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Financial Analysis of Additional Supply to Obtain Optimal Basic Costs of Provision in The Weda System

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ABSTRACT

The electricity growth in the PLN Weda Customer Service Unit (ULP) area in Central Halmahera Regency reached 26.64% in 2022, driven by national-scale nickel mining, resulting in consistent yearly increases in electricity demand. ULP Weda's electricity supply, with an installed power of 5.2 MW and a peak load of 5.6 MW, faces challenges due to high fuel prices, leading to a Cost of Supply (BPP) value of IDR 4,193, significantly higher than the average selling price of IDR 1,365 in the Veda system. To address these issues, a research methodology, incorporating SWOT and TOWS analyses, was employed. Three potential scenarios emerged: relocating Diesel Generating System (SPD) engines, adding rental generator engines, and purchasing excess power. Financial Feasibility Study (KKF) calculations, considering Nett's Present Value (NPV), Nett's Present Cost (NPC), and Internal Rate of Return (IRR), determined the excess power purchase scenario as the most viable, with an NPV of IDR 29.8 billion, NPC of IDR 623 billion, IRR of 33.49%, and the lowest BPP value at IDR 1,244. The Homer application provided insights into optimizing generating machine units for optimal BPP values. Sensitivity analysis showed that higher interest rates and lower fuel prices contribute to lower BPP values. This comprehensive research offers a strategic framework for addressing electricity supply challenges in the ULP Weda area, ensuring financial viability and optimal operation.

INTRODUCTION

The need for electrical power will continue to grow every year. Population growth and economic growth are believed to be the two main factors influencing the increasing consumption of electrical energy in a region (Ahmad et al., 2023; Lawal et al., 2024; Liu et al., 2023; Wang & Xu, 2024). In addition, other factors that also affect the growth of electricity loads include the target electrification ratio, energy substitutes, supply-side capabilities, and in some countries are also influenced by the selling price of electricity to customers, seasonal factors, changes in economic structure, and so on (Chi et al., 2023; Manigandan et al., 2024; Mohsin & Jamaani, 2023; Tang et al., 2024; Yusuf, 2023).

In line with the government's policy to develop more renewable energy, the development of renewable energy projects such as biomass is encouraged but still considers and considers economic value (price efficiency) (Chiu et al., 2023; Kang & Usher, 2023; Kutlu et al., 2020; Natan & Sumirat, 2019; Prihambodo et al., 2020). In addition, the development of renewable energy plants also continues to pay attention to the balance of supply and the status of readiness for development.

In these expected conditions there are some facts that not all electrical systems can be carried out, this is illustrated in one Vedic system located on Halmahera Island which is the largest island in North Maluku Province (Alhassan & Acquah, 2020; Andrawina et al., 2017). The Vedic system is under

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the auspices of the operation of the Customer Service Unit (Weda) at the Customer Service Unit (UP3) Sofifi, Regional Main Unit (UIW) Maluku &; North Maluku.

The Weda system is supplied by PLTD Weda with an installed power of 5.2 MW, capable power of 4.2 MW with nine (9) units of machines. In addition, it is also supplied by private rental machines with an installed power of 3.3 MW, capable power of 1.9 MW with three (3) engine units. So that the total Capable Power is 6.1 MW, while the peak load is 5.6 MW. With this condition the Vedic system is on standby.

In addition, a very high load growth of 26.64% in 2022 shows a very large demand for electricity in Vedic ULP. With a national-scale Nickel mining area in the Central Halmahera area that is still developing, the number of workers absorbed is very large, both from the surrounding community and from outside communities. A big challenge for PLN units because in fulfilling the supply of power plants is still constrained by standby status (Abdelhady, 2021; Chiu et al., 2023; Sidiq et al., 2023).

The plants available in the Vedic system come from oil-fired Diesel Power Plants (PLTD) (Listrik, 2021; PLN, 2017). With the price of fuel oil that is still high and the value of plant efficiency, the value of Cost of Supply (BPP) of Rp 4,193, -. When compared to the average selling price of the vedic system is only Rp 1,365, -. The gap that is too far between BPP and selling price makes BPP improvements necessary. BPP improvements can be made significantly if there are cheaper plants such as PLTU, PLTS, PLTA.

To note, there is one company that has its own electricity supply business license (IUPTLS) using coal-fired steam power plants (PLTU), namely PT Weda Bay Energi which supplies to PT Indonesia Weda Bay Industrial Park (IWIP) with a capacity of up to 2,500 MW.

With the condition of the system in standby condition that makes customer growth a bit braked, it is necessary to increase supply so that the Veda system is in normal condition and ready to increase electricity sales. However, in this case, BPP Pembangkit is still considered to remain in PLN's financial control. Therefore, every time there is an increase in plant supply, it is necessary to take care of the Financial Feasibility Study (KKF) so that optimal BPP is obtained.

METHODS

The research methodology employed in this study involves a series of steps outlined in the research process flow. Initially, the research begins with the preparation phase, which includes field studies and literature reviews to understand the background and conditions of the object of discussion at a specific location. Data from these studies are utilized to formulate research problems and support subsequent data collection.

After the data is gathered, the research continues with an analytical method using SWOT and TOWS analysis tools. This process aims to strengthen the formulation of problems and produce a model design. The model design originates from scenarios selected based on the analysis results, which are then evaluated through calculations and simulations using the Homer application to assess financial feasibility.

The research design adopts a descriptive approach with a quantitative method. Descriptive research provides a comprehensive overview of the social issues being discussed, while the quantitative approach is used to collect and analyze data using numerical values. Thus, variables such as income, business duration, capital, business type, and education will be processed quantitatively.

Data collection methods involve Focus Group Discussion (FGD) and observation. FGD is used to discuss survey subjects with carefully selected groups, while observation is conducted by directly observing relevant phenomena. Before data collection, the research has a framework to determine the initial conditions and research objectives.

The research stages involve four main steps: empathy, definition, ideation, and prototyping. The empathy stage is conducted through interviews and in-depth information exploration to better understand the problem. The definition stage produces problem statements from SWOT analysis findings. Next, the ideation stage generates ideas to solve external problems and develop activity scenarios. The prototyping stage involves developing scenarios, which are then tested through financial feasibility studies.

Research analysis methods include SWOT Analysis and TOWS Analysis. SWOT Analysis is used to evaluate the strengths, weaknesses, opportunities, and threats affecting the research. TOWS Analysis is used to identify strategies based on the relationship between internal and external factors. The results of the TOWS analysis are used to formulate project scenarios. Thus, this research combines descriptive, quantitative, and strategic analysis approaches to investigate and present conditions as well as solutions to the identified problems.

RESULTS

Financial Feasibility Study Scenario Calculation

In calculating the financial feasibility of adding the Vedic system in order to obtain an optimal BPP based on elements of Nett Present Value (NPV). Internal Rate Return (IRR) and Benefit Cost Ratio (BCR). This is necessary in order to ensure that the scenario created is feasibility. Financial feasibility indicators if they meet the following criteria:

Table 1. Financial Eligibility Requirements

Method	Criterion
NPV	≤ 0
BCR	≤ 1
IRR	< COC (12.00%)

The results of the method in each criterion must meet, because it will affect the speed of investment capital that has been spent. The scenario calculation was made with the total capable power of the Weda system now amounting to 7 MW made with the arrangement of each existing plant plus relocation plants from other units. So that it will be seen the setting of the engine operation pattern of each machine unit with the source of the generator to get the optimal BPP.

Self-Generating System (SPD) Relocation Calculation

In the calculation on the relocation of the power system itself, there is an additional scenario of machines using PLN machines located in the Daruba area, Morotai, so it requires a lot of money. The calculation of the financial feasibility study is made over a period of 20 years, so the results are as follows.

Table 2. Financial Feasibility Results of SPD Relocation

Method	Result	Criterion	Information
NPV	(802,467,988,734)	≤ 0	Not Worth It
BCR	0.42	≤ 1	Not Worth It
IRR	#NUM!	< COC (12.00%)	Not Worth It
The project is NOT FEASIBLE.			

In addition, it was found that the value of the Cost of Supply (BPP) in the scenario using the relocation plant machine combined with the existing generating machine amounted to Rp 3,090, -

Calculation of Addition of Power Plant Rental Machine

In the scenario of adding machines, the rental plant will use additional machines from the rental vendor. Additional needs of the machine also have a total capacity of 5 MW. The rental machine contract includes maintenance costs, so there are no more such costs that are the burden of PLN. With a more efficient engine comes cheaper fuel costs. With the scenario of adding with rental machines, it was found that the results were better than the relocation of power plants. However, the results found are still Not Feasible because they do not meet NPV, BCR and IRR. The calculation results are as follows.

Table 3. Financial Feasibility Results of Adding Rental Machines

Method	Result	Criterion	Information
NPV	(756,291,279,896)	≤ 0	Not Worth It
BCR	0.43	≤ 1	Not Worth It
IRR	#NUM!	< COC (12.00%)	Not Worth It
The project is NOT FEASIBLE.			

From the calculation above, although it occurs more cost-effective with more efficient machine quality, if calculated from financial studies, it is still not feasible because the income from the selling price is still not so high. In addition, it was found that the value of the Cost of Supply (BPP) in the scenario using additional rental machines combined with existing generating machines amounted to Rp 2,983, -.

Excess Power Purchase Calculation

In the scenario of purchasing excess power in collaboration with PT Wedabay Energy which has its own Power Supply Business License (IUPTLS) in the Weda Area, whose production is carried out by PT IWIP. The total operating machines are 2,200 MW with a total of 6x250 MW and 2x350 MW units. To supply excess power of 5 MW using a Connect Substation (GH) from PT Wedabay Energy which is connected to the PLN Weda system. The PLN system connection is connected to the 20 kV Medium Voltage (TM) air network system.

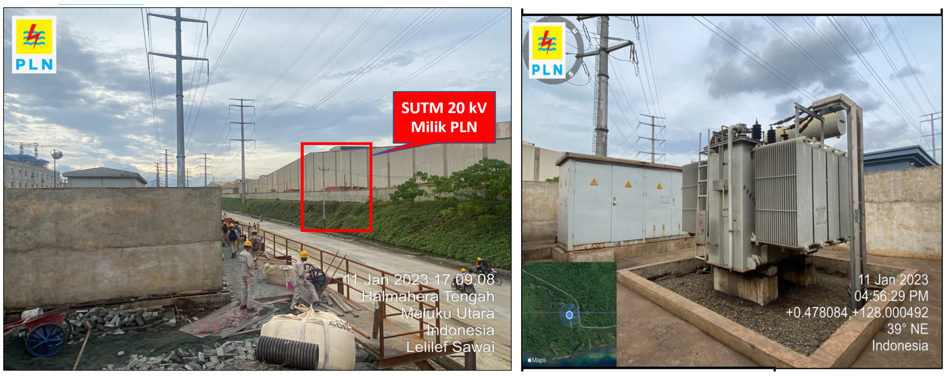

Figure 1. Excess Power Interconnect Points

A different type of plant compared to the previous two scenarios that use PLTD, this scenario uses a power plant with a capacity of 250 MW with an excess power of 5 MW. Investment needs are used to create interconnection lines from the Excess Power place to the PLN System and other costs. After calculating everything, the NPV, BCR, and IRR numbers are as follows.

Table 4. Financial Feasibility Results of Excess Power Purchase

Method	Result	Criterion	Information
NPV	29,810,800,952	≤ 0	Proper
BCR	1.05	≤ 1	Proper
IRR	33.49%	< COC (12.00%)	Proper

The project is FEASIBLE.

So from the calculation of the financial review, the excess power purchase scenario is considered **FEASIBLE.** In addition, it was found that the value of the Cost of Supply (BPP) in the scenario using Excess Power from the Wedabay Energi PLTU combined with the existing generating machine amounted to Rp 1,244,-

Project Scenario Simulation Using Homer

The use of the Homer application has advantages compared to other applications. In Homer, simulations are carried out using data on machine conditions, loading, and production financing; from this, it is believed to find process results that are closer to accurate. In addition, Homer is the optimal engine unit when operated. This implementation was done in the Veda area, Halmahera Island, North Maluku province.

The Homer application will automate simulations to determine optimal conditions to ensure efficient Nett Present Cost (NPC) values. Other indicators can be seen in the cost of production and Cost of Goods Provided from the project period undertaken (LCOE).

The simulation calculation combines existing power plants with additional sources of other power plants. With a capable load of 7 MW, there is expected to be an option to simulate the generating unit that operates optimally so that an optimal BPP value will be found. The daily load used in the operation of the plant is as follows.

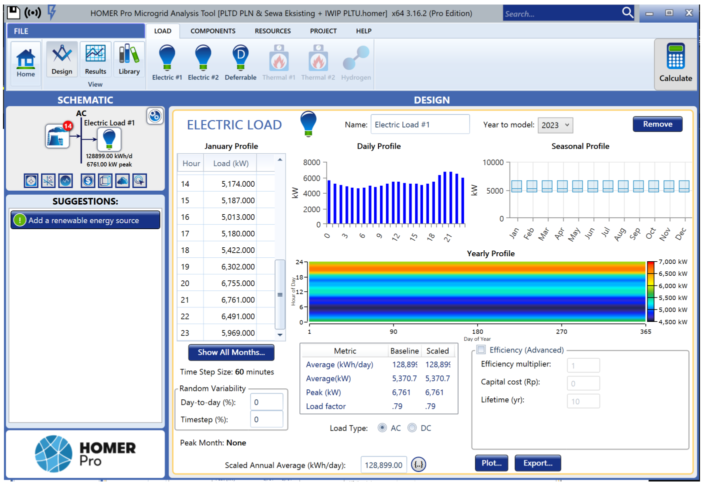

Figure 3. Homeric Design Daily Loading

Self-Generating System (SPD) Relocation Simulation

In the simulation that added the generating machine unit from the relocation of the Daruba unit with the distribution of plants in PLTD Weda. The data is entered into the field parameters in the Homer application so that it looks like below. After the data is entered, it can immediately be run by clicking the calculate logo in the upper right corner. From the results of running, it was found that there were 206 options calculated to get optimal costs.

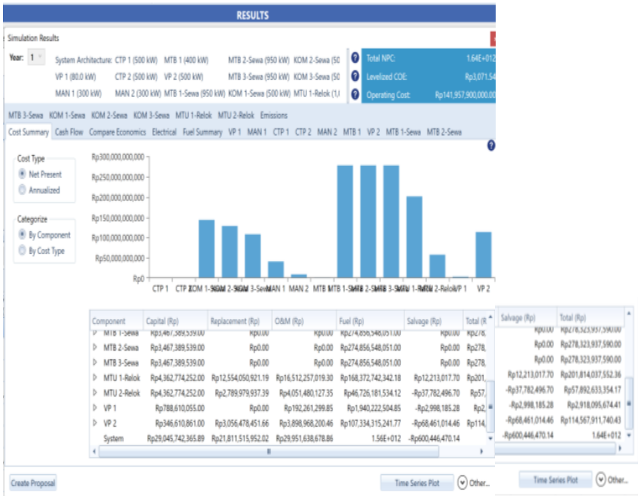

Figure 4. Results of Financial Feasibility Value of SPD Relocation Machine Scenario

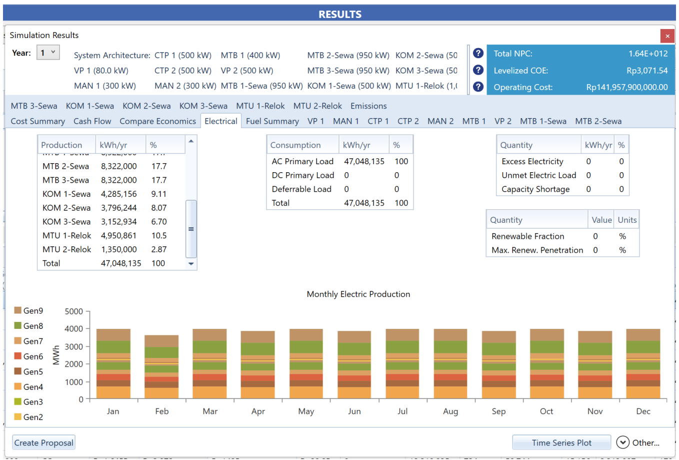

Figure 5. Production Results of SPD Relocation Machine Scenarios

From the results of the option options, it was found that the optimal one was found in the first row with an NPC value of Rp 1,645 trillion within 20 years, an operation cost of Rp 142 billion in a year and an LCOE of Rp 3,072, -.

Simulation of Adding a Power Plant Rental Machine

In the simulation with the scenario of adding a rental machine, the plant added a rental machine unit with an installed capacity of 800 kW and 1,100 kW. The distribution is as follows:

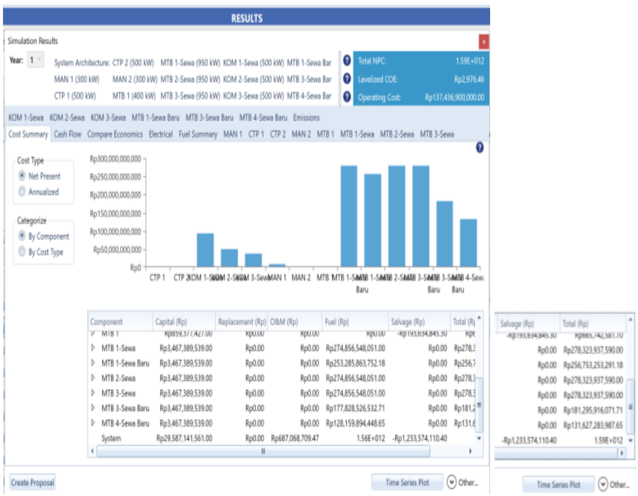

Figure 6. Results of Financial Feasibility Value of Rental Machine Addition Scenario

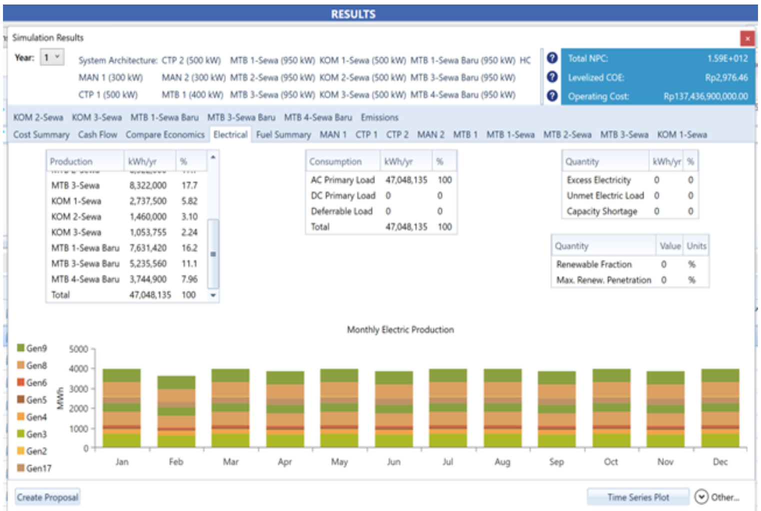

Figure 7. Production Results of Rental Machine Addition Scenario

From the results of the option options, it was found that the optimal was found in the first row with an NPC value of Rp 1,594 trillion within a period of 20 years, an operation cost of Rp 137 billion in a year and an LCOE of Rp 2,976,-

Excess Power Purchase Simulation

In the simulation of purchasing excess power, adding a generating machine from PT Wedabay Energy with a power capacity of 5 MW is taken. The plant used is a coal-fired Steam Power Plant.

Table 5. Excess Power Purchasing Machine Unit Capacity

NO	UNIT	MACHINE NAME	INSTALLED CAPACITY (kW)	CAPABLE CAPACITY (kW)
1	PLN WEDA	VOLVO PENTA	100	80
2	PLN WEDA	MAN	400	300
3	PLN WEDA	CATERPILLAR	800	500
4	PLN WEDA	CATERPILLAR	800	500
5	PLN WEDA	MAN	400	300
6	PLN WEDA	MITSUBISHI	635	400
7	PLN WEDA	VOLVO PENTA	500	REBUKE
	PLTU			
1	PT WEDA BAY		5,000	5,000

From the results of the option, it was found that the optimal one was found in the first row with an NPC value of Rp 619 billion within a period of 20 years, an operation cost of Rp 53.5 billion in a year, and an LCOE of Rp 1,156, -.

Project Sensitivity Analysis

Sensitivity analysis in project management (also known as risk analysis and sensitivity in project management) is a method for modeling risk in each assignment. Project sensitivity looks at the big picture to see what, of all the elements involved, could potentially hinder you from achieving your goals or objectives.

In this study, factors that affect the value of the project scenario will be calculated. This is to strengthen the initial calculation that the selected one is already in accordance with the parameters that are likely to affect the change. In this case, the parameters used in influencing are Discount Rate and Fuel Price.

Interest Rate Value Sensitivity

Interest Rate is a value used to calculate the present value of a value in the future because the present value is different or less than the value in the future. The calculation of three scenarios, namely the relocation of the own generation system, the addition of power rental machines, and the purchase of excess power, uses an interest rate of 6.10%, based on the value in the 2023 RKAP. Project sensitivity here uses a reference interest rate value from 5.25% - 6.75%.

Table 6. Interest Rate Condition Mapping

No	Condition	Interest Rate
1	Condition I	5.25
2	Condition II	5.50
3	Condition III	5.75
4	Condition IV	6.00
5	Condition V	6.10
6	Condition VI	6.25
7	Condition VII	6.50
8	Condition VIII	6.75

The calculation of a feasible scenario by purchasing excess power at different interest rate conditions with a value of 6.75%

Condition VIII: 6.75%

As for the recap of the conditions above, it was found that all conditions met the feasibility, both with low to the highest interest rate value. Where the highest interest rate results in the best NPV, IRR, and BCR.

Table 7. Financial Feasibility Recap of Interest Rate Conditions

No	Condition	Interest Rate	TARIFF (Rp/kWh)	CF (%)	Cost Operation (Rp)	NPC (Rp)	NPV (Rp)	BCR	IRR (%)	BPP (IDR)	Information
1	Condition I	5.25	1365	80	59,637,098,957	623,626,881,384	23,721,513,188	1.04	30.54 %	1,267	PROPER
2	Condition II	5.50	1365	80	59,341,795,196	623,626,881,384	25,452,648,492	1.05	31.43 %	1,260	PROPER
3	Condition III	5.75	1365	80	59,036,665,736	623,626,881,384	27,232,926,553	1.05	32.30 %	1,254	PROPER
4	Condition IV	6.00	1365	80	58,721,373,773	623,626,881,384	29,063,878,901	1.05	33.15 %	1,247	PROPER
5	Condition V	6.10	1365	80	58,592,333,877	623,626,881,384	29,810,800,952	1.05	33.49 %	1,244	PROPER
6	Condition VI	6.25	1365	80	58,395,571,081	623,626,881,384	30,947,085,818	1.06	34.00 %	1,240	PROPER
7	Condition VII	6.50	1365	80	58,058,897,637	623,626,881,384	32,884,177,861	1.06	34.83 %	1,233	PROPER
8	Condition VIII	6.75	1365	80	57,710,981,232	623,626,881,384	34,876,837,449	1.06	35.65 %	1,226	PROPER

Fuel Price Sensitivity

Fuel price sensitivity only calculates scenarios with decent conditions. This further strengthens the influence of changes in fuel prices that use coal. The initial calculation on the excess power purchase scenario uses a coal price of 90.48 USD / Ton. The details of the estimated changes in coal prices are as follows.

Table 8. Mapping Fuel Price Conditions

No	Case
1	Basecase (Coal 90.48 USD/Ton)
2	Case I (Coal 100 USD/Ton)
3	Case II (Coal 125 USD/ton)
4	Case III (Coal 150 USD/Ton)
5	Case IV (Coal 200 USD/ton)
6	Case V (Coal 250 USD/ton)
7	Case VI (Coal 300 USD/Ton)
8	Case VII (Purchase Price 90% BPP Kepmen)
9	Case VIII (Purchase Price 70% BPP Kepmen)

The coal price in the basecase uses coal price data of 90.48 USD / Ton. In other conditions the price with sensitivity changes from 100 USD/Ton to 300 USD/Ton. In addition, it is also calculated based on the Minister of Energy and Mineral Resources No. 19 of 2017 concerning the purchase of excess power allowed with a maximum value of 90% of the value of the local BPP. Then strengthened by PLN Perdir no 0005 of 2018 concerning the purchase of excess power is allowed with a maximum value of 70% of the value of the local BPP.

The calculation of sensitivity to changes in fuel prices below is shown in the base case condition of coal prices of 90.48 USD / Ton. Below is the result of calculating all conditions that are likely to change. Condition 1: Base case (Coal 90.48 USD/Ton). From the conditions consisting of changes in fuel prices, the results of the project assessment are as follows:

Table 9. Financial Feasibility Recap of Fuel Condition

No	Case	Excess Tariff (Rp/kWh)	CF (%)	Interest Rate	Cost Operation (Rp)	NPC (Rp)	NPV (Rp)	BCR	IRR (%)	BPP (IDR)	INFORMATION
1	Basecase (Coal 90.48 USD/Ton)	907.77	80	6.10%	58,592,333,877	623,626,881,384	29,810,800,952	1.05	33.49%	1,244	PROPER
2	Case I (Coal 100 USD/Ton)	995.30	80	6.10%	61,834,876,208	652,645,312,799	792,369,536	1.00	9.73%	1,313	PROPER
3	Case II (Coal 125 USD/ton)	1,225.16	80	6.10%	70,275,294,714	728,181,013,018	(74,743,330,683)	0.89	#NUM!	1,492	NOT WORTH
4	Case III (Coal 150 USD/Ton)	1,455.02	80	6.10%	78,715,713,219	803,716,713,237	(150,279,030,902)	0.79	#NUM!	1,672	NOT WORTH
5	Case IV (Coal 200 USD/ton)	1,914.74	80	6.10%	95,596,550,229	954,788,113,675	(301,350,431,340)	0.66	#NUM!	2,030	NOT WORTH
6	Case V (Coal 250 USD/ton)	2,374.46	80	6.10%	112,477,387,239	1,105,859,514,113	(452,421,831,778)	0.56	#NUM!	2,389	NOT WORTH
7	Case VI (Coal 300 USD/Ton)	2,834.18	80	6.10%	129,358,224,250	1,256,930,914,551	(603,493,232,216)	0.49	#NUM!	2,747	NOT WORTH
8	Case VII (Purchase	2,085.06	80	6.10%	101,850,586,917	1,010,757,262,612	(357,319,580,277)	0.62	#NUM!	2,163	NOT WORTH

	Price 90% BPP Kepmen)										
9	Case VIII (Purchase Price 70% BPP Kepmen)	1,621.71	80	6.10%	84,836,521,797	858,493,566,017	(205,055,883,681)	0.74	#NUM!	1,802	NOT WORTH

Based on these conditions, the fuel price greatly affects the project's feasibility. It can be seen that the price of Coal at 90.48 USD / Ton is the best in these conditions, and the price of Coal at 100 USD / Ton is still included in the decent category.

Project Scenario Analysis Results

From the results of the project scenario consisting of 3 (three) scenarios, namely the Relocation of the Own Generation System, the Addition of Generating Machine Leases, and the Purchase of Excess Power, it was found that the Excess Power Purchase scenario was the only feasible. In addition, in the excess power purchase scenario, the BPP value was found to be the lowest compared to other scenarios. The following is the calculation value of the Financial Feasibility Study of each scenario.

Table 10. Relocation of Own Generation System

Method	Result	Criterion	Information	BPP
NPV	(802,467,988,734)	≤ 0	Not Worth It	3,090
BCR	0.42	≤ 1	Not Worth It	
IRR	#NUM!	< COC (12.00%)	Not Worth It	
The project is NOT FEASIBLE.				

Table 11. Additional Generator Machine Rental

Method	Result	Criterion	Information	BPP
NPV	(756,291,279,896)	≤ 0	Not Worth It	2,983
BCR	0.43	≤ 1	Not Worth It	
IRR	#NUM!	< COC (12.00%)	Not Worth It	
The project is NOT FEASIBLE.				

Table 12. Purchase Excess Power

Method	Result	Criterion	Information	BPP
NPV	29,810,800,952	≤ 0	Proper	1,244
BCR	1.05	≤ 1	Proper	
IRR	33.49%	< COC (12.00%)	Proper	
The project is FEASIBLE.				

The calculation results are still influenced by several factors that have been made in the sensitivity of the project with parameters, namely the influence of Interest Rate and Fuel Price. The effect of changing the Interest Rate between 5.25% to 6.75% is to ensure the optimal value to get the best BPP. The excess power purchase scenario produces the best BPP value so that it is calculated with the effect of changes in the Interest Rate. Here's a recap of the calculations.

No	Condition	Interest Rate	TARIFF (Rp/kWh)	CF(%)	Cost Operation (Rp)	NPC (Rp)	NPV (Rp)	BCR	IRR (%)	BPP (IDR)	INFORMATION
1	Condition I	5.25	1365	80	59,637,098,957	623,626,881,384	23,721,513,188	1.04	30.54%	1,267	PROPER

2	Condition II	5.50	1365	80	59,341,795,196	623,626,881,384	25,452,648,492	1.05	31.43%	1,260	PROPER
3	Condition III	5.75	1365	80	59,036,665,736	623,626,881,384	27,232,926,553	1.05	32.30%	1,254	PROPER
4	Condition IV	6.00	1365	80	58,721,373,773	623,626,881,384	29,063,878,901	1.05	33.15%	1,247	PROPER
5	Condition V	6.10	1365	80	58,592,333,877	623,626,881,384	29,810,800,952	1.05	33.49%	1,244	PROPER
6	Condition VI	6.25	1365	80	58,395,571,081	623,626,881,384	30,947,085,818	1.06	34.00%	1,240	PROPER
7	Condition VII	6.50	1365	80	58,058,897,637	623,626,881,384	32,884,177,861	1.06	34.83%	1,233	PROPER
8	Condition VIII	6.75	1365	80	57,710,981,232	623,626,881,384	34,876,837,449	1.06	35.65%	1,226	PROPER

From this calculation, it was found that the Interest Rate value was getting bigger, resulting in the best BPP value of Rp 1,226, - This was influenced by the improvement in the value of Cost Operation on the kWh of sales produced. The effect of fuel changes starts with using the price of Coal in January 2023 of 90.48 USD/Ton to a price of 300 USD/Ton. In addition, the purchase price of 90% BPP and the purchase price of 70% is calculated from BPP according to the Decree of the Minister of Energy and Mineral Resources.

The amount of fuel prices greatly affects the cost of operations and impacts the value of BPP. The cheaper the fuel price, the lower the BPP value produced. Suppose you look at the Cost of Goods Provided (BPP) in the Vedic system in 2022 of IDR 4,193 - compared to the calculation of the financial feasibility study using Homer, the BPP value of IDR 1,156 - with kWh of production in 2023 of 47,088,000 kWh. In that case, there is a savings of *IDR 143,006,256,000* per year.

CONCLUSION

The financial feasibility calculation for the Excess Power purchase scenario shows very positive results, with an NPV value of Rp 29 billion, IRR of 33.49%, and BCR of 1.05. In addition, an analysis of the overall cost of the system over 20 years shows that the use of Homer applications in the Excess Power scenario provides the highest efficiency, with NPC of Rp 619 billion, CO of Rp 53 billion, and LCOE of Rp 1,156. Furthermore, through the process of the three scenarios, it was found that the optimal and feasible BPP value was found in the Excess Power scenario, with a value of Rp 1,244 (based on KKF calculations) and Rp 1,156 (based on Homer's simulation). The overall results of this analysis confirm that the investment in Excess Power is financially viable and efficient in the long run, giving confidence in the success of this project.

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