

## Strategic Planning in Achieving Net Zero Emissions: Case of Biomass Cofiring Technology

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### Abstract

*This study underscores the significance of strategic planning in attaining the Net Zero Emissions (NZE) objective by 2060 through the utilization of Biomass Co-firing technology. Employing a qualitative descriptive analytical approach, the research centres on the imperative of cross-sector collaboration essential for NZE attainment, particularly highlighting social and economic dimensions with a focus on stakeholder engagement, notably local communities. The study engages with various informants, including corporate leaders, support staff, and community representatives, to comprehensively understand the dynamics involved. The strategic approach aims to curtail biomass waste by 1% of the total environmental waste and reduce boiler emissions by 10-15%. Additionally, it recognizes the positive social and economic ramifications of such planning, such as bolstering income for biomass suppliers engaged in Co-firing. Nonetheless, the research underscores the challenges in organizational management that necessitate mitigation. Consequently, it advocates for a heightened commitment from entities like PT. PLN Energi Primer Indonesia to foster robust community relations, thereby advancing the vision of sustainability and shared prosperity. This study furnishes crucial insights for stakeholders committed to NZE achievement while acknowledging the pivotal role of social and economic considerations in the process.*

**Keywords:** Strategic Planning, Co-Firing, Biomass, Net Zero Emission.

### Abstrak

Penelitian ini menekankan pentingnya perencanaan strategis dalam mencapai target *Net Zero Emissions* (NZE) pada tahun 2060 dengan menggunakan teknologi *Co-firing* Biomassa, lalu dalam penelitian ini mengadopsi pendekatan kualitatif deskriptif analitis. Fokus penelitian ini adalah pada kerja sama lintas sektor yang diperlukan untuk mencapai NZE, terutama dalam hal aspek sosial dan ekonomi dengan pemusatan pada kelompok kepentingan yakni masyarakat setempat, disamping itu informan yang diteliti disini merujuk pada pimpinan perusahaan dan staf pendukung yang ada serta kelompok masyarakat yang terdampak. Tujuan strategi ini adalah mengurangi limbah biomassa sebesar 1% dari total limbah di lingkungan, serta mengurangi limbah yang dihasilkan oleh boiler sebesar 10-15%. Selain itu, penelitian ini mencatat dampak positif secara sosial dan ekonomi yang timbul dari perencanaan strategis ini, seperti peningkatan pendapatan bagi pemasok biomassa untuk *Co-firing*. Meskipun demikian, penelitian juga mengidentifikasi tantangan dalam manajemen organisasi yang harus diatasi. Oleh karena itu, PT. PLN Energi Primer Indonesia harus lebih berkomitmen untuk menjaga hubungan yang baik dengan masyarakat demi mendukung visi masa depan yang berkelanjutan dan memberikan kesejahteraan bagi semua warga. Penelitian ini memberikan wawasan penting bagi pemangku kepentingan yang berkomitmen untuk mencapai NZE sambil memperhatikan aspek sosial dan ekonomi yang sangat penting.

**Kata kunci:** Perencanaan Strategis, *Co-Firing*, Biomassa, *Net Zero Emission*.

## Introduction

If we review the energy sector, which the government has actualized, it is still a problem that has not been resolved from a policy perspective, and this is reinforced by various problems, which, of course, need to be carefully examined in terms of the strategy being played, such as the findings from (Muyasyaroh, 2024), Who argues that the existing strategy's focus on its implementation is not optimal. On the one hand, this also concerns the role of the government through its authority, namely the state electricity company, so that what is designed well can lead to results that are in accordance with the policy scheme of each entity that concretizes plans for achieving low carbon emissions.

The State Electricity Company PLN (*Pembangkit Listrik Negara*) is the entity that manages the electricity sector in Indonesia, where electricity issues are very important in various aspects of life and national development, which influence many activities such as economics, defence, politics, culture, and society. Electricity is a natural resource that plays an important role in achieving national development goals

related to various resources such as coal, gas, and water as materials for producing electricity.

In this way, it is necessary to manage the electricity sector by the state, focusing on people's welfare following the Indonesian state constitution (Constitution of the Republic of Indonesia, 1945).

From the description above, PT is able to carry out the urgency of management. PLN seeks to implement the goals mandated by the state constitution by preparing a strategic plan to realize the company's goals and mission within the agreed period and to be accountable in practice (Wibawa & Rosyadi, 2021).

However, the problem is the responsibility of PT. PLN, namely Steam Power Plants (PLTU, *Pembangkit Listrik Tenaga Uap*), is still used as the main method for producing electrical energy, the results of which have the effect of electric heat during the combustion process and result in the presence of pollutants which are indicated to be quite dangerous for health and the environment (Mohd Idris et al., 2018). If this continues, it is certain that Indonesia directly

contributes to coal burning through PLTUs, amounting to 50% of Sulfur Dioxide (SO<sub>2</sub>) emissions related to the energy sector, then 30% of Particulate emissions (PM<sub>10</sub>) and 28% of Nitrogen Dioxide (NO<sub>x</sub>) emissions (Aulia Nafis et al., 2023).

Furthermore, the pollution resulting from PLTU pollutants is very serious, especially for the people who live in the surrounding area; they (the community) feel the impact in terms of personal costs, which need to be used as an effort to avoid the impacts of the PLTU such as fever, lung cancer, stroke, as well as the heart for treatment.

Therefore, this problem is of concern to PT. PLN in managing the PLTU in question does not cause harm, especially to the community and the environment. Apart from that, the problem above is related to Indonesia, which also has made great efforts in making a renewable energy transition to reduce dependence on the main energy source from fossil fuels and its negative effects (Yang et al., 2022). Switching to biomass energy such as biogas, bioethanol, and biodiesel is an important step (Ferdinand Marini,

2018). This energy has been widely used in power generation and has proven to be more efficient (Miedema et al., 2017).

Then, Indonesia's initiative also encourages the use of new and renewable energy (EBT, *Energi Baru Terbarukan*), which is strengthened through (Regulation of the Minister of Energy and Mineral Resources No. 53 About Concerning the Use of Renewable Energy Sources for Providing Electricity, 2018) ,as the leading sector in realizing the use of EBT.

However, in the period when this regulation was passed until 2020, the realization of EBT only reached 11.31%, which means that the efforts made are still facing serious challenges, one of which is the issue of the price of EBT not being able to compete with fossil energy (oil and natural gas) (Nuryadi, et al., 2023).

Furthermore, this context relates to the use of Co-Firing in power plants, which is an important step in realizing emission reductions and savings in the Cost of Supply (BPP, *Biaya Pokok Penyediaan*) of energy through the Co-Firing program in power plants,

especially those that use mixed coal. Biomass. It is an initiative that aims to make Indonesia more sustainable in energy use, with the term PLN's "Green Booster" supporting "Net Zero Emission" (PJB, 2021).

In the National Electricity General Plan (RUKN, *Rencana Umum Ketenagalistrikan Nasional*), PT. PLN plans to apply Co-Firing technology to 52 Steam Power Plant (PLTU) units by replacing some coal with biomass materials such as wood pellets, palm shells, and sawdust. These are expected to increase the total Co-Firing capacity at PLN PLTU to around 18 Gigawatt (GW) in 2024 as part of efforts to support the development of New Renewable Energy (EBT, *Energi Baru Terbarukan*) in Indonesia (Yusniati et al., 2018). The presence of careful planning from PT. PLN is crucial in supporting achieving Indonesia's Net Zero Emission (NZE) target. These are reflected in their plan to apply Co-Firing technology to 52 Steam Power Plants (PLTU) distributed in various regions of Indonesia. As a first step, they have conducted Co-Firing trials at 26 PLTUs by replacing some of the coal

with 1-5% biomass. The following data describes this pilot deployment:

Figure 1. The Location Of Biomass Co-Firing PLTU



Source: Directorate General of EBTKE (2021)

Based on this number, 13 PLTU units have implemented it commercially, including those in question spread across various regions such as Java, Kalimantan, Sulawesi, and Lombok. Thus, the main role played by PLN as the national electricity generation sector has a significant impact on changing technology and increasing the use of renewable energy.

Then, PT. PLN is also strategically positioned to influence diverse global governance, such as leveraging Indonesia's potential regarding large carbon stocks and mineral resources that can be used to support renewable energy. So, in this context, the Indonesian government should see this condition as a golden opportunity to become an influential

player in global efforts to overcome environmental problems and encourage biomass co-firing as a form of renewable energy.

### **Methods**

This research adopts a descriptive qualitative analytical method focusing on field data analysis. This approach allows researchers to describe and analyze events or phenomena that occur in practical situations by collecting data from written or oral information from individuals while paying attention to relevant behavior in the appropriate context (Sudaryono, 2018).

In the domain of data acquisition, researchers employ a comprehensive approach integrating observation, interviews, and documentation. Primary data primarily stems from firsthand accounts gathered through structured interviews with pertinent informants, meticulously chosen based on their relevance to the research objectives. Concurrently, secondary data is sourced from documents procured from relevant institutions aligned with the research's thematic focus.

The data analysis process unfolds in three sequential stages: initial presentation of data gleaned from interviews and observations, subsequent meticulous comparative analysis, and eventual elucidation of research findings derived from distinct informant groups, including company executives, support personnel, and community representatives. Methodologies encompassed within this approach entail data collection, meticulous data presentation, reduction, and inference drawing based on the synthesized analysis.

This systematic elucidation of research quandaries not only affords clarity but also facilitates comprehension for discerning readers. This approach allows researchers to obtain rich, relevant information from selected informants (J. Moleong, 2018).

### **Result and Discussion**

This research focuses on Strategic Planning for Biomass Co-Firing, intending to achieve Net Zero Emission (NZE) by 2060 at PT. PLN Primary Energy Indonesia. This research refers to the strategic planning theory proposed by J. Constable, which

consists of five important aspects: Planning Process, Planning Decisions, Time Scale, Organizational Structure, and Organizational Activities (Bryson, 2011). Here's the description:

### **Planning Process**

In strategic planning, an organization must have plans, guidelines, or steps to achieve agreed future goals. Given a comprehensive understanding, specific confirmation was sought from Mr. Edwin Nugraha Putra, the Executive Vice President of System Planning Electricity at PT. PLN (Persero), regarding the strategic planning processes integral to the implementation of co-biomass firing.

Mr. Putra conveyed that: *“The fundamental intent behind the planning of biomass co-firing at the Power Plant (PLTU) is to achieve the ambitious goal of net-zero emissions by 2060. This initiative is anticipated to have significant and widespread implications across the entirety of Indonesia, albeit with certain areas yet to undergo optimal development. Presently, meticulous mapping of biomass types and their potential supply has been undertaken, alongside the orchestration*

*of the entire process up to the PLN power generation facility.*

*A steadfast commitment is articulated towards reducing coal consumption through the incorporation of biomass for co-firing. The primary focus is directed at enhancing biomass co-firing within PLTUs while concurrently fortifying the supply chain. Mr. Putra emphasized that the objective extends beyond mere coal replacement with biomass, encompassing the establishment of a reliable biomass supply chain involving local communities.*

*In doing so, the program aims not only to mitigate emissions but also to foster a robust economic impact directly benefiting the local populace. Consequently, PLN's adoption of this technology is not solely driven by emission reduction; it acknowledges the presence of circular economic elements that can shape an ecosystem of community-centric energy, where electricity is generated through community contributions and subsequently enjoyed by the community”.*

On the other hand, individuals providing feedback on this strategic

planning expressed the following sentiment: *"Concerning the implementation of Co-firing biomass utilization, the local community is already informed. As an entrepreneur actively engaged in this endeavor, I have firsthand experience with the potential of utilizing sawdust as a primary material for Co-firing biomass"*.

The research results describe that PT. PLN Energi Primer Indonesia (EPI) has succeeded in managing its planning process well. These are reinforced by evidence that they have carried out effective strategic planning in using co-firing biomass, which opens up opportunities for the community and has a significant positive impact on biomass fuel. In addition, PT. PLN EPI has consistently planned and implemented annual steps in implementing biomass co-firing. They also have an ambitious long-term target, namely achieving Net Zero Emissions (NZE) by 2060. From this overall picture, it can be revealed that PT. PLN EPI has demonstrated very high readiness in formulating and implementing each stage of their planning.

### **Planning Decision**

Planning decisions are a key aspect of managing an entity in the internal and external environment. The decision-making process is a crucial stage where an entity chooses the best option from various available alternatives to achieve its stated goals. The main objective in the decision-making process is to reduce risk, achieve optimal levels of effectiveness, and ensure efficiency in implementing decisions in the future. The basis of this process is the analysis of available data, facts, and information.

To expound on this, verification was sought from Mr. Edwin Nugraha Putra, the Executive Vice President of Electricity System Planning at PT. PLN (Persero), with a focus on the role of co-firing biomass as a strategic solution towards attaining the net zero emissions target by 2060.

Mr. Putra conveyed that: *"In essence, the impact of biomass utilization is relatively modest, constituting a mere 1%, and may not be immediately discernible in broader terms. Moreover, the general public might not be cognizant of which Power Plants (PLTU) are employing biomass*

*materials due to the multifaceted demands placed on the company, both internally and globally. He further expounded on the global impetus behind the adoption of biomass co-firing, citing mandates stemming from international agreements such as the G20 agreement, which underscored environmental considerations. Despite the slated implementation of Biomass Co-firing at PLTU Suralaya by 2025, Mr. Putra underscored the nuanced nature of the process, cautioning against overly swift implementation due to the concurrent exploration of various other sources of renewable energy. He emphasized that, although the impact might be relatively minor, there is a collective global and societal demand for environmentally sustainable practices, propelling the imperative to transition towards greener energy alternatives”.*

Subsequently, from the perspective of the community, individuals expressed their viewpoint as follows: *"For the community residing around this power plant, we fully support the planning process involving the utilization of Co-firing biomass towards achieving Net Zero Emission by 2060".*

Based on the description above, concerning the results of the exploration carried out, it is concluded that biomass related to planning decisions is very important in the context of co-firing. Especially when consideration of incentives provided by the government is a key factor. The question arises as to whether PLN can implement Co-firing without facing significant technical and financial obstacles, especially if the incentives are inadequate. It also highlights the importance of ongoing evaluation of the overall impact of the biomass co-firing program, especially over the next decade. This step is prudent to ensure that the program remains consistent with its stated objectives and delivers anticipated benefits.

### **Time Scale**

The time scale in strategic planning has an important role in determining the relevant period for planning and predicting the consequences of current decisions and programs. In general, strategic plans usually range from three to five years. This timeframe is considered sufficient

to estimate the impact of the current strategic decisions.

However, there are some consequences, such as investment in new areas or product development, which may not be felt significantly in the short term, less than three years. On the other hand, timeframes longer than five years may be too difficult to predict with accuracy. In the context of this study, it is highlighted that strategic planning involving co-firing biomass has a time scale approach that includes short, medium, and long-term targets to achieve the Net Zero Emissions (NZE) goal in 2060.

In order to enhance the clarity of information, the author sought confirmation from Mr. Edwin Nugraha Putra, the Executive Vice President of Electricity System Planning at PT. PLN (Persero). Mr. Putra articulated that: *“The focal point of the implementation plan revolves around prioritized objectives, contingent upon specific conditions aligned with commercial viability. Moreover, he underscored the significance of PLN's commitment to supporting long-term purchase agreements, deeming it pivotal in conveying a robust and affirmative*

*signal to attract substantial investments for the biomass industry. Given the industry's reliance on policy dynamics and its inherent high level of uncertainty, Mr. Putra emphasized that the success of the plan hinges on sustained long-term commitments from both the government and PLN, collectively working towards its realization”.*

Furthermore, from the perspective of community members regarding this context, the following sentiment was expressed: *“Considering the long-term outlook of this strategic planning involving the utilization of Co-firing Biomass, as a construction business owner myself, I certainly feel benefitted. This is because we source supplies from the surrounding community in our area”.*

The findings from the research also indicate that this strategy has succeeded in increasing the economic value in the area around the Steam Power Plant (PLTU), which in turn has a direct positive impact on people's income. Overall, it can be stated that strategic planning using co-firing biomass in the context of the time scale

can boost economic growth and community income.

### Organization Structure

Organizational structure refers to the procedures for managing an entity involving hierarchies, roles, and responsibilities assigned to individuals or managers within a certain framework. The decisions made by managers in this organizational structure can contribute to the strategic changes the entity desires. In strategic planning, the main goal is to achieve set targets while creating a conducive social environment. A concrete example of this strategic planning is co-firing biomass, where collaboration is a key element.

The author has verified this information with Mr. Edwin Nugraha Putra, the Executive Vice President of Electricity System Planning at PT. PLN (Persero). According to Mr. Nugraha Putra, it is confirmed that: *“Power Plants (PLTU) will serve as the implementing entities for the utilization of co-firing biomass. Collaboration is actively underway with the private sector and local government in this regard. Importantly, he emphasized that*

*there is a structured coordination mechanism established with the Regional Government, and partnerships are actively cultivated to ensure the seamless execution of these initiatives”.*

However, from the perspective of community members regarding this context, the following sentiment was expressed: *“If indeed the program is beneficial for the community, then I fully support it because it presents a significant opportunity. But again, there must be effective public relations efforts from the power plant to engage with the local community”.*

The research results show that extensive collaborative efforts in implementing biomass co-firing have positively contributed to the local economy and positively impacted the surrounding community. To achieve the Net Zero Emission (NZE) target by 2060, close cooperation between the government and the private sector is a key factor. In addition, there is an important note on the organizational structure of PT. PLN Energi Primer Indonesia (EPI) is well organized and has a clear mechanism. The strategic planning process is carried out consistently and shows the company's

commitment to achieving its goals in utilizing Co-firing biomass. These reflect the importance of efficient management and strong collaboration in achieving the desired strategic change (Pearce II & B. Robinson Jr, 2018).

### **Organization Activities**

Organizational activities are often related to all activities that can influence the performance of an organization. To achieve organizational goals effectively, good management is needed. Conversely, to have optimal management, organizations need to have talented, creative individuals who can work synergistically in teams to achieve organizational goals. In the context of this research, the focus is on the impact of planning the use of Co-firing biomass.

The author has substantiated this information with Mr. Edwin Nugraha Putra, the Executive Vice President of Electricity System Planning at PT. PLN (Persero). According to Mr. Nugraha Putra: *“There is a directive from the central authority guiding the management to consistently engage local communities with the aim of enhancing their economic conditions.*

*He underscores the imperative for active involvement from managerial entities to play a proactive role in advancing the economic interests of the community business sector”.*

Meanwhile, from the perspective of community members regarding this context, the following sentiment was expressed: *“For us, the concern lies in the potential scarcity of staple goods for sale in the utilization of Co-firing biomass, which could lead to loss of income. Moreover, private sector businesses are likely to enter as suppliers of biomass raw materials, introducing potential business competition”.*

This indicator shows that strategic planning for the use of co-firing biomass does not raise significant concerns regarding the use of co-firing biomass itself. Still, more attention is paid to the issue of smoke emission from PLTU, which is the main concern; furthermore, through the activities of this organization, PT. PLN Energi Primer Indonesia is expected to contribute revenue and environmental impact significantly.

Thus, cooperation between the government, the private sector, and the

community is crucial in supporting this effort, intending to achieve optimal results. These will positively affect economic growth and social welfare in the region.

Overall, exploration conducted through interviews and direct observation describes that strategic planning for using Co-firing biomass has increased organizational activities with a positive impact. One of the socialization efforts carried out by PT. PLN Energi Primer Indonesia has created increased revenue from biomass co-firing feedstock. It also assists the community in carrying out other activities, such as collaborating with the private sector to increase their supply of raw materials.

## Conclusion

This research highlights the important role of strategic planning in efforts to achieve the Net Zero Emissions (NZE) target in 2060 using Biomass Co-firing technology. Then, the research focus is oriented towards the cross-sectoral collaboration needed to achieve the goals of the NZE, with particular emphasis on social and economic aspects. Regarding this

matter, PT. PLN Energi Primer Indonesia (EPI) is examined as a key entity in this effort, where demands are to encourage sustainable economic growth while maintaining the affected environmental conditions.

On that basis, PT. PLN EPI's towards more environmentally friendly future is also a major highlight, initiated through the collaboration between the Indonesian government and PT. PLN EPI is a key element to optimize biomass production and reduce the environmental impact of the Co-firing program. This strategy aims to reduce biomass waste in the environment by 1% of total waste and reduce waste generated by boilers by 10-15%. Furthermore, Steam Power Plants (PLTU) in some regions are considered the main stakeholders in the development of biomass co-firing, with an assessment of their performance also being considered.

Overall, this research also notes the socio-economic benefits of strategic planning, including increased income for biomass suppliers for co-firing. However, challenges in terms of organizational management still exist

and need to be overcome. Therefore, PT. PLN Energi Primer Indonesia must put more effort into maintaining relationships with the community to support the vision of a sustainable and prosperous future for all citizens. This research provides important insights for stakeholders committed to achieving NZE while paying attention to social and economic aspects.

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