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Tracing the Threads of Integrity in Energy Transition: A Corruption Risk Assessment of the Biomass Co-firing Program at Coal-Fired Power Plants in Indonesia

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Field Rearcher	: Asri Widayati, Bagus Pradana, Ferdian Yazid, Gita Ayu Atikah, R. Alvino Radyatama, Fauqi Muhtaromun Nazwan, Mukhlis Ray.
Authors	: Asri Widayati, Bagus Pradana, Ferdian Yazid, Gita Ayu Atikah, Lalu Hendri Bagus
Editors	: Bagus Pradana, Ferdian Yazid
Reviewer	: Mumu Muhajir
Design & Layout	: Taqi

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FOREWORD

We express our gratitude for the completion of the research report entitled "Tracing the Threads of Integrity in the Energy Transition: Corruption Risk Assessment of the Biomass Co-firing Program at Coal-Fired Power Plants in Indonesia." This report was prepared by Transparency International Indonesia (TI-Indonesia) as part of a collective effort to promote transparency and accountability in the national energy transition agenda.

Indonesia currently stands at a crossroads in the energy transition. On the one hand, the government is committed to achieving the 23% renewable energy mix target and Net Zero Emissions by 2060. On the other hand, dependence on coal-fired power plant infrastructure remains very high. In this space of compromise, biomass co-firing emerges as a "middle strategy" considered pragmatic because it utilizes existing assets to reduce emissions without radical structural changes.

However, the energy transition is not simply a matter of technology; it is also a matter of fairness and integrity. Using a Corruption Risk Assessment (CRA) approach, this research diagnoses corruption-prone points in the co-firing policy and implementation cycle. We examine the gray areas of governance, from unregulated procurement discretion in detail, the complexity of the supply chain at the site level, to the weak traceability of raw materials.

The case studies of the Indramayu and Rembang coal-fired power plants provide a clear picture of how the risks of rent-seeking and informal practices can erode the meaning of "green energy" if not accompanied by strict oversight. Without integrity, biomass risks becoming merely an administrative label that shifts ecological burdens to production areas through deforestation or tenure conflicts.

We hope this report can serve as an evidence base for stakeholders to strengthen procurement governance and ensure that the energy transition in Indonesia is truly managed transparently, accountably, and with integrity. We extend our appreciation to the research team, field partners, and all parties who provided valuable input in the development of this research.

We hope this report will be useful for improving national energy policy for a more equitable and sustainable future.

Jakarta, February 2026


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CHAPTER I
INTRODUCTION

1.1 Energy Transition, Biomass, and Governance Challenges in the National Energy Policy

Electricity has become the most decisive currency in the energy sector. It moves clandestinely, channeling power into nearly every facet of life. From the lights illuminating study rooms to industrial machines pulsing without pause, electricity is the modern language of progress: whoever controls it sets the course of the era.

Yet much like currency, electricity is not neutral. It carries values, interests, and power relations. Behind the cables stretching across landscapes and the transmission towers looming into the sky lie political decisions, economic calculations, and often invisible inequalities. In Indonesia, electricity is unevenly distributed. Some regions are lit brightly well into the night, while in others, darkness remains a generational inheritance.

As in many other countries, Indonesia's energy transition narrative promises electricity that is clean, green, and sustainable. It is heralded as a way out of the climate crisis and a bridge toward a low-carbon future. But such promises often stop at slogans echoing through policy chambers, never fully answering the most fundamental questions: clean for whom, green in which regions, and sustainable at what social cost. Behind the label of energy transition, renewable electricity sources still demand land, extract resources, and shift ecological burdens to the margins; to villages, forests, coastlines, and communities that are rarely included in decision-making.

In other words, the transition in the electricity sector is not only a matter of technology or energy mix, but of justice. It determines who enjoys the light and who bears the darkness; who reaps the economic benefits and who must compromise their living space. Without a critical reading of these power relations, low-carbon electricity risks becoming nothing more than a new face of old inequalities. Cleaner at the centers of consumption, yet still dirty and problematic at the production sites.

It is this awareness of power dynamics and injustice that makes any discussion of electricity inseparable from the direction of state policy. Technocratic choices that appear neutral, such as energy mix targets and transition strategy options, in fact reflect political compromises and development priorities. It is at this point that the promise of energy transition is put to the test: not only by its rhetorical ambitions, but by the state's willingness to restructure the direction of national energy policy.

In this context, the direction of national energy policy in Indonesia has never been just a matter of technocratic figures and percentages. The adjustment of the new and renewable energy (NRE) mix targets illustrates how energy transition ambitions confront the realities of politics, economics, and implementation capacity on the ground. Through Government Regulation No. 40 of 2025 on National Energy Policy (*Kebijakan Energi Nasional*/KEN), the NRE mix target of 23 percent, originally set for 2025, was officially postponed to 2030.[1] The government, through the Ministry of Energy and Mineral Resources, recorded that as of 2024, the actual NRE mix achievement stood at only 14.68 percent, leaving a wide gap between plans and actual outcomes, and underscoring the limited time and policy instruments available to close it in the short term.[2]

This adjustment is not only a technocratic correction, but a signal of how electricity as an energy currency is managed and negotiated. When energy mix targets are pushed back, what shifts is not only the timeline but also the burdens borne by communities and the environment. Electricity continues to flow, power plants continue to operate, but the promised transition becomes blurred between short-term pragmatic needs and long-term moral responsibilities.

[1] Kompas, "*Kebijakan Energi Nasional: Menuju Kemandirian atau Sebatas Harapan?*" [National Energy Policy: Towards Self-Sufficiency or Mere Aspiration?]. Accessed: Jan. 28, 2026. Available: https://www.kompas.id/artikel/kebijakan-energi-nasional-menuju-kemandirian-atau-sebatas-harapan

[2] Dewi Wuryandani, "*Perubahan Target Bauran Energi Terbarukan Indonesia*" [Changes in Indonesia's Renewable Energy Mix Targets]. Jakarta, Feb. 2025. Accessed: Jan. 28, 2026. Available: https://berkas.dpr.go.id/pusaka/files/isu_sepekan/Isu%20Sepekan---III-PUSLIT-Februari-2025-206.pdf

At this juncture, electricity reveals its duality. It can function as an instrument for accelerating a move toward a low-carbon future, yet it can simultaneously serve as a pretext for preserving the status quo through narratives of target adjustment and quick fixes. To close the gap and achieve the 23 percent NRE mix by 2030, the government took a strategic step by optimizing national bioenergy potential. According to the 2019-2038 updated National General Electricity Plan (Rencana Umum Ketenagalistrikan Nasional/RUKN), a long-term planning document that serves as the primary reference for electricity system development, Indonesia is estimated to possess bioenergy potential of up to 57 GW if converted into electrical energy. Of this total, biomass emerges as the leading commodity, with a projected contribution of approximately 53.4 GW, or nearly 94 percent of total national bioenergy potential.[3] Within this framework, biomass is positioned as a transition shortcut; easy to calculate, easy to incorporate into the energy mix ledger (co-firing) as promoted by the government, and relatively compatible with existing electricity infrastructure particularly Indonesia's coal-fired power plants.
However, this technocratic convenience does not exist in a vacuum. When biomass is positioned as a quick-fix solution on paper, the critical question shifts to where and from whom these resources will be taken. The choice of biomass as a transition “shortcut” inherently demands the expansion of production areas, consolidation of feedstock supply, and reorganization of ecological and social spaces that have long sustained local communities. It is at this point that national energy planning logic begins to intersect directly with the geography of extraction.

The Sumatra region, particularly Riau and South Sumatra, is projected to become the center of national biomass exploration, contributing approximately 54 percent of Indonesia's total biomass potential.[4] Oil palm plantations, rubber plantations, and high-calorie plants such as gliricidia, calliandra, and acacia are identified as the foundations of future energy supply. Here, electricity once again shows its dual nature, arriving as a symbol of green transition while simultaneously driving new intensification of living space extraction.

Thus, when electricity is treated as a currency, what is at stake is not just the percentage of the energy mix, but the moral direction of the transition itself. Is bioenergy truly a bridge to climate justice, or just an accounting instrument to chase overdue targets? Do economic growth and Net Zero genuinely go hand in hand, or are they only brought together through the tidy language of policy?

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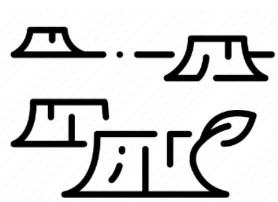
3 Ministry of Energy and Mineral Resources (ESDM), *Rencana Umum Ketenagalistrikan Nasional* [National Electricity General Plan], 2025. Accessed: Jan. 28, 2026. [Online]. Available: https://gatrik.esdm.go.id/assets/uploads/download_index/files/28dd4-rukn.pdf

4 PLN EPI, "*Potensi Bioenergi RI Capai 83,4 Juta Ton per Tahun, PLN EPI Maksimalkan untuk Ketahanan Energi*" [Indonesia's Bioenergy Potential Reaches 83.4 Million Tons per Year, PLN EPI Optimizes for Energy Security]. Accessed: Jan. 28, 2026. Available: https://www.plnepi.co.id/media-informasi/ruang-media/siaran-pers/potensi-bioenergi-ri-capai-834-juta-ton-per-tahun-pln-epi-maksimalkan-untuk-ketahanan-energi

One relevant lesson for Indonesia, as it embarks on its bioenergy-based "energy business", comes from the experience of Enviva Inc., a U.S.-based biomass company. Enviva was once hailed as an environmentally friendly biomass company supporting the clean energy transition by producing wood pellets as a "renewable" fuel. The company claimed that its pellets were made from wood waste, including branches, logging residues, and scraps from the timber industry, and that they only purchased from forests that would be promptly replanted. However, a number of investigations and on-the-ground revelations painted a picture far different from this narrative.

According to an investigation by Mongabay.com (5 December 2022), a whistleblower who had worked at an Enviva facility in North Carolina stated categorically that the company's claims of "wood waste sources" were outright lies. In practice, Enviva routinely received whole trees from natural forests, not just small leftover wood scraps, to be converted into wood pellets. The witness stated that the company "didn't care where the wood came from" and that they needed whole trees to maintain factory productivity, contributing to the clearing of natural forests.[5]

The whistleblower's testimony was further corroborated by satellite imagery showing that the expansion of Enviva pellet mills correlated with increased deforestation of natural forests in the southeastern United States, a region that serves as a significant carbon sink and a zone of high biodiversity. This controversy gave rise to accusations of greenwashing, a practice in which a company projects itself as environmentally friendly while reality is far from it. The Enviva case serves as a warning in the global debate on biomass energy: that claims of "clean bioenergy" do not automatically mean the practice truly contributes to climate change mitigation, let alone forest conservation or environmental justice. On the contrary, the case demonstrates that energy transition agendas pursued without strict oversight and a clear definition of sustainability can perpetuate old extractive practices, such as deforestation, under the guise of "green" legitimacy.[6]



[5] Mongabay, "*Whistleblower: Enviva claim of 'being good for the planet… all nonsense*.'" Accessed: Jan. 28, 2026. Available: https://news.mongabay.com/2022/12/envivas-biomass-lies-whistleblower-account/

[6] Mongabay, "*Enviva, the world's largest biomass energy company, is near collapse*." Accessed: Jan. 28, 2026. Available: https://news.mongabay.com/2023/11/enviva-the-worlds-largest-biomass-energy-company-is-near-collapse/

1.2. Energy Source Traceability as an Analytical Lens

In Indonesia, biomass co-firing is one of the instruments used by the government to increase the share of new and renewable energy in the electricity sector without requiring rapid structural changes to the existing generation system. The origin of this biomass co-firing policy can be traced to Presidential Regulation No. 22 of 2017 on the National General Energy Plan (*Rencana Umum Energi Nasional*/RUEN).[7] At the time, RUEN positioned biomass as a widely available and flexibly deployable renewable energy source. The co-firing policy choice was also closely linked to Indonesia's commitments to greenhouse gas (GHG) emission reduction and Net Zero Emission (NZE) achievement by 2060. In its positive narrative, biomass was considered a lower-emission energy source compared to coal, since the carbon released during combustion was assumed to be reabsorbed by nature. Based on this positive assumption, the electricity generated from biomass co-firing was claimed to be low-carbon electricity. This pragmatic view was subsequently adopted by the Indonesian government to pursue the 23 percent NRE mix target, previously promised for 2025 but now postponed to 2030.

The government claims that the biomass co-firing policy will drive the formation of new economic potential in the renewable energy sector at a large scale, involving various actors ranging from power plant operators, biomass suppliers, forestry and plantation businesses, to community groups and micro, small, and medium enterprises (MSMEs) at the local level. However, these claims face the reality of inconsistent planning and implementation, particularly reflected in the repeated adjustments to the Electricity Supply Business Plan (*Rencana Umum Penyediaan Tenaga Listrik*/RUPTL) 2025-2034, which raises serious questions about the targeting accuracy of the biomass co-firing policy.[8]

It is widely understood that RUPTL remains heavily influenced by a top-down approach based on energy mix targets, rather than an approach based on system readiness and governance risk. In the context of biomass co-firing, this approach risks reducing biomass to a mere instrument for meeting energy transition figures, without adequate assessment of downstream impacts that intersect with fraud risks, such as supply conflicts with local needs, sustainability and traceability issues in biomass utilization, vulnerability to rent-seeking practices and conflicts of interest in biomass procurement, or even the possible conversion of forest functions, given that provisions for Energy Plantation Forests continue to be parked in the latest RUPTL.

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7 Presidential Regulation (Perpres) Number 22 of 2017 on the National Energy General Plan (RUEN), 2017. Accessed: Jan. 28, 2026. Available: https://peraturan.bpk.go.id/Details/68772

8 PT PLN (Persero), "*Rencana Usaha Penyediaan Tenaga Listrik (RUPTL) 2025–2034*" [Electricity Supply Business Plan (RUPTL) 2025–2034], Jakarta, 2025. Accessed: Jan. 28, 2026. Available: https://web.pln.co.id/statics/uploads/2025/06/b967d-ruptl-pln-2025-2034-pub-.pdf

The potential for deforestation is detailed quite clearly in research by Trend Asia (2022), which mentioned that, based on the experience of industrial plantation forest development since the 1980s, 38 percent of the land came from deforestation or the clearing of natural forests. If the same pattern were applied to energy plantation forests, the deforestation potential would be very high, potentially reaching 2.1 million hectares (if using gliricidia).[9] This concern about deforestation is not unfounded. According to Forest Watch Indonesia (FWI), which monitored 13 industrial plantation forest concession holders that were converted into energy plantation forest concessions during 2017-2021, deforestation has reached 55,540 hectares, covering nearly 10 percent of their total concession area.[10] FWI's monitoring shows that the HTE policy does not guarantee a decline in deforestation.

Therefore, the deforestation issue within the energy plantation forest scheme cannot be viewed just as a sectoral forestry matter, but rather as an integral part of Indonesia's energy transition architecture. When biomass is positioned as a substitute fuel in the co-firing program at coal-fired power plants, its supply chain (including the source of feedstock and land governance) is directly linked to the decarbonization agenda for the electricity sector. This means that the success of energy transition should not only be measured by emission reduction figures at the power plant smokestack, but also by the extent to which the policy avoids downstream ecological impacts such as deforestation, land tenure conflicts, and degradation of forest governance.

It is at this point that the urgency of a Corruption Risk Assessment (CRA) approach becomes critical, especially when linked to the issue of traceability of biomass commodities, a dimension not yet deeply explored by previous studies in Indonesia. Without a robust traceability system—one capable of verifying the origin of feedstocks, land legality, compliance with environmental standards, and supply chain integrity—the biomass co-firing program in the electricity system risks reproducing old extractive practices under the label of "energy transition."

This is where the Corruption Risk Assessment (CRA) by Transparency International Indonesia functions as a diagnostic instrument to map vulnerability points within the policy cycle of biomass co-firing and its implementation. The CRA does not only assess formal compliance with existing regulations, but also examines whether traceability mechanisms are truly capable of closing gaps for abuse of authority and conflicts of interest. Its ultimate objective is to provide an evidence-based foundation for mitigation and policy improvement, ensuring that biomass co-firing in Indonesia does not serve as a short-term technical solution for emissions reduction, but is instead governed transparently, accountably, and in alignment with the principles of a just and integrity-driven energy transition.

[9] Trend Asia & Ranang Strategic, Ancaman Deforestasi Tanaman Energi, Jakarta, 2022. Available: https://trendasia.org/wp-content/uploads/2022/11/Ancaman-Deforestasi-Tanaman-Energi.pdf

[10] Forrest Watch Indonesia, Aksesibilitas dan Proyeksi Deforestasi dari Pembangunan Hutan Tanaman Energi, 2023. Available: https://fwi.or.id/aksesibilitas-dan-proyeksi-deforestasi-pembangunan-hutan/

1.3. Research Questions

- How are the structure and mechanism of the biomass supply chain in Indonesia's biomass co-firing program at coal-fired power plants designed and implemented?
- What governance risks arise within the biomass supply chain, from feedstock sourcing to its utilization at power plants?
- To what extent does the biomass supply chain uphold the principles of sustainability, traceability, and justice for communities?
- What are the potential forms of corruption risk within Indonesia's biomass co-firing policy?

1.4. Research Objectives

- To map the structure and mechanisms of the biomass supply chain in Indonesia's biomass co-firing program at coal-fired power plants, from feedstock sourcing, procurement processes, and distribution, to its utilization at power plants.
- To identify and analyze governance risks arising at each stage of the biomass supply chain, including regulatory gaps, institutional weaknesses, and implementation practices on the ground.
- To assess the extent to which the principles of sustainability, traceability, and social justice are applied within the biomass supply chain, particularly in relation to environmental protection and the position of local communities in production areas.
- To identify potential corruption risks in the policy and implementation of the biomass co-firing program, including risks of conflicts of interest, rent-seeking practices, supply manipulation, and weak oversight mechanisms.
- To formulate policy recommendations and risk mitigation measures to strengthen the transparency, accountability, and integrity of governance in the biomass co-firing program so that it aligns with the principles of a just energy transition.


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CHAPTER II
BIOMASS CO-FIRING, PROCUREMENT, AND TRACEABILITY IN THE BIOMASS SUPPLY CHAIN

2.1. Biomass Co-firing: An Energy Transition Solution or a Delay of Structural Change?

Biomass co-firing was not born from a great leap toward the future, but from the hesitations of the present. As an energy transition strategy, it has grown in the tension between two competing worlds: the old world still reliant on coal, and the new world that promises clean energy but is not yet fully ready to sustain the demands of the times. It is within this "in-between" space that biomass has been placed, as a supplementary fuel burned alongside coal (co-firing) in coal-fired power plants.

Biomass co-firing also serves as a marker that change is being pursued; it is positioned as a short-term emissions mitigation option. In Generating Electricity in a Carbon-Constrained World, biomass co-firing is discussed not as a radical technological breakthrough, but as a pragmatic strategy that makes use of existing power generation infrastructure in response to the growing pressure of an increasingly stringent climate regime[11]. It offers practicality; there is no need to build new power plants, no need to shut down coal-fired power plants abruptly. It is enough to replace part of the fuel with wood chips, agricultural waste, and other organic residues.

The main appeal of biomass co-firing lies in its relatively low marginal cost and speed of implementation. Compared to building renewable energy plants or carbon capture technologies, biomass co-firing offers emissions reductions that are "readily available." For this reason, the strategy is often seen as a low-hanging fruit in low-carbon electricity policy, particularly in countries already locked into long-term coal-fired power assets.[12] However, the sustainability claim of this biomass co-firing strategy depends heavily on assumptions about the supply chain. Biomass can only be considered low-carbon if it comes from waste or from sustainably managed sources, taking into account emissions from collection, processing, and transportation. Without such governance, biomass co-firing risks shifting the emissions burden from power plant smokestacks to the forestry sector.

[11] F. Sioshansi, *Generating electricity in a carbon-constrained world*. Academic Press, 2009.

[12] Ibid

2.2. Co-firing and Energy Plantation Forest Policy in Indonesia

The origins of Indonesia's biomass co-firing policy did not emerge as a standalone sectoral policy, but rather as the product of an intersection between energy transition commitments and the structural realities of the national electricity system. On the one hand, Indonesia faces pressure to increase the share of new and renewable energy (NRE) as part of its sustainable development agenda and its commitment to reducing greenhouse gas emissions. On the other hand, the national electricity system has long been locked into massive, long-lived coal-fired power plant infrastructure bound by long-term contracts. It is within this space of compromise that biomass co-firing found its relevance as a transitional strategy that allows NRE targets to be pursued without demanding radical changes to the existing generation structure.

The normative foundation of this policy can be traced to **Law No. 30 of 2007 on Energy**, which for the first time firmly established renewable energy as a pillar of national energy security and independence. This law not only emphasized energy source diversification but also opened space for the utilization of renewable energy sources as part of a strategy to reduce dependence on fossil fuels. Although it did not yet explicitly specify the types of renewable energy sources, this policy framework provided the conceptual justification for integrating renewable energy into conventional generation systems.

This framework was subsequently reinforced through **Government Regulation No. 79 of 2014 on National Energy Policy (PP KEN)**, which set NRE mix targets of 23 percent by 2025 and 31 percent by 2050. In PP KEN, biomass was identified as one of the strategic NRE sources that could be widely developed, including for the electricity and transportation sectors. At this point, the need to achieve energy mix targets began to directly confront the limited pace of new NRE power plant construction. Biomass co-firing then emerged as a policy option that was "readily deployable," as it could be implemented through limited modifications to existing coal-fired power plants.

This policy direction was further elaborated in **Presidential Regulation No. 22 of 2017 on the National Energy General Plan (RUEN)**. RUEN not only reaffirmed the role of biomass in the national energy mix but also stipulated the obligation to purchase electricity from biomass power plants and encouraged the development of at least one biomass power plant in every province. This provision reflected the government's effort to develop bioenergy based on local potential. However, the limited realization of biomass power plants at the scale and speed required also reinforced the relevance of alternative approaches, including the integration of biomass into coal-fired power plants through the biomass co-firing scheme.

Penegasan The affirmation of biomass co-firing as a key energy transition strategy was later reflected in the 2021-2030 Electricity Supply Business Plan (RUPTL), which positioned biomass co-firing as one of the flagship programs for accelerating the achievement of a 23 percent NRE mix by 2025. The RUPTL viewed biomass co-firing as a relatively low-investment option, as it makes use of existing coal-fired power plants without requiring the construction of new generation facilities or complex technological modifications. This economic argument became important in the context of limited fiscal space and the high financing needs of energy infrastructure. In addition, biomass co-firing was also projected to generate non-energy added value, as a means of handling waste and biomass residues, thereby linking the policy to the circular economy and environmental management agendas.

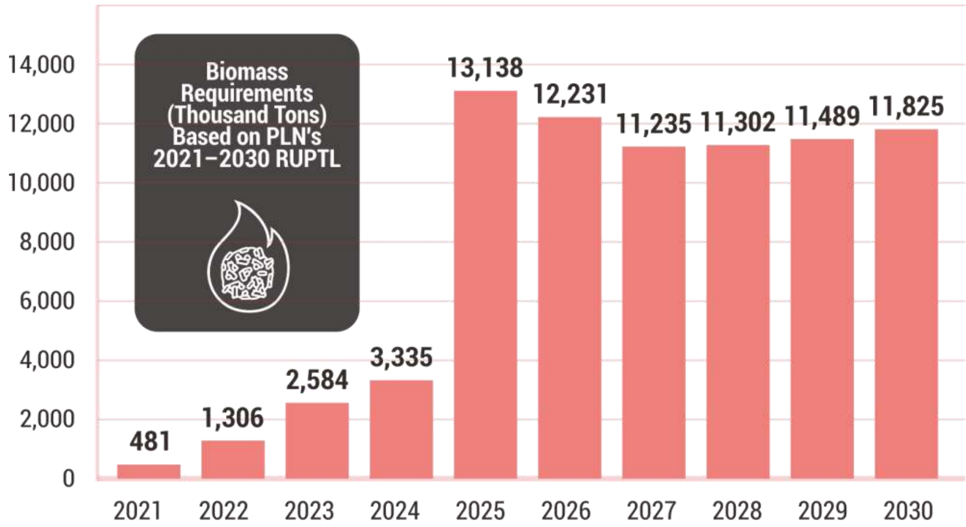
However, behind this efficiency narrative, the RUPTL 2021–2030 instead reveals a much larger and faster escalation in the scale of biomass co-firing policy than initially assumed. The implementation of biomass co-firing is planned across 52 coal-fired power plants, with biomass demand increasing gradually but sharply within a relatively short timeframe. In its early phase, biomass demand remains relatively limited, around 0.48 million tons per year in 2021, reflecting a pilot and initial implementation stage. This figure then rises to 1.31 million tons in 2022, 2.58 million tons in 2023, and 3.34 million tons in 2024, in line with the expansion of plant coverage and the intensification of biomass co-firing.[13]

The most significant surge occurred in 2025, when biomass demand was projected to jump dramatically to approximately 13.14 million tons per year. This figure represented a significant adjustment compared to initial projections based on co-firing rates of 5-10 percent, indicating a qualitative shift in biomass positioning, from a limited supplementary fuel to a core component of Indonesia's energy transition strategy. After this surge phase, biomass demand was projected to remain relatively stable yet high, in the range of 11-12 million tons per year through 2030, indicating a consolidation phase of biomass co-firing implementation in the national electricity system. [14]

[13] PLN, RUPTL 2021–2030 Dissemination Material, 2021, p. 20. Accessed: Dec. 23, 2025. Available: https://web.pln.co.id/statics/uploads/2021/10/materi-diseminasi-2021-2030-publik.pdf

[14] Ibid., p. 20.

Figure 1. Projection of National Biomass Needs Based on PLN's 2021-2030 RUPLT



Source: Compiled from RUPTL 2021-2030 Dissemination Materials (as of 5 October 2021) [15]

The strengthening of policy support for biomass uses in the national energy transition became even more evident with the issuance of **Government Regulation No. 112 of 2022 on the Acceleration of Renewable Energy Development**. This regulation marked the state's effort to create certainty and economic attractiveness for the development of renewable energy, including biomass. The strategic point offered by this regulation lies in the mechanism for purchasing electricity with a ceiling price. In the biomass context, this provision was intended to provide business certainty for private actors while also encouraging the use of biomass to support domestic power generation. With this pricing arrangement in place, biomass was positioned as one of the renewable energy options that could be economically integrated into the national electricity system.

The policy framework concerning the pricing provisions for the purchase of renewable energy-based electricity was later complemented by **Minister of Energy and Mineral Resources Regulation No. 12 of 2023 on the Utilization of Biomass Fuel as a Fuel Mixture in Coal-Fired Power Plants**. This regulation served as a technical and operational guide that governs in greater detail the implementation of biomass co-firing in coal-fired power plants. It covered aspects such as the use of biomass as a blended fuel, the control of biomass standards and quality, and the procedures for implementing biomass co-firing in a manner that remains consistent with the operational reliability of power plants. Beyond the technical aspects, Ministerial Regulation No. 12/2023 also governed biomass supply and benchmark pricing, which played an important role in ensuring business certainty within the procurement chain. The regulation also included provisions related to occupational health and safety (OHS), installation safety, and environmental protection and management. These provisions reflected the government's commitment that the future use of biomass as an alternative energy source will not disregard safety considerations or environmental impact considerations.

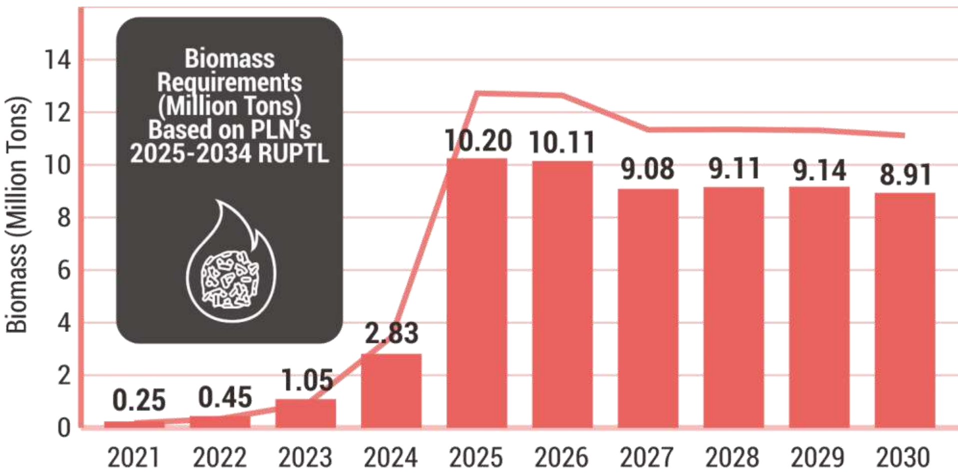
[15] Ibid., p. 20.

In late 2024, the Indonesian government ratified the most updated long-term electricity plan, the **National General Electricity Plan (RUKN) 2024-2060**. In this document, biomass co-firing was established as a priority strategy for coal-fired power plants management during the transition period for Indonesia's electricity system, particularly in the context of achieving Net Zero Emission (NZE) by 2060. The RUKN no longer positioned biomass co-firing only as a short-term solution, but as an instrument for managing coal-fired power plant assets so that they could continue operating with lower emissions during the transition toward a fully low-carbon electricity system.

This long-term framework was then translated more operationally through the issuance of **Minister of Energy and Mineral Resources Regulation No. 10 of 2025 on the Road Map for the Energy Transition in the Electricity Sector**. In this new road map, biomass co-firing at power plants was established as one of nine primary strategies for energy transition in the electricity sector. This regulation also showed that the role of biomass co-firing does not stand alone. It is linked to other strategies, including the application of carbon capture and storage (CCS). The combination of biomass co-firing and CCS was projected to yield electricity generation capacity of 54 GW, or approximately 12.2 percent of total national electricity generation by 2060. This picture shows that the role of coal-fired power plants in Indonesia's future electricity mix will remain significant, albeit in a technological configuration expected to produce lower emissions.

The latest adjustment to the national electricity system was made again through the adoption of the **2025-2034 Electricity Supply Business Plan (RUPTL)**, which set a biomass mix target of 1.3 percent, equivalent to around 0.9 GW of capacity. To achieve this target, the RUPTL estimated biomass demand at around 10.2 million tons per year, underscoring the scale of biomass supply needed to sustain the biomass co-firing program on an ongoing basis. The document also set out in detail the three main planned sources of biomass supply: first, energy plantation forests, with energy crops such as leucaena, Gliricidia, and Calliandra, as well as the utilization of wood residues from industrial plantation forests production; second, agricultural, plantation, and industrial waste; and third, urban waste..

Figure 2. Projection of National Biomass Needs Based on PLN's 2025-2034 RUPLT



	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Coal-Fired Power Plant (Location)	25	35	47	52	52	52	52	52	52	52
Production (TWh)	0.28	0.34	0.95	3.53	12.71	12.60	11.31	11.35	11.39	11.10
Biomass (Million Tons)	0.25	0.45	1.05	2.83	10.20	10.11	9.08	9.11	9.14	8.91
Emission Reduction Potential (Million Tons of CO2)	0.16	0.41	0.86	3.21	11.58	11.47	10.30	10.33	10.37	10.11

Note: The 2026-2030 period will adjust the loading pattern of coal-fired power plants (PLTU) balanced with renewable energy (KIT) and will be operational after 2025.

Emission Reduction Potential (Million Tons of CO2)

Source: Biomass Presentation in PLN RUPTL 2025-2034 [16]

[16] PLN EPI, *Biomass in PLN's RUPTL 2025-2034 Presentation*. Accessed: Jan. 28, 2026. Available: https://www.plnepi.co.id/bisnis-kami/biomassa

The 2025–2034 RUPTL also cited estimates of biomass supply potential drawn from a study by the Directorate General of New, Renewable Energy and Energy Conservation (EBTKE) of the Ministry of Energy and Mineral Resources[17] and the 2021 UNDP MTR3 report.[18] The studies indicated that existing energy forest potential reached approximately 49,587 hectares, with estimated biomass production of about 991,560 tons, while the potential for energy forest development was projected to be far greater, reaching 27,223,454 hectares with biomass potential of around 544,469,073 tons. These figures were used as the basis for policy optimism regarding long-term biomass availability.

In addition to positioning biomass co-firing as a principal strategy for managing coal-fired power plants during the transition period, the electricity planning document also opened space for the development of biomass and biogas power plants as alternative solutions in isolated areas and small islands. This option was specifically intended for regions that still depend heavily on diesel power plants, which generally have high generation costs, reliance on imported fuel supplies, and relatively high emissions intensity.

Regarding the Energy Plantation Forest (*Hutan Tanaman Energi*/HTE) scheme, the regulatory framework supporting its development was built incrementally. **Regulation of the Minister of Environment and Forestry No. 62 of 2019 on Industrial Plantation Forest Development** served as one of the initial foundations that opened space for diversification of forest product utilization, including for bioenergy needs. This regulation governed not only conventional timber production but also enabled the development of energy crops as part of a strategy for optimizing production forest areas. This regulation was subsequently revoked by Minister of Environment and Forestry Regulation No. 8 of 2021 on Forest Management and the Preparation of Forest Management Plans, as well as Forest Utilization in Protected and Production Forests. The issuance of this new regulation was part of post-Job Creation Law (Law No. 11 of 2020) policy adjustments, which promoted simplification of business licensing and integration of various forest utilization schemes into a risk-based licensing system. This change expanded the legal space for energy plantation forests and bioenergy development within the new business licensing framework.

[17] Directorate General of New, Renewable Energy and Energy Conservation (EBTKE), Performance Report 2024, Jakarta, 2024. Accessed: Jan. 28, 2026. Available: https://www.esdm.go.id/assets/media/content/content-laporan-kinerja-ditjen-ebtke-tahun-2024.pdf

[18] MTRE3, "*Climate Change Mitigation Actions through The Increase of Renewable Energy Use and Energy Efficiency*," 2021. Accessed: Jan. 28, 2026. Available: https://www.undp.org/indonesia/publications/mtre3-project-profile

This framework was further strengthened through Minister of Environment and Forestry Regulation No. 11 of 2020 on Community Plantation Forests, which introduced a different yet complementary dimension. This regulation essentially governed a plant-based social forestry scheme, with the main objectives of granting communities management access, improving local economic welfare, and maintaining forest functions sustainably. Although it did not explicitly mention the term energy plantation forest, the community plantation forest regulation opened substantial space for the development of community-based energy plantation forests, through the planting of the same types of species used as energy crops in the industrial plantation forest scheme, such as sengon, calliandra, gliricidia, bamboo, and other fast-growing species. This regulation was also replaced by a newer regulation, such as Minister of Environment and Forestry Regulation No. 9 of 2021 on Social Forestry Management. In this more recent regulation, provisions concerning community plantation forests no longer stood as a separate regulation, but were integrated into a specific chapter on the social forestry schemes. This approach reflected post-reform policy consolidation following the shift to risk-based licensing, while also broadening the scope of business activities that may be undertaken within approved social forestry areas.

Interestingly, provisions related to bioenergy or biofuels in Minister of Environment and Forestry Regulation No. 9 of 2021 were not placed exclusively in the context of Community Plantation Forests, but rather within the scope of “area utilization activities” in production forests under utilization zones, as well as within the schemes for the utilization or collection of non-timber forest products. Normatively, this construction indicates that bioenergy feedstock may originate either from timber utilization, which requires cultivation, planting, and harvesting activities as is characteristic of plantation forests, or from non-timber utilization and/or forest product collection, which in essence involves taking existing outputs without intensive cultivation processes.

Over time, the direction of bioenergy policy, particularly in the context of biomass co-firing, began to shift from mere technical discourse toward strengthening the upstream supply base. In this context, Energy Plantation Forests (HTE) were positioned as an instrument to ensure a sustainable biomass supply. One of the main measures had been the release of around 6.91 million hectares of forest area, of which about 78 percent consists of oil palm plantations considered to have the potential to be converted or utilized as a source of bioenergy.[19]

[19] Directorate General of New, Renewable Energy and Energy Conservation (DJEBTKE), Ministry of Energy and Mineral Resources (KESDM), Pedoman Investasi Pembangkit Listrik Tenaga Bioenergi [Investment Guidelines for Bioenergy Power Plants], Jakarta, 2021. Available: https://www.abgi.or.id/wp-content/uploads/2023/06/Pedoman_Investasi-PLT-Bioenergi-PLTBm-PLTBg-PLTSa-id.pdf

Beyond area release, the government also granted forest area borrow-use permits for the energy sector covering approximately 0.44 million hectares. This scheme opened space for developing bioenergy facilities and supporting activities within forest areas, including energy crop planting and biomass supply infrastructure. At the business actor level, there were recorded commitments to bioenergy development by 18 business units spread across 10 provinces, with a total energy crop land allocation of approximately 46,600 hectares. These commitments showed that biomass co-firing depends not only on residue or waste supply but also drives new investment at the upstream end of the supply chain through more intensive energy crop planting.[20]

Furthermore, data from the Ministry of Environment and Forestry up to early 2021 recorded energy plantation forest potential of 156,032 hectares managed by 14 business units across various provinces. The types of energy crops developed were relatively diverse, ranging from sengon, calliandra, acacia, mangrove, gliricidia, to bamboo; generally fast-growing species suitable for biomass needs.[21]

Historically, energy plantation forest development began in 2019 with the issuance of 13 concessions. In a relatively short time, this number rose sharply to approximately 52 concessions by 2025.[22] his data demonstrates significant policy escalation and investment interest. This surge reflects the increasingly strong role of bioenergy in forestry and energy sector planning, while marking a shift in the orientation of production forests from solely timber for industry to energy feedstock providers.

The expansion of management space in forest utilization was further solidified through **Government Regulation No. 23 of 2021 on Forestry Administration, which introduced the concept of Multi-Business Forest Utilization Permits** (*Perizinan Berusaha Pemanfaatan Hutan*/PBPH *Multi-Usaha*). This regulation allowed permit holders to undertake various forms of utilization within the same concession, ranging from timber, non-timber forest products, and environmental services to bioenergy. In the energy plantation forest context, this multi-business scheme effectively lowered administrative barriers and increased business flexibility, enabling energy crop development to proceed alongside other forestry activities. Thus, bioenergy did not stand as a separate sector but was integrated into a broader forestry business model.

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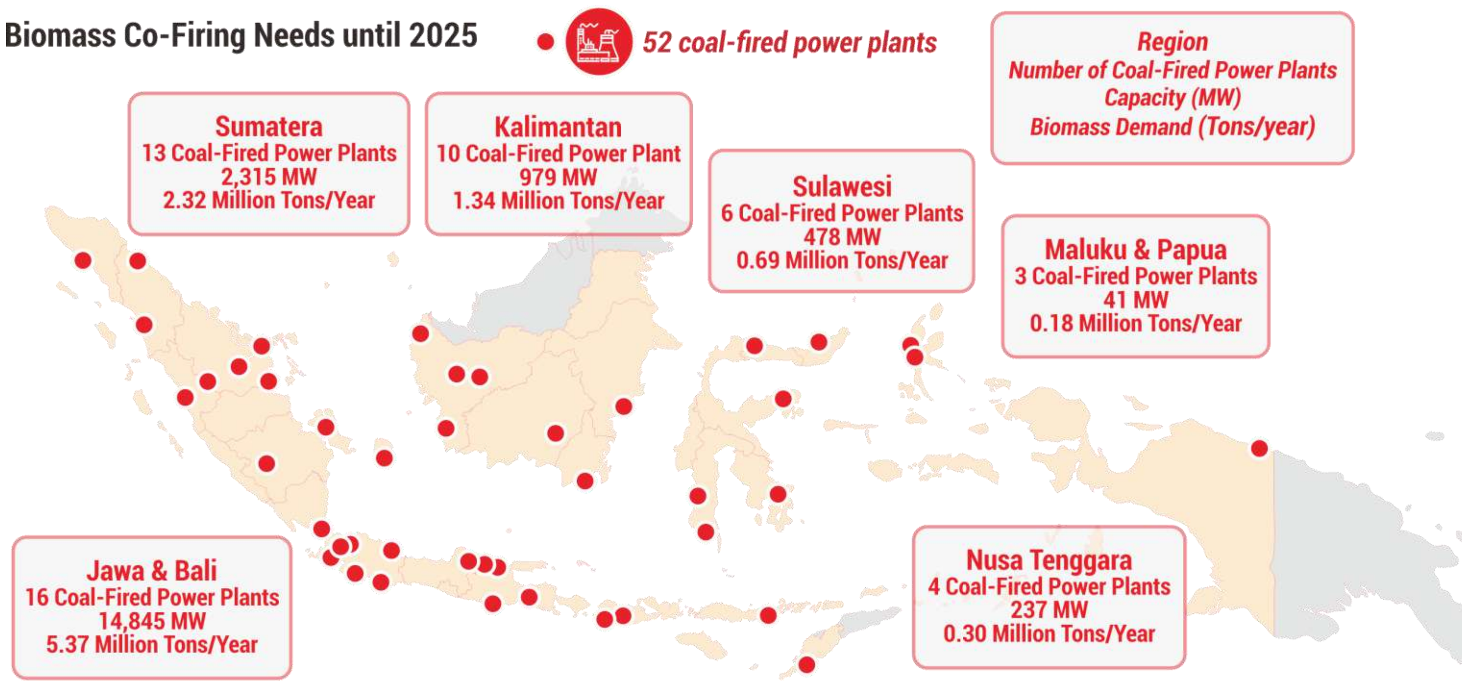
20 Ibid., pp. 50-51

21 Ibid., pp. 50-51

22 Anggi Putra Prayoga, *Bagaimana Kebijakan Transisi Energi Mendorong Deforestasi* [How Energy Transition Policies Drive Deforestation]. Jakarta: Forest Watch Indonesia, 2025.

Subsequently, **Minister of Environment and Forestry Regulation No. 7 of 2021 on Forestry Planning, Changes in Forest Area Designation and Function, and Forest Area Use** granted privileges to energy security projects by designating conversion production forest areas exclusively for such purposes. This policy explicitly reserved forest space for the national energy agenda and confirmed that bioenergy is part of the state's strategic interests. This was complemented by **Minister of Environment and Forestry Regulation (Permen LHK) Number 8 of 2021 on Forest Governance and the Preparation of Forest Management Plans, as well as Forest Utilization in Protected Forests and Production Forests,** which, in its support for bioenergy, regulated the facilitation of energy security projects by Forest Management Units (*Kesatuan Pengelolaan Hutan*/KPH), making the role of local governments and forest management units more central in field-level implementation.

Figure 3. Map of the Distribution of Biomass Co-firing Steam Power Plants in Indonesia



Source: Taken from the 2025-2034 RUPTL

2.3. Biomass Supply Chain Traceability

Biomass co-firing in Indonesia grew out of an urgent and pragmatic need: to fulfill the renewable energy mix promise and maintain electricity reliability amid a system that still depends on coal-fired power plants. It has become an "in-between strategy," a bridge connecting a fossil-based past with a low-carbon future. Yet behind that promise lie fundamental questions about where biomass comes from, the sustainability of forests and land, and justice for communities at the upstream end of the supply chain. Biomass co-firing is thus not only a matter of combustion technique, but a story about how a nation rearranges the relationship between energy, nature, and people on the journey toward a more balanced transition.

This bridge of transition called biomass co-firing is built not only on technology and policy, but also on trust. When high-calorific wood, forestry industry waste, or plantation and agricultural waste are elevated into biomass fuel, several key questions immediately arise: *where does it come from*, and *by what means does it reach the combustion chamber of a coal-fired power plant*? This is where the concept of traceability becomes the vital thread connecting the promise of the energy transition with practice on the ground.

In the context of co-firing at coal-fired power plants, biomass is not a single, homogeneous commodity. It comes from diverse landscapes, ranging from energy plantations, smallholder farms, and residues from the forestry industry to agricultural and urban waste, each carrying distinct ecological, social, and governance footprints. Without an adequate traceability system, biomass risks losing its identity once it enters the supply chain. This loss of identity often occurs through blending, layered trading, and repeated processing, in which biomass from different sources—both sustainable and problematic—is combined without adequate separation or record-keeping. At that point, biomass is transformed from a resource with a particular ecological and social context into mere **"fuel**," anonymous and detached from the traces of its origin. This condition is dangerous for at least three reasons:

1. This identity loss obscures environmental risks. Biomass originating from deforestation, forest degradation, or illegal land conversion can be "masked" and still recognized as renewable energy, thereby actually worsening ecosystem destruction in the name of energy transition.

2. Identity loss also erases the social trail, including potential violations of indigenous and local community rights, land conflicts, or substandard labor practices at the upstream end of the supply chain. Without a clear identity, no party can truly be held accountable.

3. From a policy and governance perspective, the loss of biomass identity undermines energy system integrity. Public incentives, special purchase prices, and NRE recognition may be misdirected because they are granted to biomass that in fact does not meet sustainability criteria.

In the long term, this not only weakens the goal of emissions reduction, but also erodes public trust in the energy transition agenda itself. Traceability therefore functions as a mechanism to ensure that biomass retains its "identity," and by fulfilling traceability requirements, helps ensure that the energy transition proceeds responsibly.

The urgency of traceability has also been addressed in various international publications and studies on biomass and sustainability-related commodities. Through the application of traceability principles, companies are expected to track a product or its components through various stages of the supply chain (e.g., production, processing, manufacturing, distribution, etc.). Traceability enables companies to link product volumes with specific attributes of suppliers and/or production locations. Achieving traceability often requires companies to identify the various parties involved in their supply chain and understand the relationships among them—a process known as supply chain mapping.[23] In the biomass context, the Sustainable Biomass Program (SBP) focuses on woody biomass for large-scale industrial energy production, while the International Sustainability and Carbon Certification focuses on forestry and agricultural biomass.[24]

In simple terms, traceability can be analyzed through three dimensions: **Geographical route**, **chain of custody**, and **physical evolution**.[25] All three dimensions will be traversed by a commodity throughout its supply chain. These traceability principles become critical in biomass co-firing, where renewable energy claims and emission reduction depend heavily on how biomass is produced, traded, and used.

Within this theoretical framework, biomass traceability can be understood as a mechanism for addressing three main dimensions:

1. **The geographical dimension,** which encompasses the ability to identify the origin of biomass: whether it comes from agricultural waste, energy plantation forests, industrial plantation forests, or other sources, including the location of production, processing, and distribution routes to the coal-fired power plants. This dimension is important for assessing deforestation risks, land conflicts, and consistency with forestry and environmental policies.

2. **The chain of custody dimension,** which encompasses the identification of actors involved along the biomass supply chain, from raw material producers, aggregators, and traders to end users at power plants. Chain of custody transparency becomes a prerequisite for reducing governance risks, including non-transparent procurement practices, market concentration, and corruption potential. In the context of biomass co-firing, this dimension becomes increasingly important given the growing scale of biomass demand and the involvement of various entities across the forestry, energy, and trade sectors.

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23 Accountability Framework Initiative. *Traceability*. https://accountability-framework.org/fileadmin/uploads/afi/Documents/Traceability-Accountability-Framework.pdf

24 OECD & FAO. (2023). *Business Handbook on Deforestation and Due Diligence in Agricultural Supply Chain*. https://www.oecd.org/content/dam/oecd/en/publications/reports/2023/07/oecd-fao-business-handbook-on-deforestation-and-due-diligence-in-agricultural-supply-chains_4489399b/c0d4bca7-en.pdf

25 IEA & OECD. (2025) *The Role of Traceability in Critical Mineral Supply Chains*. https://iea.blob.core.windows.net/assets/aa827202-9d85-4805-b3ac-d489d3b900e3/TheRoleofTraceabilityinCriticalMineralSupplyChains.pdf

3. **The physical evolution dimension,** which is the ability to track changes in the form and characteristics of biomass (e.g. from roundwood to wood chips or wood pellet) as well as blending that occurs before use in co-firing at coal-fired power plants. Tracking physical transformation becomes critical to ensure that information about origins and sustainability is not lost during processing and trading, especially when biomass is sourced from multiple sources.

In the context of biomass co-firing, the traceability approach is important because it functions as a guardian of meaning throughout the biomass supply chain. The absence of traceability also creates space for the entry of biomass originating from problematic practices such as natural forest logging, unlawful land conversion, the blending of biomass from legal and illegal land, or the neglect of the rights of local and Indigenous communities. This risk becomes even greater when biomass demand rises rapidly, as in a nationwide biomass co-firing program, while oversight capacity does not develop at the same pace. Without a clear trail, violations at the upstream end of the supply chain become difficult to detect, and their environmental and social impacts may remain hidden behind the narrative of the energy transition.

Indonesia actually has a systemic framework in the forestry sector designed to address issues of legality and supply chain governance for forest products, particularly timber—the Timber Legality Verification System (*Sistem Verifikasi Legalitas Kayu*/SVLK). The SVLK requires forestry business actors to ensure that the timber they produce and trade comes from legal and traceable sources. This system is supported by an online platform called the Timber Legality Information System (*Sistem Informasi Legalitas Kayu*/SILK). The platform digitally documents the movement and licensing of timber products, particularly timber products for export. Conceptually, the SVLK-SILK certification system is a state effort to build a transparent and accountable chain of custody.

However, in recent times, there has been discourse on deregulating the SVLK, which could reshape that governance landscape. In essence, this deregulation proposal would relax the requirement for V-Legal documents, especially for downstream products such as furniture and handicrafts for certain export destinations. The government plans to make V-Legal documents optional for markets outside the European Union and the United Kingdom, and to relax hundreds of Harmonized System (HS) codes in the forestry sector, including by removing due diligence and import declaration requirements for a number of timber products.[26] Although the SVLK would remain mandatory for primary timber products such as logs or beams, this approach creates a partial application between upstream and downstream stages.[27]

[26] Ferry Sandi, "*Mendag & Pengusaha 'Sepakat' Ekspor Furnitur-Kerajinan Tak Wajib SVLK*" [Trade Minister and Business Actors "Agree" That Furniture and Handicraft Exports Are Not Required to Use SVLK], May 21, 2025. Available: https://www.cnbcindonesia.com/news/20250521181700-4-635122/mendag-pengusaha-sepakat-ekspor-furnitur-kerajinan-tak-wajib-svlk

[27] Aguido Adri, "*Daya Saing Produk Mebel Tertekan Aturan Sertifikasi Ganda*" [Competitiveness of Furniture Products Pressured by Dual Certification Regulations], August 5, 2025. Available: https://www.kompas.id/artikel/daya-saing-produk-mebel-tertekan-aturan-sertifikasi-ganda

This discourse affects not only timber trade governance, but also has broader implications for other forest-based commodities, including biomass for energy needs. This is where the next challenge emerges. For biomass commodities, the challenge lies in the extent to which a traceability system such as the SVLK can accommodate the variety of biomass sources, whether from plantation forests, social forestry, wood waste, or non-timber forest product collection. Not all biomass materials used for energy blending fall under the same stringent oversight regime as timber. This is especially so when biomass is categorized as residue or industrial waste, in which case oversight may be looser than for logs or processed timber products.

This is where the need to strengthen traceability in biomass commodities becomes pressing. The potential for developing a biomass traceability system can actually be built by integrating Indonesia's existing timber legality system into reporting and verification requirements for biomass commodities. In other words, it is entirely possible to link data on feedstock origins, business permits, and timber transport documents with the biomass consumption reporting system at power plants.

Furthermore, this traceability system also enables the integration of various environmental, social, and governance (ESG) indicators, such as greenhouse gas emissions throughout the biomass life cycle, biodiversity impacts, beneficial ownership, compliance with forestry and labor regulations, as well as human rights violation and corruption risks. It can serve as the foundation for assessing whether the biomass used truly supports energy transition objectives, or only shifts environmental and social burdens to other sectors. Thus, in the context of biomass co-firing in Indonesia, the traceability approach can be understood as a cross-sectoral governance framework bridging energy, forestry, environmental, and anti-corruption policies.

2.4 Corruption Risks in Goods and Services Procurement

In the literature on public sector governance and state-owned enterprises (SOEs), the procurement function is consistently identified as an area with a high level of corruption risk, as it involves high-value transactions, discretionary space in decision-making, and intensive interaction with market interests. These characteristics are relevant to the procurement context within SOEs. The significant scale of expenditure, involvement of various internal and external actors, and technical complexity of goods and services make procurement of goods and services a governance node that is vulnerable to manipulation.

Following Klitgaard's analytical framework, corruption risk increases when monopoly of authority, high levels of discretion, and limited accountability mechanisms are present simultaneously.[28] In SOE procurement practice, all three conditions are frequently found, especially in procurement that is specialized, strategic, and conducted on a recurring basis.

The Organisation for Economic Co-operation and Development (OECD) emphasizes that integrity violations can emerge across the entire procurement cycle—pre-tender, tender, and post-award—encompassing bribery, collusion/cartels, nepotism, conflicts of interest, fraud, and product substitution. This means corruption risk is not only present "at the tender moment" but also at the initial stage of needs assessment design and at the final stage of goods receipt and payment.[29]

In line with this, the perspective of Indonesia's Corruption Eradication Commission (*Komisi Pemberantasan Korupsi*/KPK) underscores that fraud in procurement of goods and services often originates at the planning stage, for example through mark-ups in procurement plans, procurement designed to favor certain suppliers, and unrealistic scheduling. patterns that are highly compatible with a "race for volume" situation to meet biomass demand, when supply urgency is often used as a justification to accelerate processes, narrow competition, and reduce due diligence.[30]

Unlike conventional fuels, biomass is a natural resource-based commodity with a long, fragmented supply chain that is heavily influenced by geographic conditions and local markets. These characteristics amplify information asymmetry between buyers and suppliers, make it difficult to verify costs and raw material origins, and inherently increase governance and corruption risks in the procurement process.[31]

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28 R. Klitgaard, *Controlling corruption*. Univ of California Press, 1988.

29 OECD, "*Implementing the OECD Principles for Integrity in Public Procurement*," 2013. https://doi.org/10.1787/9789264201385-en.

30 ACLC KPK, "Mencegah Korupsi pada Pengadaan Barang & Jasa," [Preventing Corruption in Public Procurement]. Accessed: Jan. 28, 2026. Available: https://aclc.kpk.go.id/aksi-informasi/Eksplorasi/20240506-mencegah-korupsi-pada-pengadaan-barang-jasa

31 Transparency International Indonesia, "*Corruption Risk Assessment CRA in Renewable Energy-Based Electricity Supply*," Jakarta, 2024. Accessed: Jan. 28, 2026. https://ti.or.id/wp-content/uploads/2025/01/CRA-in-Renewable-Energy-Based-Electricity-Supply.pdf

Following the procurement cycle, the risk of manipulation in biomass procurement arises from the planning stage through to contract implementation. At the planning and needs determination stage, the primary risk lies in the engineering of technical specifications and the Owner's Estimate (*Harga Perkiraan Sendiri*/HPS). Public procurement literature shows that specification tailoring (the deliberate design of specifications that steer toward specific providers) is one of the most common and most difficult-to-detect corruption methods because it is wrapped in technical justifications that appear administratively legitimate.[32] This practice frequently occurs in procurement with high technical complexity and limited market comparisons, such as for energy commodities and natural resources.

The procurement method selection stage becomes the next critical point. Non-competitive mechanisms such as direct appointment, while legally permissible, are widely categorized as high corruption risk procedures when not accompanied by independent review and adequate transparency of justification. Transparency International asserts that less competitive procurement procedures increase the risk of favoritism, collusion, and abuse of discretion, particularly when the method selection decision cannot be openly scrutinized using market-based evidence.[33]

The significant discretion at this stage can drive paper compliance, a condition in which adherence to administrative procedures (such as completeness of justification documents and formal approvals) does not correspond to substantive corruption risk control.[34] The OECD notes that discretion not counterbalanced by independent oversight mechanisms and ex post accountability is a primary factor enabling procurement deviations, including winner rigging and vendor lock-in.[35] In the context of biomass procurement, the immature market and the pretext of urgent operational needs further amplify this vulnerability.

32 OECD, "*Preventing Corruption in Public Procurement*," 2016. (pp. 29-31)

33 M. Jenkins, A. Greco, and A. Khaghaghordyan, "*Transparency International Anti-Corruption Helpdesk Answer*," 2024.

34 Matthias Morgner and Marie Chêne, "*Public Procurement Topic Guide Compiled by The Anti-Corruption Helpdesk*," 2014. Accessed: Jan. 28, 2026. Available: https://knowledgehub.transparencycdn.org/topic-guides/Public-procurement-topic-guide.pdf

35 OECD, "*Managing Conflict of Interest in the Public Sector*," 2005. Accessed: Jan. 28, 2026. Available: http://www.sourceoecd.org/governance/9264018220http://www.sourceoecd.org/926418220

2.5. Regulatory Framework for Biomass Procurement at PLN (State Electricity Company)

The regulatory framework governing biomass procurement for Indonesia's electricity sector remains fragmented and has yet to stand as a coherent policy regime of its own. Biomass is positioned as part of new and renewable energy (NRE), yet its regulation is scattered across various legal instruments governing energy, electricity, SOE procurement, as well as forestry and environmental affairs. This condition places PLN's biomass procurement within an overlapping policy space between the mandate for energy transition and the conventional primary energy procurement regime.

Law No. 30 of 2007 on Energy and Government Regulation No. 79 of 2014 on National Energy Policy (KEN) provide the legal basis for energy diversification and the increased use of NRE, including bioenergy. This mandate was further operationalized through Presidential Regulation No. 22 of 2017 on the National Energy General Plan (RUEN), which instructed the utilization of biomass in the electricity sector, both through the development of biomass power plants and the implementation of co-firing schemes in coal-fired power plants.[36]

Recent regulatory developments, particularly Presidential Regulation No. 112 of 2022 on Acceleration of Renewable Energy Development and MEMR Regulation No. 12 of 2023 on Utilization of Biomass as Fuel Blend at Coal-Fired Power Plants, further affirm biomass as a medium-term energy transition instrument.[37] However, these regulations placed greater emphasis on output aspects (NRE mix achievement and emission reduction), while input aspects such as biomass procurement covering source legality, market structure, and supply chain governance remained insufficiently regulated in a detailed and integrated manner.

In this context, biomass procurement by PT PLN (Persero) operates in a policy space that opens wide discretion at the implementation level, as the mandate to use biomass is not matched with a specific national procurement framework.

Normatively, biomass procurement at PLN was regulated through PLN Board of Directors Regulation No. 1 of 2020 on Guidelines for Implementation of Co-Firing at Coal-Fired Power Plants with Biomass Fuel. Article 6 of this regulation stipulates that biomass procurement is conducted by PLN Main Units and/or subsidiary companies managing coal-fired power plants using the coal fuel procurement budget[38]. This arrangement reflected an integrative approach, where biomass was treated as a partial substitute for fossil fuel within the existing system.

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36 Law Number 30 of 2007 on Energy; Presidential Regulation Number 22 of 2017 on the National Energy General Plan (RUEN).

37 Presidential Regulation Number 112 of 2022 on the Acceleration of Renewable Energy Development; Minister of Energy and Mineral Resources Regulation Number 12 of 2023 on the Utilization of Biomass as a Co-firing Fuel in Coal-Fired Power Plants.

38 PLN Board of Directors Regulation No. 1 of 2020, Article 6, on Guidelines for the Implementation of Co-firing in Coal-Fired Steam Power Plants Using Biomass Fuel.

With the establishment of PLN Energi Primer Indonesia (PLN EPI) as the primary energy subholding, significant changes occurred in procurement governance. The primary energy procurement function including coal, gas, fuel oil, and biomass was consolidated under a centralized procurement scheme (single point of procurement). PLN EPI is responsible for needs planning, Owner's Estimate (HPS) determination, contract negotiation, and coordination of biomass supply for generating units within the PLN Group.[39]

This institutional change improves coordination efficiency and supply consistency, but at the same time centralizes procurement discretion in a single entity. In the context of biomass, where the market remains underdeveloped and the supply chain fragmented, this consolidation heightens governance risks if it is not balanced by adequate oversight and accountability mechanisms.

PLN Board of Directors Regulation No. 1 of 2020 thus remains the primary normative reference for biomass procurement, but its implementation now occurs within a different institutional architecture, where the primary energy procurement function is no longer entirely fragmented at the generating unit level. This institutional change is important to note because it has direct implications for patterns of discretion, oversight mechanisms, and accountability points in biomass procurement.

The same regulation stipulated that the Owner's Estimate (HPS) for biomass procurement is composed of feedstocks, production cost, transportation cost, storage cost, and margin components.[40] This pricing structure provides flexibility for PLN and, in practice, PLN EPI, to adjust biomass prices to local conditions and the varied characteristics of the supply chain. However, various studies on public procurement governance in the natural resources sector show that non-material cost components, such as logistics, transportation, storage, and margin, are the areas most vulnerable to manipulation. This vulnerability arises because these components are difficult to verify independently, highly dependent on supplier-provided information, and lack transparent price benchmarks, especially for non-standard commodities with fragmented supply chains like energy biomass.[41]

The Board Regulation also opened space for the use of non-competitive mechanisms such as direct appointment for biomass procurement in the context of pilot projects, as well as for operational periods through general procurement mechanisms or assignments to subsidiaries[42]. This flexibility is operationally understood as a response to the limitations of the biomass market, but from the perspective of corruption prevention, it also broadens the space for discretion that must be tightly controlled.

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39 PT PLN (Persero), "*Subholding PLN Energi Primer Indonesia, Beri Jaminan Kepastian Pasokan Energi Primer untuk Pembangkit Listrik*" [PLN Energi Primer Indonesia Subholding Ensures Certainty of Primary Energy Supply for Power Plants]. Accessed: Jan. 28, 2026. Available: https://web.pln.co.id/media/siaran-pers/2022/09/subholding-pln-energi-primer-indonesia-beri-jaminan-kepastian-pasokan-energi-primer-untuk-pembangkit-listrik

40 PLN Board of Directors Regulation No. 1 of 2020.

41 OECD, "*OECD Development Policy Tools Corruption in the Extractive Value Chain: Typology of Risks, Mitigation Measures and Incentives*," 2016. Accessed: Jan. 28, 2026. Available: https://www.oecd.org/content/dam/oecd/en/publications/reports/2016/08/corruption-in-the-extractive-value-chain_g1g676bf/9789264256569-en.pdf

42 PLN Board of Directors Regulation No. 1 of 2020.

CHAPTER III
RESEARCH METHODOLOGY

3.1. Research Design

The method used in this research is qualitative-exploratory, specifically framed through a Corruption Risk Assessment (CRA) approach. The qualitative-exploratory research method positions the researcher as a detective who continuously explores three main elements: ideas, inputs, and clarification of findings.[43] The CRA approach is a "diagnostic tool aimed at identifying weaknesses in a system that could create opportunities for corruption."[44] Through the CRA approach, the process of analyzing, assessing, and evaluating various corruption-causing factors and their impacts becomes entirely feasible. Thus, the chosen method determines how data is collected, while the CRA framework is used to delimit which data is gathered to explore potential corruption.

Using the CRA framework, analytical boundaries can be established by determining two main elements referred to as criteria and aspects. According to Bariroh et al. (2020), there are at least four corruption risk assessment aspects in CRA: (1) compliance, (2) implementation, (3) administration, and (4) corruption control[45]. These assessment aspects can be used as guides for evaluating various factors considered vulnerable to becoming opportunities exploited by various parties to commit corruption. After determining the aspects, each is then distilled into criteria for further identification. These aspects and criteria were not adopted literally and explicitly in this research. Rather, both concepts were used as analytical boundary guides.

In practice, the CRA approach used in this research was focused on exploring corruption risks particularly in the biomass procurement supply chain for co-firing in coal-fired power plants in Java. Biomass procurement is a program implemented by the PLN Group as a "short-term (2024-2025) and medium-term (2026-2030) decarbonization strategy.".[46] Initially, only 43 co-firing coal-fired power plants implemented the biomass-coal energy mix in their power plants in 2023. This number rose to 47 power plants in 2024 and was projected to increase

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43 Stevens, L., & Wrenn, C. (2013). Exploratory (qualitative) research. *Concise Encyclopedia of Church and Religious Organization Marketing*, *53*.

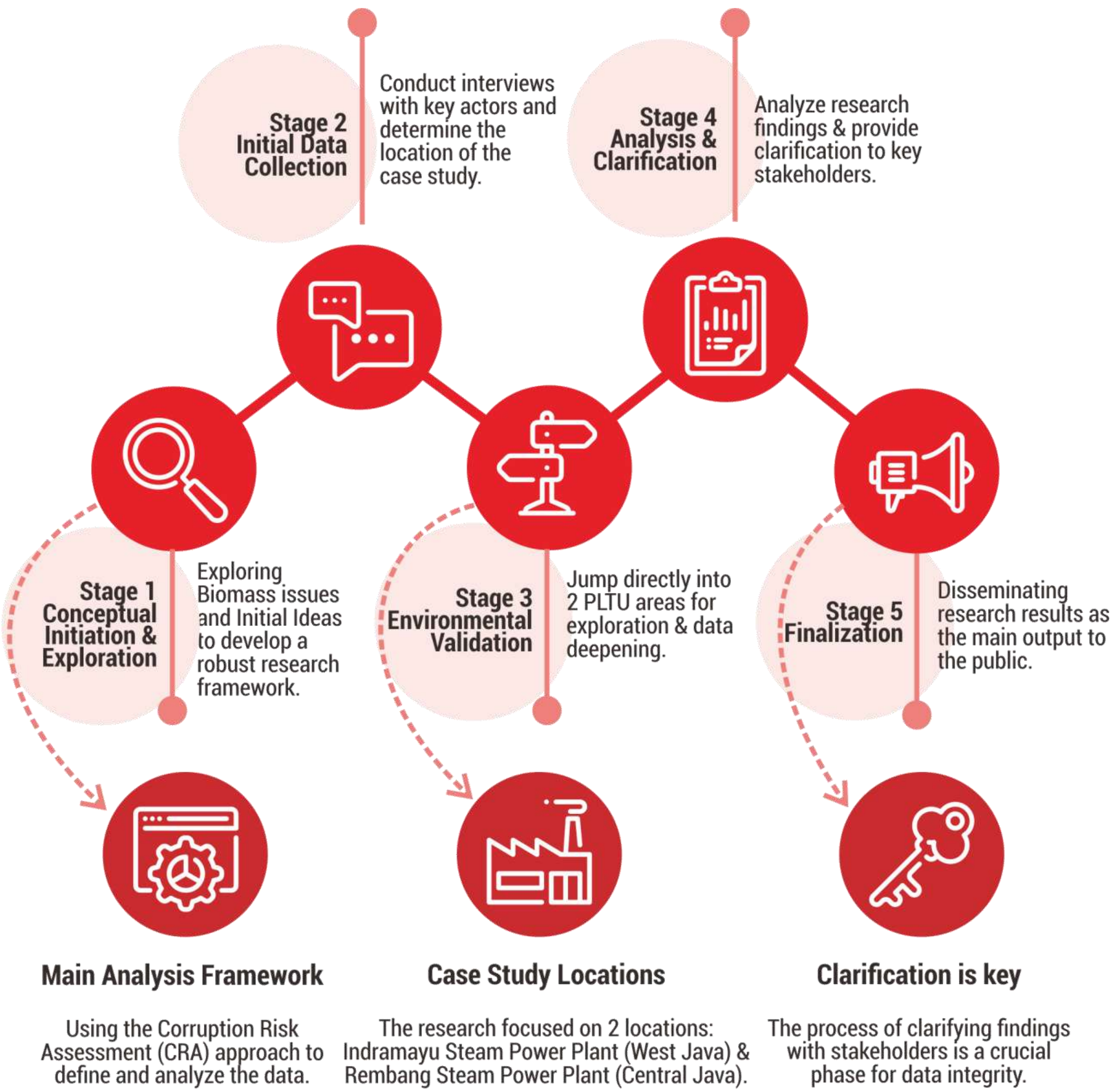
44 Andy McDevitt, "*Corruption Risk Assessment Topic Guide*," Jul. 2011. (pp. 1)

45 Barid., Bariroh et al., *"Metode CRA dalam Pencegahan Korupsi Melalui Perbaikan Regulasi"* [CRA Method in Corruption Prevention through Regulatory Improvement], Komisi Pemberantasan Korupsi (KPK), 2020.

46 PT PLN (Persero), *Annual Report 2024: Realizing Sustainable Energy Self-Sufficiency with Integrity, Transparency, and Accountability*, 2024.

further to 52 power plants by 2025. This means that amid intensive efforts to implement biomass procurement for co-firing at coal-fired power plants, the PLN Group is also simultaneously required to improve procurement policies related to the biomass supply chain. To achieve a more comprehensive analysis, this research selected two coal-fired power plants that have implemented biomass co-firing for exploration: Indramayu coal-fired power plants in West Java and Rembang coal-fired power plants in Central Java. In summary, the research design is as follows:

Figure 4. CRA Biomass Research Flow



The various research phases outlined above do not only emphasize the search for ideas and the incorporation of input from the informants consulted, but also take into account the clarification of findings, particularly with PLN EPI. It is this clarification phase that has not been found in several previous studies. Efforts to clarify findings, especially with particular stakeholders, are often overlooked. Yet within the CRA framework, such clarification is necessary in order to achieve data completeness.

3.2. Data Collection Techniques

The data collection techniques in this research are divided into two categories: general and specific. The general data collection techniques are intended to generate ideas, gather input, and at the same time provide decision-makers with a better understanding of the issue of potential corruption in biomass. These general data collection techniques consist of, *first*, a review of documents supporting the research, such as documents related to biomass procurement available on PLN EPI's official website, the Annual Reports and Sustainability Reports of PT PLN (Persero) and PT PLN EPI, sawdust supply procedure documents, and several other documents, including the National Electricity General Plan (RUKN), the Enhanced Nationally Determined Contribution (NDC), and the Electricity Supply Business Plan (RUPTL).

Additionally, data collected from the main source of the Directorate General of General Legal Administration's website were also used to enrich the case study analysis, particularly in tracing the beneficial ownership of several of PLN EPI's biomass supplier partners. *Second*, in-depth interviews were conducted with several parties, including biomass truck drivers, small furniture business owners around the power plants' area, PLN's Energy Transition and Sustainability Division (TEK PLN), PLN Energi Primer Indonesia (EPI), biomass business actors from the Indonesian Renewable Energy Society (METI), power plant workers, and biomass supplier vendors. The *third* data collection technique was field observation. It was in this field observation stage that the more specific data collection took place, as the research team was divided into two different locations: the Indramayu coal-fired power plant in West Java and the Rembang coal-fired power plant in Central Java. Both power plants have implemented biomass co-firing, which has been piloted since 2020.[47]

[47] Ministry of Energy and Mineral Resources of the Republic of Indonesia (ESDM), "*Dukung Target Bauran EBT, PLN Lakukan Uji Coba Metode Co-Firing PLTU*" [Support for Renewable Energy Mix Targets: PLN Conducts Co-Firing Trials in Coal-Fired Power Plants]. Accessed: Jan. 19, 2026. Available: https://www.esdm.go.id/en/media-center/news-archives/dukung-target-bauran-ebt-pln-lakukan-uji-coba-metode-co-firing-pltu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CHAPTER IV
NAVIGATING THE GREY ZONES IN THE BIOMASS CO-FIRING PROGRAM: GOVERNANCE, DISCRETION, AND THE SHADOW OF CORRUPTION

4.1. Corruption Gaps at the Feedstock Supply Level

Achieving a 23 percent energy mix while pursuing Net Zero Emission by 2060 is no longer a target that exists only on paper for PLN.[48] To make it happen, the approach deemed most realistic is implementing biomass co-firing, which is burning biomass together with coal in power plant boilers.[49] This process is considered capable of reducing the amount of coal burned, thereby reducing the resulting emissions. Various types of biomass, from wood pellets, sawdust, palm frond bunches, to municipal waste, have become the prized commodities needed to keep the biomass co-firing program at coal-fired power plants running smoothly.[50] PT PLN Energi Primer Indonesia (PLN EPI) plays a vital role in the procurement process to meet the supply needs of various types of biomass for power plants mandated to implement the biomass co-firing program.

However, PLN EPI's vital role as the frontline of biomass supply to numerous coal-fired power plants across Indonesia does not proceed without obstacles. An initial examination through PLN EPI's official website reveals that transparency of information related to biomass procurement remains severely limited. The information accessible to the public generally covers only the qualification of biomass partner candidates and general explanations of the open tender mechanism.[51] Yet, by policy design, biomass supply procurement for coal-fired power plants is intended to be possible through at least two mechanisms: open tender and direct appointment. The absence of adequate information regarding when and under what conditions each mechanism is applied creates a grey zone in procurement practice. After confirmation through direct interviews with PLN EPI, it was found that, to date, there are indeed no standardized and scheduled procedures governing when the open tender

48 PLN Energi Primer Indonesia, "*PLN Energi Primer Indonesia - Biomassa*." Accessed: Jan. 09, 2026. Available: https://www.plnepi.co.id/bisnis-kami/biomassa

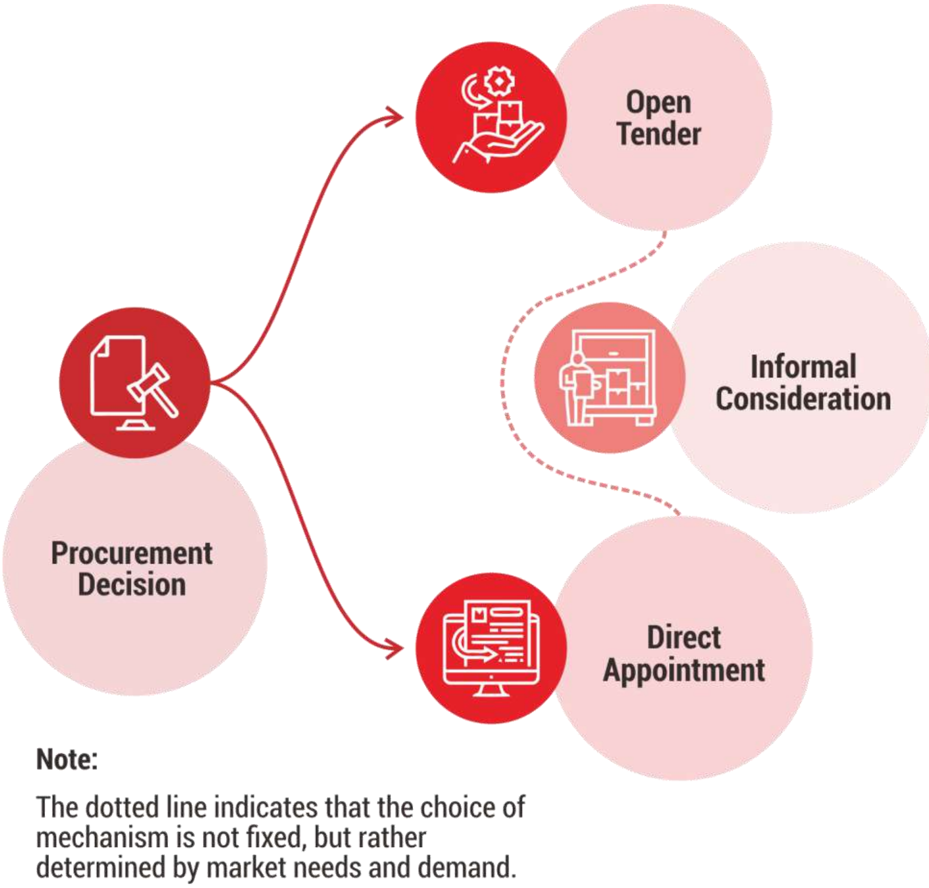
49 I. D. Apriliyanti and D. B. Nugraha, "*Burning coal in a cleaner way: Institutional fragmentation, power dynamics, and business influence in Indonesia's biomass co-firing imaginaries*," Energy Res Soc Sci, vol. 121, p. 103949, 2025.

50 PLN EPI, "*Persyaratan Umum Kualifikasi Calon Mitra Penyedia Bahan Bakar Biomassa PT PLN Energi Primer Indonesia*" [General Qualification Requirements for Prospective Biomass Fuel Suppliers of PT PLN Energi Primer Indonesia]. Accessed: Jan. 15, 2026. Available: https://cmsadmin.plnepi.co.id/storage/media/PENGUMUMAN%20PERSYARATAN%20CALON%20MITRA%20PENYEDIA%20BIOMASSA%20.pdf

51 PLN Energi Primer Indonesia, "*Informasi Pengadaan*" [Procurement Information]. https://www.plnepi.co.id/pengadaan/informasi-pengadaan. Accessed: Jan. 09, 2026. Available: https://www.plnepi.co.id/pengadaan/informasi-pengadaan

mechanism versus direct appointment of aggregator partners for biomass supply should be applied. Both open tender and direct appointment are understood as flexible options that are highly dependent on operational conditions in the field. Procurement decisions are often born from pragmatic considerations articulated in simple terms to ensure continuity of supply so that generating units can continue to operate. Within this logic, both open tender and direct appointment are viewed as equally legitimate as long as they meet the urgent needs of the electricity system. The implication is that procedural considerations and transparency principles tend to be sidelined by technical urgency, collectively framed as an effort to "keep the lights on."[52]

Figure 5. Initial Decision Making for Biomass Procurement by PLN EPI



(Compiled by authors, 2025)

[52] PLN EPI, *Interview Transcript*, December 4, 2025.

The absence of certainty regarding the choice of biomass procurement mechanism, whether through open tender or direct appointment, creates a "grey" arena in governance practice. In this context, it is not an exaggeration to describe it as a form of "irregular discretion.".[53] Conceptually, discretion may be understood as the granting of freedom to procurement administrators to make decisions guided by general principles of good governance, rather than rigid technical rules.[54] To a certain extent, discretion may indeed be necessary to respond to operational dynamics and situations that cannot be fully anticipated by written regulations.

However, when this freedom is exercised without a clear, transparent, and accountable framework, the discretionary process can become a corruption vulnerability point. The absence of clarity regarding these procedures opens opportunities for decisions that are selective, difficult to trace, and susceptible to influence by particular interests. his risk is reflected in the alleged bribery case related to the construction of the Riau-1 coal-fired power plant, in which the public questioned the direct appointment scheme used to select the project development partner by PLN's subsidiary, PT Pembangkitan Jawa-Bali (PJB). This situation became especially problematic given that under Board of Directors Regulation No. 0336 of 2017 issued by PLN, PLN's subsidiaries (such as PJB) were not required to seek a project development partner for the Riau-1 coal-fired power plant.[55] In the absence of such an obligation, the decision to nevertheless appoint a development partner through direct appointment raised questions about the basis for that decision and the accountability of the decision-making process. Ultimately, the alleged bribery case involving a member of parliament and a businessman not only shook the project's legitimacy, but also led to the temporary suspension of the Riau-1 project.[56] This case confirms how poorly managed discretion can transform from an administrative solution into a source of governance crisis.

At PLN EPI level, the absence of objective and clear criteria, particularly in deciding whether procurement should proceed through open tender or direct appointment, risks giving rise to a very similar case. To date, procurement decisions still rest on "considerations" that are largely informal and situational, especially those driven by the need to meet urgent demands so that power plants can continue operating and electricity supply is not disrupted. In this context, discretion is not exercised as a managed policy instrument, but rather as a pragmatic response to short-term operational pressure. This kind of irregular discretion can also have broader consequences in weakening the traceability and visibility of the biomass supply chain, especially at the lower levels, such as collectors, truck drivers, furniture producers, and the like. The complexity of the supply chain at this lower level is further aggravated by transaction practices that tend to be informal, including the use of social media intermediaries for biomass transactions, which makes the potential for corruption at that level difficult for the company to monitor due to the lack of documentation and audit trails. In a situation where procurement rules at the upper level remain uncertain, potential irregularities become increasingly difficult to oversee.

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53 M. Jenkins, A. Greco, and A. Khaghaghordyan, "*Transparency International Anti-Corruption Helpdesk Answer*," 2024.

54 Ibid. (p. 18)

55 "Penunjukan Langsung Pengembang PLTU Riau 1 Rawan Penyimpangan | tempo.co." Accessed: Jan. 27, 2026. Available: https://www.tempo.co/arsip/penunjukan-langsung-pengembang-pltu-riau-1-rawan-penyimpangan-884489

56 "Anak Usaha PLN: Pemilihan Mitra Proyek PLTU Riau 1 Sesuai Aturan | tempo.co." Accessed: Jan. 27, 2026. Available: https://www.tempo.co/ekonomi/anak-usaha-pln-pemilihan-mitra-proyek-pltu-riau-1-sesuai-aturan-884621

According to Transparency International researchers Jenkins, Greco, and Khaghaghordyan (2024), discretion in procurement processes is not inherently a bad decision, provided it is exercised within a clear and accountable framework.[57] In some procurement cases, discretion can be exercised for the purpose of innovation and achieving greater value for money.[58] However, discretion in procurement must not be exercised in a grey zone. The rules of the game must must remain fixed, clear, and equipped with "objective criteria" that determine when discretion may be exercised, and when it may not, so that it does not become a loophole for individuals, groups, political elites, or business interests to extract private gain from the procurement process. Furthermore, procurement arrangements that rely entirely on informal discretion tend to produce decisions that are sporadic and unpredictable. Reflecting on the procurement context at PLN EPI, decisions based on pragmatic reasoning such as "urgent needs to keep the lights on" or "to keep the power plant running" may appear technically rational, but at the same time risk sacrificing the principles of transparency and accountability. In the long term, this pattern of decision-making not only weakens procurement governance but also amplifies the risk of structured irregularities throughout the biomass supply chain.

57 M. Jenkins, A. Greco, and A. Khaghaghordyan, "Transparency International Anti-Corruption Helpdesk Answer," 2024.

58 Ibid.

In addition to weakening governance, the practice of irregular discretion also gives rise to significant rent-seeking potential. Rent-seeking constitutes a very real corruption risk within the supply chain, arising from at least two sides.

First, the uncertainty surrounding the mechanism between open tender and direct appointment creates a loophole known as contestable rent. “Contestable rent is an economic gain, privilege, or asset created through regulation that remains open to competition before that asset is formally granted to a particular economic agent.”.[59] In a regulatory environment that is not clearly defined, the status of aggregators (suppliers) is perceived as a limited and highly competitive access point among vendors or partners. This situation resembles a “lottery,” potentially encouraging informal efforts to influence supplier selection processes, including through non-transparent lobbying practices. In the context of biomass procurement, irregular discretion reflected in PLN EPI's regulations where direct appointment or open tender can be chosen based on informal operational considerations, such as the pretext of maintaining electricity supply continuity “to keep the lights on” may be used to bypass competitive procurement mechanisms. This condition creates opportunities for the emergence of gatekeepers within PLN EPI, namely actors who hold the authority to determine which parties can access procurement contracts.

Second, stemming from operational complexity on the ground, the lack of clarity in biomass procurement regulation from the initial stage has implications for the formation of relatively long and difficult-to-trace supply chain routes. Long supply chains were found, for instance, in the case of Indramayu power plant, where the sawdust supply chain (one type of biomass supplied by PLN EPI) starts from furniture producers and social media platform transactions, passes through the main aggregator, and is then channeled to the power plant via logistics intermediaries such as trucks. This lengthy process creates low visibility. Corruption and rent-seeking often remain unobserved.[60]

Modern supply chains are formed from multi-layered, complex, and dynamic aggregator (supplier) networks.[61] The more complex the supply chain, the more effective procurement accountability must be. This complexity is certainly a challenge for companies. However, considering PLN EPI's approach of simplifying the decision between open tender and direct appointment without clear regulation and tending toward informality creates its own problems, particularly impacting the difficulty of tracking visibility beyond the first aggregator (direct supplier).[62] This reality also indicates the potential for corruption risks in the lowest levels of the supply chain to go undetected.

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[59] T. S. Aidt, “*Rent seeking and the economics of corruption*,” Constitutional Political Economy 2016 *27:2*, vol. 27, no. 2, pp. 142–157, Apr. 2016, doi: 10.1007/S10602-016-9215-9.

[60] Ibid.

[61] UNGC, *Stand together against corruption*. 2013. Available: www.unglobalcompact.org

[62] Ibid.

4.2. Traceability Gaps: Case Study of PLN EPI Partners

The vulnerability in discretionary procurement practices and supply chain complexity ultimately converges on a fundamental issue: the weakness of the traceability system in the relationship between PLN EPI and its supplier partners. When the vendor selection mechanism (between open tender and direct appointment) is not framed by clear, objective criteria, or when oversight focuses primarily on meeting technical specifications downstream, the grey zone in governance widens further at the upstream end of the supply chain. Before turning to the field findings at the two study locations (Indramayu coal-fired power plant and Rembang coal-fired power plant), it is important to stress that the traceability issue is not just an operational-technical matter, but a matter of procurement governance design. The weak traceability framework from the aggregator appointment stage has direct implications for PLN EPI's limited visibility into the biomass supply chain below the first-tier supplier.

In this context, the research team from Transparency International Indonesia conducted desk research to trace a number of aggregator partners recorded as biomass suppliers to PLN EPI. The initial data for this inquiry referred to a Tempo.co repor[63] based on Press Release No. 109.PR/STH.06.01/PLN0102/XII/2025[64]. The inquiry found that PLN EPI has built its biomass supply through cooperation with regional governments and local vendors, including a biomass development agreement with PT Palma Banna Mandiri[65] and the Government of Aceh Tamiang Regency.

As is widely known, Aceh Tamiang Regency is a region with high ecological vulnerability, affected by a series of ecological disasters in Sumatra that occurred at the end of 2025. Within a risk-based governance framework, a sensitive area of this kind should have prompted the application of enhanced due diligence (EDD), including assessments of environmental impacts, corporate track records, and the traceability of feedstock sources. However, field findings indicate that oversight still relies on end-point control and has not yet been linked to independently auditable upstream verification mechanisms.

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63 Tempo.co, "*PLN EPI Dapat Pasokan Cofiring dari Lima Perusahaan*" [PLN EPI Secures Co-firing Supply from Five Companies], December 12, 2025.Available: https://www.tempo.co/ekonomi/pln-epi-dapat-pasokan-cofiring-dari-lima-perusahaan-2098224

64 PLN EPI, "*PLN EPI Gandeng 5 Mitra Strategis Perkuat Pasokan dan Dorong Pengembangan Ekosistem Biomassa*" [PLN EPI Partners with Five Strategic Partners to Strengthen Supply and Promote Biomass Ecosystem Development], December 11, 2025. Accessed: Jan. 29, 2026. Available: https://www.plnepi.co.id/media-informasi/ruang-media/siaran-pers/pln-epi-gandeng-lima-mitra-strategis-perkuat-pasokan-dan-dorong-pengembangan-ekosistem-biomassa

65 PT PLN Energi Primer Indonesia and PT Palma Banna Mandiri, "*Kesepakatan Bersama Antara PT. PLN Energi Primer Indonesia dan PT. Palma Banna Mandiri dengan Pemerintah Kabupaten Aceh Tamiang*" [Joint Agreement between PT PLN Energi Primer Indonesia and PT Palma Banna Mandiri with the Government of Aceh Tamiang Regency]. Accessed: Jan. 28, 2026. Available: https://jdih.acehtamiangkab.go.id/news/post/kesepakatan-bersama-antara-pt-pln-energi-primer-indonesia-dan-pt-palma-banna-mandiri-dengan-pemerintah-kabupaten-aceh-tamiang

Another story of potential vulnerability in traceability was found by the research team when tracing PT Cakra Alam Persada, which is also one of PLN EPI's five biomass supplier partners.[66] The company is registered as operating in sawmilling, firewood, and wood pellet businesses, activities directly relevant to wood-based biomass supply. Official corporate documents show that PT Cakra Alam Persada is controlled by its parent company, PT Aswana Dhanakirti Sinergi, which holds the majority of shares. This ownership structure places the company's strategic control at the level of the business group, rather than solely at the operational entity supplying biomass.

At the same time, investigative media reporting and independent monitoring data link this parent company with other affiliates in the forestry sector that have been highlighted for natural forest clearing practices.[67] Although this connection cannot be treated as a legal violation, within the Corruption Risk Assessment approach and environmental, social, and governance (ESG) due diligence frameworks, such cross-entity affiliations constitute a significant risk signal. This condition should trigger further due diligence on beneficial ownership, the business group's environmental track record, supply chain legality, and verification of the origin of biomass supplied to coal-fired power plants.

This case shows that without an adequate traceability system and chain of custody, the biomass co-firing program risks producing institutional greenwashing. Claims that biomass is a cleaner transition energy source may end up being only administrative, while ecological impacts and emissions are not actually eliminated, but shifted upstream in the supply chain where oversight is weak. Under conditions of high biomass demand and a limited supplier market, reliance on vendors' administrative documents alone is not enough to guarantee supply integrity.

These two case studies affirm that the success of the energy transition through biomass co-firing is determined not only by the achievement of energy mix targets, but also by the strength of procurement governance. Strengthening risk-based vendor due diligence, including tracing ownership structures and corporate affiliations, as well as implementing an auditable biomass traceability system, are essential prerequisites to ensure that the biomass co-firing policy does not reproduce old extractivist practices and greenwashing under the banner of the energy transition.

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66 Tempo.co. (12 December 2025) Op Cit.

67 Raden Ariyo Wicaksono, *"Investigasi: Dari Hutan Orangutan Kalimantan ke Rumah Orang Eropa"* [Investigation: From Orangutan Forests in Kalimantan to European Households], *Betahita*, October 21, 2025. Accessed: Jan. 28, 2026. Available: https://betahita.id/news/lipsus/11507/investigasi-dari-hutan-orangutan-kalimantan-ke-rumah-orang-eropa.html?v=1761048227

4.3. Corruption Potential at the High Demand Level

In recent years, biomass co-firing policy has been moving at an increasingly accelerated pace alongside the ambition to achieve energy mix targets and expand the number of coal plants adopting this scheme. Biomass, which was initially positioned as a supplementary fuel, has now become an important component in maintaining operational reliability of power plants, causing supply demand to increase sharply in a short period. This increased demand has not always been accompanied by market readiness, adequate supplier availability, or strengthened oversight instruments. As a result, the procurement process takes place under tight time pressure, transaction values grow in line with the scale of needs, and the choice of providers capable of meeting large volumes becomes increasingly limited. Under these conditions, information asymmetry regarding biomass prices and quality emerges, where suppliers generally possess better knowledge of market conditions and material quality than buyers. To ensure that power plants continue to operate, control and verification mechanisms are often loosened, thereby opening corruption gaps at the high demand level (demand shock) in the biomass supply chain.

In the context of PLN's 2025-2034 RUPTL, this pressure becomes even more relevant because biomass demand is projected to reach the scale of millions of tons per year. For example, under the ARED (Accelerated Renewable Energy Development) scheme proposed by PLN in the updated RUPTL, biomass demand is projected to reach 10.1 million tons by 2030 and average 10.7 million tons in the years thereafter, while the development of a higher biomass co-firing share still requires further testing (pilot testing reportedly only reached around 5% without additional investment, while a 10-20% share still requires technical verification and potential additional investment).[68]

Under such conditions, rent-seeking opportunities open up across the entire chain of decision-making, from pre-procurement (determination of needs and contract package design), to the supplier selection process, to contract implementation and performance reporting. As a result, the impacts of corruption during the demand shock phase are not limited to "price losses," but may also extend to a decline in biomass quality (high moisture content/low calorific value), distortion of the supply chain (through rent-seeking brokers/aggregators), weak traceability of sources, and performance reports that appear to "meet targets" yet cannot be fully tested independently.

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[68] PT PLN (Persero), "Rencana Usaha Penyediaan Tenaga Listrik (RUPTL) 2025-2034" [Electricity Supply Business Plan (RUPTL) 2025-2034], Jakarta, 2025. Accessed: Jan. 28, 2026. Available: https://web.pln.co.id/statics/uploads/2025/06/b967d-ruptl-pln-2025-2034-pub-.pdf

4.4. Governance Vulnerability Due to High Demand in Biomass Co-Firing Policy

The surge in biomass demand resulting from the acceleration of the co-firing program at power plants places energy procurement in a condition categorized in public procurement literature as a high-risk demand environment. Gnaldi & Del Sarto (2024) demonstrate that when public policy operates in near-emergency situations; characterized by ambitious targets, time pressure, and limited suppliers, competition mechanisms tend to be compromised through exception procedures, concentration of contract winners, and expansion of technical discretion at the pre-tender and tender stages. This pattern is relevant to biomass co-firing in Indonesia, where short-term emission reduction targets drive a focus on rapid supply volume fulfillment, while domestic biomass market capacity remains limited and not yet fully mature.

In PLN context, this pressure is implicitly acknowledged in transition risk assessments, particularly regarding the risk of limited biomass supply, which is categorized as high-level. PLN's climate report asserts that the sustainability of the biomass co-firing program depends on strengthening local supply chains, improving fuel quality, and long-term contracts, simultaneously indicating high dependence on intermediary actors, logistics, and location-specific procurement schemes.[69] This dependence constitutes a structural condition that frequently generates corruption early warning signals, as the market becomes concentrated and provider evaluation becomes increasingly difficult to verify independently when supply speed takes priority over governance quality.[70]

Furthermore, Gnaldi & Del Sarto emphasize that in strategic sectors, competition restrictions are often framed as legitimate policy needs, so that non-competitive practices gain administrative legitimacy. In biomass co-firing, this legitimacy could emerge through narratives of rapid decarbonization and energy security, consistent with PLN's ARED mandate and NZE 2060 target. However, as noted in the literature, it is precisely during this phase that the risks of price mark-up, repeat winners, and supplier capture increase because price and quality benchmarking mechanisms are not yet established. This becomes critical given that PLN also affirms that increases in supply costs will directly impact the Basic Cost of Supply (*Biaya Pokok Penyediaan*/BPP), meaning that governance risks are not only ethical in nature, but also systemic in relation to the financial stability of the electricity sector.

Corruption risk in the context of high demand is not incidental, but rather embedded in the policy design and the procurement architecture itself. In the biomass co-firing program, this risk directly intersects with the challenges identified by PLN: limited supply, supply chain complexity, and the need for coordination across multiple actors. Therefore, the red-flag indicators identified in international studies need to be positioned as **ex-ante governance tools**, rather than as only post-contract audit findings, so that the energy transition through co-firing does not create new vulnerabilities in the governance of the electricity sector.

[69] PLN, "Climate-Related Disclosure Report 2024," May 2025. Accessed: Jan. 28, 2026. Available: https://web.pln.co.id/statics/uploads/2025/07/PLN-Climate-related-Disclosure-Report-2024.pdf

[70] M. Gnaldi and S. Del Sarto, "Measuring corruption risk in public procurement over emergency periods," *Soc. Indic. Res.*, vol. 172, no. 3, pp. 859–877, 2024.

1. Energy Mix Target Pressure as a Trigger for Extreme Discretion

The target of increasing the number of co-firing coal-fired power plants from 43 units in 2023 to 52 units in 2025, coupled with estimated biomass demand surging to more than 10 million tons per year, creates a demand shock on the downstream side of the supply chain. In this situation, the continuity of power plant operations becomes the dominant argument often used to justify rapid and discretionary decision-making by procurement authorities, particularly PLN EPI.

The narrative of "keeping the lights on" functions as a justification that normalizes procedural deviations. Discretion, which should be exception-based, turns into routine practice when biomass supply demand is not matched by actual availability on the ground. At this point, high demand pressure not only accelerates the procurement process, but also weakens the standards of transparency, competition, and accountability.

2. The Illusion of Supply Competition and Market Mechanism Distortion

Under conditions of simultaneous high demand, the ideal market mechanism, where price and supply form competitively, does not fully function. Instead, what emerges is artificial competition among suppliers to secure contracts, not through increased production capacity or efficiency, but through access to proximity with decision-makers. This situation creates artificial scarcity; a supply shortage not entirely caused by material limitations, but by the consolidation of supply access in the hands of a select few actors.

As a result, high demand actually strengthens the bargaining position of certain aggregators capable of promising "supply certainty," even though such certainty is often supported by supply chains that are unsustainable, untraceable, and carry high legal and ecological risks. In this context, the biomass market no longer functions as an efficient resource allocation mechanism, but as an arena for rent distribution.

3. Price Inflation, Quality Decline, and Moral Hazard

Excessive demand pressure also drives two interrelated phenomena: biomass price inflation and declining supply quality. When coal-fired power plants require biomass in large quantities within a short time, the incentive to compromise on quality increases. Suppliers are driven to prioritize quantity first, while quality aspects—such as moisture content, origin of materials, and compliance with environmental standards—become secondary.

This condition creates moral hazard, where suppliers take greater risks because they know the buyer is under pressure. In the short term, this practice allows coal-fired power plants to continue operating and energy mix targets to be met. But in the medium and long term, it damages the integrity of the procurement system, increases hidden operational costs, and opens space for technical specification manipulation that is difficult to verify.

4. Normalization of Informal Practices at Critical Points

Persistent high demand also contributes to the normalization of informal practices at critical points in the supply chain, particularly during the logistics and goods handover phases. Long waiting times, piling truck queues, and pressure to speed up loading and unloading create space for informal actors to monetize system bottlenecks. Unofficial levies become a "quick fix" pragmatically accepted by field actors, even though they systematically damage efficiency and fairness.

Within the CRA framework, this phenomenon demonstrates how high demand pressure functions as a catalyst accelerating the shift from formal governance to shadow governance, where written rules are defeated by informal norms shaped by urgent needs and local power relations.

5. Implications for Energy Transition Integrity

Corruption gaps at the high demand level show that corruption risks in the biomass co-firing program do not stem solely from regulatory weaknesses or supply chain complexity, but also from the design of the energy transition policy itself, which places quantitative targets as the primary objective. As long as biomass demand continues to be pushed aggressively without corresponding adjustments in supply capacity and stronger oversight mechanisms, this pressure will continue to reproduce patterns of discretion, rent-seeking, and informal practices.

Thus, controlling corruption risks in biomass co-firing cannot be achieved solely by improving downstream procurement procedures, but requires a correction in upstream policy logic: from a target-chasing approach toward an approach based on system readiness and governance integrity.


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CHAPTER V

FINDINGS AND DISCUSSION: TRACING THE BIOMASS SUPPLY CHAIN ON THE GROUND

The Corruption Risk Assessment (CRA) study of the biomass co-firing policy at coal-fired power plants did not emerge solely from reading documents and reviewing policies behind a desk. It began from the awareness that corruption risks in the energy transition often reside in spaces far removed from the center of regulatory design, at the earliest points of the supply chain, where operational decisions intersect with economic interests and local power relations. On that basis, at the end of November 2025, the research team conducted direct fieldwork in two key areas of biomass co-firing implementation, namely the areas surrounding the Indramayu and Rembang coal-fired power plants.

5.1. Competing for Sawdust: Unraveling the Length of the Biomass Supply Chain for Coal-Fired Power Plants

PT PLN (Persero), as a state-owned company mandated by the state to provide electricity for the public interest, holds a strategic role in guaranteeing the availability, affordability, and sustainability of the national electricity supply. This mandate encompasses not only the operational function of electricity provision but also social and economic responsibilities to support industrial growth, public services, and community welfare across all regions of Indonesia.

As a state-owned enterprise in the electricity sector, PLN operates within the national energy policy framework that demands a balance between three main pillars: energy security, tariff affordability, and environmental sustainability. In the context of energy transition, this mandate becomes increasingly complex as PLN is required to reduce greenhouse gas emissions, increase the renewable energy mix, and maintain electricity system reliability amid continuously growing electricity demand. One strategy deemed most realistic for pursuing annual emission reduction targets is implementing the biomass co-firing program at coal-fired power plants. The foundation for this program is codified, among others, in the Minister of Energy and Mineral Resources Regulation No. 12 of 2023 governing "Utilization of Biomass Fuel as a Blend for Coal-Fired Power Plants." Beyond this regulation, the global factor of ESG Ratings, which subtly compels companies to reduce emission intensity, has also become a pressure point for PLN to decarbonize through this program.[71] The scheme involves mixing biomass into the boiler alongside coal. By reducing the coal portion and partially replacing it with biomass, the carbon emission intensity per kWh of generated electricity can be reduced without needing to build new power plants in a short time.

There are at least two types of combustion engine or technology in power plants that are compatible with biomass co-firing. First is the Pulverized Coal (PC) boiler technology, where coal must undergo a grinding process into powder before entering the combustion chamber (furnace). Combustion occurs under suspension conditions, requiring fuel with relatively uniform particle sizes and controlled moisture content, including when biomass is blended as a co-fuel.[72]

[71] Transkrip wawancara dengan Divisi Transisi Energi dan Keberlanjutan (TEK) PT PLN (Persero), 18 November 2025.

[72] T. Winahyu, D. Tampubolon, B. P. Asmoro, S. Sumedi, A. Salim, and I. Kusdwiatmaja, "*Sawdust Co-firing Operation Test on Pulverized Coal Boiler Power Plant*," in 7th International Conference on Applied Engineering (ICAE 2024), Atlantis Press, 2024, pp. 312–326.

The second type is the Circulating Fluidized Bed (CFB) boiler technology, which works by burning fuel in a bed of solid particles, usually sand, suspended by pressurized airflow. Unlike PC boilers, CFB technology has a higher degree of flexibility with respect to variations in fuel type, size, and moisture content, making it relatively more adaptive in utilizing biomass, agricultural waste, and low-quality coal. This characteristic makes CFB boilers more tolerant of higher proportions of biomass blending, although with consequences in terms of system complexity and generally higher investment cost.[73]

In practice, most coal-fired power plants in Indonesia were built between 2005 and 2015 and use Pulverized Coal (PC) boiler technology. In terms of age, these power plants are still within the 10-20 years range, meaning they are not yet considered old from a technical and economic asset perspective. However, from a climate perspective, these plants remain among the largest contributors of greenhouse gas emissions in the electricity sector. It is this condition that has led biomass co-firing to be positioned as one of the most realistic and immediately deployable transition options, given the limitations on undertaking a full-scale replacement of combustion technology. The main challenges are: first, determining what type of biomass is suitable for blending with coal, which remains the main fuel of coal-fired power plants, and second, determining the equilibrium point for the percentage of biomass in the fuel mix, with consideration for what is safe for boiler machinery and what contributes positively to meeting climate targets.

The boiler technology used in the two coal-fired power plants that are the focus of this study, both Indramayu and Rembang, is Pulverized Coal (PC), meaning that the biomass that can be blended into the fuel mix is subject to limitations, particularly in material size. PC boiler technology cannot perfectly burn biomass materials that are too large, such as wood pellets and woodchips. In this context, the type of biomass ultimately selected for blending in combustion at both Indramayu and Rembang is sawdust.

At this point, sawdust becomes the last, though not the only, option considered realistic for operating power plants under an energy-mix scheme, particularly at many coal-fired power plants in Java. Although sawdust remains the most realistic option for the co-firing program at present, operating power plants with this material is not without problems. In a scenario where the required volume of sawdust continues to rise and supply demand comes simultaneously from various coal-fired power plants across Java, competition and availability become unavoidable. Signs of the impact of this scenario are already visible on the ground, particularly in the Indramayu and Rembang case studies. The journey of sawdust in Java, which generally begins with small furniture businesses before eventually reaching the gates of coal-fired power plants, still reveals a very long and layered supply chain. This condition not only increases distribution complexity, but also opens vulnerabilities in biomass supply governance.

[73] N. Cahyo *et al.*, "*A techno-economic and environmental analysis of co-firing implementation using coal and wood bark blend at circulating fluidized bed boiler*," International Journal of Renewable Energy Development, vol. 13, no. 4, pp. 726–735, 2024.

In 2021, PT PLN (Persero), together with Perum Perhutani and PT Perkebunan Nusantara (PTPN), had actually initiated a biomass supply cooperation through the energy plantation forest scheme.[74] Conceptually, the energy plantation forest was projected as a medium-to-long-term solution to guarantee the availability of cultivation-based biomass, so that the co-firing program would not rely solely on wood waste or residual supply from small industries.

However, since the planning stage, this scheme showed several fundamental weaknesses. *First*, there was no clarity regarding the land base to be used, whether it would come from degraded land, existing concession areas, or potentially target forested areas. This ambiguity raised serious questions about the risk of land-use changes and deforestation potential. *Second*, the licensing scheme and division of authority among actors had not been mapped transparently, including their monitoring and accountability mechanisms. *Third*, the biomass purchase price scheme did not yet have a fixed and mutually agreed formula, creating economic uncertainty for land managers while opening space for negotiations not fully based on transparent market mechanisms.

Rather than becoming the foundation of national biomass supply, this cooperation instead stalled. This deadlock shows that the institutional design and governance of energy plantation forests are not yet mature enough to support large-scale biomass demand at scale. Ironically, amid this stagnation, co-firing implementation targets continues to be raised. The number of power plants implementing biomass co-firing is targeted to increase from 43 units in 2023 to 52 units by 2025.

The gap between the ambition to increase the number of power plants and the uncertainty of biomass supply sources creates structural pressure. Without a robust and transparent supply scheme, target acceleration risks driving opportunistic supply-seeking practices, which could ultimately disregard environmental sustainability, land governance, and the integrity of the biomass procurement process itself.

For the purposes of a more focused analysis, however, this discussion is first directed at the Java context. It is in this region that symptoms of increasing biomass demand are becoming concretely visible, particularly for the sawdust commodity. The journey of sawdust in Java still faces an extremely complex supply chain, one that not only increases logistics costs but also opens governance vulnerability: from traceability of feedstock origin and the potential for price mark-ups to the risk of irregularities in the procurement process. To deepen this inquiry, a sample timeline of open tenders for sawdust procurement for biomass co-firing needs at coal-fired power plants in Java is presented below:

74 Perhutani, "*PLN Gandeng PTPN dan Perhutani untuk Pasok Biomassa ke PLTU*" [PLN Partners with PTPN and Perhutani to Supply Biomass to Coal-Fired Power Plants].Accessed: Dec. 22, 2025. Available: https://www.perhutani.co.id/pln-gandeng-ptpn-dan-perhutani-untuk-pasok-biomassa-ke-pltu/

Open Tender Timeline for Sawdust for Biomass Co-firing at Coal-Fired Power Plants in Java

2024 – Early 2025				
No.	**Power Plant Name**	**Tender Process**	**Tonnage**	**Duration**
1.	Pacitan Power Plant	21 March - 1 April 2024	Not specified	Not specified
2.	Tanjung Awar-Awar (Tuban) Power Plant & Rembang Power Plant	21 March - 1 April 2024	Not specified	Not specified
3.	Indramayu Power Plant	27 - 31 May 2024	48,000 tons	1 year
4.	Labuan Banten Power Plant	27 - 31 May 2024	54,000 tons	1 year
5.	Pacitan Power Plant	9 - 15 October 2024	120,000 tons	2 years
6.	Rembang Power Plant	21 - 28 October 2024	168,000 tons	1 year
7.	Indramayu Power Plant	21 - 27 February 2025	120,000 tons	2 years
8.	Suralaya 1-7 Power Plant	3 - 18 July 2025	100,000 tons	365 days
Late 2025				
No.	**Power Plant Name**	**Tender Process**	**Tonnage**	**Duration**
9.	Tanjung Awar-Awar Power Plant	7-15 August 2025	20,000 tons	1 year
10.	Labuan Banten Power Plant	26 November- 3 December 2025	192,000 MT (min. 50% of total volume)	2 years
11.	Paiton Power Plant	26 November- 3 December 2025	240,000 MT (min. 50% of total volume)	2 years
12.	Indramayu Power Plant	20-27 November 2025	24,000 MT (min. 50% of total volume) **(rice husks)**	2 years **(different commodity)**

(Compiled by authors, 2025)

Taking as a sample the open tender timeline for sawdust procurement for several co-firing coal-fired power plants, as accessible through PLN EPI's official website from early 2024 to the end of 2025, it can be seen that the tonnage of sawdust demand for co-firing in coal-fired power plants varies considerably. This variation in demand across power plants indicates differences in capacity needs and in the level of biomass blending at each unit.

In addition to these differences in tonnage, several sawdust procurement timelines were also found to take place simultaneously. Although there are also open tender timelines that were not conducted at the same time, the periods of sawdust supply implementation still fall within the same years. This means that, at least over the three-year period from 2024 to 2027, sawdust procurement for co-firing in coal-fired power plants in Java will take place concurrently and experience a sharp increase in tonnage. It should be noted that the data in the previous table represent only demand met through the open tender mechanism. These figures do not yet include potential biomass demand fulfilled through other mechanisms, such as direct appointment or alternative contractual arrangements. As such, the total real demand for sawdust is likely higher than what is stated in the open tender documents.

In the context of this increasing and simultaneous demand, the fundamental question is: can the availability of sawdust in the domestic market truly meet these demands in a sustainable, transparent, and governance-distortion-free manner?

5.2. Identifying Traceability Gaps in the Sawdust Supply Chain at Indramayu Power Plant

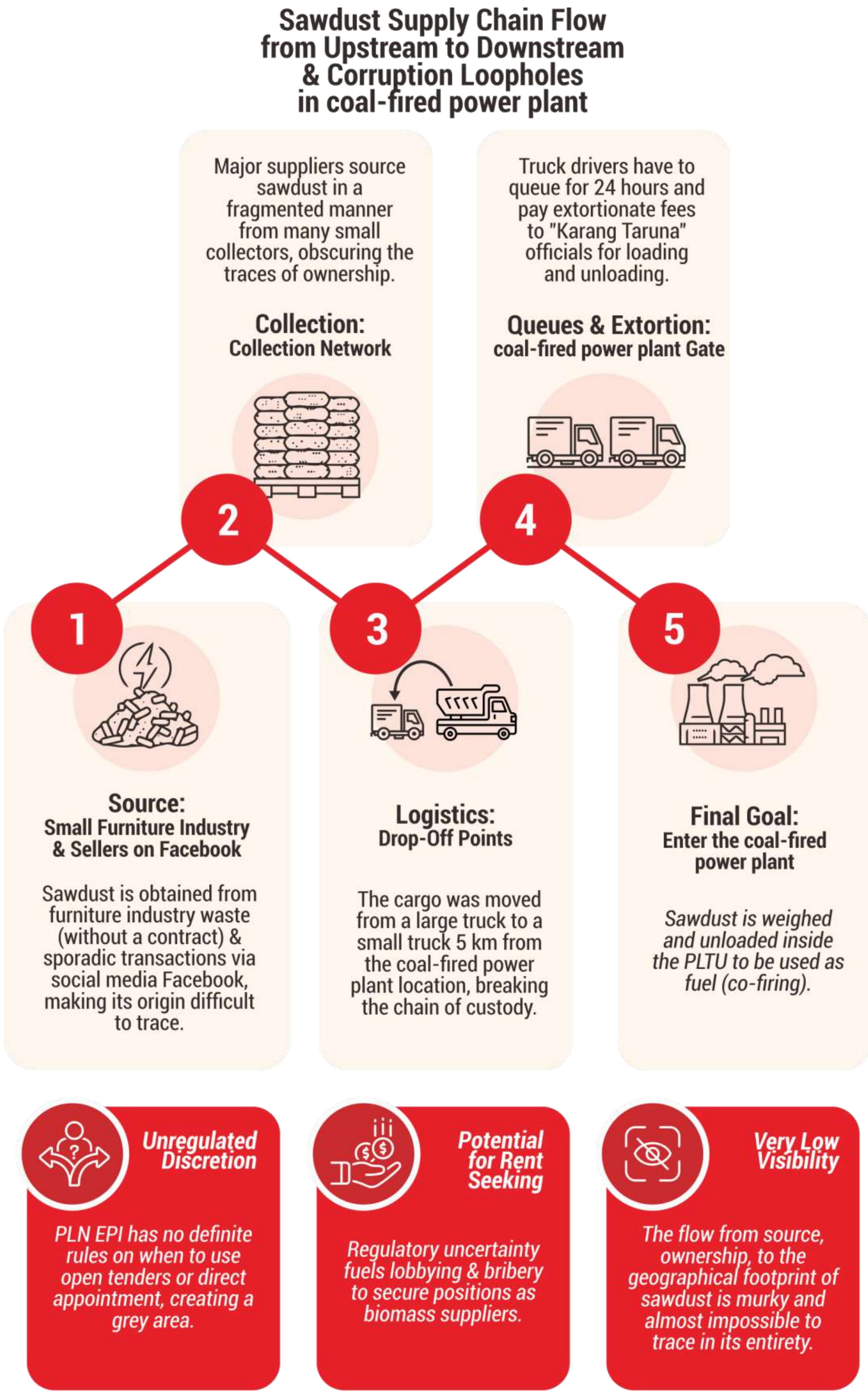
When the research team arrived in late November 2025 in the Ring 1 area of the power plant managed by PLN Nusantara Power Indramayu (Indramayu power plant) in Sumuradem Village, West Java, dozens of trucks carrying biomass in the form of sawdust were parked along the roadside leading to the plant gate. At first glance, the scene looked like an ordinary logistics queue commonly found around industrial areas. Yet the line of trucks carrying sacks of sawdust in fact reflected the complexity and length of the biomass supply chain leading to Indramayu power plant.

The long and multi-layered distribution route indicated that sawdust was not obtained through a simple or centralized supply channel. On the contrary, aggregators had to gather supply from various small and dispersed sources, which in turn extended the distribution chain before biomass arrived at the power plant. Indications of limited sawdust supply became even more apparent when PLN EPI attempted to forge cooperation with the Indramayu Regency Government to meet alternative biomass needs, not sawdust, but rice husks.[75] Shortly after the cooperation agreement was reached, an open tender requesting rice husk biomass was launched by PLN EPI.[76] This sequence of events confirm that meeting sawdust demand for the co-firing program at coal-fired power plants faces serious challenges. When the primary source becomes increasingly difficult to obtain, power plants are compelled to seek alternative biomass substitutes. Consequently, the already long sawdust supply chain stands to become even more complex, while also increasing governance and traceability risks in procurement practices. The following is an illustration of the sawdust supply chain for biomass co-firing at Indramayu power plant:

[75] Tempo, "*PLN EPI dan Pemkab Indramayu Jalin Kerja Sama Pengembangan Biomassa*" [PLN EPI and the Indramayu Regency Government Establish Cooperation on Biomass Development]. Accessed: Jan. 09, 2026. Available: https://www.tempo.co/ekonomi/pln-epi-dan-pemkab-indramayu-jalin-kerja-sama-pengembangan-biomassa-2056846

[76] PLN Energi Primer Indonesia, "*Pengumuman Tender Terbuka Pengadaan Bahan Bakar Biomassa Sekam Padi: Zona Sampai dengan Ring-2 Moda Transportasi Darat PT PLN Nusantara Power PLTU Indramayu*" [Open Tender Announcement for Rice Husk Biomass Fuel Procurement: Zone up to Ring-2 Land Transportation Mode for PT PLN Nusantara Power PLTU Indramayu], November 2025. Accessed: Jan. 09, 2026. Available: https://cmsadmin.plnepi.co.id/storage/media/Pengumuman%20Tender%20PLTU%20Indramayu.pdf

Figure 6. Illustration of the Sawdust Supply Chain Flow



One of the upstream sources of sawdust is a furniture producer located approximately 26 km from Indramayu power plant. This furniture producer does not fundamentally intend to produce sawdust. The producer only sells residual waste from furniture production in the form of sawdust, which takes approximately two months to accumulate before it can be sold. The furniture producer also does not sell sawdust through a delivery scheme. Rather, collectors who need the product come to the furniture workshop to pick up the sawdust, then transport it using motorcycles or pickup trucks. Additionally, the furniture producer has not signed contracts with any collector for sawdust transactions. The reason is that sawdust availability at the furniture workshop is unpredictable. This unpredictability also means the furniture producer does not know whether the collector sends the sawdust directly to the power plant or whether there is a larger collection point elsewhere designated by the main aggregator.

Another upstream source of sawdust, beyond furniture workshops, is consigned through social media platforms that host buy-sell groups. Browsing through sawdust buy-sell groups on these platforms reveals reveals competition among platform users seeking sawdust of varying quality, especially in relation to moisture content requirements. On these platforms, one can observe posts from users seeking sawdust suppliers for biomass needs at several power plants such as Suralaya, Indramayu, and other power plants in Java. This picture further indicates that sawdust availability is not only being competed for but is also becoming increasingly difficult to obtain. At the same time, amid limited availability, demands for good-quality sawdust with low moisture content are also becoming more pronounced. But beyond these quality requirements, where is the sawdust then collected after being transported from furniture workshops or obtained through social media-mediated transactions?

There are still major gaps in the supply chain flow after collectors obtain sawdust from furniture workshops or through social media-consigned buying and selling transactions. The next stage that could be traced was when the sawdust was transported by truck drivers to the power plant gate. Yet this stage is not short either. Before the sawdust can actually be weighed inside the power plant, the truck drivers must queue along the road in front of the plant for a full day and night waiting for their turn to unload inside the power plant. During unloading, they are also required to pay a certain fee to parties they referred to as the "youth organization" (*karang taruna*). Moreover, although the truck drivers are responsible for delivering the sawdust into the power plant, they do not transport it directly from the main aggregator. According to several testimonies, they only transport sawdust from a certain location where larger trucks have dropped off large quantities of it. At that location, approximately 5 km from the power plant, the drivers of smaller trucks then carry part of the sawdust originally transported by the larger trucks.

Based on the supply chain description above, despite remaining gaps, it clearly demonstrates that the sawdust supply chain is indeed very long. This long supply chain also makes it difficult to trace the complete chain. The absence of complete supply chain data also indicates the role of the main aggregator, who very likely sporadically collects sawdust from numerous small collectors who obtain it from small furniture producers and social media transactions. What kinds of corruption risks arise when the sawdust supply chain is not only very long, but also difficult to trace in full, appears to face supply scarcity, and yet must still be available to meet co-firing needs? The following is an inventory of corruption risks at the feedstock supply level and the structural points at which corruption may occur:

A. Potential Illegal Levies at Logistics Points (Social Cost of Rent Seeking)

At the Indramayu power plant site, truck drivers were observed queuing for extended periods and paying additional fees to a party they identified as "*karang taruna*" during the sawdust loading and unloading process inside Indramay power plant. This phenomenon is a classic example of the social cost of rent seeking[77]. Unlike bribery, which is often regarded as just "money transfer" from one pocket to another, the social cost of rent seeking is the "burning" of resources. Resources lost in this process will never return to the economic system and concretely reduce the truck drivers' total income. The existence of additional informal payments to certain parties (such as "*karang taruna*") at the power plant entrance to facilitate loading and unloading constitutes extra transaction costs that add no value whatsoever to production.

These costs are a bitter pill that truck drivers must swallow, as they reduce income on top of other losses caused by long periods of unproductive waiting. Biomass truck drivers have to queue for an entire day and night in front of the power plant simply to wait for their turn to unload. This idle time is an economic resource wasted in vain. That is why the truck drivers admitted that the work of transporting and queuing to unload sawdust only serves to fill spare time and would never become their main occupation. The reason is that the net income from this transport process is very small compared to the capital, time, and effort invested.

This reality further clarifies that rent-seeking is indicated not only in the pursuit of windfall profits, but also in small-scale extraction throughout the long supply chain at the lowest levels. In this complex supply chain, every layer—from collector to driver—potentially engages in small-scale rent-seeking that accumulates. When the position as the main sawdust aggregator at the upper level (PLN EPI) is envisioned as a "lottery" to be contested, resources are instead absorbed into lobbying and non-transparent supply chain securing activities, rather than into production innovation.

[77] T. S. Aidt, "*Rent seeking and the economics of corruption*," Constitutional Political Economy 2016 27:2, vol. 27, no. 2, pp. 142-157, Apr. 2016, doi: 10.1007/S10602-016-9215-9 (pp. 142-149)

B. Potential for Low Data Integrity and Material Quality

Small-scale but cumulative rent-seeking potential occurs not only in the form of illegal levies during the sawdust loading process. In a climate of intense market competition, particularly when sawdust availability is indicated to have low visibility and is being competed for, downstream supply chain actors are driven toward opportunistic behavior. They may extract unproductive gains (rent) by manipulating material specifications, particularly the moisture content of sawdust.[78] Efforts to "game" moisture levels constitute another concrete form of the social cost of rent-seeking.[79] Resources are used to win competition dishonestly, rather than through productive innovation, which in substance harms combustion efficiency while benefiting the actors in terms of shipment weight.

Furthermore, a serious data integrity gap emerges at the critical point of weighing and quality verification due to measurement parameter disparity. Although tender documents and procurement timelines explicitly specify sawdust supply requests in tonnage (weight), the actual operational combustion requirement at coal-fired power plants is based on calorific value (energy), which is highly sensitive to moisture.[80] This mismatch between procurement targets based on wet weight and operational objectives based on energy creates a grey area in which weak manual oversight can be exploited to manipulate weighing data or allow materials to pass that meet tonnage requirements but fall below calorific standards.

As a result, the verification process becomes highly vulnerable because ESG data validation—for instance, emission intensity reduction data compared to physical quality data—cannot be accurately performed without adequate tracking technology, thereby granting excessive discretion to field personnel. This situation places officials or verifiers in the role of gatekeepers with the power to determine who passes supply qualification, while also opening opportunities for collusion to alter quality or quantity data for private gain.

C. Low Visibility in the Supply Chain Flow

There is a very significant potential for low visibility in the biomass sawdust supply chain. This low visibility is a broader consequence of procurement mechanisms that tend to be informal, as well as the absence of firmer internal regulations within PLN EPI. *First*, visibility beyond the first-tier aggregator may go untraced.[81] Although not disclosed publicly, PLN EPI must already have a list of the names of its main biomass aggregators. Even so, considering the long and complicated biomass supply chain flow, especially at Indramayu power plant,

78 Parboaboa, "*Praktik Culas Pemasok Biomassa di PLTU Indramayu*" [Deceptive Practices of Biomass Suppliers at the Indramayu Coal-Fired Power Plant]. Accessed: Jan. 22, 2026. [Online]. Available: https://parboaboa.com/praktik-culas-pemasok-biomassa-di-pltu-indramayu

79 T. S. Aidt, "*Rent seeking and the economics of corruption*," *Constitutional Political Economy 2016 27:2*, vol. 27, no. 2, pp. 142–157, Apr. 2016, doi: 10.1007/S10602-016-9215-9

80 PLN EPI, *Interview Transcript*, December 4, 2025.

81 International Energy Agency and OECD, "*The Role of Traceability in Critical Mineral Supply Chains*," 2025. Accessed: Jan. 28, 2026. [Online]. Available: www.iea.org

the actors behind those main aggregators, such as sawdust collectors sourcing from small furniture workshops, may go untraceable.
A further consequence of the inability to trace deeper aggregator visibility is that, second, origin visibility of sawdust becomes increasingly difficult to accurately track.[82] The difficulty in tracing the origin of sawdust supply stems from the fragmented nature of its upstream sources. Sawdust sourced from small-scale furniture producers is not generated through formal contracts between collectors and furniture businesses. In fact, such contractual arrangements are unlikely, given the inherently uncertain availability of sawdust itself. Sawdust is not a primary commodity deliberately produced by furniture manufacturers; rather, it is a residual byproduct of production processes such as making doors, tables, chairs, and other wood-based furniture products.

Another sign that the origin of sawdust supply may be untraceable is the transactions carried out by collectors when they obtain goods through intermediated transactions on social media platforms. In transactions that prioritize speed of availability, the identity, legality, and verification of the origin of goods become increasingly difficult to determine, and may even be ignored. Such transactions also make visibility at the level of the chain of custody very minimal.[83] The chain of custody—from one hand to another—becomes effectively opaque. Primary aggregators are highly likely to source materials sporadically from numerous small collectors, without a coherent or traceable linkage. This fragmentation is further exacerbated during transport and handling stages. In practice, truck drivers often do not collect materials directly from primary aggregators, but instead from designated drop-off points (approximately 5 km from the power plant), where loads are transferred from larger trucks to smaller ones. This process further obscures accountability, making it difficult to determine who was responsible for the material at earlier stages.

Ultimately, there are segments of the supply chain that remain "unaccounted for" or effectively lost as materials move from collectors—who obtain sawdust either through informal transactions via social media intermediaries or direct pickup from small furniture workshops—to final aggregation points before reaching the power plant. The lack of clarity regarding where materials are consolidated and which routes are taken makes it difficult to establish a coherent end-to-end flow. This indicates that both process visibility and geographical traceability remain low. From a governance perspective, low visibility constitutes a structural corruption risk. Risks at the lower levels (such as informal levies during loading and unloading or bribery practices to secure supply contracts) become difficult to detect, either escaping corporate oversight systems or, in some cases, being implicitly tolerated. Hence, to facilitate a clearer inventory of corruption risks within this supply chain, the following table presents corruption risk points along with their respective levels of vulnerability:

82 Ibid. (p. 15)

83 Ibid. (p. 21)

Corruption Risk Table in the Biomass Supply Chain Flow

Area / Stage	Risk Description	Justification
Supply Chain Visibility (Upstream)	**Origin Obscurity** Feedstock sources are fragmented (small-scale furniture producers/social media sourcing) and largely untraceable. There is a risk of volume manipulation or mixing with illegal materials due to broken visibility at the collector (drop-off) level.	PLN EPI only has visibility at the first-tier supplier level, failing to trace lower-level actors. The long supply chain, severed at the logistics point 5 km from the power plant obscures the chain of custody.
Logistics Operations (Plant Gate)	**Informal Levies & Social Costs** Truck drivers are required to pay informal fees ("*karang taruna*") and face long waiting times (non-productive idle time) during unloading.	This reflects tangible rent-seeking practices at the operational level. While the nominal cost per transaction may be small relative to the main contracts, it signals systemic oversight failure and economic inefficiency that disproportionately burdens lower-tier supply chain actors.
Data Integrity & Material Quality	**Quality/Quantity Manipulation** Risk that delivered materials do not meet specifications (e.g., moisture content) or that weighing processes are manipulated due to weak manual/visual oversight.	Challenges in verifying ESG data and physical quality are compounded by the absence of adequate tracking technology, while gatekeeping power determines which suppliers are accepted or excluded.

(Compiled by authors, 2025)

Looking further back, Indramayu power plant as a business entity once had a dark history of corruption in land procurement. The case involved H. Irianto Mahfud Sidik Syafiuddin (Yance), former Regent of Indramayu, in corruption related to land procurement for the Sumuradem power plant project between 2004 and 2007, which caused state losses and resulted in a four-year prison sentence.[84] The legal violations at the time included the establishment of a legally flawed procurement committee, self-appointment as its head, and the determination of compensation prices that were not in accordance with the Tax Object Sales Value (*Nilai Jual Objek Pajak*/NJOP) and without involving an appraisal institution. This dark historical record, of course, cannot simply be dismissed. Just as past land corruption cases occurred due to abuse of authority and disregard for legal procedures, there currently exists a "grey arena" in PLN EPI's internal regulations regarding the open tender versus direct appointment mechanism for sawdust supply for biomass co-firing at coal-fired power plants.

[84] Case Examination Document on Corruption in Land Procurement for the Sumuradem Coal-Fired Power Plant Project.

This uncertainty creates opportunities for certain officials to act as gatekeepers who determine suppliers through informal considerations, potentially triggering lobbying or bribery for personal gain. Moreover, beyond the supply of sawdust for biomass co-firing needs, PLN EPI is now also directly cooperating with the Indramayu Regency Government in procuring another biomass commodity such as rice husk. In the absence of firmer and clearer rules governing biomass procurement, both at the structural level and in field operations, the opportunity for procurement processes to become a site of structural corruption also widens. In addition, unlike land procurement, which is fixed to a particular location, the sawdust supply chain is far longer and much more fluid. The length of the supply chain, from small furniture workshops to the point where sawdust is weighed inside the power plant, results in low visibility across the supply flow.

Low visibility in terms of origin, ownership, and geographical traceability makes the supply chain difficult to track in its entirety. This reality creates greater opportunities for rent-seeking practices that remain undetected by corporate oversight systems. In such rent-seeking dynamics, unnecessary social costs frequently arise, as reflected in informal levies imposed by certain actors during loading and unloading processes. This constitutes a form of resource inefficiency that places additional burdens on truck drivers without generating any added value to their income.

It can therefore be concluded that, although biomass co-firing is positioned by PLN as a strategic step toward decarbonization, the absence of improvements in procurement governance, combined with the extended length of the supply chain, creates conditions in which informal discretionary spaces can be exploited by individuals, groups, political elites, or business actors, as seen in past procurement corruption cases.

5.3. Identifying Governance Gaps in Biomass Co-firing at the Rembang Coal-Fired Power Plant

In addition to the Indramayu coal-fired power plant, field visits were also conducted by the research team to the Rembang coal-fired power plant. This power plant, located in Sluke District, Rembang Regency, has two generating units with Pulverized Coal (PC) boiler technology that have implemented a biomass co-firing program. Each unit is capable of generating approximately 315 megawatts of electricity, resulting in a total installed capacity of 630 MW for the Rembang power plant.

Based on information from the team responsible for biomass co-firing policy at the site, the process of determining the biomass blending composition did not occur instantaneously. It required a series of studies and gradual trials to identify a safe mixing percentage that would not disrupt machine performance or combustion stability. Since the commissioning stage in 2021, the proportion of biomass used was initially very small, at around 1 percent. This figure has gradually increased and currently stands at approximately 6–7 percent of total coal consumption.[85]

Before settling on sawdust as the primary material, Rembang power plant had tested other commodities such as rice husks and sugarcane waste. Although rice husk particle size was relatively suitable, use in larger proportions risked increasing silica content that could affect turbine performance. Therefore, rice husk use was limited to a maximum of about 3 percent. Meanwhile, supply limitations and supply continuity were also important considerations in selecting the biomass type. In practice, sawdust was assessed as more reliable in terms of supply continuity and more compatible with the technical specifications of the power plant, which has been operating for approximately 15 years. [86]

However, data obtained by the research team in the field, based on information from the PLN Nusantara Power team responsible for the biomass co-firing program at the Rembang coal-fired power plant, differs from the information stated in planning documents and policy databases. Referring to the PLN's Electricity Supply Business Plan (RUPTL) 2021-2030 as well as data from the Directorate General of New, Renewable Energy and Energy Conservation (*Direktorat Jenderal Energi Baru, Terbarukan, dan Konservasi Energi*/EBTKE) in 2021, the biomass used in the co-firing scheme at the Rembang plant is recorded as wood pellets. This discrepancy indicates the possibility of changes in biomass commodities during the implementation stage, technical adjustments at the operational level, or differences in classification and reporting between planning documents and actual practices in the field.

85 PLN Nusantara Power, Rembang Coal-Fired Power Plant, *Interview Transcript*, November 28, 2025.

86 Ibid.

From an energy transition governance perspective, this inconsistency between planning documents and actual implementation underscores the need for improved transparency and periodic data updates, so that biomass co-firing policies are not assessed solely based on numerical targets, but also on technical alignment, supply chain sustainability, and accountability across institutional levels. In practice, the selection of sawdust as the biomass material at the Rembang plant is also influenced by the structure and dynamics of the biomass supply chain needed to meet operational demand.

For sawdust supply, the PLN Nusantara Power team at the Rembang plant explained that the power plant sources its sawdust from the Blora and Jepara regions. The sawdust from these areas originates from wood waste generated by the furniture industry. However, specific details regarding the type of wood and the exact origin of the sawdust delivered to the Rembang plant are not known, as the material is sourced from small and medium enterprise (SME) furniture producers and aggregated by local collectors. Sawdust is typically a byproduct of small-scale furniture production. It is not purpose-produced, involves no formal contracts, and is frequently traded through aggregators or social media platforms. This condition results in incomplete documentation of origin, ownership, and movement pathways.

A similar pattern was also observed by the research team when tracing the sawdust supply chain for the Indramayu plant. The team's findings in Indramayu encountered a long and fragmented supply chain structure, making the traceability of sawdust difficult to establish. Field observations revealed long queues of transport trucks, as sawdust must pass through drop-off points before entering the Indramayu plant. This situation generates additional social costs due to frequent informal levies, reflecting weak oversight at the operational level. At the Rembang plant, although truck congestion was not observed due to a more organized drop-off system, the low level of traceability for sawdust remains a common issue found in both Indramayu and Rembang power plants.

With regard to the achieved biomass co-firing ratio at the Rembang coal-fired power plant, based on information from the PLN Nusantara Power team, the current co-firing rate stands at approximately 6 to 7 percent. At this level, the sawdust requirement for co-combustion with coal reaches around 600 tons per day for the two boiler units. This 6-7 percent ratio is considered a relatively stable operational point and remains tolerable for the Pulverized Coal boiler system used at the Rembang plant. Beyond this threshold, increasing the share of biomass may disrupt the combustion process and affect equipment reliability. Therefore, this level of co-firing reflects a technical compromise between emission reduction efforts and the limitations of existing combustion system design.

As for sawdust procurement, the supply of sawdust to support the biomass co-firing program at the Rembang plant is currently managed by PLN Energi Primer Indonesia (EPI) in collaboration with its partner companies. One of the main partners that frequently wins open procurement tenders from PLN EPI to supply sawdust to several coal-fired power plants in Java, including Rembang, is PT BEST YPK PLN (PT Bakti Energi Sejahtera), a company affiliated with PLN's Education and Welfare Foundation (*Yayasan Pendidikan dan Kesejahteraan* PLN/YPK PLN). Although it has an affiliation with entities within the PLN ecosystem, PT BEST is still formally permitted to participate in biomass procurement tenders, as long as it meets qualification requirements and does not violate principles of fair competition and procurement governance.

Regardless its formal compliance with procedures that allow PT Bakti Energi Sejahtera (YPK PLN) to participate in biomass procurement tenders, the configuration of affiliations between the supplier and PLN's institutional ecosystem continues to raise potential conflicts of interest and preferential treatment that warrant critical scrutiny and mitigation. These risks are particularly apparent when structural affiliations result in asymmetric access to information, indirect influence over the formulation of technical procurement specifications, and the repeated awarding of tenders to the same entity without adequate market evaluation.

In the context of a still-developing biomass procurement market characterized by a limited number of large-scale suppliers, this condition may lead to vendor lock-in and weaken the principles of fair competition. Therefore, without strong mitigation mechanisms, such as clear separation of functions, transparent tender processes, independent price benchmarking, and periodic audits, the biomass procurement scheme risks not only undermining procurement accountability but also diminishing the integrity of claims regarding a just energy transition promoted through the biomass co-firing program.

Building on fragments of information gathered from various sources at both local and national levels, the research team proceeded to trace the biomass supply chain in Rembang. The focus was directed at identifying the origin of sawdust supplied to the Rembang plant, a commodity that appears simple on the surface but reveals a far more complex network of distribution, interests, and decision-making when traced upstream. By following this supply chain, the research aims to capture a dimension often overlooked in policy evaluation, namely the "space between policy and practice." It is within this space that it is determined whether biomass truly functions as an instrument of energy transition or instead becomes a new arena for power relations and the economic interests of rent-seeking actors.

1. The Phenomenon of Information, Pricing, and Procurement Governance Gaps

Initial tracing focused on PT BEST YPK, a company affiliated with the YPK PLN Foundation (Yayasan Pendidikan dan Kesejahteraan PLN). In practice, PT BEST YPK is often perceived as one of the most prepared biomass aggregators in supporting the implementation of the biomass co-firing program across PLN's coal-fired power plant network, including expansion targets to dozens of units. This impression was obtained by the research team through field observations at the Rembang plant, notwithstanding the potential risks of conflict of interest and preferential treatment that must still be seriously examined by PLN within the framework of integrity-based procurement governance.

At the operational level, the research team also traced local suppliers managing sawdust stockpiles in the surrounding area (ring 1) of the Rembang plant. One of the entities examined was PT Wana Eka Jaya (WEJ), a company that partners with PT BEST to supply sawdust to the Rembang plant. In addition to acting as a direct supplier to the plant, PT WEJ also functions as an aggregator, collecting sawdust from various local sources, including furniture, woodworking, and plywood industries across Central Java.

However, according to informants, PT WEJ also collects sawdust from micro, small, and medium-sized furniture enterprises located around ring 1 of the Rembang plant. Informants explained that the sawdust procurement mechanism does not function solely as a commercial activity, but is also perceived as a source of livelihood for local workers involved in the collection and loading-unloading process. In practice, delays or reductions in sawdust orders can directly affect the livelihoods of these groups.

> We collect sawdust from the smallest supply chains, starting from local communities, MSMEs can supply here .... it also sustains local workers who handle loading and unloading here.... if it supports many people, then it supports many at once. Moreover, this sawdust comes from various regions, If this stops, many people will complain because this is their main livelihood. 'Stops' means, for example, if the purchase orders (PO) from the power plant are low, then stock here becomes full and we have to shut it down." the informant explained.[87]

[87] PT WEJ, *Interview Transcript*, November 28, 2025.

Regarding pricing mechanisms, information gathered from field interviews showed that sawdust prices at the local supplier level are generally determined on a volume basis, per cubic meter, at approximately IDR 150,000 per cubic meter.[88] In practice, transactions are often conducted per truckload or container, with capacities varying depending on vehicle type and material density. This volume-based pricing scheme tends to be informal and highly dependent on agreements between collectors and suppliers, without consistently measurable quality standards such as moisture content or calorific value. This condition reflects a gap between upstream procurement practices and the regulatory framework established by the government.

Through Minister of Energy and Mineral Resources Regulation No. 12 of 2023 on the Utilization of Biomass as a Co-firing Fuel in Coal-Fired Power Plants, the government has established a standard pricing mechanism for biomass that links price to energy quality parameters, particularly calorific value, and sets an upper limit for biomass purchase prices. However, field findings indicate that this quality-based pricing framework has not been fully internalized in transactions at the local supplier level. As a result, fluctuations in the quality of biomass received at the plant level remain difficult to control, while efforts to ensure transparent and market-comparable pricing are limited. In the context of large-scale biomass procurement for co-firing programs, this gap has the potential to create information asymmetry, weaken the bargaining position of small suppliers, and open space for price distortions along the supply chain.

The gap between the regulatory pricing framework and transaction practices at the local supplier level not only affects the economic aspects of biomass procurement, but also reflects weak integration of information systems along the supply chain. When pricing mechanisms are not accompanied by traceable material origin records, verified quality standards, and adequate communication reaching local suppliers, the relationship between policy at the central level and practice in the field becomes fragmented. In this context, issues of biomass pricing and quality are closely intertwined with challenges of information transparency and material traceability.

In line with these conditions, field findings also reveal inconsistencies in information at the grassroots level. Direct tracing to several furniture MSMEs in the ring 1 area of the Rembang power plant shows that some furniture producers are not clearly aware that their sawdust trading activities are directly linked to the biomass co-firing program at the plant. This lack of awareness indicates that information flows regarding the end use of sawdust have not reached upstream suppliers, reinforcing findings of traceability gaps within the biomass supply chain. This condition constitutes an important consideration in evaluating biomass procurement governance, particularly in relation to transparency, information system integration, and the protection of small suppliers' bargaining positions.

[88] PT WEJ, *Interview Transcript*, November 28, 2025 (noting that the company received sawdust supply at a price of IDR 150,000 per cubic meter, based on volumetric calculation).

2. Traceability Challenges, Deforestation Risks, and Biomass Governance

Traceability of the sawdust commodity used in the co-firing scheme at coal-fired power plants was one of the primary foundations for conducting this investigation. This focus came from concerns that, without an adequate traceability system, sawdust utilization as biomass fuel could be connected to extractive activities in the forestry sector, including deforestation practices inconsistent with sustainability principles. Thus, the primary objective of this investigation was to ensure that sawdust burned in PLN's co-firing program truly originates from industrial waste and not from the conversion or exploitation of primary or secondary forest resources.

In this context, the research team obtained clarification from PLN Energi Primer Indonesia (PLN EPI), which emphasized that PLN's commitment in implementing the biomass co-firing program at coal-fired power plants is to prioritize the principle of circular energy. Specifically for the island of Java, PLN EPI stated that the biomass used does not come from timber produced through forest logging, but rather from waste generated by the wood-processing industry, such as residues from the production of furniture, furnishings, and wood veneer industries.[89]

Several field findings, including interviews conducted by the research team with informants at PT Wana Eka Jaya (WEJ), a local sawdust supplier in the Rembang area, tend to affirm this narrative. According to the informant, the partnership between PT WEJ and PT BEST YPK, as the vendor holding biomass procurement permits for the Rembang plant, is indeed oriented toward collecting wood waste from existing wood processing industries.

However, further tracing of various secondary sources, particularly online media reports at both local and national levels, indicates a more complex picture regarding the sawdust supply chain managed by PT BEST YPK. Several media reports suggest that sawdust supply for the co-firing program does not entirely originate from Java. One relevant example is a report from Bisnis.com[90] dated 9 July 2023, which refers to a press release issued by PLN EPI No. 029.PR/STH.06.01/PLNEPI0102/VI/2023[91] which covered PLN EPI's first biomass shipment by sea. The report stated that PLN EPI, in cooperation with PT BEST YPK, had begun shipping sawdust from Bulukumba, South Sulawesi, with a volume reaching 5,600 metric tons, using a barge bound for Tanjung Awar-Awar plant in Tuban, East Java.

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89 PLN EPI, *Interview Transcript*, December 4, 2025. PLN EPI claims that, for the Java region, sawdust supply originates from wood processing industry waste.

90 Bisnis.com, *"PLN EPI Debut Kirim Biomassa Lewat Jalur Laut"* [PLN EPI Debuts Biomass Shipment via Sea Route]. Accessed: Jan. 28, 2026. Available: https://ekonomi.bisnis.com/read/20230709/44/1673142/pln-epi-debut-kirim-biomassa-lewat-jalur-laut#goog_rewarded

91 PLN Energi Primer Indonesia, *"Jamin Pasokan Energi Untuk Pembangkit PLN EPI First Unloading Pengapalan Biomassa di PLTU Tanjung Awar Awar"* [Ensuring Energy Supply for Power Plants: PLN EPI First Unloading of Biomass Shipment at PLTU Tanjung Awar-Awar]. Accessed: Jan. 28, 2026. Available: https://www.plnepi.co.id/media-informasi/ruang-media/siaran-pers/jamin-pasokan-energi-untuk-pembangkit-pln-epi-first-unloading-pengapalan-biomassa-di-pltu-tanjung-awar-awar

These inter-island shipments show that the scale and reach of the biomass supply chain for the co-firing program at coal-fired power plants extend beyond the geographic boundaries long associated with industrial wood waste sources on the island of Java. At this point, the issue of sawdust traceability becomes even more critical. Information available in the public domain does not yet provide an adequate explanation of the origin of the wood in the source regions, the characteristics of the industries generating the waste, or the verification mechanisms ensuring that the sawdust is genuinely production residue rather than a by-product of logging activities that could create new ecological pressures.

The lack of information points to a governance gap in the biomass procurement system, particularly in relation to traceability across regions and across actors. Without an integrated traceability standard covering the source of raw materials, the collection process, and their eventual use at the power plant, the sustainability claims of the biomass co-firing program risk remaining normative. In the long term, this condition may not only weaken the legitimacy of biomass-based energy transition policies, but also create space for a leakage effect, where biomass demand from the energy sector instead drives forestry resource exploitation in other regions where oversight is relatively weaker.

These governance risks become even greater when material traceability remains at a low level. In this context, biomass can no longer be treated simply as an industrial residue that is ecologically "neutral," but instead risks becoming a new extractive commodity. When the system for verifying the origin of raw materials does not operate rigorously, the line between industrial waste and timber derived from logging in natural forests becomes blurred. This situation creates economic incentives that may encourage biomass production based on energy crops or even new land clearing, especially if demands from the power sector increase significantly and continuously.

Vulnerabilities in traceability are also reflected in the policy dynamics and implementation of cooperation between PLN (Persero) and Perum Perhutani. In PLN Press Release Number 101.PR/STH.00.01/III/2022,[92] which was also reported by Detik Finance on March 2, 2022, a cooperation agreement between PLN and Perhutani was announced regarding the provision of biomass to support co-firing programs in several coal-fired power plants, including Pelabuhan Ratu and Rembang.[93] In this agreement, Perhutani stated that it would supply biomass derived from energy crop residues, particularly gamal (Gliricidia) and kaliandra.

However, confirmation obtained by the research team at the Rembang plant indicates that, to date, there is no clear realization of this cooperation, particularly regarding fundamental aspects such as pricing agreements and supply mechanisms. This lack of clarity suggests a gap between policy commitments at the central level and operational implementation at the plant level.

On the other hand, tracing official sources from Perhutani shows that the discourse on biomass development had already been underway long before the signing of the cooperation agreement with PLN. In the Rembang context, Perhutani KPH Mantingan had initiated biomass crop development as early as 2019. This effort was further strengthened through a feasibility study collaboration with the Energy Studies Center of Universitas Gadjah Mada (PSE UGM) on March 12, 2021, to assess the potential for biomass crop supply in the Mantingan area.[94]

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92 PLN, "*Sinergi PLN dan Perhutani untuk Co-firing Dorong Ekonomi Berbasis Kerakyatan*" [Synergy between PLN and Perhutani for Co-firing Promotes People-Based Economic Development]. Accessed: Jan. 28, 2026. Available: https://web.pln.co.id/media/2022/03/sinergi-pln-dan-perhutani-untuk-co-firing-dorong-ekonomi-berbasis-kerakyatan

93 Detik Finance, "*PLN Gandeng Perhutani Sediakan Pasokan Biomassa untuk Proyek PLTU*" [PLN Partners with Perhutani to Provide Biomass Supply for Coal-Fired Power Plant Projects]. Accessed: Jan. 28, 2026. Available: https://finance.detik.com/energi/d-5965830/pln-gandeng-perhutani-sediakan-pasokan-biomassa-untuk-proyek-pltu#google_vignette

94 Perhutani, "*Perhutani Dampingi Tim Studi Kelayakan PSE UGM Cek Tanaman Biomassa di Mantingan*" [Perhutani Assists PSE UGM Feasibility Study Team in Assessing Biomass Crops in Mantingan]. Accessed: Jan. 28, 2026. Available: https://www.perhutani.co.id/perhutani-dampingi-tim-studi-kelayakan-pse-ugm-cek-tanaman-biomassa-di-mantingan/

These plans were further consolidated through a series of institutional activities, including a site visit by Perhutani's Director of Wood Commercial Affairs in August 2021 to a proposed biomass processing plant location at the former wood stockyard in Landoh, Sulang District, Rembang Regency.[95] Perhutani KPH Mantingan also publicly stated that it had prepared the development of gamal as an alternative fuel in six Forest Management Units (*Bagian Kesatuan Pemangkuan Hutan*/BKPH); Sudo, Demaan, Medang, Kebon, Ngiri, and Kalinanas.[96]

This development momentum continued into early 2022, marked by a visit from the President Director of Perhutani to KPH Mantingan on January 7, 2022, to review gamal plantations and the planned biomass plant at the former Landoh wood stockyard, approximately two months before the signing of the cooperation agreement with PLN[97]. Between March and April 2022, Perhutani KPH Mantingan had also conducted coordination with the Rembang Regency Government and carried out public outreach to local communities regarding the planned establishment of a biomass processing plant.[98]

More recent developments indicate that in May 2025, Perhutani KPH Mantingan established a partnership with PT Bumi Rejo Tirta Kencana (BRTK) Rembang[99] or the utilization of biomass crops as alternative energy feedstock, with a claimed readiness to harvest approximately 1,000 tons of gamal.[100] The first harvest was reported to have taken place in July 2025 in the BKPH Kalinanas area, Rembang.[101]

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95 Perhutani, "*Perhutani Siapkan Pengembangan Tanaman Biomassa di Wilayah Mantingan*" [Perhutani Prepares Biomass Crop Development in the Mantingan Area]. Accessed: Jan. 28, 2026. Available: https://www.perhutani.co.id/perhutani-siapkan-pengembangan-tanaman-biomassa-di-wilayah-mantingan/

96 Perhutani, "*Perhutani Kembali Sosialisasikan Tanaman Biomassa di Desa Hutan Sekitar Mantingan*" [Perhutani Reintroduces Biomass Crop Socialization in Forest Villages Around Mantingan]. Accessed: Jan. 28, 2026. Available: https://www.perhutani.co.id/perhutani-kembali-sosialisasikan-tanaman-biomassa-di-desa-hutan-sekitar-mantingan/

97 Perhutani, "*Perhutani Dukung Pengembangan Co-firing Biomassa, Direktur Utama Perhutani Lakukan Kunker di Mantingan*" [Perhutani Supports Biomass Co-firing Development, President Director Conducts Working Visit in Mantingan]. Accessed: Jan. 28, 2026. Available: https://www.perhutani.co.id/dukung-pengembangan-co-firing-biomassa-direktur-utama-perhutani-lakukan-kunker-di-mantingan/

98 Perhutani, "*Sekda dan Bappeda Dukung Perhutani Dirikan Pabrik Biomassa di Rembang*" [Regional Secretary and Bappeda Support Perhutani in Establishing a Biomass Plant in Rembang]. Accessed: Jan. 28, 2026. Available: https://www.perhutani.co.id/en/sekda-dan-bappeda-dukung-perhutani-dirikan-pabrik-biomassa-di-rembang/

99 Perhutani, "*Perhutani Jalin Kerja Sama Pemanfaatan Biomassa untuk Energi Terbarukan dengan PT Bumi Rejo Tirta Kencana Rembang*" [Perhutani Establishes Cooperation on Biomass Utilization for Renewable Energy with PT Bumi Rejo Tirta Kencana Rembang]. Accessed: Jan. 28, 2026. Available: https://www.perhutani.co.id/perhutani-jalin-kerja-sama-pemanfaatan-biomassa-untuk-energi-terbarukan-dengan-pt-bumi-rejo-tirta-kencana-rembang/

100 Perhutani, "*Perhutani Bersama dengan PT BRTK Tinjau Tanaman Biomassa Siap Panen di Jukung*" [Perhutani Together with PT BRTK Reviews Biomass Crops Ready for Harvest in Jukung]. Accessed: Jan. 28, 2026. Available: https://www.perhutani.co.id/en/perhutani-mantingan-bersama-dengan-pt-brtk-meninjau-tanaman-biomassa-di-rph-jukung-siap-panen/

101 Perhutani, "*Perhutani Panen Perdana Klirisidi untuk Energi Terbarukan bersama PT BRTK Rembang*" [Perhutani Conducts First Harvest of Gliricidia for Renewable Energy with PT BRTK Rembang]. Accessed: Jan. 28, 2026. Available: https://www.perhutani.co.id/perhutani-panen-perdana-klirisidi-untuk-energi-terbarukan-bersama-pt-brtk-rembang/

However, the research team's tracing of this Perhutani partner reveals inconsistencies between media narratives and the company's operational profile. Based on company documentation, PT Bumi Rejo Tirta Kencana operates in wood processing, particularly woodchips, rather than sawdust.[102] Furthermore, the company is recorded as routinely exporting woodchips to international markets, including Kuwait.[103] These findings raise further questions regarding biomass production orientation, market allocation, and the extent to which such supply is actually directed toward domestic biomass co-firing needs at coal-fired power plants.

Overall, these findings indicate that the biomass co-firing program faces not only technical and economic challenges, but also structural governance vulnerabilities. The lack of synchronization between policy, institutional planning, and field-level practice underscores the urgency of establishing a transparent, verifiable, and cross-institutional traceability system. Without fundamental improvements in this area, the biomass co-firing program risks reproducing new forms of extractivism under the legitimacy of energy transition, rather than functioning as a just and sustainable decarbonization instrument.

102 Woodchip BRTK Rembang, "*Woodchip BRTK Rembang*" [YouTube Channel]. Accessed: Jan. 28, 2026. Available: https://www.youtube.com/@woodchipbrtkrembang

103 Woodchip BRTK, "*Woodchip BRTK*" [Facebook Page]. Accessed: Jan. 28, 2026. Available: https://www.facebook.com/woodchip.brtk/?ref=1

5.4. Corruption Prevention in Biomass Procurement by PLN EPI

This section examines the prevention of corruption risks in biomass procurement for the coal-fired power plant co-firing program managed by PT PLN Energi Primer Indonesia (PLN EPI). The discussion focuses on the regulatory framework, procurement mechanisms, and internal control practices applied in biomass procurement, with reference to field findings from the Indramayu and Rembang coal-fired power plants. This analysis is used to assess the extent to which these procurement regulations and practices are able to control the risks of fraud and corruption, particularly those arising from the complexity of the biomass supply chain.

1. Energy Transition Policy Framework and Its Implications for Procurement Governance

Overall, the regulatory framework for biomass procurement within PLN has not yet formed a specific, integrated, and cross-functional procurement regime. Although Minister of Energy and Mineral Resources Regulation No. 12 of 2023 has been issued as an umbrella regulation specifically governing the utilization of biomass fuel (B3m), including standards and quality, supply mechanisms, maximum benchmark pricing based on the coal price formula, reporting obligations, as well as guidance and oversight schemes, the existence of this umbrella regulation has not automatically resulted in a fully independent and integrated biomass procurement system in operational practice. The Ministerial Regulation primarily governs the macro policy framework, such as the maximum benchmark price formula, national targets for B3m utilization, and reporting obligations, while the technical aspects of procurement remain delegated to the goods and services procurement mechanisms established by the co-firing implementers. As a result, the concrete implementation of biomass procurement still depends heavily on PLN's internal regulations, including procurement guidelines, contract governance, risk management, and systems for verifying quality and volume.

This dependence on internal regulation creates a situation in which biomass, despite having characteristics distinct from conventional primary energy commodities, is processed within a general procurement framework. In fact, the biomass market has a fragmented supply structure, high variability in quality (calorific value, moisture content, contaminants), and involves many small-scale actors and aggregators. Without a procurement design specifically tailored to these characteristics, operational and governance risks remain significant, even if the pricing framework has been standardized.

Interviews with PLN's Energy Transition and Sustainability Division (DIV TEK) provide important empirical context for understanding how the energy transition policy framework shapes the governance environment of biomass procurement. DIV TEK explained that biomass co-firing is positioned as one of the strategic instruments for achieving emission reduction targets derived from various national and corporate policy documents, such as the National Electricity General Plan (RUKN), the Enhanced Nationally Determined Contribution (NDC), and the Electricity Supply Business Plan (RUPTL).[104]

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[104] National Electricity General Plan (RUKN, Rencana Umum Ketenagalistrikan Nasional); Government of Indonesia, *Enhanced Nationally Determined Contribution (NDC)*; PT PLN (Persero), *Rencana Usaha Penyediaan Tenaga Listrik (RUPTL) 2025-2034* [Electricity Supply Business Plan (RUPTL) 2025-2034].

Within this framework, biomass co-firing has been incorporated into greenhouse gas emission reduction Key Performance Indicators (KPIs) at the directorate level since around 2021, as stated by the informant.[105] The informant explained that DIV TEK's role is more of a helicopter view in overseeing the energy transition policy framework.[106] This functional separation has important implications for corruption prevention, as strong pressure to achieve emission targets and performance KPIs is not directly balanced by the involvement of policy units in the design and oversight of biomass procurement mechanisms. In the context of an immature biomass market and procurement processes characterized by high discretion, this institutional configuration has the potential to drive output-driven compliance, where the organizational focus on achieving quantitative indicators, such as the number of power plants implementing co-firing or the volume of biomass absorbed, is not always aligned with strengthening substantive procurement governance controls.[107]

2. Praktik Pengadaan Biomassa dan *Blind Spot* Tata Kelola

PLN Energi Primer Indonesia (PLN EPI) provides an empirical picture of biomass procurement practices in the field. PLN EPI explained that PLN appoints partners through a tender process, while those partners manage the network of collectors at the lower levels.[108] This indicates that PLN EPI's direct control ends at the level of the aggregator partner, while the process of collecting biomass on the ground falls entirely within the business domain of the partners and their suppliers. PLN EPI also acknowledged the limitations of its oversight over the supply chain below the partner level.[109]

This condition creates a governance blind spot in the upstream segment of the biomass supply chain. When the chain of custody is not comprehensively documented, the risks of manipulation related to the origin of raw materials, volume, and cost claims become more difficult to detect through formal public procurement mechanisms.

In the context of corruption prevention, weaknesses in biomass quality control not only affect technical efficiency, but also create room for fraud that is difficult to reach through formal public procurement mechanisms. Risks of manipulation also arise in relation to biomass quality. Responding to the issue of biomass being sprayed with water to increase its weight, PLN EPI emphasized that procurement is not based solely on tonnage, but on calorific value.[110]

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105 PT PLN (Persero), Energy Transition and Sustainability Division (DIV TEK, Divisi Transisi Energi dan Keberlanjutan), *Interview*, November 18, 2025

106 Ibid.

107 OECD, "*Preventing Corruption in Public Procurement*," 2016.

108 PLN EPI, Interview Transcript, December 4, 2025.

109 Ibid.

110 Ibid.

This calorific value-based approach is technically designed to reduce incentives for fraud. However, its effectiveness depends heavily on the accuracy and frequency of measurement, as well as the integrity of the testing process. PLN EPI stated that sanction mechanisms have been regulated in the contract.[111] This mechanism functions more as a control at the end point of the supply chain (the coal-fired power plant) and is corrective in nature, rather than serving as a tool to prevent manipulation in the upstream biomass supply chain.

3. *End-Point Control and the Limits of Fraud Prevention*

Various studies on fraud in commodity supply chains show that control mechanisms focused on the end point, such as goods receipt inspections, quality testing at final facilities, or post-procurement administrative audits, tend to be corrective and inadequate to prevent manipulation occurring in the upstream segment of the supply chain. Patterson et al. emphasized that traditional internal controls are designed for organizational environments that are relatively closed and hierarchical, and are therefore ill-equipped to deal with the complexity of modern supply chains, which are fragmented, involve multiple actors, and are geographically dispersed.[112] In such contexts, fraud is in fact more likely to occur in the early tiers of the supply chain, where transparency is low and direct oversight by the final buyer is highly limited.

Similar findings were presented in the study by Dekker et al., which analyzes fraud vulnerabilities across various types of natural resource-based commodity supply chains. The study shows that the controls predominantly applied by buyer organizations are generally technical in nature (hard controls), such as testing the quality of final products, while managerial and relational controls (soft controls) at the upstream level remain relatively weak.[113] As a result, manipulation related to the origin of raw materials, actual volumes, or logistics cost claims often goes undetected, because it is not directly reflected in quality parameters at the end point.

In the context of biomass procurement by PLN, this condition is reflected in PLN EPI's acknowledgment that its main oversight is focused on the specifications and quality of biomass at the coal-fired power plant, while the process of collecting biomass at the collector and initial supplier levels falls entirely within the business domain of the partners. This type of control approach places corruption prevention within a logic of ex post verification, rather than ex ante risk prevention. In other words, potential irregularities upstream only become a concern once the biomass has arrived at the power plant, thereby severely limiting the space for preventing structural fraud, especially in relation to claims regarding origin, transport costs, and margins.

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[111] PLN EPI, *Interview Transcript*, December 4, 2025.

[112] J. L. Patterson, K. N. Goodwin, and J. L. McGarry, "*Understanding and Mitigating Supply Chain Fraud*.," Journal of Marketing Development & Competitiveness, vol. 12, no. 1, 2018.

[113] S. M. Van Ruth, P. A. Luning, I. C. J. Silvis, Y. Yang, and W. Huisman, "*Differences in fraud vulnerability in various food supply chains and their tiers*," Food Control, vol. 84, pp. 375–381, 2018.

The supply chain governance literature emphasizes that risk control in procurement systems must be integrated into the design of organizational risk management and applied continuously throughout the supply chain. Within this framework, mechanisms for tracing and monitoring business relationships, which in practice can be operationalized through traceability and chain of custody approaches, should not be positioned only as additional technical instruments, but as inherent components of risk control[114]. Traceability enables buyer organizations to trace the origin of materials, the geographical routes of distribution, and the actors controlling the commodity at each stage, thereby reducing the information asymmetry that constitutes a primary precondition for fraud. From this perspective, strengthening traceability in biomass procurement is relevant not only to the sustainability agenda, but also constitutes a fundamental prerequisite for substantive corruption prevention.

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4. Conflict of Interest, Market Integrity, and Systemic Risks

In biomass procurement taking place in a market with a high degree of dependence on a single buyer, the management of conflicts of interest is not only related to the individual integrity of public procurement implementers, but also determines the integrity of the market as a whole.

In practice, PLN Energi Primer Indonesia (PLN EPI) emphasizes conflict of interest prevention through formal instruments in the form of integrity pacts.[115] Integrity pacts are commonly used instruments in public procurement systems to affirm the ethical commitments of all parties, both internal actors and suppliers. However, anti-corruption literature shows that the effectiveness of integrity pacts depends heavily on the existence of active oversight by independent monitors, conflict of interest verification mechanisms, and sanctions that are applied consistently.

Transparency International emphasized that integrity pacts standing alone without audits, independent monitoring, and process transparency tend to function as symbolic compliance rather than as substantive risk control instruments.[116]

The OECD also noted that approaches to preventing conflicts of interest that rely solely on formal declarations, without verification and periodic updates, risk failing to identify hidden relationships, informal affiliations, and potential conflicts of interest that emerge throughout the procurement cycle.[117] In the context of biomass public procurement, this risk becomes increasingly relevant given the long-term relationships between PLN, aggregator partners, and supplier networks at lower tiers, which create opportunities for the normalization of informal relationships outside formal tender mechanisms.

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114 OECD, "*Due Diligence Guidance for Responsible Business Conduct*", 2018. Available: https://www.oecd.org/content/dam/oecd/en/publications/reports/2018/02/oecd-due-diligence-guidance-for-responsible-business-conduct_c669bd57/15f5f4b3-en.pdf

115 PLN EPI, *Interview Transcript*, December 4, 2025.

116 Transparency International, *Corruption Risks in Public Procurement*, 2013

117 OECD, *Managing Conflict of Interest in the Public Sector*, Paris: OECD Publishing, 2005, pp. 21-24.

Such administrative approach limitations create room for petty fraud, such as small-scale forms of irregularity that do not always explicitly violate rules, but occur repeatedly and become internalized in the day-to-day practices of the organization. The ACFE defines petty fraud as relatively small-value manipulative acts that are often overlooked because they are considered insignificant, but which cumulatively can damage the integrity of the internal control system and create a permissive culture toward misconduct.[118] In the context of biomass procurement, petty fraud may appear in the form of tolerance for quality deviations, the acceptance of cost claims that are difficult to verify, or informal relationships between procurement implementers and suppliers.

These findings show that conflict of interest prevention in PLN's biomass procurement is still dominated by a compliance-based approach. Without strengthening conflict of interest verification mechanisms, independent audits, and integrated supply chain oversight, integrity pacts risk becoming formal instruments that are insufficiently effective in warding off structural and recurrent corruption risks.[119]

In the context of an immature and monopsonistic biomass market, conflict of interest prevention practices that rely solely on administrative instruments such as integrity pacts do not affect only individual ethics, but also directly impact market integrity. OECD analysis on public procurement and state-owned enterprise governance shows that weak competition, long-term procurement relationships, and limited transparency can increase the risks of favoritism and market lock-in, which over time may create entrenched supplier relationships that are difficult to contest.[120]

The long-term relationships between PLN EPI, aggregator partners, and biomass supplier networks have the potential to form a concentrated market structure, in which market access, price formation, and contract allocation are de facto controlled by certain actors. This condition reduces market contestability and erodes the principle of a level playing field in public procurement.[121] In such a situation, conflicts of interest are no longer personal or individual in nature, but instead manifest as systemic market distortions that ultimately weaken the principle of fair business competition and heighten the risk of corruption in biomass procurement.[122]

Under such conditions, market integrity cannot be guarded through ethical declarations and administrative compliance alone, but requires institutional capacity to trace, verify, and control relationships among actors throughout the supply chain.

118 Association of Certified Fraud Examiners (ACFE), *Fraud Examiners Manual* (Austin, TX: ACFE, edisi terbaru), bagian "Occupational Fraud and Abuse"

119 Transparency International, *Curbing Corruption in Public Procurement: A Practical Guide*, Berlin, 2014; OECD, *Managing Conflict of Interest in the Public Sector: A Toolkit*, OECD Publishing, Paris, 2005.

120 OECD, 2018 *State-Owned Enterprises and Corruption.* Diakses melalui doi.org/10.1787/9789264303058-en

121 World Bank, *Enhancing Government Effectiveness and Transparency: The Fight Against Corruption*, Washington DC, 2020

122 OECD, 2015, *Public Procurement for Sustainable and Inclusive Growth*.

5. *Supply Chain Traceability as a Prerequisite for Corruption Prevention*

The limitations in managing conflicts of interest and market integrity in PLN EPI's biomass procurement cannot be separated from the weakness of the biomass traceability system and supply chain controls. In the context of natural resource-based commodities with long and fragmented supply chains, feedstock traceability is an important prerequisite for ensuring transparency, accountability, and preventing corruption prevention from stopping at only procedural compliance.

Interview findings with PLN Energi Primer Indonesia (PLN EPI) show that the primary weak point in biomass procurement lies not only in the design of public procurement procedures, but also in the limited traceability and chain of custody systems in the biomass supply chain. In biomass procurement for co-firing at coal-fired power plants, traceability functions as an important anti-corruption instrument because biomass is a natural resource-based commodity with a long and fragmented supply chain. Studies by the FAO and the World Resources Institute (WRI) show that, in natural resource-based commodities with long and fragmented supply chains, controls that rely solely on administrative documentation and inspections at the end point are limited in their ability to detect manipulation and fraud in the upstream segment of the supply chain. Case studies of timber traceability systems in Latin America show that, without chain of custody mechanisms accompanied by verification and audits throughout the supply chain, the risks of material mixing, inaccurate claims regarding the origin of raw materials, and other irregularities remain high.[123]

The interview with PLN EPI indicates that controls currently implemented by PLN are more focused on the end point of the supply chain, such as compliance with technical specifications at the coal-fired power plant, while oversight at the upstream stage is left to the internal mechanisms of procurement partners.[124] This type of end-point control approach, although important for ensuring fuel quality, has limitations in preventing manipulation risks upstream.

In response to the limitations of market transparency and supply chain traceability in the biomass sector, PLN Energi Primer Indonesia (PLN EPI) is currently developing a biomass marketplace initiative as a digital platform to support biomass supply for co-firing at coal-fired power plants. This initiative is presented as a means of matching biomass suppliers with the needs of power plants in a more measurable way in terms of volume, quality, and logistics.[125]

[123] FAO and WRI, *Timber Traceability: A Management Tool for Governments. Case Studies from Latin America*, 2022. Available: https://openknowledge.fao.org/handle/20.500.14283/cb8909en

[124] PLN EPI, *Interview Transcript*, December 4, 2025.

[125] PT PLN Energi Primer Indonesia, *"Peringati Hari Pahlawan PLN EPI Luncurkan Marketplace Biomassa untuk Cofiring Dorong Standardisasi Pasokan dan Ekonomi Desa"* [Commemorating Heroes' Day, PLN EPI Launches Biomass Marketplace for Co-firing to Promote Supply Standardization and Rural Economy]. Accessed: Jan. 28, 2026. Available: https://www.plnepi.co.id/media-informasi/ruang-media/siaran-pers/peringati-hari-pahlawan-pln-epi-luncurkan-marketplace-biomassa-untuk-cofiring-dorong-standardisasi-pasokan-dan-ekonomi-desa

Conceptually, the development of such a marketplace has the potential to reduce information asymmetry, encourage quality standardization, and broaden market access for upstream biomass actors. However, its effectiveness as an instrument for strengthening market integrity and preventing corruption depends heavily on the governance design of the platform, its integration with public procurement mechanisms, and the system's ability to reach the upstream level of the supply chain and verify the origin of biomass in an auditable manner. Without these prerequisites, the marketplace risks functioning just as an additional administrative layer, while market concentration practices and long-term relationships among actors continue outside the formal mechanism.

Hence, the marketplace is more appropriately understood as an initial precondition for improving biomass market governance, rather than as a guarantee that transparency and corruption prevention will be achieved automatically.

The public procurement literature shows that controls focusing solely on final outputs tend to be corrective in nature and insufficiently effective in detecting irregularities occurring during the production, collection, and transportation stages of raw materials.[126]

Transparency International emphasizes that corruption prevention efforts in public procurement cannot stop at procedural and formal compliance alone. Without substantive risk control throughout the entire procurement cycle, particularly at the stages of contract implementation and oversight, corruption and fraud risks remain ineffectively managed.[127]

In the context of complex and layered natural resource-based commodity supply chains, the need for such risk control can be operationalized through mechanisms for tracing and documenting the flow of material control. This mechanism is known as chain of custody, namely a control system that ensures materials can be traced from upstream to downstream, kept separate from unlawful or problematic sources, and audited adequately.[128] In the context of biomass procurement, chain of custody serves as an important instrument for strengthening transparency and the auditability of the supply chain, thereby helping to close control gaps that are not covered by conventional public procurement mechanisms.

These findings show that strengthening traceability and chain of custody needs to be positioned as a core element in the design of PLN's biomass procurement, not only as a technical complement. Without a traceability system that extends to the upstream segment of the supply chain, corruption prevention risks being reduced to mere administrative compliance, rather than functioning as substantive and sustainable risk control.

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126 OECD, *Preventing Corruption in Public Procurement*, 2016. Available: https://baselgovernance.org/sites/default/files/2020-03/oecd_preventing_corruption_in_public_procurement_2016.pdf

127 Transparency International, *Anti-Corruption Across the Procurement Cycle*, 2024. Available: https://knowledgehub.transparencycdn.org/helpdesk/Anti-corruption-across-the-procurement-cycle_2024-English-Version.pdf

128 Forest Stewardship Council (FSC), *Chain of Custody Certification*. Available: https://my.fsc.org/my-en/get-fsc-certified/fsc-chain-of-custody-certification


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CHAPTER VI
CONCLUSION & RECOMMENDATIONS

In policy language, biomass co-firing at power plants is frequently positioned as a transitional bridge. It is claimed to be the most realistic step for fulfilling the energy transition mandate embedded in national energy policy, particularly amid limited renewable energy investment and the still-high dependence on coal-fired power plants. Biomass co-firing is presented as a middle ground: a compromise between an old world not yet ready to be abandoned and a clean future not yet fully realized. However, like any bridge, it is not neutral. The direction of transition, the distribution of benefits, and the social and ecological risks that accompany it are determined by how the policy is designed and implemented. Field findings demonstrate that the issue does not end at pricing formulas or meeting energy mix targets, but extends to the governance dimensions of the biomass supply chain itself. When procurement takes place in an immature market, with fragmented supply structures and involvement of many small-scale actors, the space for administrative and technical discretion becomes significant. It is at this point that the stakes of energy integrity and justice play out.

The analysis of traceability shows that the sustainability of co-firing is determined not only by emission reductions at the smokestacks of coal-fired power plants, but also by the origin of the biomass being burned. Without a rigorous verification system, the risk of biomass entering the system from illegal logging, unsustainable land conversion, or manipulation of volume and quality becomes real. International experience shows that the governance of biomass supply chains can become a source of serious controversy, as seen in the debate over Drax Group's biomass procurement policy[129] through its sourcing policy scheme, as well as the reporting and governance case involving Enviva in the United States. Both examples show that without responsible sourcing standards and strong internal oversight systems, sustainability claims can be publicly and reputationally challenged.

Based on the field findings and analysis of the biomass procurement process for biomass co-firing at coal-fired power plants, as well as the assessment of traceability outlined above, we recommend several strategic steps for the key actors involved in Indonesia's biomass co-firing program:

[129] Drax. (2025). Biomass Sourcing Policy (March 2025 v.1.1). Drax Global. Available: https://www.drax.com/wp-content/uploads/2025/04/Drax-Biomass-Sourcing-Policy-March-2025-v.1.1.pdf

First, develop more open and transparent biomass procurement planning by clearly defining supplier selection criteria, procurement methods, and technical parameters used in price negotiations. This approach is essential to minimize uncontrolled discretionary space and prevent non-competitive practices.

Second, beyond existing biomass pricing regulations, it is critical to strengthen traceability requirements within biomass procurement. Systems for tracking raw material origins, verifying land legality and sustainability, and conducting independent audits of volume and quality must be systematically integrated to prevent risks of deforestation and legal violations.

Third, an explicit responsible sourcing policy is required at the operational level, particularly within PT PLN Energi Primer Indonesia. Responsible sourcing is a procurement approach that ensures biomass is obtained legally, sustainably, and traceably, while respecting environmental and social considerations. This approach evaluates not only price and volume, but also the origin of raw materials, ecological impacts, and supplier compliance with independent standards. PLN EPI could adapt strategies implemented by Drax Group in its Biomass Sourcing Policy to enhance transparency, reduce reputational risks, and strengthen public legitimacy regarding biomass sustainability claims.

Fourth, strengthen the Whistle-Blowing System (WBS) to ensure the availability of safe and independent internal reporting mechanisms for detecting potential conflicts of interest, contract deviations, and manipulation of technical specifications at an early stage. Strengthening the WBS is particularly important in the biomass sector, given its vulnerability to controversy when there is a mismatch between corporate sustainability claims and actual practices, as seen in the Enviva case. [130]

Ultimately, biomass co-firing will only truly function as a transitional bridge if it is built upon a foundation of integrity. Without governance that is transparent, accountable, and oriented toward upstream-to-downstream sustainability, this bridge risks becoming an extension of the existing system under a greener façade. For energy transition is not only about replacing fuel, but about ensuring that such process of change is just, sustainable, and free from practices that harm the public interest

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[130] Justin Catanoso, "*Enviva, the World's Largest Biomass Energy Company, Is Near Collapse*", Mongabay, November 20, 2023. Available: https://news.mongabay.com/2023/11/enviva-the-worlds-largest-biomass-energy-company-is-near-collapse/

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