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DESIGN OF WOOD PELLET FACTORY FOR CO-FIRING PRODUCTION OF COAL-FIRED POWER PLANT IN TANJUNG ENIM

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ABSTRACT

Climate change is one of the leading causes that threaten life on Earth. Indonesia's efforts to overcome this problem are by signing the COP26 Coal to Clean Power Transition Statement or a statement on the transition from coal energy to clean energy. This commitment to clean energy is targeted to reach net zero emissions by 2060. The company wants to expand its business into the new and renewable energy (EBT) sector. Therefore, before the company develops its business to establish a wood pellet factory, it is necessary first to design the initial business and business feasibility, which includes aspects of feasibility analysis, including market aspects, technical aspects, environmental aspects, financial aspects, and sensitivity analysis to be able to determine whether this business development decision is feasible to run or not. The inflation rate is 3.27%, and the MARR value is 8%. Based on the feasibility calculation on the financial aspect, the establishment of a wood pellet factory is feasible with an NPV of Rp 29,393,458,729, IRR of 44.34%, PBP for 2.28 years, and BCR of 1.29. According to sensitivity analysis, the establishment of this wood pellet factory is sensitive to a decrease in product selling prices by 12.01%, sensitive to an increase in direct raw material costs by 41.57%, and sensitive to an increase in raw material supply service costs by 51.46%.

Introduction

Climate change is one of the leading causes that threaten life on Earth. Indonesia has implemented various policies to achieve the emission reduction target of Net Zero Emissions (Hardiatmoko, Defriana, Juliastuti, & Darmawan, 2023). One of the efforts is that Indonesia has signed the COP26 Coal to Clean Power Transition Statement, which is a statement on the transition from coal energy to clean energy (Mujiono & Akbar, 2023). This commitment to clean energy is targeted to reach zero emissions by 2060 or sooner.

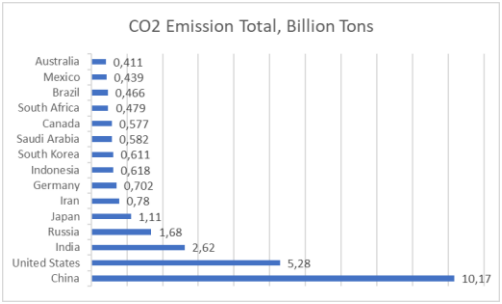


Figure 1 Graph of the World's Total CO2 Emissions

Based on Figure 1, Indonesia ranks eighth among countries with the largest CO2 emitters in the world. The most significant CO2 emissions produced by Indonesia come from coal emissions. Many power plants in Indonesia still use coal as the primary material for burning electricity.

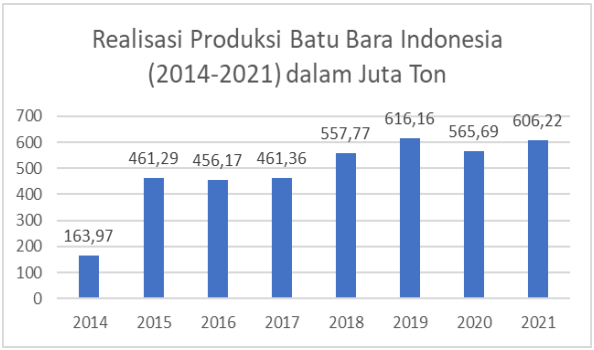


Figure 2 Graph of Coal Production Realization in Indonesia in 2014-2021 (In Million Tons)

Based on Figure 2, in 2021, Indonesia's coal production reached 606.22 million tons, an increase of around 7.2% from the previous year, which reached 565.69 million tons. Since 2014, it can be seen that coal production has shown an increasing trend, although interspersed with declines in 2016 and 2020 (Muniroh & Aminah, 2021). The Ministry of Energy and Mineral Resources predicts Indonesia's coal production will rise from 637 million tons to 664 million tons.

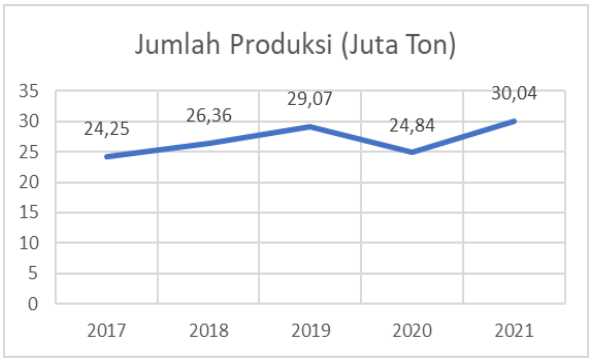


Figure 3 Graph of Bukit Asam Coal Production in 2017-2021 (in million tons)

Based on Figure 3, the Company produced coal in 2021 of 30.04 million tons, an increase of 21% compared to 24.84 million tons in 2020. The increase in coal demand in 2021 is one of the causes of increased production in 2021 (NURYADI et al., 2023).

The company wants to expand its business into the new renewable energy (EBT) sector in line with the statement about realizing an emission-free world. For this reason, careful planning is needed in carrying out business development (Nurlayalia, 2022). Therefore, before the Company develops its business to establish a wood pellet factory, it is necessary first to design the initial business and feasibility, which includes aspects of feasibility analysis, namely market, technical, environmental, financial, and sensitivity. The Company can decide whether this business development is feasible by designing and feasibility (Putri, 2021).

Business Feasibility Study

A business feasibility study is research on a business plan that evaluates whether the business can be built and how the business can be run sustainably to achieve maximum profit within an indefinite period (Kasmaniar et al., 2023).

Market and Marketing Aspects

Every market activity always involves marketing, and every marketing activity aims to find or create a market. In a more straightforward concept, a market is where sellers and buyers meet to transact (Saleh & Miah Said, 2019). However, sellers and buyers do not need to interact directly to make transactions; they can do so through electronic or digital media.

Technical Aspects

The technical aspect is planning technical specifications of all facilities, infrastructure, and equipment needed for the product or service (Winantara, Bakar, & Puspitaningsih, 2014). Analysis of operational aspects is aimed at assessing the readiness of the Company or business actors for the implementation of production by assessing the accuracy of the location, production area, and layout, as well as the business of physical machines and information system machines to be used (Matakena, Chumaidiyah, & Suryana, 2023).

Research Methods

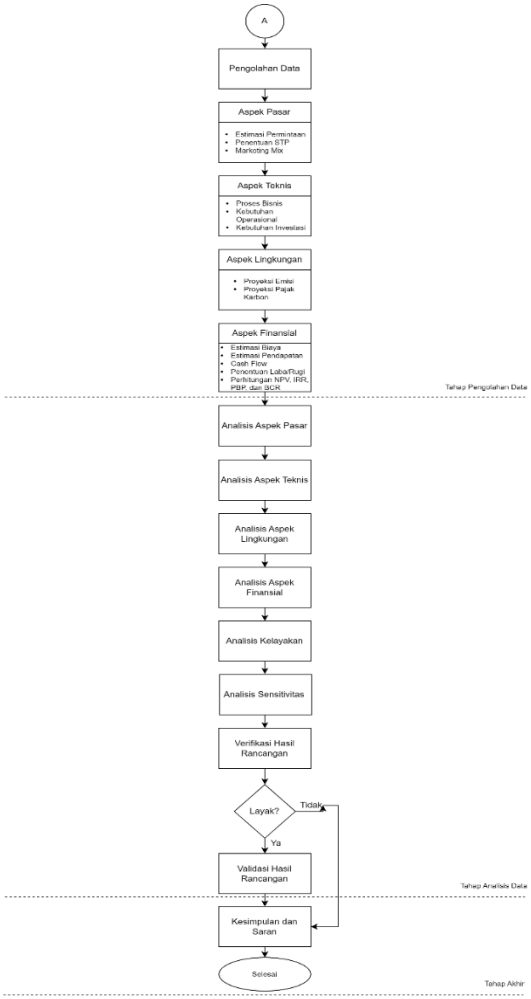


Figure 5 Problem Solving Systematics (Continued)

Initial Identification Phase

The initial identification stage involves searching for information and introducing relevant issues to the research object. In this stage, the steps include problem formulation, goal setting, and setting benefits that will support the research process.

Data Collection Levels

The data collection process is carried out to obtain information that can later be processed to overcome problems in research. The data collected in this study was obtained through two sources, namely primary data and secondary data. Primary data is data taken from the place of research directly. This study is observation and direct interviews on the object of research and its representatives. Secondary data is information that has existed before and has been processed. In this study, it is a study of literature and statistical data related to the problems raised.

Data Processing Stage

The data processing stage is carried out after the previous data has been collected. Data processing is carried out using formulas or related formulas that will produce values that researchers can analyze to obtain information about the feasibility of the business

being researched. The data processed are observational, interview, forecasting, and literature study. The data to be processed includes aspects of feasibility analysis: market, technical, environmental, and financial.

Data Analysis Phase

The data analysis stage is carried out by reviewing the data processing results to determine whether the business establishment can be considered feasible. This analysis is carried out by applying methods of the feasibility analysis.

Final Stage

The final stage is the closing stage of the research, marking the end of the entire research process. At this stage, conclusions and recommendations are presented as a result of the research that has been done.

Results and Discussion

A. Market Aspect Planning

1. Revenue Projections

Table 1
Demand Projections

Period	Demand Projections
2022	29.481
2023	30.510
2024	31.574
2025	32.675
2026	33.814
2027	34.994
2028	36.214

Demand in 2022 amounts to 29,481 tons, which will increase by 3.49% annually based on the average per capita electricity consumption in Indonesia up to 36,214 tons in 2028.

a. Marketing Strategy

1. Segmenting: Geographical Segmenting (Muara et al.), Demographic Segmenting (PLTU Market), and Psychographic Segmenting (South Sumatra residents who use PLTU electricity).
2. Targeting: Companies that run the steam power plant (PLTU) business.
3. Positioning: The company positions itself as an environmentally friendly world energy company by producing wood pellets as raw material for co-firing power plants.

b. Marketing Mix

1. Product: Wood pellet
2. Price: Rp 1.800.000 per ton
3. Place: Tanjung Enim Mining Unit
4. Promotion: Relationship between Companies.

B. Technical Aspect Design

1. Business Process

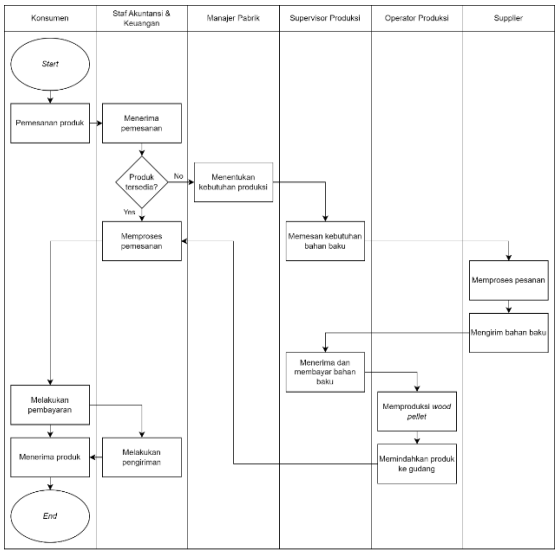
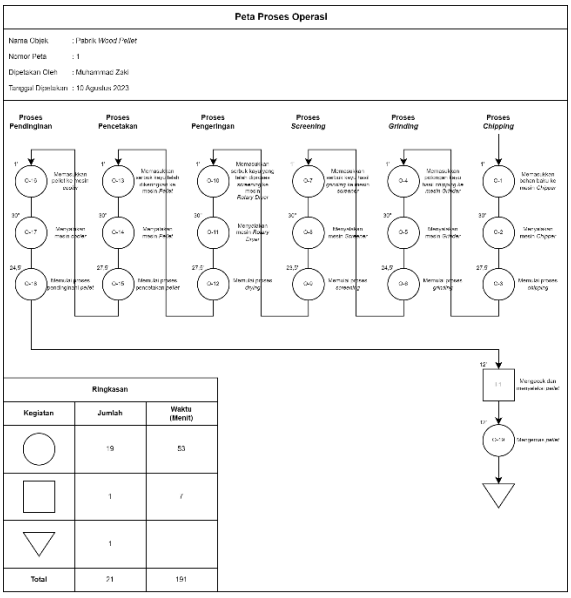


Figure 6 Business Process

The above business process is the cornerstone of the business that will be carried out at the wood pellet factory. It can be seen that there are four business process drivers from the internal factory and two external drives, namely suppliers as suppliers of raw materials and consumers as product orders.

1. Production Process



Picture 7 Operation Process Map

Based on Figure 7, the production process has seven stages. These stages consist of the chipping process, grinding process, screening process, drying process, printing

process, cooling process, and selection and packaging process, with the total production time for one cycle being 191 minutes. In 1 cycle, it can produce 8 tons of wood pellets.

2. Machine and Equipment Requirements

Machinery and equipment are needed to support the business being run. The machinery and equipment are divided based on the needs of the factory and the office. The following are the needs of machinery and equipment from the factory.

Table 2
Machine and Equipment Facility Needs

Item	Sum	Unit
Equipment and Machines		
Chipper / Shredder	1	Unit
Grinder	1	Unit
It is an excellent time to be in the world	1	Unit
Rotary Dryer	1	Unit
Pelletizer	1	Unit
Cooler and Sorter	1	Unit
Packing System	1	Unit
Conveyor	5	Unit
MCC Control Center	1	Unit
Office Equipment and Facilities		
Laptop	3	Unit
Telephone	1	Unit
Printer	1	Unit
AND	4	Unit
Dispenser	1	Unit
Table	6	Unit
Chair	13	Unit
Storage Racks	1	Unit
Meeting Desk	1	Unit

3. Manpower Needs

Labor requirements are calculated based on process time and adequate work time. The process time is obtained based on the frequency of business processes and process time. The frequency of business processes is adjusted to the amount of production based on demand estimates. Adequate working time is obtained from the working time in one month. The following is the result of the calculation of labor needs.

Table 3
Manpower Needs

Position	Manpower Needs per Year				
	2024	2025	2026	2027	2028
Factory Manager	1	1	1	1	1
Production	1	1	1	1	1

Position	Manpower Needs per Year				
	2024	2025	2026	2027	2028
Supervisor					
Accounting & Finance Staff	1	1	1	1	1
Production Operator	14	14	14	14	14
Total	17	17	17	17	17

4. Location

The wood pellet factory is located in UPTE (Tanjung et al. Unit), precisely in the West Banko mining area. This location selection results from self-determination by the Company where the author conducted the Final Project research.

5. Layout

The layout design was adjusted to the company's demand as the object of research. It adjusts to the number of equipment and machinery facilities factories and offices need. So the layout can be organized and function properly.

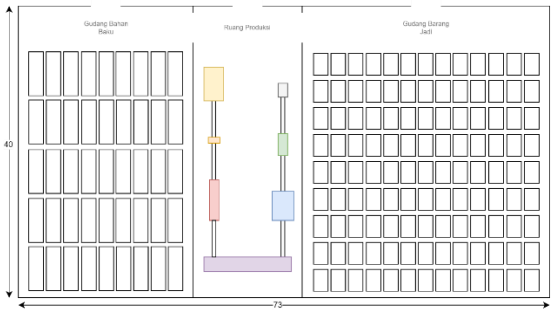


Figure 8 Factory Layout

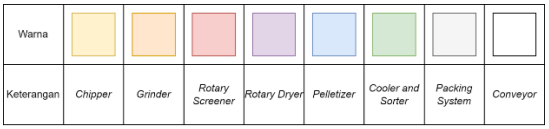


Figure 9 Factory Layout Description

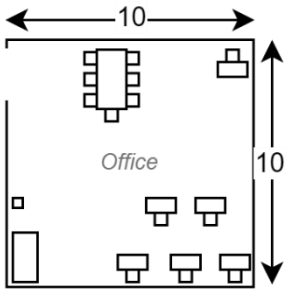


Figure 10 Office Layout

C. Environmental Aspect Design

1. Emission

Wood pellet factories are not counted as producing emissions that should be subject to carbon taxpayers based on regulations from the Ministry of Finance. As for the emissions generated from the PLTU, co-firing biomass wood pellets by 5% with 95% coal reduced emissions by 991,946 tCO2e to 942,361 tCO2e or decreased by 49,584 tCO2e.

2. Carbon Tax

Based on the emissions produced by the power plant, the carbon tax to be paid is reduced after co-firing biomass wood pellets by 5% with 95% coal. The calculation showed that the carbon tax to be paid was IDR 7,593,571,631 from the previous IDR 9,081,101,254, or a decrease of IDR 1,487,529,623.

D. Financial Aspect Design

1. Revenue Projections

Figure 11 Revenue Projections

Based on the figure above, the estimated revenue will increase every year from 2024, with a revenue of IDR 56,832,608,704, until 2028, with a revenue of IDR 74,139,412,402.

2. EAIT

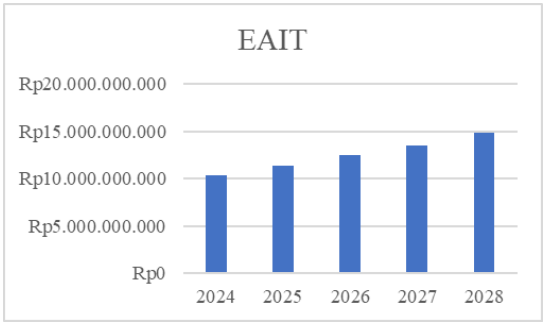


Figure 12 Net Profit Projections

Based on Figure 12, EAIT increases yearly from 2024 with an EAIT of IDR 10,390,947,442 to 2028 with an EAIT of IDR 14,851,787,732.

3. Qualification Analysis

Table 4
Qualification Analysis

Qualification Analysis	
NPV	IDR 29,393,458,729
IRR	44,34%
PBP	2,28
BCR	1,29

Based on Table 4, the value of NPV is IDR 29,393,458,729. Because the NPV value is> 0, the design for establishing a wood pellet factory is said to be feasible to run. Furthermore, it was found that the value of the IRR was 55.34%. Because the IRR value > MARR, or IRR > 8.00%, it can be said that establishing a wood pellet factory is also feasible to run. Then, it was found that the value of PBP was 2.28. Because of the value of PBP < research financial projections, establishing a wood pellet factory can be said to be feasible. Then, the value of BCR is 1.29 because the BCR value > 1, establishing a wood pellet factory can be said to be feasible.

1. Sensitivity Analysis

Sensitivity analysis measures the extent to which parameter changes, be it in the form of increases or decreases, affect the criteria in a feasibility study. The higher the percentage of sensitivity obtained, the less sensitive it is to changes in the parameters made. The following is a breakdown of the calculation of sensitivity to the decrease in the selling price of the product.

Table 5
Sensitivity Analysis

No	**Sensitivity Analysis**	**Sensitivity Percentage**
1	Decrease in Selling Price of Sensitive Products	12,01%
2	Increase in Direct Raw Material Costs	41,57%
3	Increase in the Cost of Direct Raw Material Supply Services	51,46%

Conclusion

The results of the business feasibility design of the factory establishment are appropriate based on the verification and validation process. The design that has been made also includes the formulation of the problem and research objectives. The results of this research design are feasible to run because they meet the requirements of the investment feasibility method. The design for establishing this wood pellet factory has an NPV value of Rp 29,393,458,729, an IRR value of 44.34%, a PBP of 2.28, and a BCR of 1.29.

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