage compliance but also obscure the cost-benefit analysis firms must perform when considering investments in emissions reduction or clean technology.

3.2.6 Research Gaps and Theoretical Contributions

The review reveals a critical lack of empirical studies on the firm-level impact of carbon taxation in Indonesia, particularly in terms of operational changes, investment behavior, and technological adaptation. Most available literature relies on macroeconomic simulations or international comparisons that do not account for Indonesia's unique institutional, political, and industrial characteristics. This absence of context-specific evidence limits both academic understanding and policy design.

Theoretically, this study contributes to expanding environmental fiscal policy analysis by integrating institutional and behavioral dimensions into the discussion of carbon taxation. The Indonesian case illustrates the importance of aligning fiscal tools with institutional readiness, financial access, and innovation capacity. These insights offer valuable input for refining carbon pricing frameworks in other developing countries facing similar structural limitations. The study encourages scholars and policymakers to develop more grounded, interdisciplinary approaches to climate-related fiscal instruments.

4. Conclusion

This study concludes that the current implementation of carbon tax policy in Indonesia remains insufficient to catalyze significant industrial transformation toward environmentally friendly practices. The tax rate is too low to create a strong economic disincentive for emissions, and the policy is constrained by limited sectoral coverage, weak institutional coordination, and a lack of integration with complementary instruments such as green finance and industrial incentives. As a result, most industries perceive the carbon tax as a compliance obligation rather than a strategic driver for innovation or investment in clean technologies.

Theoretically, the findings reaffirm the importance of aligning fiscal instruments with regulatory credibility, institutional readiness, and supportive

policy ecosystems. Carbon tax policies in developing countries must be accompanied by coherent governance frameworks, stakeholder engagement, and long-term regulatory signals to influence behavior and investment effectively. This study contributes to the growing literature by offering context-specific insights into the limitations and requirements of carbon pricing in structurally constrained economies like Indonesia.

4.1 Limitations

This study is limited by its exclusive reliance on secondary sources through a literature review methodology. While this approach enables a comprehensive synthesis of existing knowledge, it does not capture real-time, firm-level behavioral data from industries directly affected by the carbon tax policy. The absence of primary empirical data restricts the analysis from fully assessing the micro-level dynamics of policy implementation and industry response within Indonesia's diverse industrial sectors.

Another limitation is the temporal scope of the reviewed literature, which focuses primarily on the early phase of Indonesia's carbon tax implementation (2022–2024). Given that carbon pricing impacts often unfold over the long term, this study may not reflect delayed behavioral or investment responses that could emerge in future years. Additionally, comparisons with OECD countries, while useful, may be constrained by institutional and economic differences that limit direct generalizability.

4.2 Research Implications

The findings of this study suggest that future research should prioritize empirical investigations into how individual firms and sectors respond to carbon taxation in Indonesia. Field-based studies involving interviews, surveys, or case studies can offer granular insights into decision-making processes, risk perceptions, and technological adaptation under carbon pricing regimes. Such studies will enrich the understanding of practical barriers and enablers within industrial contexts.

Interdisciplinary research that bridges environmental economics, industrial policy, and institutional analysis is needed to explore the interaction between fiscal instruments and governance systems. Exploring the co-evolution of carbon taxation with financial innovation, labor transitions, and market incentives will provide a more comprehensive framework for designing effective climate fiscal policies. These insights will be valuable for policymakers not only in Indonesia, but also in other developing economies navigating similar climate-industry trade-offs.

4.3 Research Suggestions

Future research should focus on empirical investigations at the firm level to capture how different industries in Indonesia adapt to carbon tax policies, particularly in terms of technological investments, compliance strategies, and operational shifts. Studies that include regional comparisons will be important to uncover variations in regulatory enforcement and industrial capacity across provinces. Researchers are also encouraged to examine the interaction between carbon taxation and other policy instruments, such as renewable energy subsidies and green financing access, to assess their combined influence on industrial decarbonization. Cross-country comparisons with other developing economies in Southeast Asia can provide broader policy insights, while longitudinal studies are needed to track the long-term behavioral and institutional effects of carbon pricing beyond its initial implementation phase.

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