EDUCORETAX
Volume 6 No.3, 2026

ALIGNING FISCAL POLICY WITH ESG OBJECTIVES: ENHANCING DOMESTIC BIOMASS UTILIZATION FOR INDONESIA'S ENERGY TRANSITION

Sinar Timur Desipradana [1)*]; Abdul Hakim At Tamimi [2)]

[1)] stdesipradana@gmail.com, Directorate General of Taxes
[2)] abdul0004mbee@gmail.com, Directorate General of Taxes

Abstract
This study examines how fiscal policy can be aligned with Environmental, Social, and Governance (ESG) objectives to strengthen domestic biomass utilization in Indonesia, using palm kernel shells (PKS) as a focal case. Indonesia's power system remains structurally coal-heavy, while biomass use in 2024 was still limited relative to coal consumption; at the same time, PLN's biomass co-firing and REC programs show that transition instruments already exist but remain supplementary rather than system-shaping. Adopting a qualitative, policy-oriented case study design based on documentary analysis, the study compares Indonesia's domestic biomass framework with Japan's policy-backed biomass import regime. The findings suggest that PKS allocation is driven less by physical scarcity than by incentive asymmetry: Japan's FIT-linked biomass certification system creates stable demand and sustainability certainty for imported PKS, while Indonesia's fiscal and tax instruments remain broader, less targeted, and less directly tied to measurable output. The study conceptualizes this gap as ESG–Fiscal Decoupling, referring to the disconnect between sustainability commitments and the fiscal signals needed to change firm-level behavior. It argues that domestic biomass utilization would be strengthened by output-based tax incentives, better certification support, and tighter linkage between fiscal policy and carbon-pricing logic. The contribution of this paper lies in connecting biomass allocation, tax policy, and ESG transition design within a single analytical framework for Indonesia's energy transition.
Keywords*: Biomass Utilization; ESG; Fiscal Policy; Renewable Energy; Tax Incentive*

Abstrak
Studi ini meneliti bagaimana kebijakan fiskal dapat diselaraskan dengan tujuan Lingkungan, Sosial, dan Tata Kelola (ESG) untuk memperkuat pemanfaatan biomassa domestik di Indonesia, dengan menggunakan cangkang inti sawit (PKS) sebagai studi kasus utama. Sistem tenaga listrik Indonesia masih didominasi batubara, sementara penggunaan biomassa pada tahun 2024 masih terbatas relatif terhadap konsumsi batubara; pada saat yang sama, program pembakaran bersama biomassa dan REC PLN menunjukkan bahwa instrumen transisi sudah ada tetapi masih bersifat tambahan dan bukan pembentuk sistem. Dengan mengadopsi desain studi kasus kualitatif yang berorientasi kebijakan berdasarkan analisis dokumen, studi ini membandingkan kerangka biomassa domestik Indonesia dengan rezim impor biomassa yang didukung kebijakan Jepang. Temuan menunjukkan bahwa alokasi PKS lebih didorong oleh asimetri insentif daripada kelangkaan fisik: sistem sertifikasi biomassa yang terkait dengan FIT Jepang menciptakan permintaan yang stabil dan kepastian yang berkelanjutan untuk PKS impor, sementara instrumen fiskal dan pajak Indonesia tetap lebih luas, kurang terarah, dan kurang terkait langsung dengan output yang terukur. Studi ini mengkonseptualisasikan kesenjangan ini sebagai "Pemisahan Fiskal-ESG", yang merujuk pada ketidaksesuaian antara komitmen keberlanjutan dan sinyal fiskal yang dibutuhkan untuk mengubah perilaku di tingkat perusahaan. Studi ini berpendapat bahwa pemanfaatan biomassa domestik akan diperkuat oleh insentif pajak berbasis output, dukungan sertifikasi yang lebih baik, dan keterkaitan yang lebih erat antara kebijakan fiskal dan logika penetapan harga karbon. Kontribusi makalah ini terletak pada menghubungkan alokasi biomassa, kebijakan pajak, dan desain transisi ESG dalam satu kerangka analitis untuk transisi energi Indonesia.
Kata Kunci: ESG, Kebijakan Fiskal, Insentif Pajak, Pemanfaatan Biomassa, Energi Terbarukan

INTRODUCTION

Indonesia is currently at a critical juncture in its energy transition, as it seeks to reconcile ambitious decarbonization targets with its continued reliance on fossil-based energy systems. The government has committed to achieving net-zero emissions by 2060 or earlier; however, the realization of this target remains constrained by structural, financial, and policy-related challenges (International Energy Agency [IEA], 2023; Kementerian Energi dan Sumber Daya Mineral Republik Indonesia [KESDM], 2023; United Nations, 2015). According to the IEA

(2023), fossil fuels still dominate Indonesia's energy mix, while the growth of renewable energy has not been sufficient to meet national targets. Despite these constraints, Indonesia possesses substantial renewable energy potential, particularly in biomass. Biomass is considered one of the most promising renewable energy sources due to its availability, flexibility, and compatibility with existing energy infrastructure (International Renewable Energy Agency [IRENA], 2022; Johnstone et al., 2010).

Among biomass resources, palm kernel shells (PKS), a byproduct of the palm oil industry, represent a particularly relevant case. PKS has a relatively high calorific value and is widely available across Indonesia, making it a viable alternative fuel for power generation, including co-firing in coal-fired power plants (Demirbas, 2009; Food and Agriculture Organization [FAO], 2020; Perusahaan Listrik Negara [PLN], 2021). Rather than being utilized domestically, a significant portion of PKS is exported to international markets, where demand is supported by favorable renewable energy policies and pricing mechanisms (Japan Ministry of Economy, Trade and Industry [METI], 2022; IRENA, 2022).

Recent reporting describes Japan as the main buyer of Indonesian PKS exports, while Japan's biomass market itself is built on policy certainty rather than spot-market pricing alone (CNBC, 2025). METI-linked ISCC Japan FIT documentation explicitly lists PKS and palm trunks as eligible biomass fuels, and the certification system requires lifecycle greenhouse-gas reductions of 50% until FY2029 and 70% from FY2030 onward. In other words, Japan's biomass demand is supported by certification, traceability, and long-term sustainability criteria that make Indonesian PKS commercially attractive.

This export-oriented utilization pattern reflects a broader structural issue in resource allocation. From an economic perspective, producers respond rationally to stronger price signals and more stable demand in international markets. However, from a policy perspective, this outcome indicates a misalignment between national energy objectives and existing economic incentives. The World Bank (2020) highlights that such inefficiencies in developing countries often arise from weak policy coordination and inadequate domestic market incentives. This is consistent with empirical findings that renewable energy deployment is highly dependent on policy credibility and regulatory certainty (Aklin & Urpelainen, 2013; Marques & Fuinhas, 2012).

At the same time, global investment trends are increasingly shaped by Environmental, Social, and Governance (ESG) considerations. ESG frameworks have become central in guiding investment decisions, as investors seek to manage long-term risks associated with climate change and sustainability (Friede et al., 2015; United Nations Principles for Responsible Investment [UN PRI], 2023). Evidence suggests that ESG integration is increasingly linked to corporate financial performance, particularly when ESG factors are material to business strategy (Eccles et al., 2014; Khan et al., 2016). A recent global investor survey by PwC indicates that climate transition and sustainability performance are among the most important factors influencing investment decisions (PricewaterhouseCoopers [PwC], 2024).

In this context, fiscal policy, particularly tax incentives, plays a crucial role in shaping market behavior and investment decisions. Well-designed tax incentives can alter the relative profitability of different economic activities, thereby influencing resource allocation (International Monetary Fund [IMF], 2019; Organisation for Economic Co-operation and Development [OECD], 2020). Studies in energy economics also confirm that economic incentives and policy frameworks significantly influence innovation and investment in renewable energy technologies (Johnstone et al., 2010; Popp, 2002).

In Indonesia, various fiscal incentives have been introduced to support strategic industries, including tax reductions for pioneer sectors. While these policies demonstrate the

government's commitment to promoting investment, they remain largely general in nature and are not specifically designed to address the unique challenges of renewable energy utilization (Kementerian Keuangan Republik Indonesia [Kemenkeu], 2020). In particular, there is limited integration between fiscal incentives and ESG-related performance indicators, reducing their effectiveness in driving sustainable investment (IMF, 2019; OECD, 2020). Recent evidence suggests that tax incentives can play a measurable role in improving corporate ESG performance when properly designed and targeted (Zhang et al., 2025).

This study therefore conceptualizes the problem as ESG–Fiscal Decoupling: sustainability goals exist at the policy level, but the fiscal and market mechanisms are not yet strong enough to translate them into firm-level behavior that favors domestic biomass utilization. Accordingly, the study asks: How can ESG-aligned fiscal incentives be designed to strengthen domestic biomass utilization and support Indonesia's energy transition? By adopting a qualitative and policy-oriented approach, this study contributes to the literature by integrating ESG frameworks with fiscal policy design and offering practical policy recommendations for improving renewable energy utilization in developing economies (Creswell, 2014; Yin, 2018).

LITERATURE REVIEW

ESG and Sustainable Investment

Environmental, Social, and Governance (ESG) has become a central framework for evaluating corporate sustainability and guiding investment decisions. In practice, ESG extends financial analysis beyond short-term returns by incorporating non-financial risks and opportunities related to environmental impact, social responsibility, and governance quality. The UN PRI emphasizes that ESG integration improves investment quality and supports more sustainable financial markets, while the World Economic Forum similarly frames ESG as an increasingly important lens for aligning capital with long-term climate and development goals (UN PRI, 2023; World Economic Forum [WEF], 2020).

Empirical literature strongly supports the economic relevance of ESG integration. Friede et al. (2015) in a meta-analysis of more than 2,000 studies finds that roughly 90% report a non-negative ESG–financial performance relation. Eccles et al. (2014). likewise show that firms with stronger sustainability orientation tend to develop distinct organizational processes and better performance outcomes over time. Khan et al. (2016) further show that sustainability becomes financially meaningful when it is material to the firm's business model rather than merely symbolic. Taken together, these studies suggest that ESG is most effective when sustainability is embedded in strategic and decision-making structures rather than treated as a reputational add-on. In addition, WEF (2020) highlights that ESG frameworks play a crucial role in aligning capital flows with sustainable development goals, particularly in the context of climate change mitigation and energy transition.

Environmental Fiscal Policy and Tax Incentives

The theoretical foundation of environmental fiscal policy is anchored in the concept of externalities, where market mechanisms inherently fail to reflect the true social costs of economic activity. To address this market failure, Pigou (1920) introduced the concept of taxation, subsequently known as Pigouvian taxes, to internalize negative externalities such as pollution. This foundational premise remains critical today; recent OECD tax-policy research emphasizes the urgency of environmental tax reform, noting that polluting fuels remain chronically underpriced relative to the climate damage they inflict.

Building upon this baseline, modern policy frameworks from the IMF and OECD advocate for blending taxation with targeted fiscal incentives to drive environmentally beneficial investments. To successfully correct externalities, these fiscal instruments require

rigorous design: they must be sector-specific, transparent, predictable, and directly tied to measurable environmental outcomes (OECD, 2020; World Bank, 2022).

Nevertheless, policy literature consistently warns that poorly structured incentives can induce market distortions rather than resolve them. The IMF (2019) observes that overly broad or untargeted incentives tend to generate superficial behavioral shifts, where corporate economic decisions are driven by subsidy structures rather than underlying production efficiency or genuine sustainability. Empirical research further underscores this dynamic, demonstrating that renewable energy policy instruments influence market outcomes differently depending entirely on their design and institutional context (Marques & Fuinhas, 2012). Ultimately, while environmental fiscal policy is an essential tool for correcting market failures, the meticulous design of that policy is the decisive factor in its success.

Biomass Utilization and Energy Transition in Indonesia

Biomass is globally recognized as a cornerstone of renewable energy strategies due to its dispatchability and compatibility with existing thermal infrastructure (IEA, 2022; Demirbas, 2009). Indonesia sits at the heart of this potential through its palm oil industry. According to USDA projections, Indonesia's CPO production is expected to rise to 47 million tons in the 2025/26 marketing year, up from 45.5 million tons in 2024/25 (Palm Oil Magazine, 2025). Applying the established residue ratio where 45 million tons of CPO generates approximately 12 million tons of palm kernel shells (PKS) (Handaya et. al., 2022), the national PKS availability is estimated at roughly 12 million tons annually.

However, this massive physical potential stands in stark contrast to domestic utilization. The 2024 PLN Statistics reveal a grid still structurally dependent on coal; of the PLN Group's 46,833.23 MW total installed capacity, coal-fired plants (PLTU) account for 21,026.90 MW (27.69%), while solar, wind, and biomass combined represent a mere 34.34 MW (0.04%). This disparity is most evident in fuel consumption: while PKS potential reaches 12 million tons, PLN's generation fleet consumed only 1.62 million tons of biomass in 2024, vastly outweighed by the 71.72 million tons of coal used.

While there are positive transition signals—such as the implementation of co-firing at 47 power plants and the growth of Renewable Energy Certificates (REC) to 5.38 TWh (PLN, 2024), biomass remains supplementary within a PLN-centered system. This limited domestic absorption forces a massive allocation of PKS toward export markets, particularly in East Asia (BPS, 2023; METI, 2022). Such patterns confirm that Indonesia's PKS challenge is not a matter of scarcity, but a resource-allocation problem driven by the gap between weak domestic policy frameworks and the stronger, more stable incentives offered internationally (Johnstone et al., 2010; World Bank, 2020).

According to IRENA (2022), Indonesia's biomass potential remains underutilized due to supply chain inefficiencies, regulatory constraints, and limited domestic demand. At the same time, international markets, especially in East Asia, have developed strong demand for biomass, supported by renewable energy policies such as feed-in tariffs and co-firing mandates (IEA, 2022; METI, 2022). Evidence from renewable energy economics suggests that stable policy incentives and price mechanisms strongly influence renewable energy adoption and investment decisions (Johnstone et al., 2010; Popp, 2002).

The international demand side matters because Japan's biomass market is not purely price-driven. METI-linked ISCC Japan FIT documents show that PKS and palm trunks are recognized as eligible biomass fuels, and the certification framework requires lifecycle greenhouse-gas reductions of 50% until FY2029 and 70% from FY2030 onward. This means Japanese biomass demand is reinforced by certification, traceability, and long-term sustainability criteria, which create predictable demand for Indonesian PKS. In other words, the external market is policy-backed in a way the domestic market is still not.

This dynamic has led to an increasing trend of PKS exports, where domestic biomass resources are allocated to foreign markets offering higher and more stable returns (BPS, 2023; IRENA, 2022). The World Bank (2020) identifies similar patterns in developing economies, where weak domestic policy frameworks fail to compete with stronger international incentives.

Research Gap

Although the literature separately covers ESG, fiscal policy, and biomass energy, these strands are rarely integrated into one analytical framework explaining biomass allocation outcomes in developing economies. ESG studies mainly focus on disclosure practices, investor preferences, and financial materiality rather than resource allocation mechanisms in energy transition contexts (Friede et al., 2015; Eccles et al., 2014; Khan et al., 2016). Environmental fiscal policy research emphasizes taxation and pricing instruments but often discusses incentive design abstractly without connecting it to commodity allocation issues such as biomass export diversion (Pigou, 1920; IMF, 2019; OECD, 2020).

In Indonesia, biomass studies highlight technical potential and supply chain inefficiencies but provide limited discussion of fiscal incentive architecture shaping whether biomass is used domestically or exported (IEA, 2022; IRENA, 2022). Empirical evidence shows renewable energy deployment depends heavily on long-term policy credibility and institutional coordination rather than resource availability (Aklin & Urpelainen, 2013; Johnstone et al., 2010; Marques & Fuinhas, 2012). This aligns with development literature arguing weak domestic incentives often result in strategic resources being absorbed by international markets with stronger policy-backed demand (World Bank, 2020).

This study fills that gap by integrating ESG frameworks, fiscal policy design, and biomass allocation dynamics into a single analytical framework. Its key conceptual contribution is ESG–Fiscal Decoupling, referring to the disconnect between sustainability commitments and fiscal signals required to shift firm-level behavior. In the Indonesian PKS case, decoupling occurs when biomass that could support domestic energy transition is allocated toward export markets supported by stronger certification and policy-backed demand (METI, 2022; IRENA, 2022). Thus, the analytical gap is not whether Indonesia has biomass, but why fiscal architecture fails to redirect allocation toward domestic transition objectives (IMF, 2019; OECD, 2020; World Bank, 2022).

METHODS

This study adopts a qualitative, policy-oriented case study design. The objective is not to estimate a causal coefficient statistically, but to explain how fiscal incentives, market structure, and sustainability goals interact in shaping domestic biomass utilization (Creswell, 2014). The case study approach is appropriate because palm kernel shells (PKS) provide a concrete and policy-relevant biomass case through which Indonesia's broader ESG, fiscal policy, and energy-transition issues can be examined. The study relies on document analysis of official statistics, policy documents, institutional reports, trade publications, and academic literature, with the main source base drawn from PLN Statistics 2024, the Ministry of Agriculture's 2025 palm-oil trade report, ESDM's biomass pricing notice, and METI/ISCC Japan FIT documents.

The unit of analysis is PKS as an Indonesian biomass commodity, while the secondary unit of analysis is the policy environment surrounding PKS utilization. This includes PLN's co-firing and REC instruments, Indonesia's biomass tariff framework, and Japan's biomass certification regime. The analysis proceeds in three steps: first, it maps the structure of PKS availability, domestic biomass absorption, and export orientation; second, it compares Indonesia's domestic incentive structure with Japan's policy-backed biomass market; and third,

it evaluates whether Indonesia's fiscal instruments are sufficiently aligned with ESG objectives to redirect private behavior toward domestic biomass utilization.

RESULTS AND DISCUSSION

Domestic Biomass Utilization Remains Marginal in a Coal-Heavy System

The core finding of this study is that Indonesia's PKS issue should not be framed as a biomass scarcity problem. PLN Statistics 2024 confirm that Indonesia's electricity system remains structurally coal-heavy: coal-fired plants account for 21,026.90 MW of installed capacity, while solar, wind, and biomass combined remain only 34.34 MW. On the fuel side, PLN consumed 71.72 million tons of coal in 2024 compared with only 1.62 million tons of biomass (PLN, 2024a). This reflects global patterns where renewable energy remains marginal when fossil-fuel path dependence is reinforced by weak incentives and limited structural reform (Aklin & Urpelainen, 2013; IEA, 2023).

At the same time, Indonesia's PKS availability is large. Literature estimates that 45 million tons of CPO generates approximately 12 million tons of PKS annually (Handaya et al., 2022). With USDA projections expecting CPO production to reach 47 million tons by 2025/26, PKS availability is expected to remain substantial (Palm Oil Magazine, 2025). Thus, the central issue is not physical scarcity but allocation.

PLN Co-Firing and REC Expansion as Supplementary Transition Tools

Domestic policy progress exists but remains supplementary. PLN's co-firing initiative and REC program demonstrate that transition instruments already exist. PLN's ESG reporting shows REC sales reached 5.38 TWh in 2024, increasing from 3.54 TWh in 2023 (PLN, 2024b). However, these mechanisms remain incremental and do not yet create a fully competitive domestic biomass market. This aligns with renewable energy policy literature emphasizing that partial interventions often fail to create structural shifts unless incentives are targeted, predictable, and institutionalized (Johnstone et al., 2010; Marques & Fuinhas, 2012).

Furthermore, OECD (2020) emphasizes that climate-related fiscal incentives must be measurable, transparent, and outcome-linked to generate real decarbonization effects. In this context, co-firing is useful as a bridging instrument but remains dependent on PLN's procurement model and does not yet create independent domestic demand beyond PLN's absorption capacity.

Japan's FIT-Backed Biomass Regime and Export Diversion Dynamics

The export side explains why PKS continues leaving the domestic market. Japan's biomass framework is not solely price-driven but supported by policy-backed demand under FIT schemes. METI documentation confirms PKS eligibility as biomass fuel and imposes lifecycle greenhouse-gas reduction thresholds of 50% until FY2029 and 70% from FY2030 onward (METI, 2022). This regulatory certainty increases demand predictability and bankability. Renewable energy literature supports the argument that credible long-term incentives strongly shape adoption and resource allocation (Aklin & Urpelainen, 2013; IEA, 2022).

Trade reporting indicates Japan remains the dominant buyer of Indonesian PKS exports (CNBC Indonesia, 2025). While journalistic sources should not be the primary evidence base, this finding reinforces the broader theoretical point: firms allocate commodities toward markets offering higher certainty and stronger policy-backed profitability.

Supply Chain Fragmentation and Institutional Coordination Failures

A deeper explanation lies in supply chain and institutional structure. Even with abundant residues, domestic utilization faces fragmentation, logistics costs, storage constraints, and weak contract standardization. IRENA (2022) highlights that biomass deployment barriers in

emerging economies often stem from supply chain inefficiencies and weak domestic demand signals.

World Bank (2020) argues that weak coordination in developing economies results in domestic markets losing competitiveness against international markets with stronger incentives. Similarly, OECD climate-tax policy emphasizes that mitigation instruments become effective only when they are predictable, measurable, and linked to performance outcomes rather than broad eligibility categories (OECD, 2020). This suggests that Indonesia's domestic PKS market is not failing because it lacks resources, but because it lacks a strong incentive and governance ecosystem.

Policy Design Implication: Output-Based vs Input-Based Incentives

The evidence points to a multi-layer policy failure rather than a single missing instrument. The obstacle is not only coal dominance but also fiscal incentives that are insufficiently strong to redirect biomass toward domestic energy use. This supports the paper's concept of ESG–Fiscal Decoupling, where sustainability commitments exist at the macro-policy level but fiscal mechanisms fail to translate them into firm-level behavioral change. IMF guidance supports this logic by emphasizing that broad incentives often fail unless tied to measurable outputs (IMF, 2019).

A key policy implication concerns the distinction between input-based and output-based incentives. Input-based incentives reward investment presence (such as capital spending or facility establishment), but they do not necessarily guarantee that renewable-energy outputs are generated or that emissions reductions occur. In contrast, output-based incentives directly reward measurable outcomes such as megawatt-hours of renewable electricity, verified emissions reductions, or domestic biomass absorption volume. OECD climate policy literature emphasizes that climate instruments are most effective when they are performance-linked and verifiable (OECD, 2020). World Bank (2022) similarly argues that credible climate policy requires measurement, reporting, and verification mechanisms that connect policy instruments to outcomes.

Thus, if Indonesia's fiscal incentives were linked to verified domestic PKS absorption, measurable biomass electricity generation, and documented emissions reductions, supply chain investment would become more bankable and domestic demand would strengthen (OECD, 2020; World Bank, 2022). This aligns with renewable-energy innovation literature demonstrating that investment responds strongly to predictable and well-structured incentives (Johnstone et al., 2010; Popp, 2002).

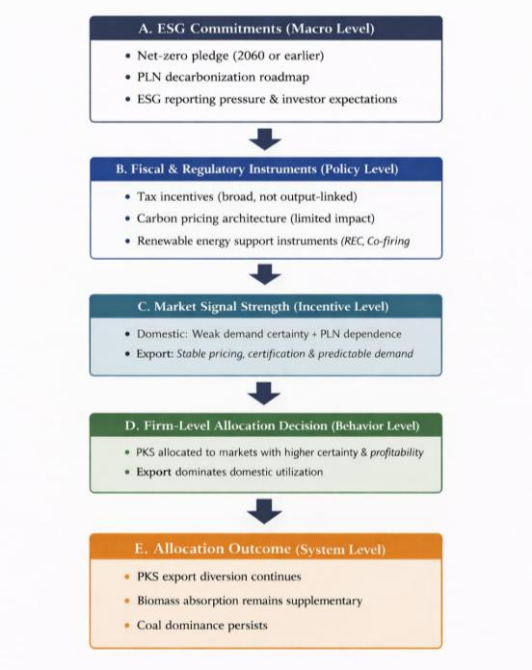
Table 1. Comparative Policy Regime: Indonesia vs Japan (PKS Biomass Market)

Dimension	Indonesia (Domestic PKS Utilization)	Japan (Imported PKS Utilization)	Implication
Policy Instrument	PLN-centered co-firing and REC programs	FIT-linked certification system and biomass fuel eligibility	Japan creates a dedicated market regime supported by regulatory certainty
Demand Certainty	Limited; dependent on PLN procurement and co-firing absorption capacity	High; supported by FIT price guarantees and stable offtake mechanisms	Export becomes more attractive at long-term demand
Price Signal	Domestic pricing less competitive and less stable	Stable returns under FIT framework	PKS allocation is pulled export markets offering higher
Sustainability Certification	Fragmented; weak standardization	Strong certification under FIT framework	Compliance becomes a market premium and increases export competitiveness
Traceability	Fragmented; weak standardization	Strong certification and traceability	Compliance becomes a market premium and increases export competitiveness

Supply Chain	Emerging hubs and logistics	Mandatory lifecycle thresholds	Higher bankability and credibility for imported PKS
Fiscal Incentive Linkage	Broad; weak output linkage	Output-linked policy and pricing	Japan provides stronger incentives for firms
Market Structure	Single dominant offtaker (PLN)	Diversified utilities and buyers	Japan offers multiple demand channels, improving market resilience
Outcome	Biomass supplementary	PKS absorbed strategically	Export diversion persists due to incentive asymmetry

Sources: PLN (2024a; 2024b); METI (2022); IEA (2022; 2023); IRENA (2022); OECD (2020); World Bank (2022)

Figure 1. ESG–Fiscal Decoupling Framework in PKS Allocation



Sources: IEA (2023); METI (2022); PLN (2024b); OECD (2020); World Bank (2022)

CONCLUSION

This study concludes that Indonesia's PKS issue is fundamentally not a biomass scarcity problem but a policy and allocation problem shaped by incentive asymmetry. PLN Statistics 2024 show that the electricity system remains structurally coal-heavy: coal-fired plants accounted for 21,026.90 MW of installed capacity, while solar, wind, and biomass combined represented only 34.34 MW. On the fuel side, PLN consumed 71.72 million tons of coal and only 1.62 million tons of biomass in 2024 (PLN, 2024a). This indicates that biomass remains marginal. Such patterns reflect global evidence that renewable resource availability does not automatically translate into deployment without strong domestic demand signals and credible incentives (IEA, 2023; IRENA, 2022).

The export orientation of PKS further reinforces this conclusion. Japan's biomass framework is not merely a market price signal but a policy-backed regime supported by sustainability certification and traceability requirements. METI documentation confirms PKS eligibility and imposes lifecycle greenhouse-gas reduction thresholds of 50% until FY2029 and 70% from FY2030 onward, creating stable demand for imported biomass (METI, 2022). Such regulatory certainty supports literature emphasizing that renewable adoption is shaped by credible long-term incentives (Aklin & Urpelainen, 2013; Johnstone et al., 2010). Recent

reporting indicates Japan remains the dominant buyer of Indonesian PKS exports, suggesting that foreign incentive ecosystems are stronger than domestic market signals (CNBC Indonesia, 2025).

Indonesia has begun a domestic transition movement through PLN's co-firing and REC expansion. PLN reporting indicates REC sales reached 5.38 TWh in 2024, up from 3.54 TWh in 2023 (PLN, 2024b). Nevertheless, these mechanisms remain supplementary rather than system-shaping, reflecting the limitations of incremental transition instruments in coal-heavy systems (IEA, 2022; IRENA, 2022).

This study therefore frames the central challenge as ESG–Fiscal Decoupling, where sustainability goals exist at the macro-policy level but fiscal and tax mechanisms remain too broad, weakly targeted, and insufficiently output-linked to shift firm-level allocation behavior. This conclusion aligns with IMF and OECD policy guidance emphasizing that environmental fiscal tools are effective only when they are measurable, transparent, and predictable (IMF, 2019; OECD, 2020).

Policy Implications

The ESG–Fiscal Decoupling framework implies that energy transition policy cannot rely solely on national commitments, corporate ESG disclosure, or PLN-centered transition tools. Instead, transition success depends on whether fiscal incentives create measurable and bankable market signals strong enough to shift firm-level allocation behavior. Without output-based and performance-linked incentives, domestic biomass utilization will remain supplementary and Indonesia will continue to experience export diversion toward markets with stronger regulatory credibility and sustainability certification regimes (IMF, 2019; OECD, 2020; World Bank, 2022).

Policy Recommendations

Accordingly, Indonesia's fiscal response should shift from generic green support toward a biomass-specific tax architecture. Tax incentives should reward the PKS value chain—collection, aggregation, drying, preprocessing, logistics, certification, and biomass-fired generation—rather than treating biomass as a broad renewable category. OECD and World Bank climate-policy research supports this approach by emphasizing that effective climate instruments must be sector-specific and linked to measurable decarbonization outcomes (OECD, 2020; World Bank, 2022).

The strongest policy recommendation is to shift from input-based to output-based incentives. Instead of rewarding investment presence alone, tax benefits should be tied to measurable outputs such as verified domestic PKS absorption, biomass electricity generation (MWh), or emissions reductions. This approach is consistent with IMF and OECD recommendations emphasizing outcome-based incentive design (IMF, 2019; OECD, 2020). It is also supported by empirical evidence that targeted tax incentives can improve corporate ESG performance when linked to measurable sustainability indicators (Zhang et al., 2025).

A second recommendation is to narrow the competitiveness gap between domestic utilization and export allocation. Rather than restricting exports, fiscal policy should make domestic absorption financially credible through tax credits for domestic biomass sales, accelerated depreciation for biomass-processing assets, and tax allowances for long-term domestic offtake contracts. Development literature supports this approach, as weak domestic market incentives often cause strategic resources in developing economies to be absorbed by foreign markets offering stronger certainty and returns (World Bank, 2020).

A third recommendation is to strengthen certification and traceability support through fiscal treatment. Japan's biomass regime demonstrates that compliance becomes part of the market value chain. Indonesia should therefore make certification and traceability costs tax-deductible or tax-favored for domestic biomass suppliers. Such a policy is aligned with climate-

policy research emphasizing that measurable verification systems strengthen sustainability markets and improve transition credibility (World Bank, 2022; METI, 2022).

Finally, fiscal policy should be designed not to replace PLN or the private sector, but to improve the balance between them. PLN will remain a dominant offtaker, but domestic biomass markets will expand faster if private actors participate more deeply in aggregation, preprocessing, and generation. A stronger fiscal framework can reduce entry costs, improve bankability, and widen the domestic biomass market beyond a single-offtaker model. This is consistent with renewable-energy innovation literature emphasizing that investment responds most strongly to predictable and well-structured incentives (Johnstone et al., 2010; Popp, 2002).

The practical lesson is clear: Indonesia does not mainly need more rhetorical support for biomass; it needs a smarter fiscal-policy architecture that makes domestic biomass utilization profitable, predictable, and structurally aligned with ESG objectives.

REFERENCES

Aklin, M., & Urpelainen, J. (2013). Political competition, path dependence, and the strategy of sustainable energy transitions. *American Journal of Political Science, 57*(3), 643–658. https://doi.org/10.1111/ajps.12002

Andersson, J. J. (2019). Carbon taxes and CO_2 emissions: Sweden as a case study. *American Economic Journal: Economic Policy, 11*(4), 1–30. https://doi.org/10.1257/pol.20170144

Badan Pusat Statistik. (2023). *Statistik perdagangan luar negeri Indonesia: Ekspor 2023*. Badan Pusat Statistik.

Bowen, G. A. (2009). Document analysis as a qualitative research method. *Qualitative Research Journal, 9*(2), 27–40. https://doi.org/10.3316/QRJ0902027

Clark, G. L., Feiner, A., & Viehs, M. (2015). From the stockholder to the stakeholder: How sustainability can drive financial outperformance. *Journal of Sustainable Finance & Investment, 5*(1–2), 1–18. https://doi.org/10.2139/ssrn.2508281

CNBC Indonesia. (2025). Cangkang sawit RI laris manis, Jepang jadi pembeli utama. *CNBC Indonesia*.

Creswell, J. W. (2014). *Research design: Qualitative, quantitative, and mixed methods approaches* (4th ed.). SAGE Publications.

Demirbas, A. (2009). Political, economic and environmental impacts of biofuels: A review. *Applied Energy, 86*(S1), S108–S117. https://doi.org/10.1016/j.apenergy.2009.04.036

Dewan Energi Nasional. (2014). *Peraturan Pemerintah Republik Indonesia Nomor 79 Tahun 2014 tentang Kebijakan Energi Nasional*. Dewan Energi Nasional.

Eccles, R. G., Ioannou, I., & Serafeim, G. (2014). The impact of corporate sustainability on organizational processes and performance. *Management Science, 60*(11), 2835–2857. https://doi.org/10.1287/mnsc.2014.1984

Food and Agriculture Organization. (2020). *Bioenergy and food security: Guidance for policymakers*. FAO.

Friede, G., Busch, T., & Bassen, A. (2015). ESG and financial performance: Aggregated evidence from more than 2000 empirical studies. *Journal of Sustainable Finance & Investment, 5*(4), 210–233. https://doi.org/10.1080/20430795.2015.1118917

Goldemberg, J. (2007). Ethanol for a sustainable energy future. *Science, 315*(5813), 808–810. https://doi.org/10.1126/science.1137013

Handaya, Marimin, Indrawan, D., & Susanto, H. (2022). A comparative life cycle assessment of palm kernel shell in ceramic tile production: Managerial implications for renewable energy usage. *Sustainability, 14*(16), 10100. https://doi.org/10.3390/su141610100

International Energy Agency. (2022). *World energy outlook 2022*. IEA.

International Energy Agency. (2023). *World energy outlook 2023*. IEA.

International Energy Agency. (2023). *Renewables 2023: Analysis and forecast to 2028*. IEA.
International Monetary Fund. (2019). *Fiscal policies for Paris climate strategies: From principle to practice*. IMF.
International Renewable Energy Agency. (2022). *Renewable power generation costs in 2021*. IRENA.
International Renewable Energy Agency. (2022). *World energy transitions outlook 2022: 1.5°C pathway*. IRENA.
Japan Ministry of Economy, Trade and Industry. (2022). *Feed-in tariff scheme and feed-in premium scheme in Japan*. METI.
Johnstone, N., Haščič, I., & Popp, D. (2010). Renewable energy policies and technological innovation: Evidence based on patent counts. *Environmental and Resource Economics, 45*(1), 133–155. https://doi.org/10.1007/s10640-009-9309-1
Kementerian Energi dan Sumber Daya Mineral Republik Indonesia. (2017). *Peraturan Presiden Republik Indonesia Nomor 22 Tahun 2017 tentang Rencana Umum Energi Nasional (RUEN)*. Kementerian ESDM.
Kementerian Energi dan Sumber Daya Mineral Republik Indonesia. (2023). *Handbook of energy & economic statistics of Indonesia 2023*. Kementerian ESDM.
Kementerian Keuangan Republik Indonesia. (2020). *Peraturan Menteri Keuangan Republik Indonesia Nomor 130/PMK.010/2020 tentang pemberian fasilitas pengurangan pajak penghasilan badan*. Kementerian Keuangan Republik Indonesia.
Kementerian Keuangan Republik Indonesia. (2021). *Undang-Undang Republik Indonesia Nomor 7 Tahun 2021 tentang harmonisasi peraturan perpajakan*. Kementerian Keuangan Republik Indonesia.
Khan, M., Serafeim, G., & Yoon, A. (2016). Corporate sustainability: First evidence on materiality. *The Accounting Review, 91*(6), 1697–1724. https://doi.org/10.2308/accr-51383
Knoepfel, P., Larrue, C., Varone, F., & Hill, M. (2011). *Public policy analysis*. Policy Press.
Marques, A. C., & Fuinhas, J. A. (2012). Are public policies towards renewables successful? Evidence from European countries. *Renewable Energy, 44*, 109–118. https://doi.org/10.1016/j.renene.2012.01.007
Organisation for Economic Co-operation and Development. (2020). *Tax policy and climate change*. OECD Publishing.
Palm Oil Magazine. (2025). USDA projects Indonesia's palm oil production to reach 47 million tons in 2025/26. *Palm Oil Magazine*.
Perusahaan Listrik Negara. (2021). *Rencana usaha penyediaan tenaga listrik (RUPTL) 2021–2030*. PT PLN (Persero).
Perusahaan Listrik Negara. (2024a). *Statistik PLN 2024 (Indonesian-English Edition)*. PT PLN (Persero).
Perusahaan Listrik Negara. (2024b). *PLN ESG performance report 2024*. PT PLN (Persero).
Pigou, A. C. (1920). *The economics of welfare*. Macmillan.
Popp, D. (2002). Induced innovation and energy prices. *American Economic Review, 92*(1), 160–180. https://doi.org/10.1257/000282802760015658
PricewaterhouseCoopers. (2024). *PwC global investor survey 2024*. PwC.
Stern, N. (2007). *The economics of climate change: The Stern review*. Cambridge University Press.
United Nations. (2015). *Paris agreement*. United Nations Framework Convention on Climate Change.
United Nations Principles for Responsible Investment. (2023). *Annual report 2023*. PRI Association.

World Bank. (2020). *World development report 2020: Trading for development in the age of global value chains*. World Bank.
World Bank. (2022). *State and trends of carbon pricing 2022*. World Bank.
World Economic Forum. (2020). *The global risks report 2020*. World Economic Forum.
Yin, R. K. (2018). *Case study research and applications: Design and methods* (6th ed.). SAGE Publications.
Zhang, X., Jiang, Q., Cifuentes-Faura, J., Hu, X., & Li, Y. (2025). Do tax incentives matter in promoting corporate ESG performance toward sustainable development? *Business Strategy and the Environment, 34*(1), 57–69. https://doi.org/10.1002/bse.3966