



Tax policy and green sukuk in closing the sustainable finance gap

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ABSTRACT

Background: Indonesia faces a significant climate financing gap, while existing fiscal instruments have not yet produced consistent reductions in financing costs or clearly measurable environmental outcomes. This study aims to propose an integrated mechanism that links environmental tax revenues with green sukuk, drawing on insights from the literature on green bond governance, risk-premium theory, climate budget tagging, and outcome-based budgeting to address persistent issues of project readiness, investor risk perception, and impact verification. **Methods:** The study applies a descriptive-analytical approach supported by quantitative modeling using 2018–2024 historical data on carbon tax potential, green sukuk yields, issuance volume, and selected outcome indicators, complemented by a theoretical review of the above frameworks. **Findings:** The analysis indicates that allocating 0.5–1% of environmental tax revenue into a Green Financing Reserve can reduce perceived risk, potentially lowering yields by 10–25 basis points and expanding issuance capacity, while improving project execution through milestone-based disbursement. This pattern is consistent with the theory that credible risk buffers and verifiable outcomes can compress risk premia and strengthen the causal chain from earmarked revenue to financing efficiency and environmental results (e.g., emission reduction and renewable energy deployment). **Conclusion:** The Carbon Tax-Backed Green Bond Enhancement Model offers a fiscally disciplined and outcome-oriented framework to enhance both the affordability and effectiveness of green sukuk as a climate financing instrument. **Novelty/Originality of this article:** This article introduces an integrated model that systematically links carbon tax revenues with sovereign green sukuk risk mitigation through a dedicated fiscal reserve aligned with syariah governance, offering a replicable and evidence-based mechanism for narrowing national climate financing gaps.

KEYWORDS: carbon tax; green financing; green sukuk.

1. Introduction

Climate change has become a systemic and multidimensional challenge for climate-vulnerable countries, including Indonesia. As global temperatures continue to rise beyond the planetary safe threshold, the economic, social, and environmental risks they pose are also increasing (IPCC, 2023). In Indonesia, these risks manifest in various forms, such as sea-level rise threatening densely populated coastal areas, extreme weather events disrupting agricultural production, and biodiversity loss weakening ecosystem services that support livelihoods and food security. Addressing these interconnected risks requires substantial and sustained investment in both mitigation and adaptation. The Ministry of Finance estimates that Indonesia will need approximately IDR 4,000 trillion in climate finance by 2030 to achieve its Nationally Determined Contribution (NDC) and long-term

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climate strategy (Ministry of Finance of the Republic of Indonesia, 2023). However, Indonesia still has structurally limited fiscal space. Public financing is projected to cover only around 10–15% of the total needs, leaving a gap that must be mobilized from private and other non-budgetary sources (OECD, 2023). Therefore, the climate finance gap poses a significant challenge to integrating fiscal policy, financial market mechanisms, and environmental objectives into a coherent financing framework.

To address this gap, Indonesia has begun developing fiscal regulations for sustainable finance. Presidential Regulations No. 98 of 2021 concerning the Economic Value of Carbon introduces a range of carbon pricing mechanisms, including a carbon market, an emissions trading system, results-based payments, and a carbon tax. This, coupled with Law No. 7 of 2021 concerning the Harmonization of Tax Regulations, officially mandates the introduction of a carbon tax to internalize the negative externalities of emissions-intensive activities. These two instruments position carbon pricing as a key pillar of Indonesia's climate policy, aligning with the global economic framework. It recognizes carbon pricing as an efficient tool to drive decarbonization and change market behavior (High-Level Commission on Carbon Prices, 2017). Meanwhile, alongside fiscal reforms, Indonesia is actively utilizing Islamic sustainable finance instruments, particularly government green sukuk. Since its inaugural issuance in 2018, Indonesia has become one of the world's leading sovereign green sukuk issuers, attracting significant interest from ESG-aligned domestic and global investors (Climate Bonds Initiative, 2024). Green sukuk have two objectives: mobilizing capital for climate-resilient projects while remaining compliant with Sharia law and deepening the Islamic financial market. In principle, these instruments can act as a bridge between the global sustainable finance agenda and the ethical foundations of Islamic finance, ultimately enhancing financial inclusion and climate ambition.

Despite this progress, several challenges remain, indicating that Indonesia's current sustainable finance architecture remains unsound. Market performance indicators show that the expected returns, or greenium, from government green bonds are inconsistent, suggesting that investor perceptions of risk reduction have not yet been fully realized (Bachelet et al., 2019; Löffler et al., 2021). In some issuances, green sukuk are priced close to or even above conventional benchmarks, indicating that climate-related and implementation risks are still perceived as significant. At the same time, impact reporting practices are largely *ex ante*, meaning they focus on projected outcomes rather than verified results, thus limiting investor confidence in the measurable environmental performance of financed projects (OECD, 2022). This situation reflects broad structural constraints within Indonesia's climate finance ecosystem. These stem from fragmented coordination between fiscal authorities, financial regulators, and Sharia governance institutions. The pool of eligible, ready-to-implement green projects is often lacking, while mechanisms for credible results-based verification are still developing. As a result, regulatory and financial instruments exist, but systemic capacity to close the financing gap and translate commitments into verifiable climate outcomes remains hampered. This gap between institutional design and implementation on the ground raises an important question, how can fiscal and financial instruments be more closely integrated to reinforce each other.

The growing international literature on sustainable finance often examines the roles of carbon taxes or pricing and green bonds in mobilizing climate finance as largely parallel. Studies on carbon pricing emphasize its ability to generate revenue and reshape incentives, while discussions on how carbon pricing revenues are used tend to focus on revenue recycling, fund allocation, or integration into broader fiscal packages, rather than on explicit design linkages with sovereign debt instruments (Marten & Vender, 2019; Black et al., 2022). In contrast, research on green bonds (including green sukuk) typically focuses on pricing dynamics, investor demand, and governance mechanisms such as rules on the use of proceeds, impact reporting, and the role of external review or second-party opinion in reducing information asymmetries (Cortellini & Panetta, 2021; ICMA, 2021; Dorfleitner et al., 2022). Overall, this implies relatively few references that treat environmental tax policies and green debt instruments as a single, mutually reinforcing framework, particularly in the context of emerging markets and Islamic finance.

Against this backdrop, Indonesia offers a particularly relevant case. Indonesia is a pioneer in sovereign green sukuk, with a Green Bond/Sukuk framework launched in 2018 and publicly described as the first sovereign green sukuk issuer, along with a well-established approach to climate budget tagging and annual allocation/impact reporting. At the same time, Indonesia has also formalized carbon pricing instruments through a carbon economic value framework and a legal basis for a carbon tax, placing Indonesia among countries developing carbon pricing policies while expanding sustainable debt markets. However, existing arrangements for green sukuk governance emphasize identifying eligible expenditures, managing proceeds in the government's general account, and reporting. While carbon pricing instruments are typically managed through separate fiscal policy channels, there is room for an integrated framework that regularly links carbon tax revenues to the structure and performance of sovereign green sukuk (Marten & Vender, 2019).

In response to this gap, this paper proposes a Carbon Tax-Backed Green Bond Enhancement Model, conceptualized as an integrated fiscal-financial mechanism that explicitly links environmental taxes, particularly carbon tax revenues, to the issuance and performance of government green sukuk. The core hypothesis is that allocating a small portion of environmental tax revenues as a risk-buffer reserve can boost investor confidence and reduce perceived risk. A reserve equivalent to 0.5–1.0% of annual carbon or environmental tax revenues is expected to function as a partial credit enhancement, allowing for a reduction in yield spreads by approximately 10–25 basis points, in line with empirical evidence on collateral structures and green bond markets (Chen et al., 2023; Cheng, 2024). Over time, this cost reduction could generate a reinforcing cycle where lower issuance costs enable larger sukuk volumes, which finance additional climate projects, which in turn strengthen compliance incentives and broaden the environmental tax base, thus creating a policy-finance driver. The proposed model's distinctive feature is its emphasis on results-based budgeting and verification. Each sukuk issuance backed by fiscal reserves is required to demonstrate independently verified climate performance indicators, shifting the classification of green sukuk from commitment-driven instruments to measurable climate impact instruments. This approach aligns with emerging standards in sustainable finance that emphasize post-issuance verification, lifecycle emissions accounting, and transparent proceeds-use frameworks (Islamic Financial Services Board, 2023; The Green Bond Principles, 2024). By embedding these principles into fiscal allocations and financing structures, this model can strengthen the causal chain linking tax collection, financing efficiency, and environmental outcomes.

Therefore, this study has three main objectives. First, it maps the performance and limitations of the current scale of Indonesian government green sukuk within the broader climate finance landscape. Second, it compares international experience with fiscal incentives and governance arrangements for green debt instruments, focusing on lessons relevant to emerging markets and Islamic finance. Third, it develops and illustrates the Carbon Tax-Backed Green Bond Enhancement Model as a conceptual framework for aligning environmental tax revenues with risk mitigation in government green sukuk. The primary research question guiding this analysis is the extent to which allocating carbon tax revenues as fiscal reserves for government green sukuk can reduce financing costs and improve verifiable environmental outcomes in Indonesia's sustainable finance ecosystem. By answering this question, this paper contributes to the discourse on integrated sustainable finance architecture in countries vulnerable to climate change. The study also positions green sukuk and environmental taxes as components of a broader public finance system that transforms environmental externalities into long-term public value. Therefore, this research aims to generate policy-relevant insights for Indonesia and other developing countries seeking fiscally disciplined, Sharia-compliant, and results-oriented pathways to closing their climate finance gaps.

2. Methods

2.1 Research design

This study employs a qualitative approach with a descriptive design to assess the feasibility and policy logic of the Carbon Tax-Backed Green Bond Enhancement Model. This approach is particularly suitable for exploring complex policy frameworks that require in-depth contextual interpretation rather than numerical measurement. The research focuses on reconstructing policy design, institutional responsibilities, and implementation pathways using document-based analysis (Bowen, 2009).

2.2 Case study context

Indonesia is selected as the case study, representing an instrumental policy context observed during the period 2018–2024. This selection is based on the country's active development of sustainable finance instruments and evolving regulatory framework in climate policy. This timeframe captures the full trajectory of the government's green sukuk issuance since 2018 as well as the formative stage of the national carbon pricing agenda.

2.3 Data sources and selection criteria

The study relies entirely on secondary data derived from four main categories of documents, namely laws and regulations related to carbon pricing and environmental taxation, government green sukuk documents (including frameworks, issuance summaries, and impact/allocation reports), climate-related public finance documents such as Climate Budget Tagging, as well as international analytical reports used for triangulation and contextual analysis. Documents were selected based on the following criteria: relevance to the research objectives, clarity of institutional roles and processes, coverage within the 2018–2024 period, and sufficient detail to meet qualitative research standards (Creswell & Poth, 2017).

2.4 Data analysis procedure

The analysis follows three main steps. First, policy mapping is conducted to describe existing arrangements for carbon pricing and green sukuk. Second, a structured gap analysis is performed by comparing current practices with governance principles and recurring issues identified in the literature on sustainable finance and carbon pricing. Third, the findings are synthesized into a proposed integrated mechanism, including the specification of fiscal flows linking environmental revenues to green sukuk performance.

2.5 Validity, reliability, and limitations

To enhance the credibility of the analysis, this study applies triangulation across multiple document types and sources, including laws and regulations, fiscal documents, green sukuk reports, and international references. This approach helps ensure the consistency and reliability of the findings. However, this study is limited by its reliance on document-based analysis, which cannot substitute for empirical implementation evidence. Therefore, the findings are framed as design feasibility and should be further validated through pilot implementation and evaluation once the proposed mechanism is operational (Yin, 2018).

3. Results and Discussion

3.1 Market performance and scaling limitations of Indonesia's green sukuk

Indonesia's green sukuk program was first launched in March 2018, marking a sustained policy commitment to increasing Sharia-compliant climate finance. By 2023, cumulative green sukuk issuance reached USD 6.9 billion, as reported in the Government's Allocation and Impact Report (Ministry of Finance Republic of Indonesia, 2023). Indonesia also returned to the market with a 5-year and 10-year global green sukuk, opening up market access and sustained investor demand (Bank Indonesia, 2024). However, despite this track record of repeated issuances, the scale of these instruments remains modest compared to the country's estimated climate mitigation financing needs of IDR 4,002.44 trillion for 2018–2030 (equivalent to an average of IDR 307.88 trillion per year), while central government spending on climate during 2016–2023 was reported at only IDR 607 trillion (an average of IDR 75.9 trillion per year). This means the state budget only covers approximately 12.3% of the annual mitigation funding requirement. This large gap suggests that green sukuk are unlikely to be the sole solution.

Although Indonesia's green sukuk program has steadily expanded, the often-anticipated benefits of thematic government bond issuance have been inconsistent in practice. First, a frequently cited indicator is greenium, where some investors accept slightly lower yields in exchange for environmental preferences and reputational value. However, empirical research shows that any premium is typically small and depends heavily on the credibility, verifiability, and characteristics of the issuer (Bachelet et al., 2019; Zerbib, 2019). In green sukuk, pricing can also reflect perceived risks, including reputational and environmental factors, making direct comparisons with non-green instruments difficult (Sasongko & Sakti, 2020). As a result, yields can remain sensitive to broader market conditions and investor risk appetite rather than reliably providing cheaper funding year after year (Bank Indonesia, 2024).

Second, there is the closely related issue of translating allocations into implementable and verifiable projects. Proceed utilization instruments depend on credible and bankable workflows. In Indonesia's sustainable finance landscape, the limited availability of bankable projects has been repeatedly cited as a practical obstacle limiting effective allocation (IESR, 2022). At the same time, government green sukuk proceeds are embedded in public financial management and multi-actor coordination, leading to delays and uneven reporting quality. Research highlights that weak inter-ministerial coordination can slow impact reporting and erode investor confidence, while capacity constraints at the subnational level can weaken realized impact relative to expectations (Mujizat, 2021). These challenges are compounded by inherent compliance and disclosure burdens, which emphasize that issuers must provide updated proceed utilization information and update reporting annually until allocations are fully utilized, coupled with robust tracking systems (ICMA, 2021). In line with this, green sukuk guidelines note that transparency and impact reporting can be challenging when systems and resources are limited. Ultimately the impacts appear more like expectations because they cannot be measured in the initial implementation cycle (UNDP, 2024).

The third challenge relates to accountability and impact verification. In the thematic bond market, impact reporting often begins with ex ante estimates because compiling verified ex post results requires additional data systems and can be resource-intensive, particularly when the results span multiple sectors and implementing agencies (Asian Development Bank, 2021). Indonesia's green sukuk reporting reflects a broader pattern where official disclosures present environmental and social impact projections accompanied by limited assurance, which can strengthen confidence in the reporting process (Bank Indonesia, 2024). However, this does not always resolve uncertainty about realized outcomes. Consistent with this, the Indonesian Green Bond and Green Sukuk Framework positions impact reporting as an estimation exercise and emphasizes that early-

cycle impact claims can be tentative until performance data matures (CICERO, 2018). This challenge is compounded by the fact that methodologies (baselines, attribution rules, time horizons, and assumptions) and indicator availability vary across sectors. As a result, the depth of verification and comparison can be uneven unless the assumptions and calculation approaches are clearly and consistently disclosed (ICMA, 2021).

Finally, a structural gap remains between environmental fiscal instruments and green finance instruments. Indonesia's carbon pricing architecture, under Presidential Regulation No. 98 of 2021 and carbon tax provisions under Law No. 7 of 2021, establishes the legal basis for carbon economic value instruments and allows carbon tax revenues to be allocated to climate change mitigation, but does not create a rules-based fiscal transfer or dedicated reserve that automatically supports government green sukuk. International evidence shows that revenue use constraints and allocation practices vary widely across jurisdictions, with the credibility of revenue recycling highly dependent on governance clarity and transparency (Marten & Vender, 2019; World Bank, 2024). Without clear fiscal guarantees or formal risk-sharing rules, green sukuk pricing is likely to remain driven primarily by broader sovereign risk and global interest rate conditions, limiting the ability of these instruments to deliver stable, impact-linked financing returns over time.

Overall, these findings suggest that scaling up green sukuk, in addition to increasing issuance, also requires strengthening the design linking fiscal policy, project implementation, and market confidence. Cross-country evidence suggests that governments apply varying degrees of restrictions and allocations to carbon pricing revenues. Transparent, rules-based allocation of funds used to build moderate fiscal reserves can make policy commitments more credible and provide investors with a visible buffer, thereby reducing perceived risk and supporting more stable pricing (World Bank, 2024). On the expenditure side, outcomes can be aligned with performance-based budgeting, that is, systematically using performance information to inform budget decisions. This is consistent with the results-linked financing approach, which disburses funds based on achieved results rather than intentions. Combined, small fiscal supports can narrow the gap between projected and realized impacts while enabling larger issuances without relying solely on headline volumes.

3.2 International benchmarking of fiscal and governance instruments for green debt

Comparative experience shows that green finance markets tend to develop more rapidly when issuance barriers are reduced through fiscal support and governance rules that make the green label credible after issuance. Malaysia is one example. Under the Sukuk and SRI Bond Grant Scheme, eligible issuers can claim support that offsets up to 90% of external review costs, capped at RM300,000 per issue. Practically, this is important because external reviews (such as second-party opinions or verification) are often a fixed upfront cost required to ensure the instrument meets SRI/green requirements. When these costs are subsidized, it makes it easier for smaller or first-time issuers to enter the market (MSFI, n.d). Malaysia also complements the grant with a time-limited income tax exemption for grant recipients, further improving the cost calculation for eligible). Importantly, the regulator later expanded the scheme to include SRI-linked sukuk, indicating that incentives and governance can evolve as the market shifts (Securities Commission Malaysia, 2022).

Singapore has taken a different path by basing its sustainability strategy on a predictable carbon pricing pathway and an explicit revenue-use narrative. Singapore's carbon tax was raised to S\$25/tCO_{2e} starting in 2024, is scheduled to rise to S\$45/tCO_{2e} in 2026–2027, and is intended to reach S\$50–80/tCO_{2e} by 2030 (NCCS, n.d). The government also stated that carbon tax revenues will be used to support decarbonization efforts and the transition to a green economy, while mitigating impacts on businesses and households. This framework strengthens policy coherence by linking the price signal (preventing emissions) with practical support for the transition. For investors, this design is important because it

reduces uncertainty about whether carbon pricing is a temporary measure or part of a longer-term transition package.

India's experience highlights a third dimension: credibility and disclosure discipline can influence whether green bonds will survive. When India issued its first government green bond in January 2023, the bond was reportedly priced around 5–6 basis points below comparable conventional government securities, indicating moderate green bonds at the time of issuance (Reuters, 2023). However, research on government green bonds has cautioned that average government green bonds are often small and can be fragile, particularly when market volatility increases or when post-issuance reporting is perceived as weak (Panizza et al., 2025). Therefore, India's framework emphasizes ongoing transparency, including annual updates to allocation reporting until full allocation and a commitment to impact reporting (Department of Economic Affairs India, 2022).

Taken together, the cross-country lessons are quite concrete. First, reduce fixed issuance costs (Malaysia's grant and tax approach). Second, strengthen policy coherence through predictable carbon pricing and credible revenue use (Singapore's revenue use framework, coupled with increased tax rates). Third, protect credibility through consistent post-issuance disclosure and verification (India's framework, coupled with broader evidence that greenium effects can be small and sensitive). For Indonesia, this supports the argument that green sukuk should be embedded in a broader fiscal-financial design where environmental revenues can be used not only as behavioral signals but also as credibility mechanisms, such as reserves and verification capacity, that help the market trust pricing and impacts over time.

3.3 Design of the carbon tax-backed green bond enhancement model

3.3.1. Fiscal policy architecture

The proposed fiscal policy framework is deliberately constructed to integrate environmental taxation, particularly carbon taxation with green financing mechanisms, most notably sovereign green sukuk, within a coherent and unified policy architecture. Rather than treating carbon tax revenues as undifferentiated fiscal inflows, the model conceptualizes these revenues as strategic financial resources that actively support the mobilization of capital for low-carbon development. Under this framework, each unit of revenue generated through carbon taxation performs a dual function, contributing to overall fiscal capacity while simultaneously enhancing the scale, credibility, and effectiveness of sustainability-oriented financing instruments. This approach represents an extended operationalization of Pigouvian taxation, which traditionally emphasizes the use of taxes to internalize negative environmental externalities arising from carbon-intensive economic activities (Pigou, 1920). In contrast to a narrow price-correction perspective, the proposed model embeds carbon taxation within a broader fiscal-financial transmission mechanism. Carbon taxes not only alter relative prices and discourage emissions but also create a predictable and policy-anchored revenue stream that can be leveraged to support long-term investments in renewable energy, climate-resilient infrastructure, and other low-carbon development priorities (High-Level Commission on Carbon Prices, 2017).

By explicitly linking carbon tax revenues to sovereign green sukuk issuance, the model strengthens fiscal signaling and enhances investor confidence through clearer revenue earmarking and improved transparency. This linkage helps mitigate concerns related to greenwashing by demonstrating a rule-based commitment to channeling environmentally motivated tax revenues into verifiable green expenditures (OECD, 2024). Moreover, such integration reduces financing risks by aligning environmental objectives with fiscal credibility and capital market development, thereby lowering the cost of green capital over time. Consequently, the Carbon Tax-Backed Green Bond Enhancement Model reframes fiscal policy and capital market instruments as mutually reinforcing components of a single ecosystem rather than as parallel and disconnected policy domains. Taxation, in this context, evolves from a passive revenue-collection tool into an active catalyst for

sustainable finance, offering a coherent policy pathway for governments seeking to address climate financing gaps while maintaining macroeconomic stability and fiscal discipline.

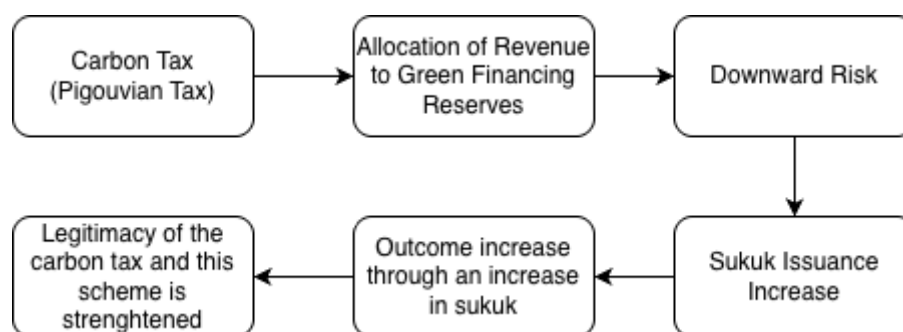


Fig. 1. Carbon tax-backed green bond enhancement model

Fig. 1. Illustrates the operational mechanism underlying the proposed policy model. Revenues generated from carbon taxation are first consolidated within the state budget, after which a limited and pre-defined share is allocated to a Green Financing Reserve (GFR). The GFR is designed as a fiscal policy instrument that supports green financing through targeted risk-mitigation measures, thereby enhancing investor confidence. By embedding a fiscal buffer within the financing structure, the mechanism conveys a clear market signal that a portion of project execution and implementation risk is absorbed by the state. At the same time, the structure remains fully consistent with Islamic finance principles, particularly the prohibition of excessive uncertainty (*gharar*) and interest-based returns (*riba*) (IFSB, 2009).

Pigouvian-based carbon taxation constitutes the primary funding source within this cycle. The instrument serves two interrelated functions: first, it internalizes environmental externalities by assigning an explicit price to carbon emissions, and second, it provides a stable and predictable fiscal resource to support the broader energy-transition agenda (World Bank, n.d.). A modest proportion of total carbon tax revenues illustratively between 0.5 and 1.0 percent is channeled into the GFR through a targeted earmarking mechanism that is explicitly linked to outcome-based objectives. Crucially, this allocation is not intended to operate as a permanent subsidy. Instead, it functions as a catalytic fiscal intervention aimed at enhancing the credibility, bankability, and market acceptance of green sukuk and related sustainable finance instruments.

From the perspective of risk premium theory, investors demand higher expected returns to compensate for assets perceived as riskier (Keynes, 1936; Hayes, 2025). When the GFR provides partial protection against implementation risks and market volatility associated with green projects, perceived risk declines. This reduction is expected to translate into lower sukuk yields or narrower greenium spreads, which have historically been volatile due to uncertainties surrounding policy consistency and project delivery. Empirical evidence from global green bond markets suggests that fiscal guarantees and credit-enhancement mechanisms can reduce risk premiums by approximately 8–30 basis points, depending on the issuing government's credibility and the maturity of the project pipeline (Climate Bonds Initiative, 2025).

By lowering capital costs, the Carbon Tax-Backed Green Bond Enhancement Model improves fiscal efficiency and expands access to financing for projects classified under the Climate Budget Tagging (CBT) framework. In this context, CBT functions as an institutional bridge linking fiscal policy, national development planning, and green financing instruments. As a result, taxation, financing, and planning frameworks no longer operate as fragmented policy domains but are structurally integrated into a single implementation ecosystem (OECD, 2021). This integration ensures that the growth of green finance is anchored not only in capital-market issuance but also in project-level execution that

delivers verifiable environmental outcomes, including emissions reductions, renewable energy deployment, ecosystem conservation, and enhanced climate resilience.

Over time, as these outcomes become increasingly measurable, the model strengthens the political and fiscal legitimacy of maintaining carbon taxation and scaling up green financing mechanisms. Such legitimacy is essential, as environmental tax regimes frequently encounter public resistance when tangible benefits are not clearly visible (High-Level Commission on Carbon Prices, 2017). In this respect, implementation outcomes emerge as a central determinant of the model's long-term viability. The feedback loop embedded in the Carbon Tax-Backed Green Bond Enhancement Model reinforces public, regulatory, and investor support for carbon taxation while simultaneously consolidating market confidence in green sukuk as a credible and impactful financing instrument.

3.3.2. Institutional architecture ensuring fiscal and shariah alignment

The effective operationalization of the Carbon Tax-Backed Green Bond Enhancement Model is fundamentally dependent on the establishment of an integrated institutional architecture capable of synchronizing fiscal policy instruments, sustainable finance mechanisms, and Shariah governance. Such an architecture is critical to ensure that carbon-pricing revenues are not only mobilized efficiently but also allocated transparently and accountably to green financing instruments particularly sovereign green sukuk while preserving fiscal discipline and adherence to Islamic legal and ethical principles. Existing literature emphasizes that climate-related fiscal instruments tend to underperform when revenue mobilization and expenditure allocation are institutionally disconnected, underscoring the importance of coordinated governance arrangements (OECD, 2021; World Bank, 2021).

To address this challenge, the model proposes a multi-layered governance framework that clearly distinguishes between strategic oversight and operational execution, while embedding accountability mechanisms across all levels of implementation. At the strategic level, a high-level Steering Committee functions as the apex policy body responsible for defining the overarching direction of the mechanism. Its mandates include setting annual green sukuk issuance targets, determining the ceiling of the Green Financing Reserve (GFR), and identifying priority investment sectors. These strategic decisions are explicitly aligned with Indonesia's Nationally Determined Contributions (NDC), the National Long-Term Development Plan (RPJPN), and the Medium-Term National Development Plan (RPJMN), thereby ensuring consistency between climate commitments, development planning, and fiscal strategy (Bappenas, 2020; UNFCCC, 2022). Through cross-ministerial coordination particularly among the Ministry of Finance, the Ministry of Environment and Forestry, the national development planning agency, and sectoral ministries overseeing mitigation and adaptation programs the Steering Committee plays a central role in preventing policy fragmentation and maintaining alignment between carbon tax revenue flows and green sukuk issuance pathways.

At the operational tier, the Directorate General of Budget Financing and Risk Management (DJPPR) and the Directorate General of Treasury (DJPb) act as the principal implementing institutions translating strategic guidance into executable fiscal and financial operations. DJPPR is responsible for structuring and issuing green sukuk, integrating GFR-backed risk-mitigation features into the instrument design, and managing investor communication to enhance transparency and market confidence. DJPb complements this role by managing cash flows, formally recording the GFR within fiscal accounts, and ensuring that disbursements to line ministries adhere to performance-based allocation criteria. Such arrangements are consistent with best practices in results-based public financial management, which emphasize linking budget execution to measurable outcomes (Caselli et al., 2024). Technical ministries and implementing agencies execute projects financed under the Climate Budget Tagging (CBT) framework, ensuring that financial flows are directly connected to verifiable climate outcomes. Disbursements are tied to predefined

milestones and performance indicators, reducing the risks of inefficiency, misallocation, and fiscal leakage.

Governance integrity within the model is further reinforced through dual and complementary accountability mechanisms. On one hand, a Shariah Supervisory Board provides continuous oversight to ensure that all financing structures, contractual arrangements, and cash-flow mechanisms comply with Shariah principles, including clarity of risk-sharing, avoidance of interest-based elements (*riba*), and the minimization of excessive uncertainty (*gharar*). On the other hand, independent environmental verification bodies are tasked with validating emissions-reduction claims, assessing climate performance, and confirming alignment with recognized green taxonomies. These verifiers ranging from accredited audit firms to research institutions operate under standardized methodologies and disclosure requirements, which are widely recognized as essential for maintaining the credibility of sustainable finance instruments (Climate Bonds Initiative, 2024). Beyond formal institutional controls, the model deliberately incorporates external oversight through the involvement of civil society organizations, non-governmental organizations, and academic institutions as independent watchdogs and knowledge partners. Their engagement in scrutinizing project selection processes, monitoring implementation reports, and evaluating the use of GFR resources contributes to mitigating greenwashing risks and strengthening transparency. Prior studies indicate that such participatory oversight mechanisms enhance the social legitimacy of environmental fiscal policies, particularly in contexts where carbon taxation faces political resistance (High-Level Commission on Carbon Prices, 2017)

Taken together, the institutional architecture outlined conceptually elaborated in the appendices of this study demonstrates that effective governance extends beyond regulatory enforcement alone. It requires the construction of durable institutional arrangements that integrate fiscal prudence, Shariah accountability, and rigorous climate-performance verification within a single, coordinated framework. When these elements function in synergy, the Carbon Tax-Backed Green Bond Enhancement Model emerges as a financially viable, socially endorsed, and institutionally resilient policy instrument, an essential precondition for scaling sustainable public financing and supporting Indonesia's long-term transition toward a low-carbon, climate-resilient economy.

3.4. Policy implications for Indonesia's climate-finance architecture

The analysis yields several substantive implications for the design and implementation of Indonesia's fiscal and financial policies in the context of climate transition. First, the findings indicate that carbon tax policy should be explicitly linked to green financing objectives. Rather than treating carbon tax revenues as fully fungible fiscal resources, policymakers could allocate a modest and clearly defined share to a Green Financing Reserve (GFR). Such earmarking would serve a dual purpose: it would provide a visible and politically communicable narrative namely, that carbon pricing revenues are directly recycled into climate solutions while simultaneously enhancing the credibility of both the carbon tax and sovereign green sukuk among investors and the broader public (OECD, 2021; World Bank, 2021). Empirical studies suggest that public acceptance of environmental taxes increases when revenue use is transparent and demonstrably aligned with environmental objectives (High-Level Commission on Carbon Prices, 2017).

Second, the proposed model underscores the importance of moving beyond a project-by-project financing logic toward a more systemic and portfolio-based architecture. Green sukuk issuance should be embedded within a medium- to long-term portfolio strategy, in which the GFR supports multiple issuances over time and is calibrated to the aggregate risk profile of the green project pipeline rather than to individual projects. This portfolio-based approach allows the government to deploy its fiscal space more efficiently, reducing reliance on full guarantees while still delivering meaningful risk mitigation. By spreading risk across a diversified set of projects, the model improves fiscal efficiency and enhances

the scalability of green sukuk as a recurring financing instrument rather than an ad hoc policy tool.

Third, the analysis highlights the central role of outcome-based budgeting and robust verification frameworks. Strengthening ex post impact verification, standardizing climate-performance indicators across sectors, and integrating these requirements into budget execution rules would help close the persistent gap between projected and realized climate impacts. Over time, the accumulation of verified performance data would reduce information asymmetry between issuers and investors, a factor that has been identified as a key constraint in green bond pricing (Climate Bonds Initiative, 2024). A credible track record of delivered outcomes is likely to support more favorable pricing conditions in the sukuk market, reinforcing the stability and persistence of greenium effects.

Fourth, the findings emphasize the strategic value of regional and international cooperation. Indonesia is well positioned to leverage its growing leadership in Islamic green finance to promote shared standards, co-financing arrangements, and structured knowledge exchange within ASEAN and across the wider Global South. Collaborative initiatives such as the development of regional green taxonomies, joint verification platforms, or co-guarantee mechanisms can amplify the impact of national policy efforts while broadening the investor base for green sukuk (Asian Development Bank, 2021). Such cooperation also reduces fragmentation in sustainable finance markets and enhances cross-border comparability, which is increasingly valued by institutional investors.

Finally, the model underscores that political economy considerations are integral to the long-term sustainability of reform. For the Carbon Tax-Backed Green Bond Enhancement Model to remain viable, policy reforms must be communicated in a manner that resonates with taxpayers, investors, and affected economic sectors. Clear and consistent narratives demonstrating how carbon tax revenues are recycled into tangible climate and development benefits such as renewable energy deployment, climate-resilient infrastructure, or job creation can help build durable coalitions of support and mitigate resistance to both carbon taxation and green financing reforms (Klenert et al., 2018). In this sense, political legitimacy is not a peripheral concern but a core determinant of the model's durability and scalability.

3.5. Limitations and directions for future research

This study is subject to several limitations that should be acknowledged and that simultaneously point to important avenues for future research. First, the quantitative assessment relies on stylized simulations calibrated using historical data and parameter values drawn from international literature. While such simulations are widely used in early-stage policy analysis to illustrate plausible orders of magnitude, they do not provide precise forecasts of future market outcomes (IMF, 2022; World Bank, 2023). In particular, the estimated effects on sukuk yields and issuance capacity should be interpreted as indicative rather than predictive. Future research could strengthen the empirical foundation of the model by employing more advanced macro-fiscal and financial frameworks, including stochastic modeling and dynamic feedback mechanisms that capture interactions between carbon tax revenues, investor behavior, and broader macroeconomic conditions.

Second, the analysis relies exclusively on secondary data sources and does not incorporate primary evidence from key stakeholders. As a result, the study does not fully capture how the proposed model might be perceived or operationalized by market participants, policymakers, or affected communities. Qualitative methods such as interviews or surveys involving investors, rating agencies, underwriters, project implementers, regulators, and civil-society organizations could provide valuable insights into perceived credibility, risk-sharing preferences, and potential implementation challenges. Prior research suggests that stakeholder perceptions play a critical role in shaping the effectiveness of sustainable finance instruments, particularly in emerging markets (OECD, 2024).

Third, the scope of the analysis is limited to sovereign green sukuk and does not examine in detail how the Carbon Tax-Backed Green Bond Enhancement Model might interact with other segments of the sustainable finance ecosystem. These include subnational green bonds, corporate sukuk, and blended-finance instruments involving multilateral development banks or philanthropic capital. Extending the framework to these domains could help identify complementarities, potential crowding-out effects, and opportunities for scaling climate finance through multi-layered financing structures.

Fourth, important distributional and justice-related considerations fall outside the scope of this paper. While the model is designed to enhance the efficiency and effectiveness of climate financing, it does not explicitly analyze the incidence of carbon taxation or the distribution of benefits generated by green investments. Existing literature highlights that carbon pricing can have uneven impacts across income groups and regions if compensatory mechanisms are not carefully designed (High-Level Commission on Carbon Prices, 2017). Future research could integrate social and spatial equity dimensions by examining how carbon tax revenues and GFR-supported projects are distributed across regions, sectors, and vulnerable populations, thereby aligning the model more closely with principles of just transition.

Finally, the analysis implicitly assumes a relatively stable political and regulatory environment. In practice, climate and fiscal policies are often shaped by shifting political priorities, economic shocks, and external pressures. Such dynamics may affect the durability and credibility of integrated tax-bond architectures over time. Longitudinal studies and cross-country comparative analyses could provide valuable insights into the institutional and political conditions under which similar mechanisms have proven resilient and capable of delivering sustained climate and development outcomes. Despite these limitations, the model presented in this study offers a structured and policy-relevant starting point for rethinking the relationship between carbon taxation and green sukuk. By articulating a clear fiscal-financial transmission mechanism and embedding it within a coherent governance framework, the analysis provides a conceptual and analytical foundation upon which future empirical studies, pilot programs, and policy experiments can build.

4. Conclusions

This study concludes that aligning environmental tax revenues with sovereign green sukuk through the Carbon Tax-Backed Green Bond Enhancement Model offers a coherent, fiscally disciplined, and institutionally feasible pathway for narrowing Indonesia's climate-financing gap. By allocating a small and manageable share of carbon tax receipts to a dedicated Green Financing Reserve, the state can provide targeted risk-mitigation support that lowers perceived credit and implementation risks associated with green investments. In line with risk premium theory, this reduction in perceived risk has the potential to decrease required yields, stabilize greenium dynamics, and expand the issuance capacity of sovereign green sukuk without undermining fiscal sustainability. More broadly, the findings reinforce the view that fiscal instruments and sustainable-finance mechanisms do not operate effectively in isolation. Their impact depends critically on the depth of their structural integration through institutions, rules, and incentive systems. Carbon taxation shapes relative prices and generates public revenues; green sukuk translate policy commitments into mobilized capital, climate budget tagging links financing flows to development planning priorities, and verification systems convert project performance into credible and trusted information. When these components are aligned, they form a policy-finance flywheel in which environmental externalities are progressively transformed into long-term public value rather than short-term fiscal inflows.

From an academic perspective, this paper contributes to the public finance and sustainable finance literature by introducing one of the first frameworks that systematically connects carbon taxation with sovereign green bond credit enhancement in an emerging-market and Islamic finance context. Conceptually, it demonstrates how Pigouvian taxation

principles can be combined with risk premium theory and outcome-based budgeting within a Shariah-compliant institutional architecture. Practically, the model offers a replicable policy blueprint that can be adapted to different national contexts, fiscal capacities, and climate priorities, particularly in countries seeking to deepen sustainable debt markets while maintaining fiscal discipline.

For Indonesia, the Carbon Tax-Backed Green Bond Enhancement Model is not presented as a comprehensive solution to all climate-financing challenges, but rather as a strategic complement to ongoing reforms in carbon pricing, sustainable budgeting, and Islamic finance development. Its effectiveness will ultimately depend on sustained political commitment, strong inter-institutional coordination, and continuous policy learning informed by both domestic experience and international best practices. At the same time, the model holds relevance beyond the Indonesian context. For other emerging economies facing constrained fiscal space, increasing climate risks, and growing interest in sustainable debt instruments, the framework provides a structured starting point for jointly designing tax policy and green bond markets to accelerate low-carbon transitions. In sum, the study argues that the next phase of climate-finance innovation in emerging economies will require moving beyond fragmented and instrument-specific approaches toward integrated, outcome-oriented policy architectures. By linking carbon tax revenues to green sukuk risk mitigation through a dedicated and Shariah-compliant fiscal reserve, Indonesia and its peers can make meaningful progress toward closing climate-financing gaps in a manner that is economically efficient, socially legitimate, and environmentally impactful.

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