

**STRATEGY OF BIOMASS SUPPLY FOR COFIRING
MINE MOUTH POWER PLANT 3X10 MW**

FINAL PROJECT

**In partial fulfilment of the requirements
for the master's degree
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**INSTITUT TEKNOLOGI BANDUNG
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ABSTRACT

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PT Bukit Asam Tbk (PTBA) supports the national energy transition goal and Indonesia's commitment to achieve Net Zero Emissions (NZE) by 2060. PTBA has created a co-firing program at a 3×10 MW mine-mouth power plant in West Banko, South Sumatra with a biomass target of 5–10% to reduce coal and carbon emissions. This program is highly dependent on biomass availability, but there is no clear strategy to ensure biomass availability. Through comprehensive external and internal analysis such as PESTEL (General Environment), Porter's Five Forces (Industry Environment), Competitor Analysis, McKinsey 7S, VRIO, Value Chain Activity, SWOT, and TOWS, this study identifies opportunities and threats from the external environment, as well as PTBA's internal strengths and weaknesses. This study proposes a number of actionable strategies, including the use of fiscal incentives such as PMK 130/2020, access to green financing, development of energy plantations on pre/post-mining land and the formation of biomass cooperatives. The strategy is made in an implementation plan that has considered the risks. This strategy is expected to answer the challenges that exist and as a real action of PTBA in carrying out clean energy transformation in Indonesia and the world.

Keywords: PT Bukit Asam Tbk, Net Zero Emissions, Biomass, co-firing, strategy, mine-mouth power plant, internal and external analysis

ABSTRACT

STRATEGI PASOKAN BIOMASSA UNTUK COFIRING PEMBANGKIT LISTRIK MULUT TAMBANG 3 X 10 MW

Oleh

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(Program Studi Magister Administrasi Bisnis)

PT Bukit Asam Tbk (PTBA) mendukung tujuan transisi energi nasional dan komitmen Indonesia untuk mencapai Net Zero Emissions (NZE) pada tahun 2060. PTBA membuat program co-firing di pembangkit listrik mulut tambang kapasitas 3×10 MW di Banko Barat, Sumatera Selatan dengan target biomassa sebesar 5–10% untuk mengurangi batubara dan emisi karbon. Program ini sangat tergantung pada ketersediaan biomassa, namun belum ada strategi yang jelas untuk menjamin ketersediaan biomassa. Melalui analisis eksternal dan internal yang komprehensif seperti PESTEL (General Environment), Porter's Five Forces (Industry Environment), Competitor Analysis, McKinsey 7S, VRIO, Value Chain Activity, SWOT, dan TOWS, studi ini mengidentifikasi peluang dan ancaman dari lingkungan eksternal, serta mengetahui kekuatan dan kelemahan internal PTBA. Penelitian ini mengusulkan sejumlah strategi yang dapat ditindaklanjuti, diantaranya pemanfaatan insentif fiskal seperti PMK 130/2020, akses pembiayaan hijau, pengembangan kebun energi di lahan pra/pasca tambang dan pembentukan koperasi biomassa. Strategi tersebut dibuat dalam suatu rencana implementasi yang telah mempertimbangkan risikonya. Strategi ini diharapkan dapat menjawab tantangan yang ada dan sebagai aksi nyata PTBA dalam melakukan transformasi energi bersih di Indonesia dan dunia.

Keywords: PT Bukit Asam Tbk, Net Zero Emissions, Biomass, co-firing, strategi, pembangkit listrik mulut tambang, analisis internal dan eksternal.

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I dedicate this thesis to my beloved family, **Annisa Anggiriani Putri** my amazing wife, **Mikayla Gazala Naila** and **Maira Ghazea Nafisa** my beloved daughters. Both of my parents who have always supported me until now sincerely and all the families and parties who have helped the completion of this thesis.

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LIST OF ABBREVIATIONS AND SYMBOLS

ABBREVIATIONS	NAME	Page of initial usage
BPDH	Badan Pengelola Dana Lingkungan Hidup	
COP	Conference of the Parties	
EBT	Energi Baru Terbatukan	
kWh	kilo Watt hour	
LTS-LCCR	Long-Term Strategy for Low Carbon and Climate Resilience	
MJ/kg	Mega Joule /	
MW	Mega Watt	
NDCs	NDCs	
PKS	Palm Kernel Shell	
PTBAE	Principles, Terms and Basis for Allocation of Efforts	
RDF	Refuse-Derived Fuel	
SNI	Standard Nasional Indonesia	
SRN-PPI	Sistem Registri Nasional Pengendalian Perubahan Iklim	
UNFCCC	United Nations Framework Convention on Climate Change	
USD	US Dollar	
VCM	Voluntary Carbon Market	

Chapter I Introduction

I.1. Background

The Paris Agreement is a landmark international treaty adopted on December 12, 2015, during the 21st Conference of the Parties (COP21) to the United Nations Framework Convention on Climate Change (UNFCCC) in Paris, France. Its purpose is to hold the increase in global warming to well below 2°C above the pre-industrial level and to pursue efforts to limit the temperature increase to 1.5°C (UNFCCC, 2015). It also assists countries in adapting to the effects of climate change and developing climate resilience, and it renders finance flows compatible with a low greenhouse gas emissions and climate-resilient development pathway. Höhne et al. (2020) in *Environmental Research Letters*, since the Paris Agreement entered into force, several countries have enhanced their climate ambitions. A case in point is the European Union, which had upgraded its target of cutting the emissions by at least 55% by 2030 relative to the 1990 baseline. Most developing nations, nonetheless, continue to experience limitations of finance and technology, which demand further heightened global collaboration (Höhne et al., 2020). If a nation chooses to withdraw from the Paris Agreement, there are various serious repercussions that can impact the nation and the international community at large. The reductions in greenhouse gases need to be rapid, immediate and at a massive level in an effort to maintain global warming at or near 1.5°C or 2°C (IPCC, 2021). It has the ability to decrease the occurrences of catastrophes like floods, storms and droughts. The nations that do not participate in global climate change initiatives face diplomatic isolation and lose their right to take the lead at the international negotiating table (Dimitrov, 2016). More importantly, it misses the chance for foreign support since the Paris Agreement offers an avenue of financing and technology transfer to developing nations in climate change mitigation and adaptation (Dimitrov, 2016). The non-participant nations risk missing out on the advantage of accessing global technology transfers and financing needed in sustainable development. The Paris Agreement creates reputational incentives for participation and compliance, and thus not participating in the Paris Agreement is a reputational risk with economic implications (Falkner, 2016).

(UNFCCC, 2015) Nations that have ratified the Paris Agreement bear a fundamental responsibility to formulate and periodically revise their Nationally Determined Contributions (NDCs). Each sovereign state is mandated to delineate its climate action framework in the format of an NDC, which must encompass comprehensive strategies aimed at mitigating greenhouse gas emissions and enhancing resilience to the repercussions of climate change. NDCs are required to undergo revisions every five years, thereby reflecting the progressive enhancement of ambition over time. Subsequently, nations are obligated to submit biennial reports detailing their emissions, advancements towards NDC objectives, and undertaken climate actions, as an integral component of a robust transparency framework. These reports will undergo scrutiny by technical experts and will be subjected to a multilateral deliberation process. Furthermore, every five years, all nations engage in a global assessment of collective advancements towards fulfilling the objectives of the Paris Agreement. This stock take will provide critical insights for future updates of NDCs.

Within the framework of its international obligation under the Paris Agreement, Indonesia has completed and updated its Nationally Determined Contribution (NDC) that describes the national approach to tackle climate change. In its Updated NDC report to the UNFCCC in 2021, Indonesia has aimed to cut emissions by 31.89% unconditionally (using its own domestic resources) and up to 43.20% conditionally, subject to international support in the form of finance, technology, and capacity development (Government of Indonesia, 2021). This is derived from a business-as-usual (BAU) projection of 2,869 MtCO_{2e} in 2030. The plan for realizing this target hinges on cuts from five main sectors, which are: energy, forestry and land use (FOLU), agriculture, industry and waste. Among the five sectors, the forestry sector is the cornerstone of Indonesia's emissions reduction. The FOLU Net Sink 2030 is a national priority to get the forest and land sector emissions offset or sequestered through forest conservation and restoration (MoEF, 2022).

In addition to decline, Indonesia's NDC also includes aspects of climate change adaptation. The Government emphasizes the importance of recovery of climate change by creating food security systems, water resources management and community capacity enhancement in the face of climate disaster. These measures are aimed at protecting vulnerable groups and maintaining the ability to restore national economic. This is also consistent with the long-term strategy of carbon recovery and low climate (LTS-LCCR) in 2050, expected to develop with long-term low-term carbon (MOEF, 2022). The implementation of Indonesia NDC is based on global partnerships. To achieve conditional goals of 43.20%, Indonesia needs international cooperation, whether by the green climate fund, Redd + mode or the carbon market. The transparency of the reports and assessing the success of the NDC is also made through periodic reports, according to the transparent framework specified in the Paris Agreement (CNICCC, 2015).

The Indonesian government has published a number of regulations to support the achievements of the goals set out in NDC. Some of these provisions are the Minister of Energy and No. 16 In 2022, adjust the process of implementing the economic value of carbon in the electrical production item, including the application of copper biomass. Establish a higher technical approval of emission limits (principles, terms and basis for allocation of efforts - PTBAE) to power plants, can encourage the implementation of biomass coats to respect the specified emissions limit. After that, the Minister of Energy and Regulations on mineral resources No. 12 years 2023 adjusted the use of biomass fuel as a mixture in power plants in general, without distinguishing between the mouth and the mine and the mouth that was not my power plants. Attach an annual goal for the use of biomass for reasonable in power plants, as well as the highest reference price for biomass. The Minister of Energy and Mineral Resources may set a priority policy to request a biomass to meet the internal needs.

PT Bukit Asam Tbk (PTBA) constitutes a preeminent Indonesian state-owned corporation engaged in the extraction of coal and the production of energy. The organization assumes a crucial role in bolstering Indonesia's energy security by

providing coal to power generation facilities, industrial sectors, and export markets within Asia and beyond. The enterprise stands as a trailblazer in the adoption of sustainable and environmentally conscious mining methodologies, emphasizing the transition of coal, as a predominant energy resource, into cleaner and more efficient energy alternatives. PTBA is proactively diversifying its operational portfolio by investigating renewable energy options, including biomass co-firing in coal-fired Power Plants, as well as expanding its endeavors into solar energy initiatives. Furthermore, PTBA is significantly engaged in power generation through its diverse array of power plant projects, which utilize its extensive coal reserves to enhance Indonesia's energy security. Banko Mine-Mouth Power Plant, 3 x 10 MW, is a power plant owned by PTBA and is designed mainly to provide electricity for mine operational needs and, if there is a surplus availability, it will be distributed to the PLN grid. To support the government program under the NDC, PTBA can be provided with the ability to utilize 5-10% biomass as co-firing in Power Plants in 2030. Biomass is organic matter, usually plant material, that can be utilized as a renewable energy source. Wood, crops, waste residues, and animal manure are some of the substances that are regarded as biomass. But in this instance PTBA will utilize plants as biomass.

However, to achieve the target of 5-10% biomass for co-firing in the power plants, PTBA has no plans to use biomass for co-firing the Banko Barat 3x10 MW power plants. Therefore, this thesis will provide several strategies so that the use of biomass for co-firing can be achieved sustainably. However, before developing a strategy to achieve the target of 5-10% biomass for co firing, it is important to analyze external and internal factors. This will be very helpful in formulating a strategy, because the company will know well about the current conditions. There are factors that are already strong that must be further enhanced by looking at existing opportunities or because they are aware of weaknesses, the company needs to create a strategy to avoid threats that can attack the company's weaknesses. The strategy that will be proposed is a strategy that can be applied directly so that PTBA is ready to achieve the targets that have been set.

I.2. Company Profile

PT Bukit Asam Tbk, hereinafter referred to as “the Company” or “PTBA”, was officially established on March 2, 1981 based on Government Regulation No. 42 of 1980 concerning the Capital Participation of the Republic of Indonesia for the Establishment of a Company (Persero) of Bukit Asam Coal Mine. Company (Persero) Bukit Asam Coal Mine. The Company has a long history along with the history of coal mining in Tanjung Enim, Muara Enim, South Sumatra, which was started by the Dutch Colonial Government in 1919.

The Company conducted an Initial Public Offering to the public in 2002. Thus, since December 23, 2002, the Company's shares have been listed on the Indonesia Stock Exchange with the ticker stock “PTBA”. Then the Company's name changed to PT Tambang Batu Bara Bukit Asam (Persero) Tbk. On March 21, 2023, following up on Government Regulation No. 46 of 2022 concerning the State Capital Participation of the Republic of Indonesia for the Establishment of a Company (Persero) in the Mining Sector and Decree No. 516/KMK.06 /2022 concerning the Determination of the Value of Capital Participation of the Republic of Indonesia for the Establishment of a Company (Persero) in the Mining Sector, the Republic of Indonesia established a State-Owned Enterprise in the Mining Industry under the name PT Mineral Industri Indonesia (Persero) which is the parent of PT ANTAM Tbk, PT Bukit Asam Tbk, PT Timah Tbk, and PT Indonesia Asahan Aluminum and has direct shares in PT Freeport Indonesia, PT Vale Indonesia Tbk, PT Indonesia PP Minerals and MIND ID Trading, Pte. Ltd

The company has a vision to become a world-class energy company that cares about the environment, and a mission to manage energy resources by developing corporate competencies and human excellence to provide maximum added value for stakeholders and the environment. This vision and mission has always been the basis for every activity carried out by the company. Until 2023, PTBA has 8 (eight) Mining Licenses located in South Sumatra Province, West Sumatra Province, Riau Province and East Kalimantan Province with a total mining area of 65,632 Ha (Figure I.1). Coal resources of 5.81 billion tons with reserves of 2.98 billion tons.

In addition, PTBA also has 3 (three) ports located in South Sumatra Province, West Sumatra Province and Lampung Province.

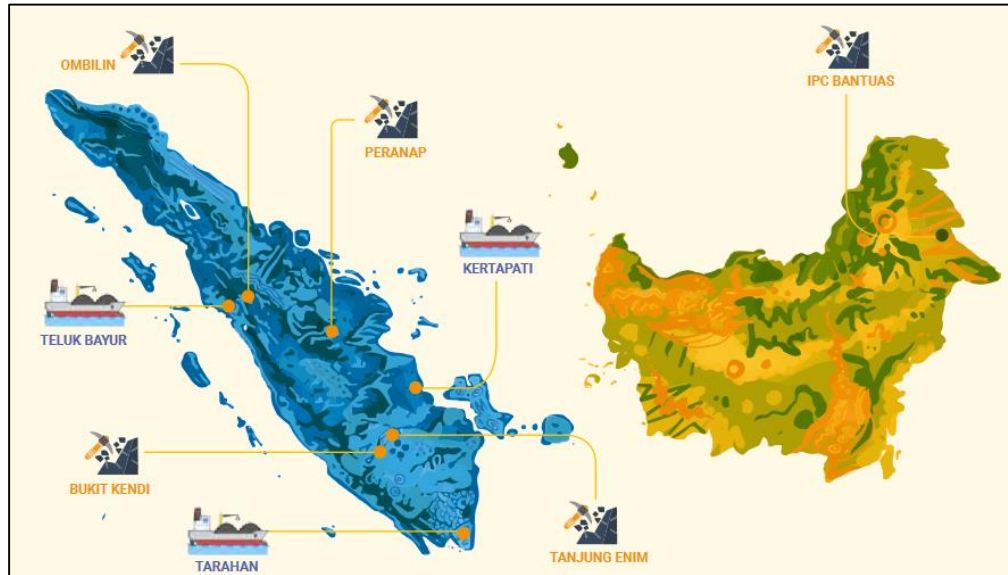


Figure I. 1 Mining area and port of PT Bukit Asam Tbk

As a coal-based energy company, PTBA's main business process is coal mining. The main business process is based on the following process flow and supply chain (Figure I.2):

- Mining and Sales in Mine Mouth for Power Plants. Similar to the previous process, the mining process is carried out by open pit mining and then the coal produced is transported to the nearest stockpile. From the stockpile, the coal is delivered using a belt conveyor to the Mine Mouth POWER PLANTS.
- Mining and Sales via Port This process begins with open pit mining followed by coal delivery to the stockpile using a dump truck. Next, from the stockpile, coal is loaded onto trains using a Train Loading Station. Coal that has been loaded into railroad cars owned by PT Kereta Api Indonesia (Persero) is then sent to PTBA's port for loading to the buyer's or trader's ship/vessel.
- Mining and Mine Mouth Sales for the Benefit of Other Industries (End User). The process is carried out by open pit mining, then the coal is sent to

the stockpile. From the stockpile, the coal will be sold to end users. The end user itself with the end user's transportation mode will deliver coal from PTBA mine to the end user's industry location.

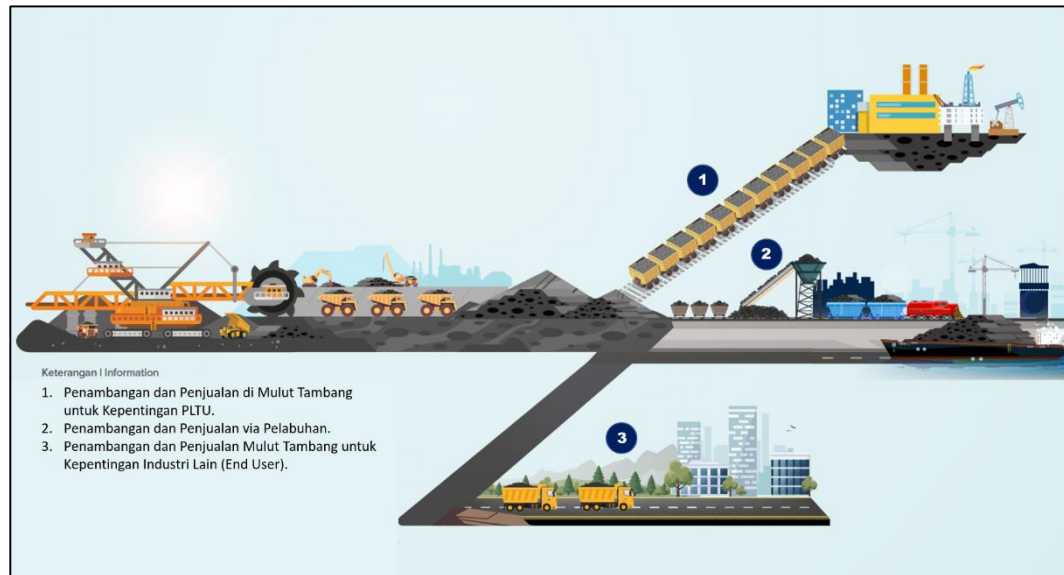


Figure I. 2 Business Process Flow

PTBA is a pioneer in implementing sustainable and eco-friendly mining practices, focusing on transforming coal as a primary energy source into cleaner and more efficient energy solutions. PTBA is actively diversifying its business by exploring renewable energy sources, such as biomass co-firing in coal-fired Power Plants, and expanding into solar energy projects. PTBA is actively involved in power generation through its various power plant projects, which leverage its vast coal resources to contribute to Indonesia's energy security. A flagship project is the Sumsel-8 Mine-Mouth Power Plant, located in South Sumatra, with a capacity of 2 x 620 MW, supplying electricity to the national grid under the 35,000 MW program. Additionally, PTBA operates the Banjarsari Mine-Mouth Power Plant, a 2 x 110 MW facility that utilizes low-calorific-value coal from its nearby mines. POWER PLANTS Tarahan, is a coal-fired power plant located in Bandar Lampung, Indonesia. The plant has an installed capacity of 2 x 8 MW, totaling 16 MW. PTBA operates the Banko Mine-Mouth Power Plant, a 3 x 10 MW for The Banko Barat POWER PLANTS is intended primarily to supply electricity for mine operational purposes and if there is excess access, it will be distributed to the PLN grid.

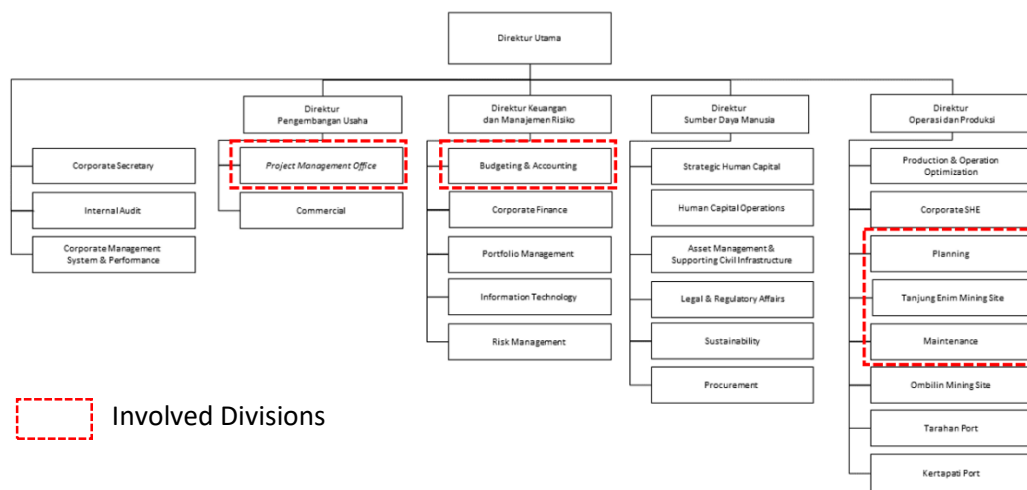


Figure I. 3 Organization Structure

The Company is led by the President Director and assisted by the Director of Business Development, Director of Finance and Risk Management, Director of Resources and Human Resources, and Director of Operations and Production. (Figure I.3.)

With relation to this project, there are several key divisions involved, which are:

1. Project Management Office Division, which initiated the research and development of co-firing and biomass supply design.
2. Budgeting & Accounting, which provides for and records the funds required and to be used.
3. Tanjung Enim Site (Environmental Support and Mine Support Division), which supervises and controls the quality of biomass.
4. Maintenance Division, responsible for the operational activities of the 3 x 10 MW power plants in Banko Barat.
5. The planning division is responsible for providing areas where necessary for biomass crop planting.

I.3. Business Issue

PT Bukit Asam (PTBA) as a state-owned company has a strategic role in supporting government policies, including energy transition commitments and greenhouse gas

(GHG) emission reduction targets as outlined in the Enhanced Nationally Determined Contribution (ENDC) and Long-Term Strategy for Low Carbon and Climate Resilience (LTS-LCCR) 2050 documents. One of the support programs of PTBA for that purpose is the biomass co-firing program in PTBA's 3 x 10 MW Mine Mouth Power Plants with a target of 5-10% coal substitution as set in the Company's Long-Term Plan (RJPP) 2024-2029. Aside from complying with corporate commitments, the co-firing initiative is part of the strategic commitment of the Ministry of SOEs which pushes for all SOE businesses to become green and sustainable enterprises. The Ministry of SOEs via the "SOE Net Zero Emission 2060 Roadmap" has ensured that the energy sector - particularly mining and electricity firms - is the main driver of decarbonizing the national portfolio. As one of the SOE holdings in the energy and mining sector, PTBA has the mission to be a forefront in decreasing carbon emissions by diversifying energy based on biomass and developing a low-carbon energy ecosystem.

But up to now, PTBA has no plan whereby co firing activities, particularly in terms of biomass availability, can be supplied sustainably to the Mine Mouth Power Plants at Banko Barat. Because, one of important part of this activities are continuity of biomass. This unpreparedness has led to a strategic gap between the target and implementation in the field. Without a good strategy, the implementation of co-firing is in danger of not running effectively.

This would have a huge effect on PTBA's image as an SOE that is unable to meet the government mandate, not supporting the national energy transition program, and not aligned with the principles of sustainability fostered by the Ministry of SOEs. In addition, if co-firing fail to implementation, it's also risks hampering the achievement of management Key Performance Indicators (KPIs) and corporate goals in the RJPP, weakening the company's position in accessing fiscal incentives and green funding such as the Green Fund Badan Pengelola Dana Lingkungan Hidup (BPD LH), and reducing stakeholder confidence in the company's ESG (Environmental, Social, Governance) commitment. Therefore, the preparation of

this strategy is not only important for PTBA, but indirectly this strategy will effect for BUMN and national energy transition to support the global climate crisis.

I.4. Research Questions & Objectives

I.4.1. Research Question

Based on the background and business issues previously, the following research questions need to be answered:

- What are the external and internal factors that influence the company in its efforts to ensure a sustainable biomass supply for the 3x10 MW mine mouth power plant?
- What is the strategy a sustainable biomass supply chain for co-firing mine mouth power plants 3 x 10 MW?
- What is the risk in the selected strategies?

I.4.2. Research Objectives

The research objectives of this research is:

- To find out what external and internal factors influence the company in its efforts to ensure a sustainable biomass supply for the 3x10 MW mine mouth power plant?
- To create strategies of biomass to ensure that biomass supply for co firing mine mouth 3 x 10 MW
- To create risk analysis for selected strategies

I.5. Research Scope and Limitation & Brief Writing Structure

In this research, the author analyzed the potential area of support for supplying biomass to Power Plants. This limitation focuses on mine mouth power plant Banko 3 x 10 MW. The following items are included in the scope of this final project:

- Identify the current condition (internal and external) of biomass for power plant.
- Identification of key issue and challenge facing the company
- Create strategies to ensure biomass for the co-firing power plant.

Furthermore, below is the writing structure of this final project:

CHAPTER 1 INTRODUCTION

Chapter 1, the researcher will explain about background and company profile including company's business activities, locations, values and organization structure. This will involve identifying and formulating the problem, outlining our research objectives, defining the scope and limitations of this research.

CHAPTER 2 LITERATURE REVIEW

Chapter 2 of the thesis will conduct an in-depth analysis of the definitions and theories used, which are obtained from several reliable sources, academic books, journals, expert opinions, and previous final projects. These sources are carefully selected to strengthen the researcher's theories and provide a solid foundation for this thesis.

CHAPTER 3 RESEARCH METHODOLOGY

Chapter 3 explains the conceptual framework and research design, types of data, data collection methods, and data analysis.

CHAPTER 4 FINDINGS AND BUSINESS SOLUTION

Chapter 4 presents the results and analysis of the research findings to provide solutions. The analysis followed the formulation of the strategy based on the conceptual framework and research methodology. The proposed strategy will be finalized with an implementation plan and risk analysis.

CHAPTER 5 CONCLUSION AND RECOMMENDATION

Chapter 5 concludes with conclusions based on the analysis in chapter 4. The conclusion is in the form of a statement answering the research questions in Chapter 1. The recommendation consists of a summary of practical implications for the company.

Chapter II Literature Review

II.1. Strategic Management

Strategic management is a process carried out by a company to analyze and learn from various environments, including the company's internal and external environments, set strategic directions and create strategies that aim to achieve predetermined targets by carrying out the strategies that have been made (Barney & Hesterly, 2016). Strategic management is the art and science of formulating, implementing, and evaluating decisions with various functions aimed at achieving predetermined organizational goals. (David & David, 2017). Management strategy is the goal and scope of the company in a long time to help the company gain an advantage through the configuration of resources in a dynamic environment, to be able to meet market needs and expectations of stakeholders (Johnson, et all, 2017).

Strategic management can start from analyzing internal and external factors. The analysis will result in a position where the company will know what the strengths and weaknesses are, then the company will get information about what opportunities can be utilized and what threats can damage the company. After knowing the internal and external conditions, the company can then create corporate, business and operational strategies. This corporate strategy will affect all aspects of the company. Business strategies will affect one or several divisions, while operational strategies will directly touch operational activities. Management should be able to decide which strategy will be carried out referring to the priority scale.

The strategy that has been made will be immediately informed to the parties involved. This is very necessary, so that the plans or strategies that have been made can be carried out properly to get the desired goals. In order for this implementation to run well, in addition to strategies that must be understood by each party, it is also important to carry out regular monitoring. This is so that management can always see whether the strategy is successful or not. If it is successful, then it needs to be continued, but if the results do not match the target, then an evaluation needs to be

carried out. In this thesis, the target is to create a strategy and implementation plan in order to ensure the availability of biomass for co firing the 3 x 10 MW Banko Barat power plant.

II.1.1. External Analysis

External analysis is the methodical process of identifying, assessing, and examining external factors influencing the organization that are likely to impact the performance, strategy, and long-term viability of the organization. The general emphasis of this analysis is to identify opportunities and threats emanating from the external environment like political, economic, social, technological, legal, environmental conditions, and industry competition. External analysis is the process of identifying the most significant threats and opportunities in a company's external competitive environment that will influence how a company will achieve its mission (Barney & Hesterly, 2016). External audit, or environmental scanning, is a procedure dedicated to recognizing and assessing trends and events outside the control of any single company. These are forces exterior to the organization itself and can be grouped into five broad sets: economic, social, cultural, demographic, and environmental; political, legal, and governmental; technological; and competitive forces (David, Fred R. 2017)

II.1.1.1. PESTEL Analysis (General Environment)

PESTEL analysis or general environment takes into account the political, economic, social, technological, environmental, and legal forces that can impact an organization. It is utilized for external force analysis that can influence strategic choices (Johnson, Scholes, & Whittington, 2017) (Figure II.1)

- **Political** factor takes into account how government policies and actions—like tax policies, trade policies, tariffs, labor laws, and political stability—may affect business activities. Political stability can encourage business expansion, whereas political instability or a change in policies may generate uncertainty and risk. Political factors are the means by which government policies, political stability, and public institutions affect business operations. They consist of taxation policies, trade tariffs, government regulation, labor laws, and foreign policy.



Figure II. 1 PESTEL Analysis

- **Economic** factor deals with macroeconomic determinants such as inflation rates, interest rates, exchange rates, economic growth, and unemployment. They all ascertain consumer purchasing power, cost of capital, and the level of demand in the market. For instance, during a recession, firms are likely to experience decreased revenues owing to weakened consumer spending.
- **Social** dimension takes into account societal trends, cultural values, population demographics, education levels, lifestyle changes, and attitudes of consumers. Social issues provide an insight into how companies can redirect their strategies to adjust to evolving public expectations or changing cultural habits, e.g., growing environmental consciousness or changing eating habits.
- **Technological** drivers include innovation, automation, R&D, and the pace of technological change. Technological change creates possibilities for new efficiencies and product development but can make current processes or products obsolete.
- **Environmental** dimension has gained growing significance because of global climate change, sustainability issues, and environmental regulations.

Companies now need to account for their green footprint, recycling, and how they address environmental issues like carbon footprint and natural resource depletion.

- **Legal** factor means existing and future legislation that will affect operations, e.g., employment law, consumer protection law, health and safety law, and intellectual property rights. Failure to comply will lead to legal sanction or damage to reputation.

With these six dimensions, PESTEL analysis enables organizations to identify external opportunities and threats, anticipate likely changes in the environment, and design their strategic plans accordingly. It is most useful in complicated and dynamic markets where environmental sensitivity is crucial for maintaining competitiveness.

II.1.1.2. Porter's Five Force (Industry Environment)

In 1979, Michael E. Porter created 'Porter's Five Forces Analysis' for strategic management. It is used to evaluate external factors in an industry (industry environment) and how present competitors clamor for value or technological advancements. With this model, it is easier to understand the complex business environment without altering the inner workings of a firm or its strategical decisions as it reveals the competitive structure of an industry (Porter, 2008). This figure (Figure II.2.) simplifies understanding for businesses seeking clarity around their industry structure.

- **Threat of New Entrants:** The entry of new players causes binary increases in both supply and demand, resulting in a decline in cost efficiency and higher operating costs. Economies of scale, capital requirements, distribution accessibility, regulatory policies all edify barriers while tightly restricting flexible alternatives acts decrease these barriers
- **Bargaining Power of Suppliers:** Dominant suppliers augment this force which leads to a significant control over pricing and quality rendering severely limited input substitutes. Increased supplier power generally leads towards amplification toward industry profits

- **Bargaining Power of Buyers:** Consumers are able to enforce price reductions, require greater quality or additional services, and pit rival businesses against one another. The influence of buyers is stronger when the goods are purchased in bulk or when the goods being bought are commoditized.
- **Threat of Substitute Products or Service:** Substitutes limit an industry's potential returns by limiting the prices. Having substitutes with a better price-performance trade-off increases this threat, especially when there are low switching costs.
- **Industry Rivalry:** This refers to the level of competition between the existing companies in the industry. High rivalry constrains profitability and may be caused by many competitors, low industry growth, poor differentiation, or high exit barriers.

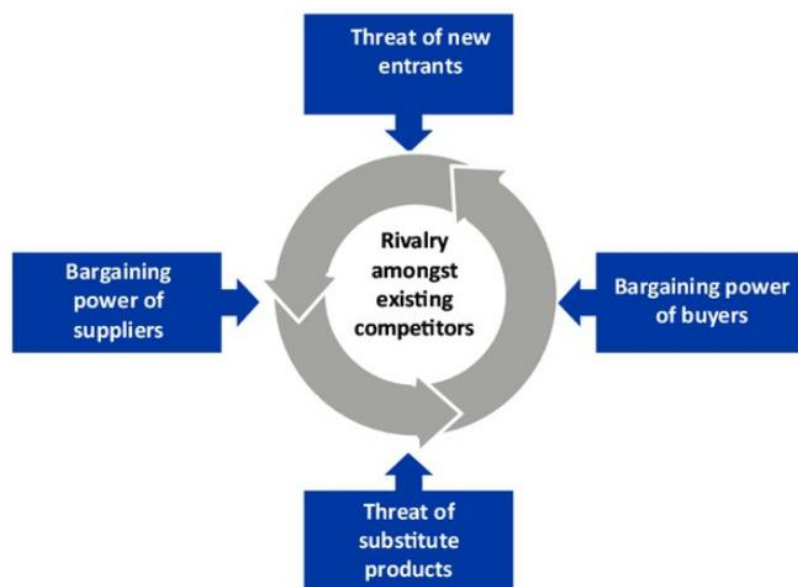


Figure II. 2 Porter's Five Forces Analysis

(Dobbs, 2012), Porter's five forces have several functions including:

Porter's Five Forces is useful for business leaders because it allows them to understand what the competitive intensity looks like within an industry and helps them evaluate its prospects over time. There are different purposes for which this model is created, one of which is to mitigate competition and achieve a relatively

favorable position in the industry. Insights provided by Business Strategy analysis help create value-based strategies for positioning focusing on rivalry as differentiation in offer, and low-cost or niche focus.

II.1.1.3. Competitor Environment Analysis

Competitor Environment Analysis is a strategic analysis procedure that involves objectively analyzing existing and potential competitors in an industry to value their strategies, capabilities, weaknesses, resources, and potential responses to market forces. Under this analysis, organizations such as PT Bukit Asam are ought to determine competitive threats, opportunity detection, benchmarking their own strengths, and strategizing responses that will improve their market position. It would generally involve knowing the competitors, examining their market share, measuring their strategic objectives and abilities, and forecasting how they will behave in reaction to internal or external industry developments. Such an analysis is necessary for creating long-term competitive advantage, particularly in transforming industries, like energy, where renewable integration and co-firing are transforming value chains and competition.

As Michael E. Porter (1980), competitor analysis is a fundamental component of studying an industry structure and designing strategies that take competitor reaction into account. Further, Robert M. Grant (2019) suggests in *Contemporary Strategy Analysis* that an understanding of competitor behavior and position helps firms make resource allocation, strategic timing, and differentiation-related decisions. Similarly, Jay Barney (2011) in *Gaining and Sustaining Competitive Advantage* highlights the importance of competitor analysis being aimed at internal sources of strength and market opportunity to build authentic strategic value. These sources provide a theoretical foundation for competitor analysis to be used as a vehicle for strategic planning and implementation.

II.1.2. Internal Analysis

Internal analysis is the process of examining an organization's internal environment—including its resources, capabilities, core competencies, and value

chain activities—to determine its strengths and weaknesses. Internal analysis is the process of recognizing and assessing the unique resources and capabilities within an organization that serve as the foundation for achieving and maintaining a competitive advantage. (Barney & Hesterly, 2016). The goal is to assess how well-positioned the organization is to achieve competitive advantage and support strategic decision-making. Internal analysis is essential in the strategic management process because it helps identify what the company does well (strengths) and where it needs improvement (weaknesses), which feeds into frameworks like SWOT analysis. In this thesis, the internal analysis used is the McKinsey 7S Framework, VRIO analysis, and Value-Chain activity. In this thesis, the internal analysis used are the McKinsey 7S Framework, VRIO analysis and Value-Chain activity.

II.1.2.1. McKinsey 7S Framework

McKinsey 7S Framework is presented as a diagnostic and alignment model designed to analyze and improve the effectiveness of an organization by examining seven interdependent elements that are crucial to achieving organizational objectives (Paschal and Austin, 2013). The 7-S Framework implies that significant progress in effectiveness can be made only when the relationship among these elements is managed in a balanced way (Waterman, Peters, and Phillips, 1980). The McKinsey 7S Framework is presented as a holistic tool for organizational analysis and effectiveness, emphasizing the interconnectedness of seven critical internal elements within an organization. These elements must be aligned for a company to perform well and remain adaptable in a changing environment (Peters, T. J., & Waterman, R. H., 1982). Here is the explanation about seven elements of the McKinsey 7S Framework. (Figure II.3)

- **Strategy** is a long-term work or action plan implemented by a company or organization to gain a competitive advantage and achieve predetermined goals. Strategy describes how the company positions itself in the market, how to respond to environmental changes, and allocate existing resources.
- **Structure** describes the organization chart, lines of authority, roles, responsibilities, and communication flows within an organization or

company. The structure will show how the organization is centralized, decentralized, hierarchical, or flat.



Figure II. 3 McKinsey 7S Framework

- **Systems** are the day-to-day procedures, workflows, and operational processes that support an organization to run efficiently. The system is expected to be a guide in every matter so that it has clear standards. This includes things like performance management, budgeting, IT, HR systems, and logistics.
- **Shared value** provides motives for engaging in superordinate goals which encompass primal assumptions regarding a company's ethics and atmosphere along with behaviors entailed at all levels that motivate employees through unified cooperation towards targets beyond personal gain. This aspect is put in the center of 7S model since it also includes all other aspects.
- **Style** covers the level of culture where an organization's leadership norms are inscribed such as decision making processes alongside leader's conduct concerning execution supervision communication conferred expectations relationship interactions while line directed governance marks including execution etiquettes.

- **Staff**, this parameter focuses primarily on human resources i.e. the personnel within an organization, their competencies, training, motivation, and development paths. It shows how personnel are recruited, maintained, and retained.
- **Skills** are the basic abilities and technical competencies of employees and the organization as a whole. This includes current skills and future skills gaps that need to be addressed, fixed or even improved.

II.1.2.2. VRIO Analysis

(Barney, 2007) The VRIO Framework is a tool used in strategic management to be able to evaluate a company's internal resources and capabilities and determine whether or not they can be a source of sustainable competitive advantage. The framework is used with the understanding that not all resources offer the same value-only certain resources, when evaluated against certain criteria, can help companies consistently outperform their rivals. This is particularly relevant in today's competitive and fast-changing markets, where internal strengths must be aligned with strategic objectives to be achieved.

VRIO is composed of Value, Rarity, Imitability, and Organization. According to Barney, the first step is to determine whether a resource is valuable-that is, whether it enables the company to exploit opportunities or neutralize threats. If a resource is valuable, then whether it is rare - not widely shared by competitors. Valuable and rare resources can provide a temporary competitive advantage, but for the advantage to be sustainable, the resource must also be non-duplicable, meaning difficult or costly for competitors to imitate due to factors such as historical conditions, causal ambiguity, or social complexity. Finally, valuable, rare, and inimitable resources will not generate sustainable advantages unless the firm is organized to capture their value-through the right systems, structures, processes, and culture (Figure II.4).

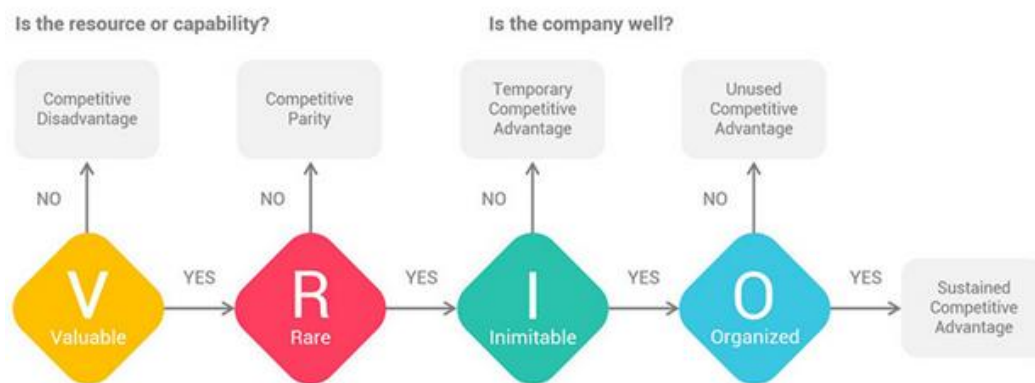


Figure II. 4 VRIO Analysis Model

Barney's contention is that sustainable excellence emerges only when all four conditions of the VRIO framework are met. If a company has valuable, rare, and inimitable resources, but lacks the organizational capability to use them effectively, then the potential benefits of those resources remain untapped. This emphasis on internal alignment emphasizes the importance of not only acquiring resources, but also strategically managing and integrating them.

As such, the VRIO framework serves as a diagnostic tool that helps companies identify which resources are strategic and worth investing in. The framework supports decision-making about where to allocate leadership time, capital and attention. For example, companies with strong brand equity (a valuable and scarce resource) must protect and build it through marketing, culture and governance to ensure that it cannot be imitated or diluted. As such, VRIO provides a structured method to evaluate and improve competitive advantage from within.

II.1.2.3. Value-Chain Activity

Value-Chain Activity is defined as a chain of related internal business processes or functions through which an organization carries out in an effort to design, produce, market, deliver, and support its product or service. Every activity adds value to the final product or service either directly or indirectly and collectively determines the firm's competitive advantage. Michael E. Porter (1985), when he segmented activities into primary activities (inbound logistics, operations, outbound logistics, marketing & sales, and service) and support activities (infrastructure, human

resources, technology development, and procurement). Value-chain activities are analyzed to determine which of the value-creating activities are internal, where differentiation or cost reduction may occur, and how a company can achieve competitive advantage. With knowledge of the value chain, firms are able to strategically plan their resources and capabilities in an attempt to maximize value creation and enable sustainable competitive advantage (Porter, 1985).

II.1.3. SWOT Analysis

Gurel and Tat (2017), SWOT analysis is a basic tool in strategic management that helps organizations evaluate their current internal and external environments. This analysis divides the strategic situation into four categories: Strengths, Weaknesses, Opportunities, and Threats. Strengths and weaknesses are internal characteristics—such as resources, processes, and capabilities—that can support or hinder goal achievement. In contrast, opportunities and threats arise from the external environment, including market trends, regulations, technological changes, and social dynamics. According to Pickton and Wright (1998), SWOT analysis is a strategic tool that can be used to assess factors such as Strengths, Weaknesses, Opportunities, and Threats that impact an organization's ability to compete in the global marketplace (Figure II.5). They describe SWOT not only as a tool for creating internal and external factors, but also as a highly organized, structured framework that can be used for strategic thinking. Its strength lies in its simplicity and versatility, allowing companies or organizations to diagnose in detail the core factors that can shape their better future direction. Most importantly, they emphasize that SWOT should be more than an academic exercise - it should be integrated with strategic decision-making and action.



Figure II. 5 SWOT Analysis

II.1.4. TOWS Analysis

Kotler and Keller (2012) define the TOWS Matrix as a structured planning tool to help organizations identify strategic options by matching them with internal strengths and weaknesses and external opportunities and threats. Kotler and Keller emphasize that while SWOT analysis serves as a diagnostic tool, the TOWS Matrix takes the next step by facilitating strategy development, helping companies solidify what to do about the issues discovered through SWOT. (Figure II.6)

	Strengths	Weaknesses
Opportunities	SO Maxi - Maxi Strategies	WO Mini - Maxi Strategies
Threats	ST Maxi - Mini Strategies	WT Mini - Mini Strategies

Figure II. 6 TOWS Matrix

The TOWS matrix allows marketers and strategists to develop four types of strategies:

1. S-O (Strength-Opportunity): This strategy uses internal strengths to exploit external opportunities. This strategy is an ideal strategic area where the organization can aggressively grow or expand.
2. W-O (Weakness-Opportunity): This strategy that aims to minimize weaknesses by exploiting existing opportunities. This strategy is often used as a repair or development strategy.
3. S-T (Strength-Threat): This strategy uses the organization's strengths to avoid or reduce the impact of external threats. This strategy tends to be more protective or defensive in nature.
4. W-T (Weakness-Threat): This strategy seeks to minimize weaknesses and threats. This strategy is known as a survival strategy, especially relevant in crisis conditions.

The TOWS Matrix as an essential element of strategic market planning, helping organizations craft market-responsive and capability-driven strategies. The goal is to translate analysis into action, allowing for strategic alignment between an organization's internal capabilities and external environment. (Kotler and Keller, 2012). TOWS enhances SWOT by encouraging the formulation of strategy options that integrate environmental analysis with internal resource considerations. (Dyson, 2004)

II.1. 5. Risk Analysis

Risk analysis is a systematic process to identify, evaluate, and understand risks that have the potential to affect the achievement of organizational or project goals. When viewed from the perspective of strategic management and project management, risk analysis will greatly assist organizations in recognizing uncertainty, assessing the probability of risk occurrence, and predicting its impact so that mitigation decisions can be taken more precisely and effectively risk analysis is the backbone of risk management, used not only to anticipate crises but also to exploit opportunities. A comprehensive risk analysis allows for early

warning systems and proactive response (Sadgrove, 2016). Risk analysis helps organizations understand uncertainty in projects and operations and enables better decision-making by quantifying risks and identifying their causes and effects (Hillson, 2023). Hopkin (2018), risk analysis is the core of risk management because it provides the basis for information used as a basis for making data-based decisions, not just based on intuition. This process generally includes several main stages: risk identification (inventorying all possible risks), probability and impact assessment (usually through a risk matrix), risk level evaluation (priority), and mitigation strategy planning to reduce the likelihood or impact.

Likelihood and impact are two very important or core things in risk analysis that are used to assess and prioritize risks. Both will help an organization determine how to manage uncertainty and allocate resources effectively. Risk analysis will involve understanding the source of uncertainty (hazard, vulnerability, or threat), evaluating the likelihood of the uncertainty occurring, and estimating the potential consequences or impacts if it occurs. Risk analysis serves as a basis for making informed decisions about how to manage or mitigate risks that may be present, thus supporting strategic planning, considering operational continuity, and stakeholder trust (Hopkin, 2018).

(Hopkins, 2018) Likelihood refers to the probability or frequency of a risk event occurring, while impact refers to the magnitude of consequences if that event occurs. For instance, a risk with a high probability but low impact (e.g., minor equipment malfunction) may be less concerning than one with a low probability but high impact (e.g., catastrophic plant failure). These two dimensions are usually plotted in a risk matrix or heat map, which visually categorizes risks into severity zones based on their likelihood-impact combinations. This enables organizations to prioritize risks and allocate resources effectively. Mitigation refers to the proactive strategies and measures implemented to reduce either the likelihood or the impact of a risk. (Hillson & Murray-Webster (2017) Effective risk mitigation not only involves physical or technical measures but also governance, process redesign, training, and contingency planning.

In simple terms, a risk assessment will begin by identifying the risks. This is usually done by looking at all potential risks in a place or event. Then, the results of the identification are analyzed for further evaluation. From this stage, the company will later get information about the risk level. This risk level is what is being controlled by taking mitigation actions. After mitigation is carried out, it is hoped that the risk level will be lower.

II.2. Conceptual Framework

A theoretical framework is a structure that guides research by relying on existing theories or models. It provides a foundation for the study by outlining key variables, their relationships, and the theoretical context. It serves as the basis for formulating research questions, hypotheses, and interpreting findings. (Imenda, 2014). A conceptual framework, on the other hand, focuses on the researcher's synthesis of literature to explain a phenomenon. It is more flexible than a theoretical framework and is often used to show the researcher's perspective on how variables or ideas interconnect. (Ravitch & Riggan, 2017).

This framework outlines a systematic approach to incorporating biomass as part of a supply chain management of biomass as a substitute raw material for coal (co-firing) mine mouth power plant 3 x 10 MW. The chart identifies the primary issue by business issue as the uncertainty of biomass supply for Power Plants. This could mean irregular availability, lack of consistent sourcing, or unreliable supply chains that hinder power plant operations. Identifying the annual coal demand of the Power Plants. From this baseline, a small percentage—5% biomass substitution—is introduced to calculate the biomass demand per year. This reflects a growing strategy to reduce coal dependency and promote renewable energy integration by using biomass as a partial substitute for coal in energy generation. Co-firing of biomass in a coal-fired power plant in an amount equivalent to replacing 10% of its capacity without having to replace the existing boiler (Rony et al, 2014). PTBA has a plan to be able to substitute coal (co-firing) in the 3 x 10 MW Mine Mouth Power Plant with biomass by 5-10% (RJPP PTBA 2024-2029), but for current situation

PTBA does not yet have a strategy that can guarantee the sustainability and sustainability of the biomass that will be used if the scenario is implemented.

In general, this research is divided into 3 phases, namely strategic analysis, strategic formulation and finally strategic implementation. Strategic analysis begins with the presence of a business issue that is present, then the business issue is made an objective. The objective is then analyzed externally and internally. The results of this analysis will be continued to the analysis of strategy making using SWOT and TOWS analysis. The strategy obtained from the TOWS analysis will later be selected based on the priority matrix in this study will use the Einsenhowe Matrix. After that, a risk analysis is carried out and finally a strategy implementation plan will be made. (Figure II.7.)

The framework presented in the image illustrates a strategic management model designed to guide organizations through the formulation and implementation of effective strategies. The framework serves as a logical roadmap for diagnosing business issues, setting strategic objectives, analyzing both internal and external environments, making strategic decisions, and implementing those decisions to ultimately achieve corporate advantage. Once the issue is clearly identified, the objective is formulated to address this problem.

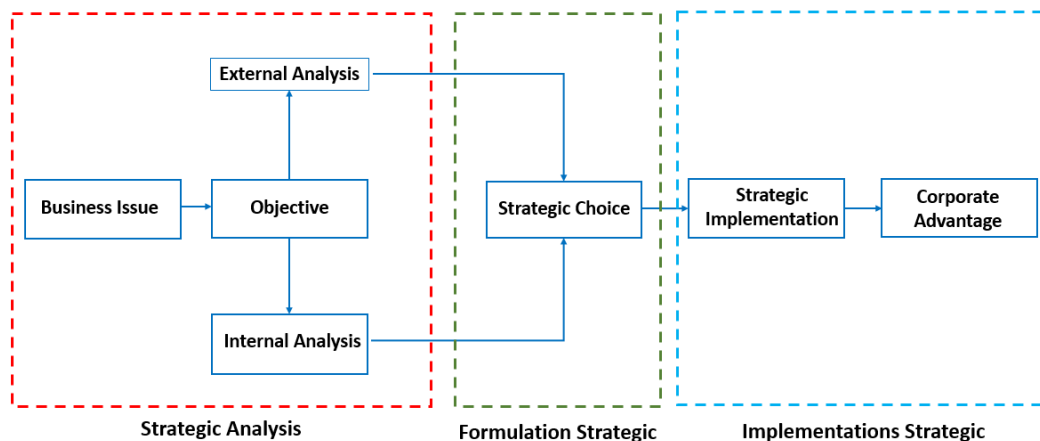


Figure II. 7 Conceptual Framework

After setting objectives, the framework proposes external and internal analyses as parallel activities. External analysis includes evaluating macro-environmental factors using tools such as PESTEL, Porter's Five Forces and identifying opportunities and threats. Internal analysis, on the other hand, focuses on PTBA's internal capabilities and resources. Using tools like the VRIO Framework and McKinsey 7S Frameworks. Based on the insights from both analyses, the organization moves into the strategic choice phase. The options are then evaluated by SWOT and then using prioritization tool by TOWS matrix to identify the most viable strategy. Before implementation, it is necessary to conduct a risk analysis to find out what risks have the potential to occur. By knowing the risks that will arise, it is necessary to create a mitigation plan in order to reduce the possibility and impact of potential risks.

Next phase, after a strategic direction is chosen, the organization proceeds to strategic implementation. This involves translating the chosen strategy into detailed action plans. The final outcome of the framework is achieving corporate advantage. Corporate advantage can support what is corporate target in long term planning (RJPP).

Chapter III Research Methodology

III.1. Research Design

Research design is a structured methodology for addressing business problems through a comprehensive process of research, data collection, analysis, formulation/simulation, and conclusion (Figure III.1). It begins by identifying the core business problem, which serves as the starting point for the entire framework.

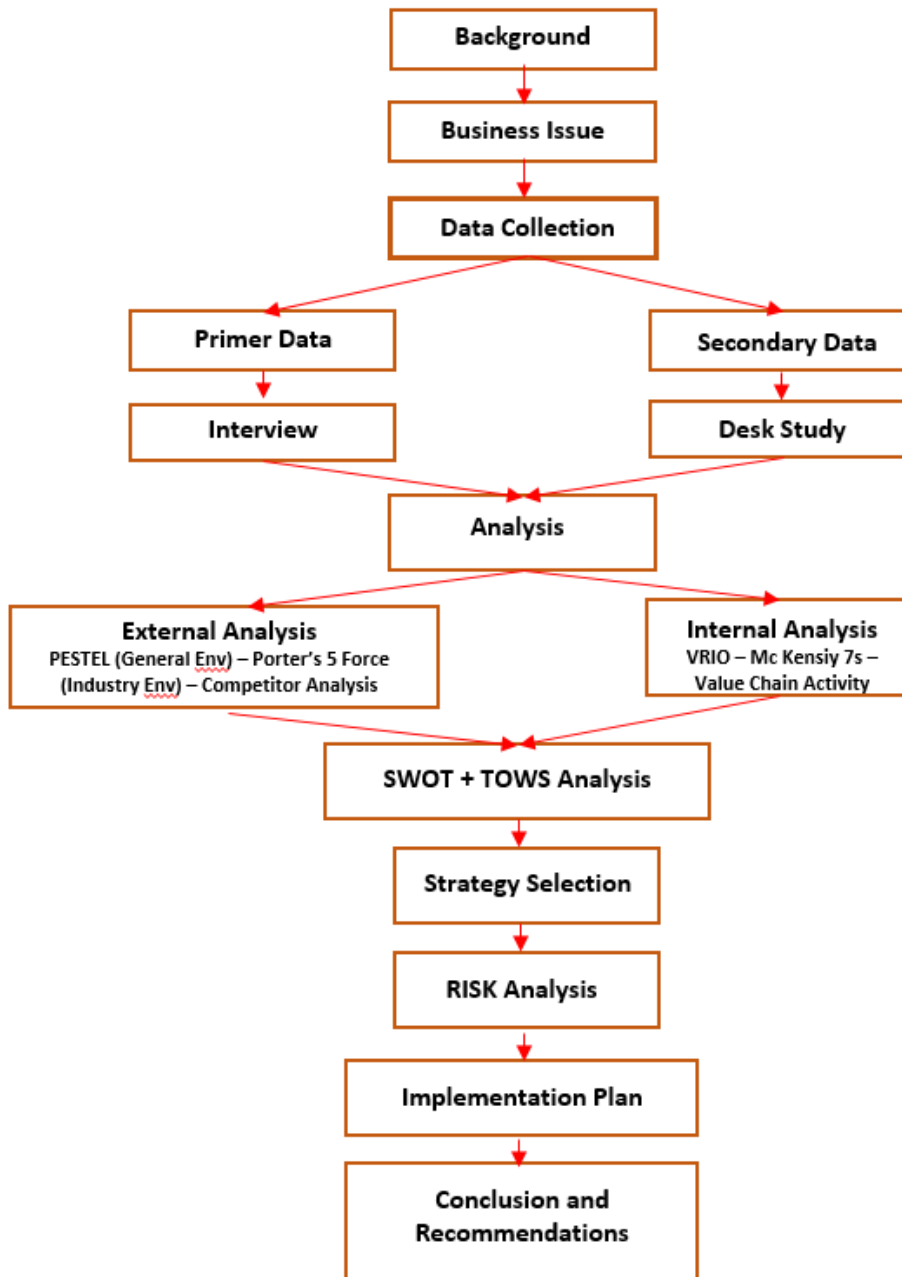


Figure III. 1 Research Design

The strategic analysis process begins with a background, which explains the broader context that drives the research, such as net zero emissions issues, environmental regulations, energy transition mandates, or sustainability goals. This leads to the identification of a business problem. A business problem is a major challenge or issue that an organization or company wants to address. In this thesis, a strategy is needed to ensure a sustainable biomass supply for power generation, the business problem can be the absence of a clear strategy regarding a reliable supply to ensure biomass sustainability.

After defining the problem, the next stage is the data collection stage, starting with using primary and secondary sources. Primary data is obtained by involving interviews with internal stakeholders (Divisions), the Divisions interviewed are divisions that have sufficient information relevant to the existing business issues. While secondary data includes all regulatory documents, internal reports, scientific literature, and market studies. Creswell (2014), combining several data sources increases the reliability and depth of research through triangulation. The next step is to conduct an analysis, which is divided into 2 assessments, namely external and internal. External analysis will use tools such as PESTEL - to understand macro environmental forces such as policy changes, energy prices, or technological advances - and Porter's Five Forces, which evaluate competitive pressures from suppliers, buyers, new entrants, substitutes, and industry competition (Porter, 1980). As for internal analysis, it will use the VRIO Framework tool - which assesses whether the resources are valuable, rare, inimitable, and organized to provide sustainable competitive advantage (Barney, 2007). Then, the McKinsey 7S Framework is of course used to ensure alignment between strategy, structure, systems, shared values, style, staff, and skills (Waterman, Peters, & Phillips, 1980), which is essential for successful strategy execution.

After obtaining information on factors related to internal and external insights, the stage continues to the SWOT analysis, which will be divided into 4 categories, namely the company's strengths, weaknesses, opportunities, and threats. Later, this SWOT will be used in the TOWS matrix, a strategy-making tool that aligns internal

capabilities with external circumstances. For example, a company can use a strong R&D team (strength) to take advantage of green energy incentives (opportunities) or reduce supply chain risks (threats). Kotler and Keller (2012) emphasize that TOWS plays a very important role in developing targeted strategic options that are not only relevant but also actionable.

From the TOWS matrix, several strategic alternatives will be obtained. The stage of selecting these strategies involves evaluating these options using criteria such as feasibility, impact, availability of existing resources, and alignment with previously established company goals. After the selection, it will be continued with one important stage, namely risk analysis. This involves mapping each strategy into a risk map based on the likelihood and impact of potential disruptions. Hopkin (2018) explains that the visual risk assessment will help prioritize mitigation actions and increase management awareness. The selected strategy will then be made into an implementation plan. The implementation plan will be prepared regarding several important things such as: details of actions, setting a schedule, and determining which Division is the main person in charge (PIC) for each activity, and estimating the budget. Finally, conclusions and recommendations will be made, where the main findings, strategic implications, and suggestions for future research or policy development are presented. This stage ensures that the thesis can provide not only theoretical value but also practical utility for decision makers.

III.2. Data Collection Method

Data collection is an important and fundamental stage in the research process. Research or thesis requires the systematic collection of information obtained to understand a phenomenon, test a hypothesis, or answer a research question. In many qualitative and quantitative studies, the success of the research depends heavily on how well the data collection phase is designed and implemented. This shows that good data will be obtained if it is done in a good way or method. Effective data collection ensures that the information collected is accurate, reliable, and appropriate for analysis, which ultimately leads to valid and meaningful conclusions. Creswell (2014), the choice of data collection methods must be in line

with the design, objectives, and research questions to maintain the integrity of the research process. Mistakes in determining the data collection method will affect the results obtained.

There are two primary types of data: primary data and secondary data. Primary data is information collected directly by the student through first-hand method is interviews. It is especially useful for specific, real-time, or contextually relevant information is needed. In this there are some divisions as subject matter experts.

- Project Management Office (PMO) Division: is the function of preparing the company's long-term plan (RJPP). In this RJPP there are targets that will be achieved by the company within the next 5 years. All company activities must refer to the RJPP, including the plan to use biomass for Power Plants. In addition, the PMO also oversees the field of R&D, which is one of the initial stages in the use of biomass for Power Plants.
- The finance and budget division can be used as a resource, related to financial parameters. Current internal financial condition as well as financial potentials that can be profitable for PTBA, especially for cofiring project using biomass for 3x10 MW Banko Barat power plant.
- Planning Division: can provide information on mine plans, pre- and post-mining areas, land status and share information related to operational plans in the field.
- Tanjung Enim Site (Environmental Support and Mine Support Division). This Division Can provide information and data on plants that are good for biomass, how land conditions in pre or post mining areas. This division is the party that knows the conditions in the field most intimately.

Maintenance Division: The Maintenance Division has the function of managing the 3 x 10 MW Banko Barat Power Plant. Supervision and monitoring of operational activities are carried out day to day. What is done by the Maintenance Division also includes the availability of raw materials, namely coal.

In contrast, secondary data consists of information that has already been collected and published by other entities. This includes reports, academic literature, company

documents, policy regulations, and statistical databases. Secondary data is particularly helpful for establishing background, validating primary findings, or identifying trends over time. In strategic and environmental research, documents such as national energy policies, sustainability reports, and market studies often provide critical context. As noted by Bowen (2009), document analysis—an important secondary method—enables researchers to review and interpret relevant documents to uncover patterns, biases, or thematic insights.

The main methods of data collection in this thesis include:

1. Interviews - Interview activities are conducted with existing stakeholders. Interviews can be structured, semi-structured, or unstructured used to collect detailed qualitative data. Kvale & Brinkmann (2009) emphasize that interviews will produce depth and allow for exploration that is very necessary in this thesis. So how this interview process is carried out can later affect the results.
2. Document/Desk Study - This is certainly done by reviewing existing reports, studies, and data sets to extract relevant information. This is very useful in environmental and policy research. However, it is necessary to pay attention to whether the data comes from valid sources or not, because if the data is not obtained from valid sources, the results obtained will not be good.

Primary data is used to extract in-depth information about the organization's real strengths and weaknesses, which can then be analyzed using tools such as SWOT, VRIO, McKinsey 7S, or Value-Chain Activity. In addition, primary data will provide a realistic basis for developing implementation plans, allocation of responsibilities, and risk mitigation strategies. Meanwhile, secondary data is more used to analyze external conditions using frameworks such as PESTEL, Porter's Five Forces and Competitor Analysis. In addition, secondary data is needed as information to compare the company's strategy with industry best practices (if any) and support or corroborate the findings obtained from primary data.

In order for the data obtained to be reliable for use in the next process, namely analysis, the data that has been obtained needs to be validated. Data validation can be done in several ways. Primary data will be validated by comparing the results of interviews with internal documents or observations made by the author or by confirming the results of interviews with sources. As for secondary data, validity is tested by assessing the credibility of the source (whether it comes from a trusted institution), the suitability of the publication time (whether it is still relevant to current conditions), and cross-verifying between sources. By applying this method, researchers can ensure that the data is valid and reliable for use in this thesis. In the best data collection process, data collection that is carried out well will certainly increase the resilience and credibility of research findings, supporting effective decision making and strategic planning.

Chapter IV Finding and Business Solutions

IV.1. External Analysis

The external analysis that will be conducted in this thesis are PESTEL analysis (General Environment), Porter's Five Forces analysis (Industry Environment), and Competitor Environment. This analysis is carried out to see opportunities and threats that come from the environment outside the company. This analysis is one that is considered in developing the desired strategy.

IV.1.1. PESTEL Analysis (General Environment)

IV.1.1.1. Political

The Indonesian government has demonstrated a strong political commitment to the clean energy transition and the achievement of the Net Zero Emission (NZE) target by 2060. This commitment is affirmed in the Long-Term Strategy for Low Carbon and Climate Resilience 2050 document as well as the Enhanced Nationally Determined Contribution (ENDC) updated in 2022. Within this framework, the energy sector is the main focus as it accounts for more than 30% of national greenhouse gas emissions (MEMR, 2023).

One of the methods or strategies used to reduce emissions from coal-fired Power Plants is through the implementation of biomass co-firing. The government has targeted the new renewable energy (EBT) mix to reach 23% by 2025 and increase progressively until 2050 (Figure IV.1.). This is reinforced by the issuance of Presidential Regulation Number 112 of 2022 concerning the Acceleration of Renewable Energy Development for Electricity Provision which provides strategic direction to state-owned enterprises in the energy sector including PT Bukit Asam (PTBA). As part of the mining state-owned enterprises and a member of the MIND ID company, PTBA also supports this policy by developing various green initiatives such as biomass co-firing and the use of pre- or post-mining land for cultivating energy crops and processing agricultural waste into alternative fuels.

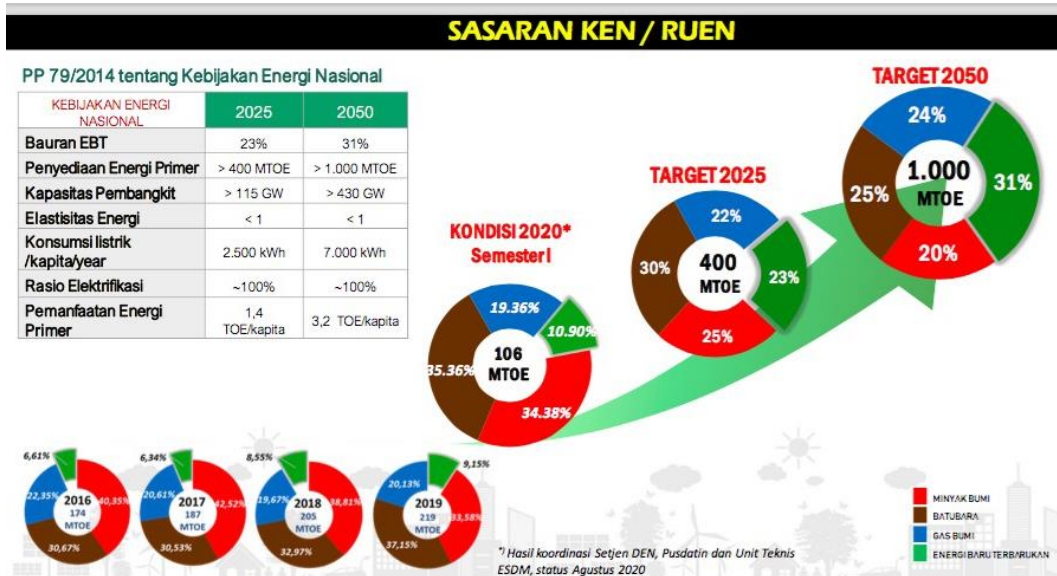


Figure IV. 1 National Energy Policy Goals

Furthermore, the Ministry of Energy and Mineral Resources has set a national co-firing policy in 52 PLN-owned Power Plants units with a total capacity of 1.8 GW, using a biomass mixture of up to 10% depending on technical readiness and supply availability. The status at the end of 2023, information was obtained that as many as 41 Power Plants units had implemented the co-firing program with varying results. This scheme can be utilized by entities such as PTBA in the 3x10 MW Banko Barat Power Plants, with regulatory support from PLN as a reference in designing fiscal incentives such as special rates for green electricity, biomass price subsidies, or carbon taxes. This is very important because economically, the price of biomass per unit of energy is still higher than coal, so policy intervention is needed to ensure the sustainability of the project. Of course, if these incentives are not implemented, it can disrupt the company's performance.

At the regional level, South Sumatra Province also shows good political stability, including in terms of accelerating investment and partnerships for the development of biomass supply chains. The provincial government has included bioenergy as a priority in the Regional Energy General Plan (RUED), including initiatives to utilize plantation and agricultural waste as energy sources. This has received real and concrete support including ease of licensing, external and internal synergy, and can also be with inter-agency (agriculture, forestry, ESDM), and the active role of

local farmer cooperatives. These factors create a stable and progressive political environment, which is very important in building a reliable, local, and sustainable biomass supply chain.

Based on data from Dewan Energi Nasional (DEN), it is very relevant if it is associated with the development of biomass as an alternative fuel for co-firing at PLTU Bukit Asam. One of the main focuses of the policy is to increase the mix of new and renewable energy (EBT) to 23% by 2025 and 31% by 2050. In this context, biomass is one of the potential sources of EBT, especially for the electricity sector, through the co-firing mechanism in PLTU.

If we look at the actual condition in 2020, which only reached 10.9% of the EBT portion, then the development of biomass becomes very strategic to catch up with the shortage, especially in the South Sumatra region where Bukit Asam is located. PT Bukit Asam's 3x10 MW Banko Barat mine mouth PLTU, which is planned to conduct a co-firing program with biomass, is a concrete example of efforts to implement this policy. With the ambitious renewable energy mix target and the urgency of reducing dependence on coal and petroleum, co-firing is one of the quick solutions to support the energy transition program. PLTU Banko Barat has the potential to become a pilot project on a national scale, because in addition to its location close to biomass sources, it also has the infrastructure and support from Bukit Asam as one of the mining SOEs.

RUEN targets an increase in generating capacity to ± 115 GW by 2025 and ± 430 GW by 2050. This will be an opportunity for the cofiring program to be carried out, as it can help the government in achieving the existing targets. However, there are challenges in the biomass supply chain, from upstream to downstream. This challenge must be addressed by preparing a strategy that can guarantee the existence and supply of biomass so that the cofiring program can run sustainably. Thus, the KEN/RUEN policy provides a strong framework of direction and strategic justification for the development of biomass co-firing at PLTU Bukit Asam. Successful implementation at this PLTU can contribute significantly to the

achievement of national renewable energy targets, as well as being an important part of Indonesia's energy transition agenda towards a cleaner, more independent and sustainable system.

IV.1.1.2. Economic

Fossil energy prices, especially coal, are highly susceptible to global market fluctuations that are closely related to geopolitical factors, climate crises and industrial demand. For example, as can be seen in the graph above (Figure IV.2), Newcastle coal prices peaked at USD 400/ton in March 2022, triggered by the global energy crisis exacerbated by the conflict between Russia and Ukraine as well as a surge in coal demand from countries that rely on thermal plants again and post-COVID-19 economic recovery. However, coal prices experienced another deep correction, compared to prices in March 2022, to around USD 130-150/ton in early 2024 (Trading Economics, 2024). This reflects that coal prices are highly sensitive to global conditions and issues that result in high price uncertainty which also automatically affects the financing of coal-based power plant operations. Then, coal prices continued to show a significant downward trend and stabilized at around 100 USD/ton in 2025. This indicates a recovery in global energy supply as well as pressure on the coal sector due to increasing energy transition commitments and carbon regulations.



Figure IV. 2 Newcastle coal price trend from 2021 to 2025

This decline in coal prices has two important implications. First, for the coal industry, this condition signals a decline in profitability that encourages companies to diversify, streamline operations, or integrate with clean energy technologies. Second, for Indonesia's energy transition agenda, especially for the co-firing program of PLTU with biomass, this condition opens strategic opportunities. Despite declining coal prices, national policy still demands an increase in the share of new and renewable energy. With coal prices back low, cost parity between biomass and coal is a challenge. Therefore, the success of the co-firing program depends not only on policy encouragement, but also on supply chain efficiency and large-scale availability of biomass at competitive prices.

Unlike coal, biomass derived from various materials such as energy wood, agricultural waste, and palm kernel shells has the potential to have a more stable price if developed through an integrated and sustainable domestic supply chain. However, according to research by the Institute for Essential Services Reform (IESR, 2023), the price of biomass fuel still ranges from USD 5-9 per Gigajoule (GJ), compared to coal where the price still ranges from USD 2-3 per GJ. This is also a real economic barrier to biomass co-firing projects, especially in the first investment and operation stages. Although more expensive, biomass can provide the potential for carbon market compensation, both locally through the National Registration System for Climate Change Control (SRN-PPI), and globally through the Voluntary Carbon Market (VCM). This scheme can be used to reduce the net cost of electricity generation through biomass, while also providing an alternative source of revenue for developers such as PT Bukit Asam.

To overcome this financial barrier, the Indonesian government has initiated a number of fiscal and non-fiscal incentives that directly benefit new and renewable energy (NRE) projects. For investors in the EBT sector under PMK No. 130/2020, a tax deduction of up to 100% of Corporate Income Tax for 5-20 years is available, based on the scale of investment. Other incentives are Government Borne VAT (DTP) for the purchase of capital goods in EBT projects, super deduction tax for R&D and workforce training, and licensing facilitation in the OSS-RBA system. In

addition, the Environmental Fund Management Agency (BPDLH) offers access to Indonesia's Green Fund, in the form of grants, low-interest loans, and blending finance programs, for PTBA to use in the development of logistics infrastructure and biomass processing facilities. Competitiveness in the market is also taken into account.

Demand for biomass in the international market is increasing sharply, especially from countries such as Japan, which plans to use up to 10 million tons/year, and South Korea through the Renewable Portfolio Standard (RPS) scheme. This has led to an increase in exports of biomass commodities such as wood pellets and CPO, which are more valuable in the international market than the domestic market. In the absence of a national policy in prioritizing supply, local producers will tend to export their products, which will disrupt the supply of biomass for local co-firing such as in West Banko PLTU. Therefore, biomass supply allocation policies, domestic price incentives, and long-term offtake contracts are essential to ensure the sustainability of the national biomass supply.

IV.1.1.3. Social

The development of the biomass supply chain for the co-firing program in the Banko Barat Power Plants has tremendous potential for the economic empowerment of local communities, especially village communities in the area around the operating field of PT Bukit Asam (PTBA) in South Sumatra. A significant proportion of the feedstock utilized for biomass comes from forest residues and agricultural by-products such as straw, rice husks, TKKS (empty palm oil bunches), and energy crops including gamal and calliandra. According to research by the Ministry of Villages, Development of Disadvantaged Regions and Transmigration (Kemendesa PDTT, 2022), an estimated 56% of Indonesian villages are found to have untapped biomass potential. Through the involvement of cooperatives, BUMDes, and farming groups, communities can participate in the process of collecting farm waste, cultivating energy crops on marginal or former mining land, and supplying biomass to Power Plants using locally-based supply chains. This approach creates new job opportunities, as well as reduces open

burning of organic waste, which otherwise has been contributing to air pollution and health problems. But such a program has to be pursued with the spirit of Free, Prior, and Informed Consent (FPIC) in order to ensure voluntary and informed participation by communities, and to prevent land conflicts-especially if there is land conversion from food land to energy land.

As the general public's concern over climate change concerns heightens, especially among young people and environmental groups, businesses such as PTBA also come under social pressure to reduce their carbon footprint and become sustainable operations. PTBA's biomass co-firing initiative is an appropriate move in maintaining a "social license to operate," while further reiterating the firm's commitment to decarbonization. This strategy can be incorporated in Environmental, Social, and Governance (ESG) reporting and in the National Registry System - Climate Change Control (SRN-PPI) under the leadership of the Ministry of Environment and Forestry. According to a World Bank report (2023), the application of renewable energy technologies by SOEs has a significant influence on the favorable image of the company among the community, reduces the risk of social conflict, and fosters relations with local stakeholders. To this end, PTBA would gain from having a strategic opportunity to be a pioneering fossil-energy SOE that is at the front lines of energy transition in a social-ecological and inclusive way, not just for reputation, but for long-term business sustainability.

IV.1.1.4. Technological

Biomass co-firing power plant technology has finally reached commercialization and is ready to be used with the support of global suppliers such as General Electric (GE), Mitsubishi Power, and Doosan Enerbility, providing biomass-coal blended combustion systems with 30% or more, depending upon feedstock and the readiness of a unit. Japan (Handa power plant) and the UK (Drax power plant) are a few nations that have utilized this technology to a very large extent with good technical and commercial readiness. For optimal use of biomass, advanced processing steps such as torrefaction, pelleting, drying, and automated feeding systems must offer energy density, moisture content, and supply stability according to the standards

required to operate a power plants; as IRENA (2023) remarks, torrefied biomass can improve combustion efficiency by 30% and reduce risk of corrosion. Yet, despite all these positives, the technology comes with an enormous initial price tag of around USD 60-120/ton capacity/year.

In addition to technical readiness, the success of the biomass supply chain is also dependent on digitalization of the distribution system using Internet of Things (IoT) and block chain technology, enabling real-time monitoring of the moisture content, volume and location and transparent documentation of the origin of biomass. World Economic Forum (2023) reports that digitization can increase efficiency in logistics by 25% and losses by 15%, while facilitating integration with the National Registry System (SRN-PPI) in order to facilitate emissions reporting and carbon markets. Therefore, application of this upstream to downstream technology is an important pillar in building a trustworthy, efficient and sustainable biomass supply chain at PT Bukit Asam's Banko Barat Power Plants.

IV.1.1.5. Environmental

It is in an effort to supplement Indonesia's commitment towards being Net Zero Emission (NZE) compliant by the year 2060 that the policy of the implementation of biomass co-firing in Power Plants is one of the feasible and sustainable energy transition pathways, specifically for PT Bukit Asam (PTBA) as a state-owned enterprise in the energy industry. Co-firing allows co-mixing of coal with biomass such as agriculture residues and forest residues, a carbon-neutral fuel due to the fact that CO₂ released during combustion can be captured during the process of photosynthesis from biomass. According to IRENA (2023), co-firing has the potential to reduce carbon emissions by 300-500 kg/MWh, depending on feedstock quality and combustion system efficiency. Additionally, such emission cuts may be traded in the voluntary carbon market and documented under the National Registry System (SRN-PPI) to become eligible for carbon credits. However, massive biomass application has massive ecological risks, especially if feedstock is obtained without sustainability regulations, such as forest clearance of natural forests or the reclamation of agricultural lands to energy crop plantations.

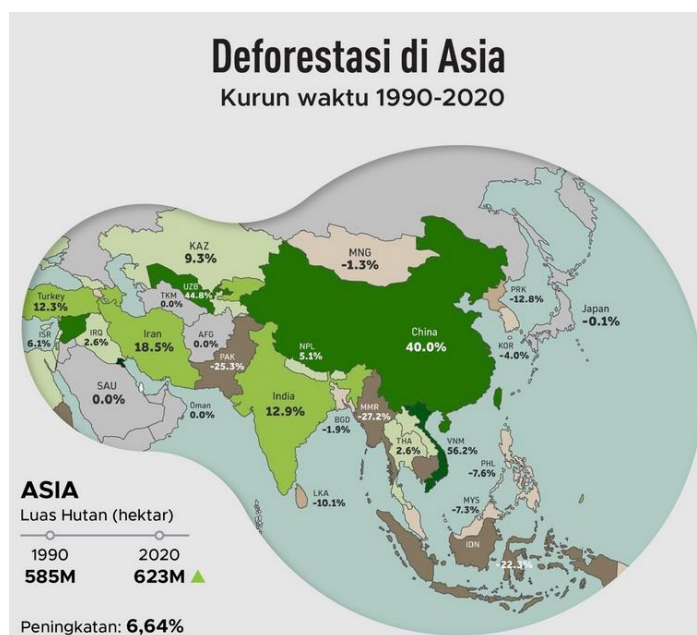


Figure IV. 3 Dispersion in Asia for the period 1990 - 2020

The GIZ study (2022) estimates Southeast Asia would experience more than 300,000 hectares’ deforestation if the needs of biomass increase drastically without proper regulation. Other dangers are disrupting biodiversity and land conflict because of competition between food need and energy needs (food vs fuel). Therefore, PTBA needs to adopt a sustainable sourcing policy that intensely manages raw material origin, advocates for marginal land utilization, and inclusively involves local society into the supply chain of biomass. This policy, together with ensuring that co-firing actually minimizes emissions, will ensure ecosystem and social integrity in the area of operation, hence lessening the likelihood of overall sustainability principle infringement.

IV.1.1.6. Legal

Legislative support for the development of new renewable energy (EBT) in Indonesia is a good legal foundation for the implementation of biomass co-firing policies in Power Plants, including PT Bukit Asam (PTBA). Presidential Regulation No. 112 of 2022 is the main reference that requires efforts to increase EBT utilization in the national energy mix, including guarantees for prices and

competitive EBT electricity selling and purchasing programs. On the other hand, PLN's 2021-2030 Electricity Supply General Plan (RUPTL), or the "greenest" RUPTL, evidently has a target for implementation of co-firing in 52 Power Plants with a combined capacity of 1.8 GW, and this can be used as a strategic reference even though it is indicative. Further rationale stems from inter-sectoral policy documents such as the National Action Plan for Greenhouse Gas Emissions Reduction (RAN-GRK) and the Value of Carbon Economy (NEK) ministry of finance roadmap that make opportunities available to incorporate co-firing projects in domestic and international carbon trading systems.

In addition to the technical legal regime, PTBA as a state-owned enterprise listed on the Indonesia Stock Exchange is also bound by sustainability reporting pursuant to POJK No. 51/POJK.03/2017 and Ministry of SOEs' ESG guidelines. The report encompasses GHG emissions, energy consumption, use of renewable energy, waste management, and community engagement—all of which are highly interrelated with the impact of the co-firing program. Adherence to these ESG regulations is not merely imperative for reputation management and accountability, but also a key requirement to receive green financing, ESG-based loans, and low-carbon investment schemes from domestic and international financial institutions. Legal and regulatory aspects thus become the essence of legality and strategic sustainability of biomass co-firing implementation in Banko Barat Power Plants.

Table 1 Summary of PESTEL Analysis

Factors	Key Points	Outcome
Political	Strong commitment from the Indonesian government to renewable energy and NZE 2060; policies that support co-firing of power plants as a decarbonization strategy; regional political stability will support investment in the biomass sector.	Opportunities
Economic	Very rapid Fossil Energy Price Fluctuations or Uncertainties and Biomass Stability Potential. The Existence of Fiscal and Non-Fiscal Incentives for Biomass Investment, Quite tight market competition but there are still opportunities for biomass exports	Threats Opportunities

Social	Potential for Empowering Local Communities through Biomass Supply Chain, Environmental Awareness and Social Pressure on the Mining Industry	Opportunities
Technological	There are already technologies that support co-firing activities on a commercial and operational scale, biomass processing technology, the use of IoT and blockchain for transparency and efficiency	Opportunities
Environmental	Biomass needs will also affect deforestation activities. These activities must be balanced with reclamation.	Threats
Legal	There are some regulations on new renewable energy, Corporate ESG Compliance. This must be met to maintain the company's name.	Threats

IV.1.2. Porter's 5 Force (Industry Environment)

IV.1.2.1. Threat of New Entrants

The threat of new entrants for the biomass supply chain is also high to moderate, especially for the upstream segment, i.e., biomass feedstock collection and production from agricultural waste. The reason is the relatively low entry barrier, where local actors such as village cooperatives, farmers, or MSMEs can easily get access to and produce organic waste into simple fuels without excessive investment. Over 60% of Indonesia's biomass availability comes from small, dispersed and informal local actors, a report by IESR (2023) shows, so the market is fairly open to new entrants.

Second, there is no single dominant player that has a high market share in the country's biomass supply chain. Absence of a centralized market structure makes it a competitive platform for new entrants to find and sell in the market, especially near Power Plants that require a reliable source of local biomass. This is also backed up by the prevalence of raw material such as rice husks, corn cobs, and sawdust that are not utilized to capacity. However, there are also limiting factors in new entrants' entry, specifically in the form of dependency upon direct contacts with offtakers, i.e., Power Plants. Without long-term contracts (offtake agreements) with companies such as PTBA, new players cannot sell their products in bulk quantities. The Ministry of Energy and Mineral Resources (2022) further indicated that the majority of co-firing plans were not realized since the biomass supplies are not technically feasible. This is due to the lack of technical competence of upstream

players to produce quality biomass, such as in terms of moisture content below 20%, uniform size, and minimum heating value of around 15 MJ/kg, as stipulated in SNI 8021-2014.

IV.1.2.1. Bargaining Power of Suppliers

Now, the bargaining power of the suppliers of biomass is significant, owing mainly to the fact that the structure of supply is dispersed, seasonal, and not yet standardized. Rice husks, corn cobs, and palm kernel shells constitute most of the biomass feed stocks that are still controlled by geographically dispersed farmers and small-scale enterprises. Their supply is very sensitive to harvest periods, climatic factors, and other local factors. This fragmentation produces price uncertainty and complicates large buyers such as PTBA in ensuring constant supply. Based on FAO statistics (2021), the informal players without permanent contracts provide around 70% of biomass in the Southeast Asian region, making the suppliers' bargaining position against generators strong, particularly during the material shortage period.

Supplier power is also augmented by competition from overseas market exports, with countries such as Japan and South Korea aggressively buying biomass from Indonesia to produce electricity for renewable energy. Export commodities such as palm kernel shell (PKS) and wood pellets are exported at premium rates of USD 120-160 per ton, which is much higher than the domestic buying price of approximately USD 70-90 per ton (JETRO, 2024). This circumstance motivates most of the domestic suppliers to shift their supply overseas, especially in case they lack long-term commitments from local buyers. Or else, PTBA as a state-owned company and huge biomass off-taker has strong bargaining power in terms of buying volume and demand stability. Its dependence on third-party suppliers, however, limits this leverage in practice as it does not possess an in-house biomass manufacturing plant currently. This implies that PTBA is still subject to price fluctuation and supply uncertainty from small-scale suppliers that do not possess advanced processing capacity (i.e., pelleting and drying) on par with co-firing requirements.

IV.1.2.3. Bargaining Power of Buyers

For biomass supply chain for Power Plants Banko Barat co-firing needs, PTBA is currently a buyer, but never a seller. Therefore, buyer power can at most be realized if PTBA will also become a seller or a producer of biomass for either local market (e.g. private Power Plants or cement sector) or export market (e.g. Japan and South Korea). Today, the bargaining power of buyers from other segments than PTBA remains minimal because domestic biomass demand is not big yet. For example, co-firing in the cement industry remains in the trial stage and has yet to use huge volumes (hence PTBA, if it later enters this business), will possess a fairly strong bargaining power to set prices and terms of contract.

But the scenario would dramatically change if PTBA becomes an exporter of biomass. The export market, particularly in East Asia and Europe, is dominated by a highly structured buyer base that is price- and quality-oriented. Importers like Japan and South Korea have consolidators and big energy players who use economies of scale to maintain purchase prices low. According to the JETRO report (2024), the standard purchase contract for wood pellets and PKS from Indonesia to Japan utilizes a competitive tender method in the long run, therefore producers' (like PTBA) bargaining power will generally be inferior to that of the buyer.

Therefore, although PTBA is in a dominant position currently as a biomass buyer from local cooperatives or farmers, the dominance may not necessarily be transferable if the company extends its role to a biomass producer and exporter. In such an expansion scenario, PTBA would have to change its pricing, quality and logistics strategies to compete in a high buyer power market involving intense price competition. Besides that, PTBA will also have to invest in certification and processing technology to meet strict international standards

IV.1.2.4. Threat of Substitutes

new generation infrastructure. Its deployment is relatively quick and affordable as it would be possible to implement it with upgrades to existing Power Plants at an investment of approximately USD 50-100 per kW, which is significantly lower than

the investment in constructing new renewable facilities such as solar farms or wind parks that can be as much as USD 1,000-1,500 per kW (IRENA, 2023). But in the medium to long term (5-15 years), substitutes for energy are starting to appear, notably solar PV, wind power, and even green hydrogen. Both solar and wind power are experiencing fabulous cost reduction-the cost of utility-scale solar PV power in Indonesia has come down to below USD 0.06/kWh (IESR, 2023)-and have enduring popularity as they produce nothing. Also, the development of green hydrogen technology, which currently is being encouraged through pilot projects by PLN and the private sector, can be a long-term solution to power sector decarbonization.

Substitution can also take the form of alternative fuel in the co-firing program itself. One of them is Refuse-Derived Fuel (RDF), a municipal solid waste treatment fuel. RDF has also been piloted in TPP Jeranjang and Power Plants Suralaya, specifically where there is low biomass potential but there is high volume of domestic waste. Although RDF is less effective than biomass in the aspect of moisture content and energy content, its application has been well endorsed by the city government in the form of energy-based waste management system. But the current strength of biomass is its technological maturity and readily available infrastructure, and it can be made compatible for application in existing Power Plants without major changes.

IV.1.2.5. Industry Rivalry

Competition in Indonesia's biomass co-firing business is showing an increasing trend, especially as the number of individuals starting to adopt biomass-based decarbonization initiatives increases. PLN is among the strongest players, and in its 2021-2030 RUPTL has made a commitment to biomass co-firing in 52 Power Plants totaling about 1.8 GW capacity. This action makes PLN not only the largest biomass consumer, but also the proprietor of national technical standards and operating procedures. Aside from PLN, Independent Power Producers such as Jawa Power and PJB Services have also started embracing co-firing as part of its ESG strategy and the reduction of its emissions in order to qualify for green finance and carbon credits. Meanwhile, at the upstream level, biomass exporters compete with

one another in securing feedstock stocks, such as wood pellets and palm kernel shell (PKS), to meet feedstock demand from South Korea and Japan with high prices. Such competition leads to a misbalance between domestic demand and supply, and pressures buyers such as PTBA to make the biomass supply chain sustainable and stable.

However, as the industry is still in its early stage of development, competition is not at a level of saturation like for the fossil energy market. There is still room for coordination between industry players, for instance, in the form of a regional biomass supply consortium, mutual cooperation in processing technology innovation, or joint national quality standards. This allows PTBA to be a pioneer and a standard setter if the company is the one that spearheads the consolidation of the supply chain from upstream to generation.

Using the leverage of its status as a state-owned firm and current Power Plants player, PTBA can secure a strategic position ahead of the next 5-10 years of the industry when it enters a more heated competition stage. Immediate actions such as investments in pelleting facilities, roll-outs of logistics digitalization infrastructures, and single partnerships with local suppliers will be a sustainable competitive advantage.

Table 2 Summary of Porter's Five Forces

Driving Forces	Key Points	Outcome
Threat of new entrants	The biomass market is still open and dominated by informal players (60% according to IESR, 2023) and barriers to entry are low.	Opportunities
Bargaining power of Suppliers	Supply is fragmented, seasonal and disrupted by export markets (mills & pellets) and export prices are much higher.	Threats
Bargaining power of Buyers	PTBA is the final buyer, not dependent on other buyers.	Opportunities
Threat of substitute products	PTBA as a supplier of solar, wind, RDF, and green hydrogen is growing fast. But co-firing is the most feasible at the moment. end buyer, independent of other buyers.	Threats Opportunities
Rivalry among existing competitors	PLN and IPPs dominate downstream, exporters compete upstream and competition for raw materials increases.	Threats

Based on porter's five force analysis, there are still enough opportunities that can be utilized to support this research. Then the existing threats are things that need to be anticipated so that the threat does not harm the company.

IV.1.3. Competitor Environment Analysis

PTBA's competitor environment analysis, in relation to developing a sustainable biomass supply chain for co-firing its 3×10 MW mine mouth PLTU at Banko Barat, reflects increased competition from foreign as well as local entities. With co-firing as a national goal in RUPTL 2021–2030 and Presidential Regulation No. 112/2022, state electricity company PLN has quickly followed up on co-firing schemes for 52 coal-fired units with biomass substitution levels of 5% to 10% to be achieved. According to the IESR 2023 report, PLN has already co-fired successfully in 36 PLTUs and is progressively developing biomass demand to over 680,000 tons in 2022 from wood chip, sawdust, rice husk, and palm waste as primary sources. This expansion makes PLN a key market driver and significant player for the biomass feedstock in Indonesia.

Globally, Indonesia is subject to high demand for biomass exports, most notably from Japan and South Korea, who have both committed to utilizing certified wood pellets and other renewable biomass sources toward their decarbonization goals. APROBI and Gaikindo Biomass Data (2023) report that Indonesia shipped more than 1.2 million tons of biomass (primarily wood pellets) during 2022 at prices of USD 100–130 per ton—well above domestic procurement standards for co-firing. This is a severe competitive pressure on the domestic customers like PTBA, which may have difficulty in getting safe and cheap supply since the seller prefers to sell the product in the export market.

Business model competition is also being driven by other independent power producers (IPPs) and energy players venturing into integrated biomass businesses, which have superior technological capabilities as well as better digital traceability. For instance, PJB Services and Indonesia Power formed partnership with forestry

companies and technology firms to create closed-loop biomass plantations with integrated logistics. These investments allow them to control both upstream and downstream biomass supplies, enhancing supply reliability and quality conformance—both essential hallmarks of successful co-firing operations.

As compared to its competitors, PTBA has some positives—such as direct ownership of power plants, provision of reclaimed post-mining land, and ESG mechanisms in favor of sustainability reporting. However, PTBA still lacks a specialized biomass unit, sound digital infrastructure, and sound upstream supplier network integration. Unless these gaps are addressed, PTBA may lose market competitiveness, especially with other players increasing their scale operations and adopting new technologies.

Table 3 Matrix of Competitor Environment Analysis

Aspect	Description	Implication for PTBA
Key Competitors	<ul style="list-style-type: none"> ▪ PLN (co-firing at 36 PLTUs) ▪ IPPs (e.g., PJB Services, Indonesia Power) ▪ Exporters to Japan & Korea 	Competing for same biomass sources; some players more integrated and agile.
Biomass Demand (Domestic)	<ul style="list-style-type: none"> ▪ PLN's co-firing reached 680,000 tons in 2022 across multiple PLTUs (IESR 2023) ▪ Targeted co-firing ratio: 5–10% 	High domestic competition for feedstock; PTBA must secure reliable long-term supply contracts.
Biomass Export Market	<ul style="list-style-type: none"> ▪ Indonesia exported 1.2 million tons of wood pellets in 2022 (Gaikindo/APROBI) ▪ Export price: USD 100–130/ton, higher than domestic rates 	Exporters draw supply away from domestic users like PTBA due to higher prices; threatens supply availability.
Competitor Advantage	<ul style="list-style-type: none"> ▪ PJB & Indonesia Power use vertically integrated models: energy plantations and digital traceability 	PTBA risks falling behind in supply chain control and sustainability transparency if not upgraded.

	<ul style="list-style-type: none"> ▪ Technology adoption: IoT, ESG-based logistics 	
PTBA's Strategic Position	<ul style="list-style-type: none"> ▪ Owns mine mouth PLTU ▪ Has access to reclaimed land for energy crops ▪ Strong SOE support and ESG framework 	Unique advantages if leveraged with integrated upstream-downstream strategy.
PTBA's Current Gaps	<ul style="list-style-type: none"> ▪ No specialized biomass unit ▪ Weak supplier integration ▪ Digital traceability system not yet developed 	Operational and reputational risks in biomass quality, volume consistency, and ESG compliance.
Opportunity for PTBA	<ul style="list-style-type: none"> ▪ Lead in ESG-compliant local biomass ecosystem ▪ Establish cooperatives, develop plantations, and build own pellet plant ▪ Utilize fiscal incentives (PMK 130/2020) 	Potential to secure long-term supply, reduce cost volatility, and become a benchmark for sustainable co-firing.

IV.2. Internal Analysis

Internal analysis to be performed in this final project is McKinsey 7S frameworks analysis and VRIO analysis. It is performed to see the strengths and weaknesses emerging from this environment within the organization. The analysis is one of the considerations given in developing the wanted strategy.

IV.2.1. McKinsey 7S Frameworks Analysis

- **Strategy**

PTBA's main strategy is to back the 2060 Net Zero Emission target and 23% renewable energy proportion by 2025 through the introduction of biomass co-firing. In the 2024-2029 RJPP, PTBA has committed to reducing carbon emissions in its operational activities. One of the efforts to reduce emissions is through a co-firing program for 3x10 MW power plants. Need to creating regional biomass value

chains (energy crops, PKS, agricultural residues), vertical integration, and carbon market participation through SRN-PPI.

- **Structure**

PTBA's company structure consists of the Board of Directors, Board of Commissioners, and several divisions that support the company's operations. To support the establishment of biomass co-firing, PTBA established a special department whose responsibility is to develop new and renewable energy (EBT) that comprises a department to handle biomass supply chain development and co-firing projects. PTBA has a comparatively complicated, but stable, SOE corporate organizational structure with clear divisions in energy, sustainability and business development. For co-firing, there must be a cross-functional task force (production, ESG, logistics, finance) and a special task force to focus on the biomass supply chain such that integration from upstream to downstream can function optimally.

- **Systems**

PTBA's report system and operational management already include ESG reporting, centralized procurement, and digitalization of finance. The biomass supply chain management system is still immature. It is necessary to design an IoT-based system and digital traceability (blockchain/SRN) for recording supply, quality, and emissions in real-time and authenticated throughout the biomass supply chain. PTBA has implemented Bukit Asam Integrated Management System (SMBA) consisting of: ISO 9001:2015 Quality Management System, ISO 14001:2015 Environmental Management System, ISO 45001:2018 Occupational Safety and Health Management System, ISO 50001:2018 Energy Management System. In addition, PTBA developed CISEA (Corporate Information System and Enterprise Application) applications which support business process digitalization, e.g., supply chain management and reporting modules.

- **Shared Values**

PTBA also possesses strong core corporate values: sustainability, social responsibility and energy efficiency. This is in line with the biomass co-firing

approach based on economic, environmental and social factors. Strengthening the green mindset (sustainability culture) throughout the company will be one of the key elements of the uniform implementation of such a strategy. PTBA is based on sustainability principles, innovation, and social responsibility. Commitment to ESG (Environmental, Social, and Governance) is reflected in a number of company programs, including: Development of renewable energy through biomass co-firing and solar power plant. Corporate Social Responsibility (CSR) activities regarding community development and environmental protection. Compliance with Good Mining Practices and environmental regulations.

- **Style**

PTBA is top-down in leadership but progressive in adopting the energy transition agenda. Leadership that is transformative is required in speedup co-firing through project units capable of inspiring cross-divisional and external alliances (farmers, cooperatives, regulators). PTBA's leadership is transformational with priorities in innovation and adaptation to change. PTBA's management fosters cross-divisional working and involvement of external stakeholders to achieve strategic aims, including the deployment of biomass co-firing.

- **Staff**

PTBA also has qualified operational and technical human resources in electricity and mining. Reskilling needs to be done, though, to assist the creation of new biomass and supply chains in fields like agribusiness, waste, biomass logistics, and carbon accounting. To accelerate this process of transition, interaction with universities, NGOs and green consultants can be facilitated. PTBA also has competent human resources in mining and energy. To facilitate the transition to the utilization of renewable energy, the company embarks on: Capacity building and staff training in biomass technology and supply chain management. Staff recruitment of professionals in renewable energy and sustainability. Collaboration with institutions of learning and research to build employee capability.

- **Skills**

PTBA has skilled technical and operating human resources for mining and electricity. Nevertheless, it needs to be reskilled to build new biomass and supply chains, most importantly in agribusiness, waste, biomass logistics, and carbon accounting. It is able to accelerate this process of adjustment by collaboration with universities, NGOs and green consultants. PTBA has competent human resources in mining and energy. To facilitate the transition to renewable energy, the company undertakes: Staff training and capacity development in biomass technology and supply chain management. Recruitment of specialist personnel in the field of renewable energy and sustainability. Collaboration with institutions of learning and research to develop staff capabilities. The fundamental skills of PTBA are now available in mine operation, Power Plants, and mega-project management. To ensure biomass co-firing is successful, new competency such as community partnership management (cooperatives, BUMDes), pelleting/torrefaction technology, and emissions data management will be essential. Extensive technical training and cross-sectoral learning are necessary. PTBA is developing new competencies under the energy transition strategy, including: Co-firing and biomass processing technology mastery. Complex biomass supply chain management mastery. Reporting and verification of carbon emissions skills for access to the carbon market.

Table 4 Summary of McKinsey 7S Framework

7S Component	Key Points	Outcome
Strategy	Biomass co-firing strategy aligned with NZE 2060, RUPTL, and national renewable policy	Strength
Structure	The organizational structure supports cross-functional projects, but there is no dedicated biomass supply chain unit.	Weakness
System	CISEA, ISO 50001, and SMBA exist as the basis for ESG digitization and reporting, but biomass supply chain integration is not optimal.	Weakness
Shared Value	Culture of sustainability and social responsibility embedded at management level and CSR strategy	Strength
Style	Transformational leadership that is adaptive to the energy transition, driving innovation	Strength
Staff	Strong human capital in the mining sector, but little experience in renewable energy and agribusiness supply chains Transformational	Weakness

	leadership adaptive to energy transition, driving innovation	
Skills	Power Plants 's technical capabilities are strong; new skills in biomass and carbon are still under development.	Weakness

IV.2.2. VRIO Analysis (Resources Analysis)

There are some resources that become sustainable competitive advantage, but there are also some that become temporary competitive advantage, this is because not only PTBA can do or have these resources. There are two type of resources are tangibles and intangibles. Nevertheless, all advantages can be utilized to make strategies in the short, medium and long term.

Table 5 Tangible Resources and VRIO

No	Resources	V	R	I	O	Com In
1.	Interconnected infrastructure from Mine to Mine Mouth Power Plant (owned)	V	V	V	V	SCA. A highly valuable asset that is very difficult for other companies to duplicate.
2.	Pre / post land mining access	V	V	X	V	SCA. Strategic and rare asset; can be utilized for energy plantations. Long-term source of excellence. but can still be copied by competitors.
3.	Mine mouth power plant	V	V	X	V	UCA. Improves cost efficiency; but can still be copied by competitors.
4.	Operational equipment	V	X	X	V	CPA. Not rare and can still be copied by competitors.
5.	Potential for internal biomass unit development facilities	V	V	V	X	TCA. There isn't special organization for responsible of co firing and biomass.

Table 6 Intangible Resources and VRIO

No	Resources	V	R	I	O	Com In
1.	PTBA's status as a state-owned enterprise	V	V	X	V	UCA. Access to government regulation and support; can be used for policy negotiation and influence.
2.	Reputation and commitment to ESG	V	V	X	V	UCA. It is important to gain market trust and green funding; but it is replicable in the long run

3.	Relationship with stakeholder	V	V	X	V	UCA. High-value strategic relationships; not necessarily exclusive if not managed sustainably.
4.	Environment and Quality Management System	V	X	X	V	CPA. Important for certification and sustainability audits; need to improve digitization
5.	Capabilities of biomass and co firing	X	X	X	X	CD. Currently an internal weakness; capacity building needs to be prioritized.

The main advantage of PTBA is that it has complete infrastructure from upstream to downstream. This is very necessary in the cofiring process, of course this makes PTBA difficult to compete with or imitate by its competitors.

IV.2.3. Value-Chain Activity

Value Chain Activity Analysis is a strategic tool used to examine the internal activities of an organization in order to identify which activities create value for customers and which do not. The concept was introduced by Michael E. Porter. It helps companies break down their operations into primary and support activities, so they can understand how value is added at each stage—and ultimately identify sources of cost advantage, differentiation, or areas for improvement.

Table 7 Primary Activities

No	Activities	Assessment
1.	Inbound Logistics	Still dependent on informal biomass suppliers; lacks storage and preprocessing centers
2.	Operations	PLTU supports co-firing technically; initial tests and trials completed with promising results.
3.	Outbound Logistics	Not applicable (biomass is for internal use); but traceability system for volume and quality is still lacking.
4.	Marketing & Sales	Not a focus area unless biomass is commercialized; but branding for ESG impact could be improved.
5.	Service	Supplier development is weak; no structured training or long-term contracts with biomass providers.

Table 8 Support Activities

No	Activities	Assessment
1.	Firm Infrastructure	PTBA has a strong governance structure and is well-organized under SOE management.
2.	HR Management	Lacks specialized expertise in biomass supply chain; talent development in renewable energy needed.
3.	Technology Development	Digital system for traceability/logistics not yet deployed; opportunity for innovation.
4.	Procurement	Still fragmented; no structured procurement model for long-term biomass contracts.

IV.3. SWOT Analysis

IV.3.1. Strength

IV.3.1.1. PTBA's status as a state-owned enterprise

PT Bukit Asam's (PTBA) state character and being held by the MIND ID is amongst its most significant strategic benefits in the use of biomass co-firing, especially for the A3x10 MW Banko Barat Power Plants because of the direct access it provides to the policies for national energy transition, PLN's electricity grid, as well as the government incentives that are not driven by private interests. There, PTBA is required to contribute to 23% renewable energy composition by 2025 and Net Zero Emission (NZE) by 2060 targets as stipulated in Presidential Regulation No. 112 of 2022 and Indonesia's Enhanced NDC document (2022). In addition, as a peer SOE, PTBA's integration with PLN-which in the 2021-2030 RUPTL targets application of co-firing to 52 Power Plants -reinforces PTBA as a strategic biomass provider with captive market and guarantee of electricity distribution. These advantages also allow PTBA to acquire some financial incentives such as 100% tax exemption for the next 20 years and financing facilities offered by the Environmental Fund Management Agency (BPD LH) in accordance with PMK No. 130/2020. This institutional support is evident in the commissioning of PTBA's wood pellet pilot plant in Tanjung Enim and preparing a Sustainability Report according to GRI standards and POJK No. 51/POJK.03/2017 signaling PTBA's readiness in fulfilling ESG requirements as well as participation in the national carbon market (SRN-PPI). With policy, institutional arrangements, and public legitimacy blend, the SOE

designation puts PTBA at the forefront of biomass-based energy transformation in Indonesia.

IV.3.1.2. Existing power plant infrastructure and pre/post mining land access

PT Bukit Asam (PTBA) strengths in the biomass co-firing method are its property and management of existing Power Plants capacities - notably the 3x10 MW Banko Barat Power Plants - that are technologically feasible to be upgraded with co-firing technology, and direct availability of spacious pre/post-mining land spaces that can be seeded with a proper source of biomass feedstock such as calliandra, gamal, or mixed agricultural waste. These advantages allow PTBA to implement a vertical integration approach from the upstream (production of feedstock) through the downstream (electricity production) and reduce dependency on third parties, decrease the cost of logistics and supply volatility.

PTBA has set up a pilot program of red calliandra cultivation on reclaimed land of ±80 hectares in Tanjung Enim as a concrete step towards establishing a sustainable and local biomass source. The existing Power Plants plant itself can be retrofitted to co-fire relatively with relatively low retrofit capital cost compared to building a new power plant and is part of the national decarbonization program by PLN as planned in the 2021–2030 RUPTL. The combination of power plant and land availability places PTBA in an advantageous position to build a biomass supply chain in an integrated, efficient, and sustainable manner.



Figure IV. 4 Soft Launching of Reclamation Another Form

IV.3.1.3. ISO 50001/14001 certification & ESG reporting system

This system allows PTBA to transparently monitor and report energy consumption, GHG emissions, new and renewable energy use, and social and environmental impacts of its Power Plants and supply chain, including biomass co-firing. This advantage not only builds the company's reputation with society and the regulators, but also is an essential prerequisite to access the national carbon market through the National Climate Change Control Registry System (SRN-PPI) and the international voluntary carbon market. In addition, ESG reporting under the GRI (Global Reporting Initiative) standard that has been adopted by PTBA as part of complying with POJK No. 51/POJK.03/2017 makes the company more competitive and credible in the eyes of green financing-driven investors. The implementation of the ESG system and certification also supports the implementation of sustainable governance practices in the development of biomass supply chains, such as tracing raw material sources, managing waste, and complying with the zero deforestation policy. With this systemic framework, PTBA is more prepared organizationally to implement a co-firing policy in responsible and environmentally audited terms.

IV.3.1.4. Biomass wood pellet production pilot plant facility

Availability of a pilot plant unit for the production of biomass wood pellets in Tanjung Enim, a proof of technology readiness and a concrete step towards self-sufficiency in the production of raw materials for the Power Plants co-firing program. This facility has an initial 200 kg-per-hour capacity and utilizes raw materials from the cultivation of energy crops such as red Calliandra cultivated on the company's old mine land. The existence of this pilot plant not only acts as a platform for an increased scale of production, but also as a hub of training for pelleting technology, drying of biomass, and trial of the quality of solid fuel through technical standards.

This also consolidates PTBA's position in the country's biomass value chain because it has in-house upstream production control, while opening up prospects for commercialization of wood pellet products to domestic and export markets, especially to Japan and South Korea that are increasing demand for biomass for

feed-in tariff (FIT) based Power Plants. Apart from that, this pilot plant showcases PTBA's dedication to supporting the national decarbonization plan and further building regulators', industry partner's, and green finance institutions' confidence. In proving the technical and financial feasibility of small-scale, PTBA is in a stronger position to recommend scaling up production via a successful business model. The company's culture of sustainability and transformational leadership are the drivers responsible for accelerating the energy transition plan, such as biomass co-firing at the Banko Barat Power Plants.



Figure IV. 5 Pilot Plant Wood Pellet from Red Calliandra

IV.3.1.5. Sustainability culture and transformational leadership style

PTBA's commitment to sustainability is found in its vision as a global-class energy and chemical company concerned about the environment in the long term, as well as in ESG governance practices through yearly reporting in GRI standards and POJK No. 51/POJK.03/2017 regulations. It is reported in the 2022 Sustainability Report by PTBA that 25% of the CSR budget was allocated to empowerment programs for the community aligned with the environment and fresh renewable

sources, including energy farmer training programs in Tanjung Enim and raw materials for biomass from agricultural waste (PTBA, 2022). Transformational leadership approach is also reflected in cross-division involvement in the pilot exercise of the biomass plant and forward-looking collaboration with universities, local governments, and local cooperatives in the achievement of a closed-loop biomass supply chain. Mutual values that are pro-environment and visionary style of leadership are two of the most important determinants in closing the consistency of strategic transformation direction in the McKinsey 7S Framework. With a culture of organizational operation that encourages green innovation and multi-stakeholder engagement proactively, PTBA has a strong value system and leadership style to effectively contribute to the national energy decarbonization initiative.

IV.3.2. Weaknesses

IV.3.2.1. Dependence on informal and seasonal suppliers

Significant dependency on non-standardized, ad-hoc biomass suppliers, especially during the initial phases of establishing the biomass supply chain for the Banko Barat Power Plants co-firing program. More than 60% of Indonesia's biomass supply is provided by small operators such as farmers, village cooperatives, and micro-enterprises that do not yet have a quality control system, logistics, and fixed contracts with large consumers such as Power Plants, based on the IESR report (2023). The biomass offered by this small-scale supply is characterized by high water content fluctuations (more than 30%), irregular particle size, and calorific value below the co-firing minimum standard of 15 MJ/kg, thus posing increased technical risk to the power plant operations' efficiency and security. Dependence on this informal supply chain leads to price instability due to the absence of a standard price mechanism and the dominance of seasonal markets—e.g., availability of rice husks is lower during the dry season or crop losses. This is aggravated by the absence of an integrated national biomass market system and no enforcement of requirements for certification such as SNI 8021-2014 in totality. Its vulnerable and unstable supply infrastructure, PTBA is deeply concerned about how the continuity and quality of fuel supply can be maintained to ensure secure and economic co-firing operation.

IV.3.2.2. Limited human resources and expertise in the biomass sector (wood pellets / co firing)

Because PTBA is a firm with experience in the key competences of coal mining business, most of its human resources up to date have been focused on coal mining business, coal supply chain, and conventional Power Plants management, technical competences such as pelleting technology, torrefaction, biomass water content management, and carbon emission management from biomass are still extremely low. The training carried out continues to be dominated by occupational safety, finance, and mine administration aspects, according to PTBA's 2022 Sustainability Report; while training in renewable energy has only started in 2021 and represents <10% of the total annual training hours. This indicates an internal capability shortfall in addressing the technical problems of the biomass supply chain, such as fuel quality specifications, low-emission combustion technology (low-NOx burners), and carbon reporting systems such as SRN-PPI. In addition, the IESR report (2023) also highlights that the operators of most of the Power Plants in Indonesia are still not very familiar with the characteristics of biomass fuels and their impact on the efficiency of the power plant, i.e., the threat of fouling and corrosion. Without an institutional reskilling and capacity building program, this gap could postpone the technical and economic success of the co-firing project of PTBA's Power Plants units.

IV.3.2.3. The absence of digitalization of the biomass supply chain

The absence of a digital supply system chain has resulted in inadequate tracking of raw material origin, biomass quality, supply volume, and failure to report carbon in real-time. Though PTBA has developed an in-house system using the CISEA (Corporate Information System and Enterprise Application) application for operation monitoring, the latter is still an asset and mining management system lacking a specific digital module for IoT-based biomass logistics, quality sensors, or blockchain-based traceability as required by the national registry system (SRN-PPI) or the international carbon market. According to the World Economic Forum (2023), digitalization of the bioenergy value chain can improve efficiency by 25%

and logistics losses by 15% through the use of humidity sensors, GPS, and quality assurance systems. Such a lack of integration gives PTBA a challenge in ensuring transparency in the biomass supply chain, especially in cases where raw material is being sourced from local cooperatives or dispersed agricultural communities

IV.3.2.4. The scale of biomass production and supply is still very limited

PTBA's biomass production capability is still very limited and has not been capable of meeting the whole operational needs of co-firing, both for domestic Power Plants and for prospective PLN business expansion and exports. To date, 2023, PTBA Tanjung Enim wood pellet pilot plant only has an output of 200 kg/hour or about 1,600 tons/year if in full operation—far less than the optimum capacity for a 3×10 MW Power Plants that can operate at up to 20,000–30,000 tons of biomass per year with 10% co-firing. Nationally, data from IESR (2023) indicates that Indonesia's capacity for biomass production remains less than 1 million tons annually, whereas co-firing requirements of PLN in 52 Power Plants total 8 million tons/year (RUPTL 2021–2030). This gap in scale necessitates that PTBA depend on outside supplies from the illegal market or other regions, increasing the level of risk and uncertainty of costs. Without investment in mass industrial development and integrated production infrastructure (like biomass hubs), PTBA will not be able to meet stable demand and long-term co-firing technical requirements

IV.3.2.5. The organizational structure has not yet formed a special operational unit for biomass

The second weakness is the absence of a specialized structural unit in the PTBA organization tasked with overseeing end-to-end biomass supply chain management, from upstream (raw material production), midstream (processing & logistics), to downstream (combustion & emission reporting). The current PTBA organizational structure is still dominated by coal business units and mines, with new and renewable energy (EBT) development still within the business development work unit or other work areas. This leads to decision-making, HR deployment, and biomass performance monitoring not being most-coordinated. Among the prerequisites for a successful transition towards renewable energy for a company,

according to McKinsey (2022), is setting up a clean energy unit that is specialized with cross-functional authorities and an independent budget structure. Without the establishment of a "PTBA Bioenergy" department or, at a minimum, a cross-director working group, the biomass co-firing project can become an add-on project, not integrated, and slow to respond to market forces and national energy policies.

IV.3.3. Opportunities

IV.3.3.1. Increasing Domestic Biomass Demand

The key opportunity for PTBA is growing demand for local biomass as a blended fuel (co-firing) in PLN's national decarbonization plan, which officially includes the adoption of co-firing in 52 Power Plants units with a total biomass demand of 8 million tons annually by 2025. This is mentioned in the 2021-2030 Electricity Supply Business Plan (RUPTL) document, which is also called the greenest RUPTL in history because for the first time biomass has been incorporated as a major component of the national energy mix. With a 3×10 MW capacity Banko Barat Power Plants and with 10% co-firing potential, PTBA has a very good chance to become both an internal source of biomass and a strategic partner of PLN in South Sumatra, a province that has significant biomass potential in the form of agricultural and forestry residues. This co-firing program is also upheld by the Ministry of Energy and Mineral Resources through the Directorate General of EBTKE in the context of the acceleration of Net Zero Emission (NZE) 2060.

IV.3.3.2. Global Biomass Export Market Growth

Demand for biomass, especially in the PKS and wood pellet forms, has increased by leaps and bounds all over the globe, especially from Japan, South Korea, and EU countries, which are pursuing aggressively clean energy targets through Feed-in Tariff (FIT) programs and Renewable Portfolio Standard (RPS) schemes. Japan, for example, targets biomass consumption at 10 million tons annually by 2030, and South Korea is promoting more imports with long-term agreements. The export price of Indonesian wood pellets to Japan ranges from USD 120–160/ton, much greater than the domestic market price (±USD 70–90/ton), according to JETRO

statistics (2024). This provides an enormous opportunity for PTBA to export surpluses of biomass production—especially from the wood pellet plant business venture in Tanjung Enim—with higher economic value, in addition to growing the company's green portfolio in the international market.

IV.3.3.3. Fiscal Support and Green Finance from Governments and Global Partners

Yet another significant opportunity lies in the diversification of fiscal incentives and green funding schemes by the Indonesian government as an effort to drive investment into the new and renewable energy (EBT) industry, and also into biomass schemes. With Minister of Finance Regulation (PMK) No. 130 of 2020, the government provides incentives for the reduction of Corporate Income Tax for 5–20 years up to 100% depending on the value of investment, VAT incentives underwritten by the government, super deduction tax for EBT research & work training, and the streamlining of licenses through OSS-RBA. Additionally, the government has put forward the Green Fund Indonesia program through BPD LH (Environmental Fund Management Agency) providing grants, soft loans, and blended finance programs for green projects. PTBA as a strategic BUMN enjoys the advantage of being the priority beneficiary of such incentives as part of the national energy transition program.

IV.3.3.4. The Great Potential of Local Biomass from Agricultural and Forestry Waste

Indonesia has a vast and untapped local biomass potential from energy crops of marginal land, agricultural waste, and forest residues. The Ministry of Energy and Mineral Resources statistics (2023) show that the national potential of bioenergy in Indonesia is 56.9 GW or millions of tons of biomass materials such as rice husks (± 10 million tons/year), corn cobs, palm oil waste (TKKS, PKS), sawdust, and sawmill waste. South Sumatra where the PTBA Power Plants is situated is among the provinces with the highest biomass potential, due to the synergy between the agriculture, forestry, and mine reclamation land sectors that are available for use as energy plantations. By setting up relationships with farmer cooperatives and

BUMDes, PTBA can build a decentralized biomass supply model that is low-cost, sustainable, and rooted in the local economy.

IV.3.3.5. Market and Investor Demands for ESG Transparency and Carbon Reporting

With increasing world conscience of sustainability, the energy industry is under mounting pressure from regulators, investors, and capital markets to take up transparent ESG reporting and participate in carbon markets both at the domestic level (SRN-PPI) and international level (VCM – Voluntary Carbon Market). PTBA, being a firm that has implemented GRI and ISO 50001 standards in its Sustainability Report, can reinforce its reputation as one of the pacesetters of state-owned firms in carbon transparency and environmentally friendly supply chain management. The existence of facilities such as the National Registry System – Climate Change Control (SRN-PPI) run by the Ministry of Environment and Forestry also facilitates companies to record and sell emission reductions in co-firing plans as carbon credits that can generate additional income and improve green competitiveness. By having strong ESG, PTBA can access low-cost finance from banks based on green lending principles or sustainability-linked loans.

IV.3.4. Threats

IV.3.4.1. Competition for Raw Materials from More Profitable Export Markets

The biggest risk in the development of the biomass supply chain is the competition of local raw materials with overseas markets, which offer higher prices and foreign currency-based payments, especially for countries such as Japan, South Korea, and Europe. Indonesian biomass commodities like palm kernel shell (PKS) and Indonesian wood pellets are sold for export purposes at USD 120–160 per ton, whereas the domestic market purchases it only for approximately USD 70–90 per ton (JETRO, 2024). This compels the majority of the local suppliers to find it more favorable to export their commodities abroad, leading to a shortage of raw materials for domestic co-firing initiatives, e.g., the Banko Barat Power Plants of PTBA. This is backed by the absence of export quota regulations or domestic market obligations

(DMO) for biomass, the same as with coal. Without intervention policies, the risk of regional shortages of supply will also increase with increasing global demand for low-emission biomass.

IV.3.4.2. Fluctuations in Supply and Quality of Materials

The second risk is the high volatility of quality and quantity of biomass supply, largely conditional on harvesting season, rainfall, and non-standard processing by small suppliers. Agricultural waste biomass such as rice husks, corn cobs, and sawdust have very changeable water content (20–50%) and below SNI 8021–2014 standards (≥ 15 MJ/kg) at times for calorific value, contributing to technical problems such as reduced boiler efficiency, fouling, and corrosion in the combustion system. PTBA, which still relies on material feeds from cooperatives or farmers without a standardized drying process, is susceptible to reducing co-firing performance and potential operating losses. IESR (2023) has reported that less than 30% of Power Plants in Indonesia are able to maintain technical stability of co-firing because raw material quality is not standardized.

IV.3.4.3. Threat of Substitution by Other Renewable Energy Technologies

In the long and medium term, PTBA's biomass co-firing strategy stands in serious risk of being overtaken by other renewable energy sources such as PLTS (Solar Power Plants), Refuse-Derived Fuel (RDF), and green hydrogen, which are now growing fiercely in Indonesia. IRENA statistics (2023) show the cost of electricity produced with utility-scale PLTS in Indonesia has reduced to USD 0.058/kWh, which is cheaper in the long term compared to Power Plants and co-firing. Besides that, RDF is already implemented in Power Plants Jeranjang and Suralaya and has received widespread support from local governments regarding waste management. As a matter of fact, PLN and Pertamina green hydrogen pilot project is the first stage of new technology competition for the power sector. If PTBA does not accelerate the development of the efficiency and economics of biomass co-firing, it will be replaced by cleaner energy alternatives that are technically and economically more attractive

IV.3.4.4. Socials and Ecological Risks

Extensive biomass growth, if not regulated by principles of sustainability, has the potential to result in harsh environmental and social impacts such as the alteration of food land into energy land, forestry, and tenurial conflicts with local farmers or indigenous communities. The GIZ report (2022) puts the estimate that if biomass is targeted as a major energy source without rigorous sustainability criteria, Southeast Asia may lose over 300,000 hectares of forest within the next decade. In Indonesia, some of the co-firing initiatives have been slammed for the sourcing of raw materials from conservation-sensitive forests or without community agreement (FPIC - Free, Prior, Informed Consent). If PTBA does not delineate clear biomass zoning and implement an ESG-oriented environmental audit system, this project can damage the company's reputation, slow down licensing, and even trigger social protests.

IV.3.4.5. Regulatory Inconsistency and Uncertainty of Government Incentives

PTBA is also exposed to risks from regulatory inconsistency and unclear fiscal incentives, which can deter long-term profitability for biomass projects. Even though PMK No. 130/2020 offers tax advantages for the renewable energy sector, there is no long-term assurance concerning the duration, evaluation mechanism, or biomass price subsidy program for co-firing schemes. In addition to that, there are no rules for certain feed-in tariff or premium pricing on Power Plants with the implementation of co-firing, making it difficult for operators such as PTBA to determine with certainty the economic viability of the project. Different cancellations of clean energy projects by PLN in recent years due to policy changes underscore the fact that regulatory and policy risks remain high in the Indonesian energy sector. Uncertainty can discourage investment commitments and make biomass projects difficult to compete with fossil fuel and other renewable energy.

Table 9 Matrix SWOT

Strengths	Weakness
<ul style="list-style-type: none"> • PTBA's status as a state-owned enterprise • Existing Power Plants infrastructure and pre/post-mining land access • ISO 50001/14001 certification & ESG reporting system • Biomass wood pellet production pilot plant facility • Sustainability culture and transformational leadership style 	<ul style="list-style-type: none"> • Dependence on informal and seasonal suppliers • Limited human resources and expertise in the field (woodpellet/cofiring) • Lack of digitalization of biomass supply chain • The scale of biomass production and supply is still small • The organizational structure has not formed a special operational unit for biomass
Opportunities	Threats
<ul style="list-style-type: none"> • Growing Domestic Biomass Demand • Global Biomass Export Market Growth • Fiscal Support and Green Finance from Governments and Global Partners • Huge Potential of Local Biomass from Agricultural and Forestry Waste • Market and Investor Demands for ESG Transparency and Carbon Reporting 	<ul style="list-style-type: none"> • Raw Material Competition from Export Markets • Fluctuations in Supply and Quality of Materials • Threat of Substitution by Other Renewable Energy Technologies • Social and Ecological Risks • Inconsistent Regulations and Uncertainty of Government Incentives

IV.4. TOWS Analysis

TOWS analysis is a strategic planning tool developed by Heinz Wehrich in the early 1980s as an extension of SWOT analysis. Unlike SWOT which focuses on identifying internal (Strengths and Weaknesses) and external (Opportunities and Threats) factors, TOWS Matrix emphasizes strategy formulation based on the relationship between the four elements. In other words, if SWOT is a diagnostic tool, then TOWS is a strategic therapy tool.

TOWS is used to develop four main types of strategies:

- SO (Strengths – Opportunities): Using internal strengths to take advantage of external opportunities.
- WO (Weaknesses – Opportunities): Overcoming internal weaknesses by taking advantage of external opportunities.
- ST (Strengths – Threats): Using internal strengths to reduce the impact or deal with external threats.
- WT (Weaknesses – Threats): Minimizing weaknesses and avoiding external threats.

IV.4.1. S/O Strategies (Maxi–Maxi)

- Using state-owned company status and PLN access to obtain fiscal incentives PMK 130/2020 and green financing from BPD LH/Green Fund. (S1,O3)
- Develop pre/post-mining land into energy plantations (eg: kaliandra) to meet internal and external needs. (S2,O2)
- Integrate PTBA's ESG system into SRN-PPI for carbon monetization and biomass supply chain transparency. (SO3,O5)
- Increase the capacity of wood pellet plants from pilot to industrial, to meet internal and external needs. (SO4,O1)

IV.4.2. S/T Strategies (Maxi- Mini)

- Encourage national Biomass DMO policy so that local producers do not only export (coordination between BUMN). (S1,T1)
- Using existing Power Plants infrastructure as a technology buffer against varied and fluctuating raw materials. (S2,T2)
- Implementing ESG screening of biomass provider partners to avoid deforestation and land conflicts. (S3,T4)
- Positioning co-firing as a cheap transition solution compared to PLTS & RDF, strengthen LCA (lifecycle analysis) studies. (S4,T3)
- Using BUMN networks to encourage harmonization of co-firing regulations and EBT incentives. (S5,T5)

IV.4.3. W/O Strategies (Mini-Maxi)

- Establishing a farmer biomass cooperative and SNI 8021–2014 training with CSR funds or Green Fund grants. (W1,O3,O4)
- Conducting HR training (internal & external) in biomass technology through partnerships with experts in the field. (W2,O3)
- Building an IoT-based digital traceability system for supply quality verification and carbon reporting to SRN. (W3,O5)
- Increasing wood pellet capacity through a Public Private Partnership (PPP) scheme and green financing. (W4,O1)
- Establishing a “PTBA Bioenergi” division specifically for cross-functional and regional biomass supply chain management. (W5,O2)

IV.4.4. WT Strategies (Mini-Mini)

- Diversification of suppliers and long-term contract systems and quality grading to prevent supply only to exports. (W1,T1)
- Training of human resources in alternative transition technologies (PLTS, hydrogen, RDF) for medium-term flexibility. (W2,T3)
- Implementing a logistics dashboard based on real-time humidity and temperature sensors for raw materials. (W3,T2)
- Conducting periodic environmental audits and a moratorium on the use of food land for energy crops. (W4,T4)

IV.5. Strategy Selection

The Eisenhower Matrix, also known as the Urgent-Important Matrix, is a strategic decision-making instrument used to guide individuals or groups to choose between decisions and actions by the two primary axes of urgency and importance. The matrix was named after the leadership philosophy of the 34th President of the United States, Dwight D. Eisenhower, who is most famous for his time management strategy and prioritization.

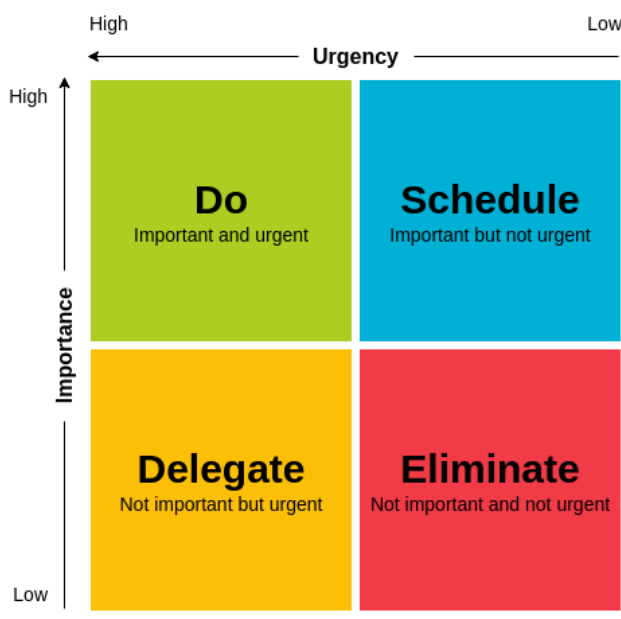


Figure IV. 6 Eisenhower Matrix

Under strategy selection, the Eisenhower Matrix is used to classify and decide on which strategies must be:

- Implemented immediately (**Do**) – those that are urgent and important
- Planned (**Schedule**) – the things that are important but not urgent
- Delegated (**Delegate**) – strategies that are urgent but less important,
- Avoided or postponed (**Eliminate**) – strategies that are not important and not urgent

In this thesis, prioritization is done by conducting discussions with experts and resource persons. Based on the experience and knowledge of the experts, it can help in prioritizing strategies. There are several factors that are considered in prioritizing strategies, including the suitability of the strategy to the company's vision and mission, contribution to the biomass cofiring target, availability of human resources and budget, and the level of risk that may occur.

By considering these factors, the strategy created is a strategy that can be implemented. The strategy needs to be added with a risk analysis to be able to see what potentials can support or hinder its implementation. Risks that can hinder must

be mitigated immediately, so that what has been planned can be implemented. Ensure that the divisions that will implement this strategy know and understand what they have to do. Then it is necessary to prepare and approve the budget, however, sometimes the budget approved by Management is not as large as proposed, this sometimes makes the planned strategy adjusted to keep it running and achieve its goals.

Table 10 Strategy for Eisenhower Matrix

Do		Schedule	
SO1	Using state-owned company status and PLN access to obtain fiscal incentives PMK 130/2023 and green financing from BPDH/Green Fund	SO4	Increase the capacity of wood pellet plants from pilot to industrial, to meet internal and external needs. (SO4,O1)
WO1	Establishing a farmer biomass cooperative and SNI 8021–2014 training with CSR funds or Green Fund grants. (W1,O3,O4)	WO4	Increasing wood pellet capacity through a Public Private Partnership (PPP) scheme and green financing. (W4,O1)
WT1	Diversification of suppliers and long-term contract systems and quality grading to prevent supply only to exports. (W1,T1)	WO2	Increasing wood pellet capacity through a Public Private Partnership (PPP) scheme and green financing. (W4,O1)
SO2	Develop pre/post-mining land into energy plantations (eg: kaliandra) to meet internal and external needs. (S2,O2)	WT2	Training of human resources in alternative transition technologies (PLTS, hydrogen, RDF) for medium-term flexibility. (W2,T3)
ST2	Using existing PLTU infrastructure as a technology buffer against varied and fluctuating raw materials.	ST1	Encourage national Biomass DMO policy so that local producers do not only export (coordination between BUMN). (S1,T1)
		WO5	Establishing a “PTBA Bioenergy” division specifically for cross-functional and regional biomass supply chain management. (W5,O2)
Delegate		Eliminate	
WO3	Building an IoT-based digital traceability system for supply quality verification and carbon reporting to SRN. (W3,O5)	WT4	Conducting periodic environmental audits and a moratorium on the use of food land for energy crops. (W4,T4)
SO3	Integrate PTBA's ESG system into SRN-PPI for carbon monetization and biomass supply chain transparency. (SO3,O5)	ST4	Positioning co-firing as a cheap transition solution compared to PLTS & RDF, strengthen LCA (lifecyle analysis) studies. (S4,T3)
ST5	Using BUMN networks to encourage harmonization of co-firing regulations and EBT incentives. (S5,T5)	ST3	Implementing ESG screening of biomass provider partners to avoid deforestation and land conflicts. (S3,T4)
WT3	Implementing a logistics dashboard based on real-time humidity and temperature sensors for raw materials. (W3,T2)		

IV.6. Business Solution

IV.6.1. Using state-owned company status and PLN access to obtain fiscal incentives PMK 130/2020 and green financing from BPD LH/Green Fund

Key Point:

- PTBA's status as a BUMN provides superior access to fiscal facilities.
- Tax incentives (0–100% reduction), VAT DTP, and BPD LH soft funds → can support all other strategies.

Business Solutions:

- Need to create a special team tasked with preparing and managing access to PMK No. 130/2020.
- Register biomass projects currently being carried out by PTBA to the BPD LH portal and OJK's Green Taxonomy.
 - Provide funding for the following activities:
 - Biomass plant investment,
 - Development projects related to biomass or green energy o
 - Financing training & technology on biomass.

IV.6.2. Establishing a farmer biomass cooperative and SNI 8021–2014 training with CSR funds or Green Fund grants

Key Point:

- Addressing fundamental weaknesses in the supply chain (W1): unstable, informal, and non-standard supply.
- Great opportunities to utilize the potential of local agricultural waste (O4).
- Strong social support: supporting ESG, CSR, and the local economy.

Business Solutions:

- Build a long-term partnership MoU with 3–5 local farmer cooperatives / BUMDes.
- Conduct technical training based on SNI 8021–2014
- Provide simple tools (sieving tools, solar dome dryers).
- Form an internal quality control unit at PTBA for quality assurance.

IV.6.3. Diversification of suppliers and long-term contract systems and quality grading to prevent supply only to exports

Key Point:

- Without contracts, farmers/suppliers tend to sell to export markets (T1).
- Quality and volume become unpredictable if there is no certainty of supply.

Business Solutions:

- Establish 1–3 year off-take contracts with bonus schemes for best quality.
- Create a grading system: for example Grade A (>15 MJ/kg), Grade B (13–15 MJ/kg).
- Apply differentiated pricing based on quality and continuity of supply.
- Insert ESG clauses (no deforestation, no food land) in the contract.

IV.6.4. Develop pre/post-mining land into energy plantations

Key Point:

- PTBA has extensive pre or post mining reclamation land assets that have not been utilized optimally.
- Energy crops such as red calliandra, lamtoro, and gamal can be cultivated on the land because they are drought-resistant, grow quickly, and have high calorific value.
- The increasing demand for biomass in the export market (Japan & South Korea) opens up long-term business opportunities for PTBA as a producer and user of biomass.
- This strategy strengthens the upstream side of the supply chain, reduces dependence on external farmers, and contributes to decarbonization and productive land reclamation.

Business Solutions:

- Zoning of reclaimed land: Identify and design an energy farm map on PTBA's ex-mining land of 50-100 hectares in the initial stage.
- Plant superior energy crops: Focus on red calliandra and gamal which have high productivity and have been tested in South Sumatra.

- Partnership with KTH (Forest Farmer Group): Involve local communities in planting, maintaining, and harvesting biomass through a profit-sharing scheme.
- Integration with pellet plant facilities: The harvest is sent to PTBA's biomass processing unit (Tanjung Enim wood pellet plant).
- Register with SRN-PPI and carbon verification system: To open up opportunities for the voluntary carbon market (VCM) and generate added value

IV.6.5. Using existing Power Plants infrastructure as a technology buffer against varied and fluctuating raw materials

Key Point:

- Biomass quality from local suppliers varies widely (moisture content, size).
- Fluctuations can cause fouling, high emissions, and boiler damage.

Business Solutions:

- Add light pre-treatment in the Power Plants area (solar dryer, mixer).
- Use storage silos (buffer stock) to stabilize supply.
- Monitor temperature, pressure, and emissions in real time during combustion.
- Retrofit burners gradually to be tolerant of biomass variations.

This implementation plan puts PTBA in a strategic position to ensure the success of the biomass co-firing program at the Banko Barat Power Plants. With a systematic and integrated approach from upstream to downstream, the company not only strengthens energy security and contributes to Net Zero Emission, but also creates real social and environmental value.

IV.7. Risk Analysis

Risk analysis is carried out on the strategy to be implemented. This analysis is expected to reduce the possibility and/or impact that may occur in each strategy. The following is a classification of possibilities, impacts, risk levels, and heat maps used in this study. The classification of possibilities and impacts was obtained from

interviews with informants, while for the risk level and heatmap, it is the classification currently used by the company.

Table 11 Probability Classification

Score	Category	Description
1	Very Rare Happens	Risk is almost non-existent. Probability < 10%
2	Rarely Happen	Risk may occur occasionally. Probability between 10-30%
3	Could Happen	Risk may occur in some cases. Possibility 30-60%
4	Very Likely Happen	The risk is very likely to occur. Probability 60-80%
5	Almost Certain to Happen	The risk is almost certain to occur. Probability > 80%

Table 12 Impact Classification

Score	Category	Description
1	Very Low	Minimal impact, does not impact time, cost, quality, or strategic
2	Low	Minor impact, can be resolved without major disruption
3	Moderate	Disruptions in time or cost, requiring limited adjustments
4	High	Interfering with project success, causing delays or major cost
5	Very High	Critical impact, causing failure of the project or strategic objective.

Table 13 Risk Level

Skala Risiko	Level Risiko
1 - 5	Low
6 - 11	Low to Moderate
12 - 15	Moderate
16 - 19	Moderate to High
20 - 25	High

- Risk Heat Map**

Heatmap is a visualization provided for stakeholders to understand the distribution of risks in terms of likelihood and impact, and assist in prioritization and decision making for mitigation strategies (Hopkin, 2018). The heatmap used in this thesis is adopted from the heatmap used by the company.

Table 14 Heat Map

PROBABILITY	almost certain to happen 5	7 Low to Mod	12 Mod	17 Mod to Low	22 High	25 High
	very likely happen 4	4 Low	9 Low to Mod	14 Mod	19 Mod to Low	24 High
	could happen 3	3 Low	8 Low to Mod	13 Mod	18 Mod to Low	23 High
	rarely happen 2	2 Low	6 Low to Mod	11 Low to Mod	16 Mod to Low	21 High
	very rare happens 1	1 Low	5 Low	10 Low to Mod	15 Mod	20 High
		Very Low 1	Low 2	Moderate 3	High 4	Very High 5
		IMPACT				

Table 15 Risk analysis

DO		RISK	Pro	Imp	LvL	MITIGATION	Pro	Imp	LVL
SO1	Using state-owned company status and PLN access to obtain fiscal incentives PMK 130/2020 and green financing from BPDLH/Green Fund (S1,O3)	Failure to access fiscal incentives (PMK 130/2020) The project did not pass the fiscal incentive verification	3	4	18	Prepare complete documents and consult from the start with DJP/BPDLH	3	3	13
WO1	Establishing a farmer biomass cooperative and SNI 8021–2014 training with CSR funds or Green Fund grants. (W1,O3,O4)	Biomass quality does not comply with technical standards / SNI	3	4	18	Provide SNI 8021-2014 training and distribution of measuring instruments	2	3	8
WT1	Diversification of suppliers and long-term contract systems and quality grading to prevent supply only to exports. (W1,T1)	The supplier refused to do so	3	3	13	Implement incentive pricing and grading-based purchase guarantees	2	2	4
SO2	Develop pre/post-mining land into energy plantations (eg: kaliandra) to meet internal and external needs. (S2,O2)	Community resistance to pre/post-mining land conversion Failure to grow energy crops	3	4	18	Test the soil and select plant varieties that are tolerant to field conditions in the company.	3	2	6
ST2	Using existing Power Plants infrastructure as a technology buffer against varied and fluctuating raw materials. (S2, T2)	Incompatibility of supply with Power Plants capacity Power Plants is not compatible with low quality biomass	2	4	9	Burner modification and discussion of biomass moisture content < 20%	1	3	3

Table 16 Heat map for risk analysis

PROBABILITY	almost certain to happen 5	7	12	17	22	25
	very likely happen 4	4	9 ST ₂	14	19	24
	could happen 3	3 ST ₂	8 WO ₁	13 WT ₁ SO ₁	18 WO ₁ SO ₁ SO ₂	23
	rarely happen 2	2	6 WT ₁	11 SO ₂	16	21
	very rare happens 1	1	5	10	15	20
<div style="display: flex; align-items: center; gap: 10px;"> <div style="border: 1px solid black; border-radius: 50%; width: 20px; height: 20px; background-color: #000080; color: white; display: flex; align-items: center; justify-content: center; font-size: 10px; font-weight: bold;">A</div> Before Mitigation </div> <div style="display: flex; align-items: center; gap: 10px;"> <div style="border: 1px solid black; border-radius: 50%; width: 20px; height: 20px; background-color: #ccccff; color: #000080; display: flex; align-items: center; justify-content: center; font-size: 10px; font-weight: bold;">A</div> After Mitigation </div>		Very Low 1	Low 2	Moderate 3	High 4	Very High 5
		IMPACT				

In the heat map table, it can be seen that there are several decreases in risk levels, all of which are in the moderate to high area moving towards medium. This assumes that mitigation has been successful.

IV.8. Implementation Plan & Justification

This thesis has created implementation plans for the selected strategies. The entire strategy is planned to take about 6 months, with each plan being detailed. These strategies can be implemented simultaneously, but the concern is the human resources. Since there is no special division that handles this, it is important to immediately create an organization or team that can play an active role in this activity. Each strategy will be influenced by technical, institutional, social regulatory, sustainability and integrated parameters. For details of each strategy, see Table 16.

Table 17 Implementation Plan

No	Strategy	Activity	PIC	M1	M2	M3	M4	M5	M6	Cost Est. (Rp)	
SO1	Using state-owned company status and PLN access to obtain fiscal incentives PMK 130/2020 and green financing from BPD LH/Green Fund (S1,O3)	Create special team for preparing and manage PMK 130/2020	PMO And Acc&Budgt Div.	■						Rp 200.000.000,-	
		Identification of biomass projects that meet the criteria of PMK 130/2020 and the BPD LH Green Fund	PMO And Acc&Budgt Div.	■							
		Preparation of submission documents (proposal, feasibility study, environmental documents, work plan and budget) and consult from the start with DJP/BPD LH	PMO And Acc&Budgt Div.	■	■						
		Registration and official submission to DJP (for fiscal incentives) and BPD LH (for green financing)	PMO And Acc&Budgt Div.		■	■					
		The process of clarification, revision and technical negotiation with related ministries/institutions	PMO And Acc&Budgt Div.			■	■				
		Monitoring, reporting, and (if approved) tracking of disbursement of incentives and grant/soft loan funds	PMO And Acc&Budgt Div.				■	■	■		
WO1	Establishing a farmer biomass cooperative and SNI 8021–2014 training with CSR funds or Green Fund grants. (W1,O3,O4)	Identification of potential villages and cooperatives around the PLTU	Tanjung Enim Site	■						Rp 250.000.000,-	
		Preparation and signing of partnership MoU	Tanjung Enim Site & Legal	■	■						
		Biomass quality technical training (based on SNI 8021-2014)	Tanjung Enim Site & HR		■	■					
		Provision of simple tools (weighing tools, sieves, dryers)	Tanjung Enim Site & Procr			■	■				
		Supply quality monitoring and incentives based on grading	Tanjung Enim Site				■	■	■		
WT1	Diversification of suppliers and long-term contract systems and quality grading to prevent supply only to exports. (W1,T1)	Identification and selection of potential suppliers based on location and type of biomass raw materials	Maintenance Div.	■						Rp 100.000.000,-	
		Preparation of biomass quality grading system (water content, size, calorific value) according to SNI 8021-2014	Maintenance Div.	■	■						
		Preparation of long-term contract models (1–3 years) with quality-based incentive schemes	Maintenance Div.		■	■					
		Socialization and contract negotiation with cooperative suppliers and local entrepreneurs	Maintenance Div.		■	■					
		Implementation of grading system and recording of volume and quality at the point of delivery	Maintenance Div.				■	■	■		
SO2	Develop pre/post-mining land into energy plantations (eg: kaliandra) to meet internal and external needs. (S2,O2)	Mapping and zoning of pre/post-mining land suitable for energy plantations	Tanjung Enim Site	■	■					Rp 250.000.000,-	
		Selection of energy plant types (kaliandra, gamal) and preparation of garden design	Tanjung Enim Site		■						
		Procurement of seeds, planting tools, and construction of simple irrigation facilities	Tanjung Enim Site			■	■				
		Initial planting and maintenance of energy crops (±50 ha)	Tanjung Enim Site				■	■			
		Growth monitoring, biomass yield evaluation, and farmer group training	Tanjung Enim Site					■	■		
ST2	Using existing PLTU infrastructure as a technology buffer against varied and fluctuating raw materials. (S2, T2)	Technical Study of Combustion System Adaptation	Maintenance Div.	■	■					Rp 250.000.000,-	
		Construction of Quality Buffer Facilities	Maintenance Div.		■	■					
		Operator Training and Co-Firing SOP	Maintenance Div. & HR			■	■				
		Multi-Quality Operational Trial	Maintenance Div.				■	■			
		Evaluation of Results and SOP Integration	Maintenance Div.					■	■		

IV.8.1. Organization Structure, Performance Management, and Governance

In strategy implementation, please focus on Organizational Structure, Performance Management, and Governance. Please focus, for example, on the community to obtain raw materials for combustion. Please conduct a future analysis to build communities related to raw materials and waste. In addition to the implementation plan that has been made, this thesis also proposes several things that can support the implementation of the business strategy plan well, namely proposals regarding important aspects, such as: Organizational Structure, Performance Management, and Governance, which are specifically directed to support community involvement in the provision of biomass feedstock and waste management in support of co-firing the 3×10 MW mine mouth PLTU owned by PT Bukit Asam (PTBA).

IV.8.1.1. Organizational Structure

To implement a sustainable biomass supply strategy, companies need to design an organizational structure that specifically supports the integration between plant operations and communities as feedstock suppliers. One way to do this is to establish a cross-functional Biomass Working Team, consisting of operational, environmental, CSR, supply chain and procurement divisions. This unit should have a direct line of coordination with the board of directors and be equipped with specialized roles such as field teams for community development, biomass logistics teams, and quality control officers. The structure should also encourage cross-sector collaboration and be flexible to field dynamics, particularly in interacting with cooperatives, farmers and BUMDes.

Table 18 Proposed Structure

Level	Job Description
Executive Sponsor (Board level)	Strategic oversight, budget approval, ESG alignment
Biomass Program Leader	Leads biomass strategy implementation, stakeholder engagement
Supply Chain & Community Development Team	Coordinates with farmers/cooperatives, manages logistics
Technology & Quality Assurance Team	Ensures SNI compliance, tests quality/energy content, and trace the biomass

IV.8.1.2. Performance Management

Performance management should include indicators that are not only technical-operational, but also social and environmental. A Key Performance Indicators (KPI) system needs to be set up to monitor the biomass supply from the community, including quantity (tonnage per month), quality (moisture content, heating value), continuity, and contribution to emission reduction. On the social side, indicators such as the number of partner farmers/cooperatives, number of trainings, and economic value returned to the community should also be measured. All these KPIs will help the company evaluate the effectiveness of the implementation and monitor the impact of the program in a holistic and transparent manner. Performance management should be aligned with both technical and socio-environmental KPIs. Since community-based biomass involves informal and decentralized actors, PTBA must establish inclusive and measurable metrics.

Table 19 Proposed KPI

Category	KPI Example
Supply	Tons of biomass delivered/month from community sources
Quality	% batches meeting moisture and calorific standards
Community Engagement	Number of trained farmers/coops; active MoUs
Cost Efficiency	Average procurement cost/ton vs. coal price
Sustainability	GHG avoided (tCO ₂ /year), % waste-based biomass

IV.8.1.3. Governance

Governance plays a crucial role, especially when dealing with community-based supply chains. For this reason, companies need to develop SOPs (Standard Operating Procedures) on biomass procurement from community partners, fair payment systems, quality standards, and dispute resolution mechanisms. In addition, a digital recording system, for example using an app or QR code, is needed to record the origin of raw materials, their type and quality. Within the framework of participatory governance, the company can establish a Biomass Committee Forum consisting of representatives from PTBA, communities, village

governments and NGOs. This forum will serve as a platform for transparency, social monitoring and shared learning.

IV.8.2. Integrating business strategy and functional initiatives

In order to enable the success of the biomass co-firing approach in the 3×10 MW West Banko mine mouth PLTU, company has to develop an effective key business strategy and at stages make sure that all functional strategies and initiatives are aligned. The most appropriate business strategy to implement in this case is sustainable differentiation. This strategy emphasizes the dominance of company in producing green and clean energy from biomass, and involving local communities as part of equitable supply chains. With this strategy, PTBA can reduce the carbon footprint of its power plants, while providing economic and social dividends for the communities surrounding them.

This business strategy then has to be converted into operational strategies in various sectors. Operationally, PTBA has to install biomass pre-treatment plants close to the PLTU and alter the combustion system in a way that effectively handles the biomass-coal mixture. For supply chain, PTBA needs to have medium- to long-term collaboration with cooperatives, supplier, and/or BUMDes, and implement a digital traceability system in order to ensure biomass supply according to quality standards. Empowerment of the community and CSR are also essential whereby PTBA can arrange training, provide equipment assistance, and train local people to be able to supply biomass feedstock on a sustainable basis. From the ESG and communication perspective, PTBA should actively disclose its contribution to reducing carbon emissions through sustainability reports and public media, and listing the program under the national green financing scheme or green taxonomy. Internal HR development is also necessary in driving all these initiatives, including the creation of cross-functional teams and training technical and field staff in biomass and community.

By aligning the sustainable differentiation strategy with all of the company's functional lines, PTBA not only improves its competitive advantage in the energy

sector, but makes also a contribution toward a true contribution to an inclusive and equitable national energy transition. All projects developed will directly contribute to the main strategic goal: to be an environmentally friendly and socially oriented mining-based energy company.

Chapter V Conclusion and Recommendations

V.1. Conclusion

The Indonesian government has set ambitious targets through NZE 2060 and a 23% renewable energy target by 2025. Policies such as Presidential Regulation No. 112/2022 and PMK No. 130/2020 show strong support for the energy transition. PTBA as a strategic BUMN is in a key position to support this agenda through the development of biomass co-firing at the Banko Barat Power Plants. Based on the analysis conducted, there are several strategies that can be implemented. The following are recommended strategies to ensure the biomass supply chain at the Banko Barat Power Plants.

V.1.1. Using state-owned company status and PLN access to obtain fiscal incentives PMK 130/2020 and green financing from BPD LH/Green Fund

As a state-owned company, PT Bukit Asam (PTBA) possesses relatively less complex access to government policies and government funding. One of them is through PMK No. 130/2020, which provides fiscal benefits in the form of relief of income tax, Government-absorbed VAT (DTP), and import duty exemption for green projects. This strategy is complemented by PLN as the main off-taker of the produced energy, thus improving the project's viability for regulators and financiers. On the other hand, BPD LH (Environmental Fund Management Agency) or Green Fund is a government green fund facility aimed at climate change mitigation projects, including biomass and renewable energy projects. With this strategy, PTBA not only reduces the upfront investment burden through budgetary incentives and cheap finance, but also optimizes equity and accelerates the development of biomass-to-energy projects with better-controlled financial risks.

V.1.2. Establishing a farmer biomass cooperative and SNI 8021–2014 training with CSR funds or Green Fund grants

The Farmer Cooperative Partnership Strategy and Biomass Quality Training are the most important steps for PT Bukit Asam in confronting inherent weaknesses in the biomass supply chain, especially in relation to unstable, unofficial supply that does

not meet technical requirements such as water content, size, and calorific value according to SNI 8021–2014. With this approach, PTBA taps the vast potential of local agricultural waste materials such as rice husks, corn cobs, and straw that have not been fully treated through the involvement of cooperatives and BUMDes as the main source suppliers. Partners are formed through long-term MoUs with 3–5 farmer cooperatives around the Banko Barat Power Plants, which also receive technical training and the provision of simple equipment such as solar dome dryers and digital weight measures. For quality assurance purposes, PTBA should also form an internal quality control unit for sorting biomass and providing timely feedback to partners. This strategy not only ensures quality and supply continuity, but also a socially positive impact by strengthening the village economy and firm's ESG aspects, and offering room for emissions monetization through carbon reporting on a local community basis to the Ministry of Environment and Forestry SRN-PPI platform.

V.I.3. Diversification of suppliers and long-term contract systems and quality grading to prevent supply only to exports

Long-Term Contract Strategy and Supplier Grading System are fundamental ways of creating stable, sustainable, and quality-focused biomass supply chain. In the absence of official contracts, small business operators and farmers will opt for most lucrative markets such as export to Japan and South Korea, thereby rendering domestic supply volatile and uncertain in both quantity and quality (T1). This is a critical risk for Power Plants that require uninterrupted access to quality biomass to secure the efficiency and safety of co-firing operations. PTBA therefore needs to introduce a regime of off-take agreements on a medium term (1–3 years) with cooperatives, BUMDes, and local business actors, complemented by incentives in terms of quality performance. The quality grading of prepared—say, Grade A with calorific content of >15 MJ/kg, Grade B 13–15 MJ/kg—can be the foundation for differential pricing, with price incentives and contract preference being given to the better quality supplies. Apart from ensuring supply continuity, the system also encourages the suppliers to maintain quality and quantity of production. It is also required of PTBA to specify ESG clauses within the contract, such as forbidding

the usage of deforestation material, land use conversion for agricultural purposes prohibition, and reporting sustainability requirement. Apart from providing certainty of supply to PTBA, this also creates a biomass market ecosystem that is competitive, fair, and aligned with the concepts of the sustainable energy transition.

V.1.4. Develop pre/post-mining land into energy plantations to meet internal and external needs

The Pre/Post Mining Land Development Masterplan to an Energy Farm is a visionary undertaking of PT Bukit Asam to transform idle post-mining reclamation land into a productive and high-value source of biomass-based renewable power. PTBA has vast ex-mining land assets that are very prospective for cultivation of energy crops such as red calliandra, gamal, and lamtoro, which are tolerant of drought, have a rapid growth rate, and have a high calorific content (>18 MJ/kg) to be used as raw materials for co-firing and wood pellets. With increasing demand for biomass globally, especially from Japan and South Korea with targets in millions of tons annually, the strategy not only strengthens the upstream segment independence of PTBA's biomass value chain but also translates into long-term business opportunity as a low-carbon energy exporter. In its implementation, PTBA can start by apportioning 50-100 hectares of land in phase one, planting high-value energy crops, and contracting with Forest Farmer Groups (KTH) for planting and maintenance under a profit-sharing partnership scheme. The biomass harvest will be fed into PTBA's pellet plant facility at Tanjung Enim to meet internal co-firing needs as well as potential export sales. Apart from that, the project may be registered in the National Registry System – Climate Change Control (SRN-PPI) for carbon validation as well as for open access to the voluntary carbon market (VCM) so that the project not only is cost-effective and productive, but also environmentally friendly and compliant with the ESG and Net Zero Emission 2060 agenda.

V.1.5. Using existing Power Plants infrastructure as a technology buffer against varied and fluctuating raw materials.

As can be seen, raw biomass material from a variety of local origins (agricultural residues, energy crops, etc.) has immense differences in water content, particle size, calorific value, and degree of homogeneity. These differences can give rise to instability in combustion performance unless anticipated. Through the utilization of current Power Plants facilities, companies can create more flexible combustion and operating systems — for example by conducting multi-grade blending tests, creating operational SOPs in terms of mixture quality, and utilizing more precise quality control and temperature measurement systems. Additionally, utilizing current Power Plants facilities is also less costly as it does not require constructing new combustion plants. This strategy allows firms to sustain the enhanced operation of biomass co-firing plans in stages, as they keep upgrading the quality of the supply chain upstream. Hence, Power Plants acts as a technology buffer that provides time and room for firms to stabilize the continuity and quality of biomass supply on a long-term basis.

V.2. Recommendations

Always examine and verify the already adopted strategies. This is necessary to assess how effective the strategy is. Continuing with those strategies which require more effort, time and influence. If the strategy runs smoothly, the use of biomass can be expanded for all PTBA-owned Power Plants and it is necessary to ascertain the most optimal formula for the use of biomass in Power Plants.

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APPENDICES

Question:

- What do you know about Net Zero Emission?
- How should companies deal with this issue?
- Do you know about biomass cofiring program?
- In your opinion, what are the advantages, weaknesses, opportunities and threats if the company will conduct the program?
- What is the company's readiness regarding biomass if cofiring for power generation is carried out?
- Who needs to be responsible for the sustainability of the program?
- When does the preparation for the program need to be done?
- Are there any financial regulations or rules that can support biomass or cofiring activities?
- What are the risks involved in securing biomass?
- What are your suggestions or recommendations for this plan to be implemented?

Source: Project Management Office Division (Inc. Mining Development Sub-Division) - Mr. Bagus Totok Purnomo (Department Head of Research and Development)

What do you know about Net Zero Emission?

NZE is an effort by both corporations and countries to reduce their emissions below a threshold.

How important is net zero emission to you? Very important, whether we realize it or not, the increase in emissions will affect our environment, such as increasing temperature, threatening animal life, which will eventually affect human life.

How should companies deal with this issue?

Currently, the issue has a huge effect on the coal business. Inevitably, the company's future strategy must include carbon emission issues in its policies in order to maintain business sustainability.

Do you know about the cofiring program using biomass? Cofiring is the addition or replacement of raw materials for steam power plants that use coal with biomass.

What do you know about biomass?

Any form of organic matter that can or has energy utilization value. However, in Bukit Asama, biomass are perennials that can be used as power plant materials.

What do you think are the strengths, weaknesses, opportunities and threats if the company is going to do the program?

Strengths: (1) Emissions produced are environmentally acceptable because they use biomass (2) Extend the life of the PLTU (3) energy is cheaper than from other power plants (4) There is pre and post mining land that can be planted with biomass plants. (5) The company has conducted research on biomass and has a small-scale wood pellet or biomass production facility.

Weaknesses: (1) The land required is very large, if you want to fulfill >10% cofiring. (2) There are no human resources with special competencies related to biomass and cofiring. (3) Land ownership issues from the community.

Opportunities: (1) The company's image will be very good if it carries out the program because the company is considered to carry out environmentally sound activities (2) It is proof that the company is committed to reducing emissions (3) The company has land assets that can be used for energy crops

Threats: (1) Biomass supply is not sustainable (2) Biomass quality is doubtful to be consistent (3) If there is a power plant with better technology, this program can be abandoned (4) Need a large area of land, must share with other interests. (5) regulatory uncertainty regarding biomass.

What is the company's readiness regarding biomass if cofiring for power generation is carried out?

It is necessary to conduct preliminary research on soil properties for the suitability of energy crops. (2) Land availability must be ensured. (3) Infrastructure and place for biomass production/storage need to be prepared.

Who needs to be responsible for the sustainability of the program?

For operational activities in the PLTU, in accordance with the job desk, carried out by the Maintenance Division, where the Maintenance Division.

For activities in the field related to plants, it should be carried out by the Environmental Support and Mine Support Division (GM UPTE).

When does the preparation of the program need to be done?

Preparation can be done after a definite instruction from Management.

Are there any financial regulations or rules that can support biomass or cofiring activities?

Not sure. However, it is necessary to support the net zero carbon program.

What risks may occur in ensuring the sustainability of biomass?

- Changes in land use that will affect the availability of land
- Changes in regulations related to biomass or cofiring.
- Changes in company policy

What are your suggestions or recommendations for this plan to be implemented?

- It is necessary to map the readiness of biomass supply, preferably close to the cofiring area.
- It is necessary to map the land requirements for cofiring by considering the time and volume of planting and harvesting cycles.
- A budget should be prepared to support this activity

Source:: Budgeting and Accounting Division - Mr. Aditya Firza Pratama (Department Head of Accounting)

What do you know about Net Zero Emission?

Net zero emissions are greenhouse gas emissions that affect the local and global climate.

How important is net zero emission to you? It is important, because if seen in relation to the company, then net zero emissions will affect the strategy that will be made by the company. Where coal companies are considered as large emitters.

How should companies deal with this issue?

The company must be ready for the issue. Companies must also prepare programs that can care for the environment. Companies need to show that coal companies can also play an active role in reducing emissions, not just increasing emissions.

Do you know about the cofiring program using biomass?

Yes, I know. The program is the blending of plants in power plants. Biomass is used to replace coal as the main source of power generation. However, the amount of biomass used cannot be too much

What do you know about biomass?

Plants or crops that can be used as fuel to replace coal in power plants.

What do you think are the strengths, weaknesses, opportunities and threats if the company is going to do the program?

Strengths: (1) PTBA's status as a state-owned enterprise, as it will receive priority and support for cofiring (2) Management that has a commitment to do activities that care about the environment.

Weaknesses: (1) There is no structure or division responsible for this program. (2) Limited budget each year.

Opportunities: (1) If the program runs smoothly and biomass production is high, it can be a new source of income for the company. (2) Increasing the value associated with ESG. (3) Potential use of green funds from the government or partners.

Threats: (1) Limited supply of biomass (2) There are power plants that are preparing or even have conducted cofiring programs, making the supply reduced (Regulations) are still unclear that discuss biomass.

How is the company's readiness regarding biomass if cofiring for power plants is carried out?

The company must prepare budget, human resources, and others if it wants to do this program sustainably.

What is the company's readiness regarding biomass if cofiring for power generation is carried out?

The company must prepare budget, human resources, and others if it wants to conduct this program sustainably.

Who needs to be responsible for the sustainability of the program?

The Accounting Division will play a role in preparing the required budget by considering other program budgets and can also help in looking at the potential use of fiscal incentives for green energy funding together with the PMO Division.

Maintenance Division for operational activities at the PLTU

Environmental Support and Mine Support Division (GM UPTE) which will take care of the plants to be used as biomass.

When does the preparation for the program need to be done?

Preparations can be made immediately because this program has been included in the long-term plan. Preparations must be started even though in stages.

Are there regulations or financial regulations that can support biomass or cofiring activities?

There is. PMK 130/2020 on the Provision of Corporate Income Tax Reduction Facility. It is necessary to study whether this can be used, because if it can be used it will greatly help the company's finances.

What risks may occur in ensuring biomass sustainability?

- Regulations that change according to current conditions.
- PMK 130/2020 incentives cannot be used by the company.

What are your suggestions or recommendations for this plan to be implemented?

- It is necessary to communicate to relevant parties about the company's potential to obtain fiscal incentives and green funding.
- Coordination with parties that can produce biomass (outside the company) is needed.

Source:: Mine Planning Sub - Division (Planning Division) - Mr. Hardian Aries Nugraha (Head Department of Long Term Mine Planning)

What do you know about Net Zero Emission?

Net zero emission is a program created to reduce emissions as low as possible. Net zero emission is needed to maintain the world's temperature to prevent climate change.

How important is net zero emission to you? Very important. Because net zero emissions can prevent environmental damage and prevent climate change.

How should companies deal with this issue?

Companies should act adaptively, in accordance with the current world conditions. The issue of net zero emissions is a global issue that companies should be able to respond to properly. We know that this company is a coal mining company, which is considered a large emitter. So the company should respond to this condition by preparing a work program that supports the achievement of net zero emissions.

Do you know about the biomass cofiring program?

As far as I know, the program is one of the efforts made by the company in reducing emissions in power plants. Emissions are considered to be reduced due to the presence of organic raw materials or biomass that supplement or replace coal. However, this program seems to still need a more comprehensive study, to determine the company's readiness to do so.

What do you know about biomass?

Biomass is an organic product, usually from plants, that can be used as a source of energy, such as raw material for power plants.

In your opinion, what are the strengths, weaknesses, opportunities and threats if the company will carry out the program?

Strengths: (1) PTBA as a state-owned enterprise, it will be easier to gain support from various parties, because it is considered as a government or state party (2) There is still enough land for research and development of energy gardens (3) PTBA already has ISO 50001/14001 on Energy Management System and routinely makes ESG reports.

Weaknesses: (1) There are no personnel or employees who have expertise in biomass or cofiring. (2) The company does not yet have supporting facilities for biomass production.

Opportunities: (1) Biomass can be an energy plant to utilize pre and post-mining land. (2) New opinions when biomass production is abundant and prices are competitive.

Threats: (1) The quality of biomass produced can still be produced consistently (2) Limited land that can be used because it adapts to the mining plan.

What is the company's readiness regarding biomass if cofiring for power generation is carried out?

The company is still not too ready. There are still things that need to be prepared before the program starts. The company can do mapping, which aspects are ready or not. Cofiring, must be prepared carefully, because the readiness of biomass sustainability will affect this program.

Who needs to be responsible for the sustainability of the program?

The Planning Division prepares the land used for biomass planting.
Environment Management and Mining Support Division (Tanjung Enim site) is responsible for the growth of plants to be used as biomass, the quality of biomass produced.
Accounting Division to prepare the budget including green financing.
Maintenance Division to monitor cofiring operations in PLTU.

When does the preparation of the program need to be done?

Preparations should begin when management has given clear instructions regarding the implementation of this program.

Are there any regulations or rules on finance that can support biomass or cofiring activities?

I don't really understand, but I believe there are regulations that can be used to support this program.

What risks may occur in ensuring the sustainability of biomass?

- The necessary land is not yet available.
- There may be community resistance if the company does excessive land clearing at the mine and support sites.

What are your suggestions or recommendations for this plan to be implemented?

- Mapping of land needs should be done
- Special land needs to be provided for energy gardens
- This program is carried out with respect to ISO 50001 and ESG reporting.

Source:: Environment Management and Mining Support Sub - Division (Tanjung Enim Mining Site) - Mrs. Adi Arti Elettaria (Revegetation Sec. Head)

What do you know about Net Zero Emission?

Net zero emissions are efforts made to make emissions very low.

How important is net zero emissions to you? Very important. Because net zero emissions can affect many things, especially for the environment.

How should companies deal with this issue?

Companies should support net zero carbon by making plans that can reduce emissions or can absorb carbon. This should be a concern for companies, because in the future, the world will pay more attention specifically to environmental aspects. As a mining company, we must be able to prove that we can participate in achieving net zero emissions.

Do you know about the biomass cofiring program?

Yes, I know. The program is very good for the company because it can replace coal with plants or biomass. The use of biomass in power plants is considered to reduce emissions compared to using full coal.

What do you know about biomass?

Biomass is a product produced by organic material, usually plants, that can be used as an energy source.

What do you think are the strengths, weaknesses, opportunities and threats if the company is going to do the program?

Strengths: (1) PTBA's status as a state-owned enterprise, this makes it easier to get support from various parties, because the company's presence is considered as a representative of the government or state (2) The company has a large enough land for research or energy garden projects

Weaknesses: (1) The company's biomass production is still very small, so it still depends on suppliers outside the company who are not stable and consistent. (2) There are no personnel with expertise in biomass. (3) There is no digitization program that can track and monitor biomass demand.

Opportunities: (1) There is a huge demand for biomass, which can be a new business opportunity. (2) Biomass can utilize waste or leftover agricultural or forestry activities in the area around the company. (3) Increase the ESG value of the company because it has conducted programs that support Net Zero Emission.

Threats: (1) Very limited supply of biomass (2) Larger land requirement than available land.

What is the company's readiness regarding biomass if cofiring for power generation is carried out?

The company must prepare all things related to the program from upstream to downstream. For example, the company must provide land, seedlings, human resources, and budget if they want the program to start and be sustainable.

Who needs to be responsible for the sustainability of the program?

The Environment Management and Mining Support Division (Tanjung Enim site) is responsible for the growth of plants to be used as biomass, the quality of the biomass produced.

Accounting Division to prepare the budget.

Maintenance Division for readiness and monitoring of cofiring operations in PLTU.

When does the preparation for the program need to be done?

Preparations can already be started, especially related to planting and biomass to be produced. Planting needs to be done immediately because it takes time for the plants to be harvested.

Are there any regulations or financial regulations that can support biomass or cofiring activities?

Not too clear, but the potential can be seen in PMK 130/2020 on the Provision of Corporate Income Tax Reduction Facility.

What risks might occur in ensuring biomass sustainability?

- Plants are not suitable with the soil in Tanjung Enim, so they fail to grow and harvest.
- Biomass produced is not in accordance with the standard, namely SNI 8021-2014 on wood pellets.

What are your suggestions or recommendations for this plan to be implemented?

- It is necessary to coordinate with parties that can produce biomass (outside the company).
- It is necessary to control the biomass produced from outside the company, so that the biomass that will be used is in accordance with the required specifications.

Source:: Maintenance Division - Mr. RM Fauzih (Head Department of CHF & Main Min Equip Mtc Plan)

What do you know about Net Zero Emission?

Net Zero Emission is a program created to support the Paris Agreement in maintaining global temperature rise and preventing climate change.

How important is net zero emission to you? Very important. Because net zero emissions can affect human life. For example, if no effort is made to reduce emissions, there will be an increase in global temperature and consequently climate change. If climate change occurs, there will be many natural disasters that will harm humans.

How should the company deal with the issue?

The issue should be taken into consideration in making the company's strategy. For a company like Bukit Asam, which is not only a mining company, but also has a power plant, this issue will certainly be very influential. The company must prepare programs that can offset the emissions generated from mining activities and power plants.

Do you know about the biomass cofiring program?

Of course I know about it. Cofiring has been carried out several times at the 3x10 MW power plant, but due to biomass limitations, cofiring is not carried out on an ongoing basis. Cofiring is very good for the company's image.

What do you know about biomass?

Biomass is plants or plant residues that can be used as a source of energy, such as raw materials for power plants.

In your opinion, what are the strengths, weaknesses, opportunities and threats if the company will carry out the program?

Strengths: (1) PTBA as a state-owned enterprise, will make it easier to gain support from various parties, because it is considered as a government or state party (2) The company has its own power plant that can be used for trials (3) Pre and post-mining land is still sufficient for research and development of energy gardens (4) PTBA already has ISO 50001/14001 on Energy Management System and regularly makes ESG reports.

Weaknesses: (1) Unprepared personnel competence in biomass or cofiring. (2) There is no organizational structure that has specific tasks for this.

Opportunities: (1) Considerable demand for biomass from domestic and export. (2) Become a key player if it can produce biomass in large quantities.

Threats: (1) The quality of biomass produced is inconsistent because it comes from different woods. (2) Limited land that can be used because it adjusts to the mining plan.

What is the company's readiness regarding biomass if cofiring for power generation is carried out?

The company needs to prepare things that affect the sustainability of this program.

Who needs to be responsible for the sustainability of the program?

Maintenance Division for monitoring cofiring operations at PLTU
Planning Division prepares the land used for biomass planting.

Environment Management and Mining Support Division (Tanjung Enim site) responsible for the growth of plants to be used as biomass, the quality of biomass produced.
Accounting Division to prepare the budget including green financing.

When do preparations for the program need to be made?

Preparations can begin now, but will be adjusted to the needs.

Are there any regulations or rules on finance that can support biomass or cofiring activities?

Not sure, but I believe there are regulations that can be used to support this program.

What are the possible risks in ensuring biomass sustainability?

- The necessary land is not yet available.
- The quality of biomass produced does not meet SNI.
- Power generation is not competiable with biomass.

What are your suggestions or recommendations for this plan to be implemented?

- Good communication is needed with the area community regarding biomass supply.
- It is necessary to conduct training for residents, so that the biomass produced is in accordance with the needs of the PLTU.
- This program should be conducted with ISO 50001 and ESG reporting in mind.