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Investment Valuation of Long-Term Coal Mining Project at Pit J Using Discounted Cash Flow Method

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ABSTRACT:
Pit J is a new pit at Binungan 8 that will be developed to the west in 2024 and has a mine life of 9 years. The initial plan was to develop Pit J, which produced around 23 million tons of coal. However, there is a second alternative that can increase Pit J production to 28 million tons. Therefore, a project investment analysis of these two alternatives was conducted to determine which mining scheme to take and which is more profitable. This research uses a method of conducting investment valuation of the Pit J mine project, namely discounted cash flow (DCF). A deterministic approach using DCF was first conducted to determine the value of economic feasibility parameters, including net present value (NPV), internal rate of return (IRR), and payback period. This was followed by the identification of variables that most affect the NPV value through sensitivity analysis. Based on the research, both mining alternatives were declared financially feasible through the discounted cash flow method, with the first alternative having an NPV of 65.8 million USD, IRR of 60%, and a payback period of 4.77 years, while the second alternative resulted in an NPV of 88.4 million USD, IRR of 65%, and payback period 4.55 years. Sensitivity analysis shows that the variable change in Coal price is the most sensitive variable to the valuation of Pit J. Therefore, the second alternative is chosen as the best alternative to run.
Keywords: Discounted Cash Flow, Net Present Value, Coal Price, Alternative, Pit J Binungan 8.

INTRODUCTION

The introduction sets the stage for the thesis by providing an overview of the research topic, explaining its importance, and outlining the context. It presents the problem statement, clearly defining the issue the research aims to address, and lists the research objectives and questions. This chapter also discusses the study's scope and limitations and outlines the thesis's structure.

The need for electrical energy is still not separated from fossil fuel sources because coal accounted for 45% of global electrical energy in 2022, while renewable energy still reached 17% (Bolson et al., 2022; Kabeyi & Olanrewaju, 2022; Overland et al., 2022; Strielkowski et al., 2021).

The large value of investment and technology in creating renewable energy is one reason coal still prevails (Bulut & Muratoglu, 2018; Gallagher, 2014; Shakeel et al., 2016; Vidadili et al., 2017).

Based on data from the Ministry of Energy and Mineral Resources, in 2022, Indonesia's coal reserves will reach 33.37 billion tons, with the largest portion of reserves in East Kalimantan at as much as 41% (Afiffa & Warmadewanthi, 2024). It also encouraged the government to increase the coal production rate after the COVID-19 pandemic in 2021. Indonesia's 2023 coal production realization by the end of November met the annual target of 101%, or 703 million tons, while its sales realization, consisting of exports and domestic, reached 105%, or 725 million tons.

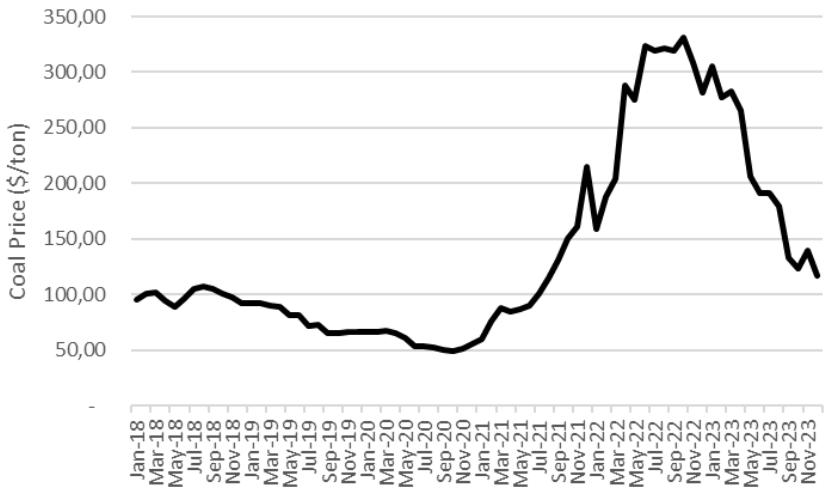

Figure 1. Coal Price (HBA) 2018-2023

PKP2B license PT BC will expire in 2025. However, PT BC still has the option to apply for a 2 x 10-year license extension to continue its activities. This option creates a new opportunity to extend the life of the Company's coal mine, especially in Pit J Binungan 8 until 2033, and is also the last pit that is still active in Binungan 8.

The development of the Pit J mine until 2032 creates a new challenge. In 2025, a creek will cross the progress of the mine area, so there are two options in the execution of the mine: not to cut the creek as alternative 1 or not to cut the creek as alternative 2.

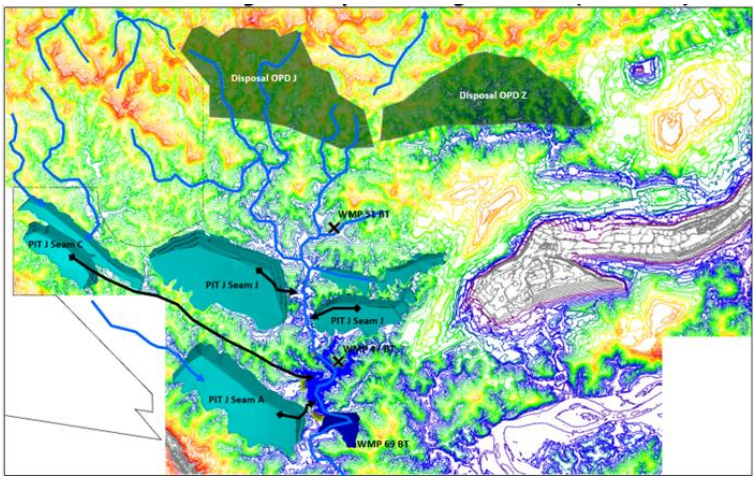

Figure 2. Pit J Design if Not to Cut the Creek (Alternative 1)

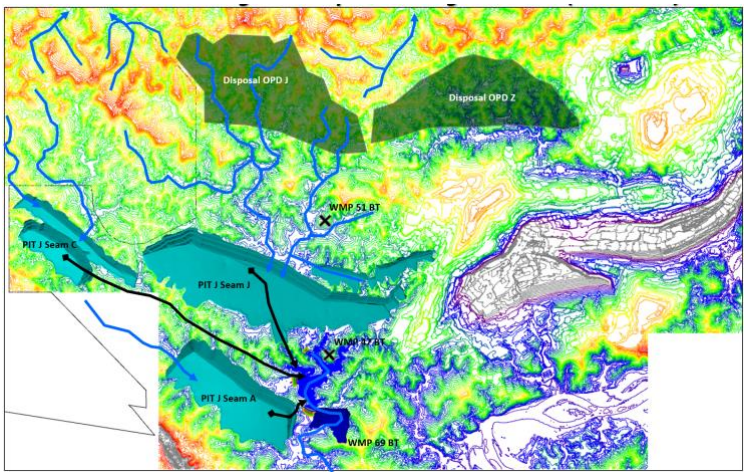

Figure 3. Pit J Design if Cut the Creek (Alternative 2)

The main concern in Pit J mining is managing water from mining activities because it affects the supporting facilities, such as water monitoring points (WMP), that will be made and the amount of coal reserves that will be mined.

This research aims to determine the feasibility and the best alternative for Pit J in the mining process until the end of LOM (Life of Mine) in 2032, as it has the largest coal reserves in Binungan 8 for the period 2023-2032. The research questions include the feasibility of the project, the most sensitive variables affecting the NPV, and the project's feasibility under extreme conditions of these variables. Valuation results must be accurate by considering internal and external conditions to determine mitigation measures for potential risks during the Pit J mining process. The research scope is to obtain the NPV from the Discounted Cash Flow (Deterministic) to determine the feasibility of the Pit J Binungan 8 coal mining project, with some limitations including the geological model version 0923 (September 2023), the assumption of no

environmental and social impacts, indicative company data due to confidentiality, working partners remaining the same until the end of the project in 2032, and no terminal value as all assets will be returned to the government.

RESEARCH METHODS

This chapter describes the research design, explaining and justifying the chosen approach (Creswell & Poth, 2016; DePoy & Gitlin, 2019; Hennink et al., 2020; Leavy, 2022). It details the population and sample, including sampling techniques and sample size. The data collection methods section outlines the tools and procedures for gathering data. The data analysis techniques are explained, and the methods and software used are specified.

The Research Design begins by identifying the problem being discussed in this research related to the Investment Valuation of Pit J Binungan 8. The next research step is a literature review related to financial modeling, including theories and frameworks such as steps in valuation using deterministic and probabilistic methods. The literature review results are used as a reference in analyzing the current business situation at PT BC, especially the Pit J Binungan 8 coal mining project, which consists of internal analysis (related to resources) and external analysis related to coal price uncertainty. The next step is to collect the required primary and secondary data, which will be utilized in data analysis in the form of a financial valuation of the Pit J mining project. The valuation results will be used as a reference for the recommendations in making Pit J Binungan 8 mining decisions.

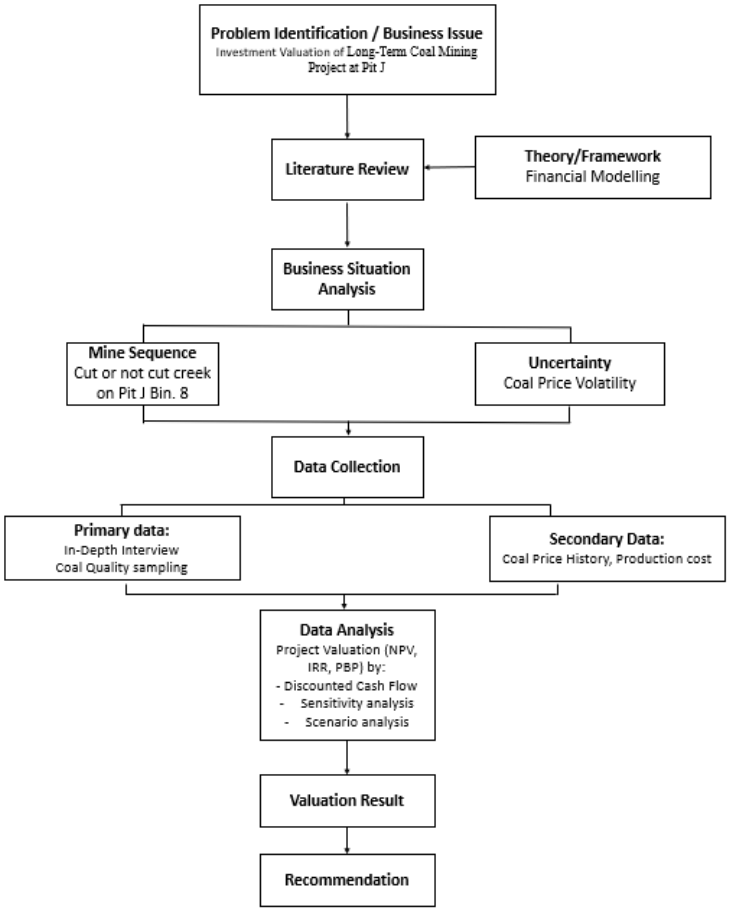

Figure 4. Research Design

Data Collection Method

The study uses Primary data in the form of in-depth interviews about each alternative's production plan and coal quality sampling. At the same time, a particular company report obtains secondary data related to coal price history and production cost.

In-Dept Interview

Interviews were conducted directly between the author and the mine planner to discuss the sustainability of the Pit J coal mining project and whether it will continue until 2032. The interview results are in the form of two mine development alternatives, namely by cutting the creek or without cutting the creek, which is planned to be implemented in 2025 or 2026. Pit J's production plan relates to the two alternatives described in this business issue research, divided into two schemes if Pit J's mine progress cuts across the creek and does not cut across the creek.

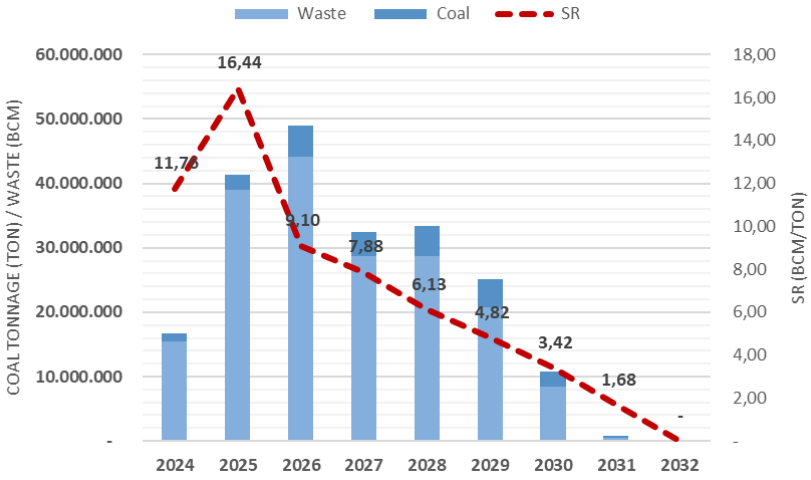

Figure 5. Pit J Production Alternative 1 (without cut creek)

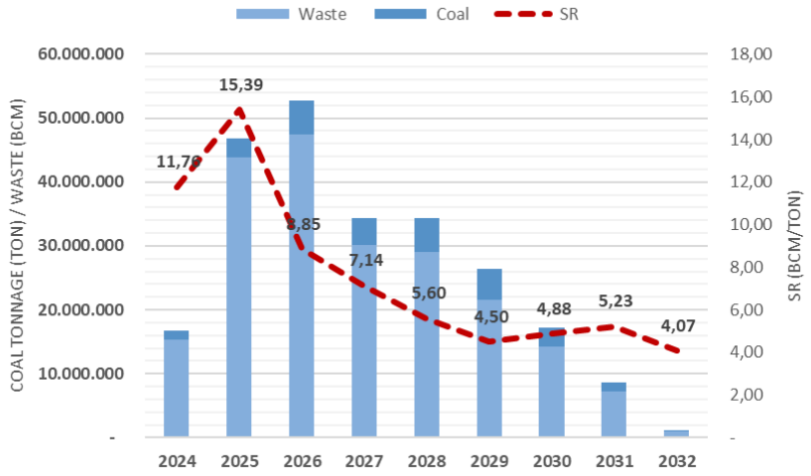

Figure 6. Pit J Production Alternative 2 (cut creek)

Coal Quality Sampling

Direct coal sampling aims to validate the quality of coal in the field. The quality parameters obtained include ash, total moisture, sulfur, sodium, and HGI. This quality is essential because it will determine the coal price adjustment used in calculating project revenue.

Table 1. Coal Quality of Pit J Binungan 8

Plt	Desc	Seam J	Seam M	Seam K	Seam L
-	TM (ar)	25,73	26,35	25,99	25,35
	IM (adb)	18, 31	15,84	15,99	17,83
	Ash (adb)	4,19	4,82	5,45	3,87
	VM (adb)	39,16	40,43	39,56	39,67
	FC (adb)	38,34	38,92	39,00	39,59
	TSADB (adb)	0,17	0,34	0,18	0,13
	CV (adb)	5.417	5.536	5.459	5.461,50
	Na2O (%)	2,18	1,23	2,35	3,38
	AFT IDT RED (deg)	1.175	1.268	1.167	1.171,36
	AFT FLOW RED (deg)	1.272	1.393	1.261	1.248,88
	Relative Density	1,33	1,34	1,35	1,32
	Hardgrovability Index	45	47	45	50,46

Data Analysis Method

All available data will be analyzed using financial models to obtain valuation results that can be used to make project feasibility decisions. Data analysis is started by discounted cashflow valuation as the deterministic method, which includes calculating net present value, internal rate of return, and payback period.

Free Cash Flow

Free cash flow or project cash flow is the amount of cash a company generates after deducting expenditures to maintain or expand its assets. It measures a company's ability to generate cash after meeting its operating obligations and capital expenditures. Investors often use free cash flow to assess a company's financial health and ability to pay dividends, pay off debt, or make new investments.

$$Free\ Cash\ Flow = Operating\ Cash\ Flow - Capital\ Expenditures$$

Weighted Average Cost of Capital (WACC) Calculations

According to Gitman et al. (2015), WACC represents the blended cost of various sources of capital, incorporating the proportionate weights of equity, debt, and preferred stock in the firm's capital structure. Gitman and Zutter emphasize that WACC is a crucial metric for discounting future cash flows in capital budgeting decisions, ensuring that the cost of capital reflects the firm's overall financing mix. The formula considers the cost of equity, the cost of debt adjusted for taxes, and the cost of preferred stock. WACC theory posits that this composite rate is the minimum return required by the firm to satisfy investors and creditors, providing a benchmark

for evaluating the attractiveness of investment opportunities and guiding financial decision-making in maximizing shareholder value. The WACC formula is expressed as follows:

$$WACC = (cost\ of\ equity * \%equity) + (cost\ of\ debt * \%debt * (1 - tax\ rate)$$

Discounted Cash Flow Method

Many businesses use net present value (NPV) in capital budgeting and investment planning to evaluate the investment projects' long-term profitability. The NPV computation is used to get the present value of a future stream of payments. The net present value (NPV) of a project is determined, according to Gitman et al. (2015), by subtracting the initial investment (CF_0) from the project's present value of cash inflows (CFt), which is then discounted at a rate equivalent to the company's cost of capital (r). If the NPV is positive, the project should be approved. Otherwise, the project should be rejected if the NPV is negative.

$$\boldsymbol{NPV = \sum_{t=1}^{n} \frac{CFt}{(1+r)^t} - CF_0}$$

Internal rate of return (IRR) is the rate of return on investment (in percent) when the Net Present Value is equal to zero or the rate of return on investment when the sum of Present Worth is positive and Present Worth is negative. The IRR value can be used to determine the feasibility of an investment by comparing the IRR value with the WACC (i*) set by the company. The investment is economically feasible if the IRR value exceeds the WACC. Conversely, the investment is not economically feasible if the IRR is less than WACC.

$$\boldsymbol{\sum Present\ Worth\ Revenue = \sum Present\ Worth\ Cost}$$

The payback period is the time (in years) required by a project's income to return the value of the investment/capital that has been invested in the project. Investments with short payback periods are preferred over investments with long payback periods because short payback periods indicate that the investment can generate income quickly throughout its life so that investment costs can be replaced quickly as well, high liquidity levels, fast investment return rates, and lower investment risk levels. The analysis of the payback period method is explained by Gentry (2016) as follows:

1. The method is simple and easy to calculate.
2. It can be controlled by considering the level of investment risk. Investments with a high level of risk must have a payback period as soon as possible to reduce the risk effect.

3. The payback period method can reduce lost opportunity risk in the company. The shorter the payback period, the smaller the lost opportunity risk, and vice versa.
4. The payback period method represents the breakeven point. Projects with a longer life than the payback period will generate profits for the company. Conversely, projects with a shorter life than the payback period will be detrimental to the company.

RESULTS AND DISCUSSION

Coal Price and Revenue

Pit J Binungan 8 mining project revenue is obtained by multiplying the coal price by the amount of coal sold. In addition, according to the explanation of royalties in Chapter III, the revenue obtained earlier will be reduced by the sales royalty to get net revenue. The assumptions used are 25% domestic sales with a fixed 14% royalty and 75% export sales with a royalty percentage adjusting to the current year's reference coal price (HBA).

The coal price used refers to the index used by PT BC, namely Indonesia Coal Index class 3 (ICI3), according to the quality of Binungan 8 coal, which has a calorific value of 5000 GAR. The following are the results of the calculation of Pit J Net Revenue.

Table 2. Coal Revenue Calculation

Year of Operation			1	2	3	4	5	6	7	8	9
Flat IC13 price	$/t		80,31	80,31	80,32	80,33	80,34	80,35	80,36	80,37	80,38
Factor for ICI 3 to HBA	x	1,56									
HBA price	$/t		125,28	125,29	125,30	125,31	125,32	125,33	125,34	125,35	125,36
DMO ceiling price	$/t	70									
DMO HPB ICI3 Price	$/t		44,87	44,88	44,89	44,90	44,91	44,92	44,93	44,94	44,95
DMO proportion	%	25 %									
ICI3 price after DMO adjusted			71,45	71,46	71,47	71,48	71,49	71,50	71,51	71,52	71,53
Price Adjusment - ICI3 price											
CV Premium	$/t		-	(4,21)	(2,42)	(3,44)	(4,57)	(6,89)	(6,87)	(6,86)	(6,84)
TS Premium / Discount	$/t		-	-	-	-	-	-	-	-	-
Ash Penalty	$/t		-	-	-	-	-	-	-	-	-
ICI3 Price Adjusment - Coal Quality	$/t		-	(4,21)	(2,42)	(3,44)	(4,57)	(6,89)	(6,87)	(6,86)	(6,84)
Price Adjusment - ICI3 price											
CV Premium	$/t		-	(2,35)	(1,35)	(1,92)	(2,55)	(3,85)	(3,84)	(3,83)	(3,82)
TS Premium / Discount	$/t		-	-	-	-	-	-	-	-	-
Ash Penalty	$/t		-	-	-	-	-	-	-	-	-
DMO HPB ICI 3Price Adjusment - Coal	$/t		-	(2,35)	(1,35)	(1,92)	(2,55)	(3,85)	(3,84)	(3,83)	(3,82)

Export price - ICI3 price adjusted	$/t		71,45	67,24	69,03	68,01	66,88	64,56	64,58	64,59	64,61
Domestic price - DMO price adjusted	$/t		44,87	45,52	43,52	42,95	42,32	41,02	41,03	41,04	41,05
DMO proportion	%	25 %									
Domestic Market	mton		-	0,33	0,59	1,21	0,91	1,17	1,03	0,61	0,08
Export Market	mton		-	0,98	1,78	3,64	2,74	3,51	3,24	1,84	0,24
Royalty rate - domestic	%		13,5 %	13,5 %	14,0 %	14,0 %	14,0 %	14,0 %	14,0 %	14,0 %	14,0%
Royalty rate - export	%		13,5 %	13,5 %	28,0 %	28,0 %	28,0 %	28,0 %	28,0 %	28,0 %	28,0%
Revenue Domestic	USD M	251	0,00	13,90	25,76	52,04	38,63	47,98	44,30	25,19	3,31
Revenue Export	USD M	1.189	0,01	65,97	122,60	247,22	183,14	226,52	209,19	118,93	15,65
Less: domestic royalty	USD M	(35)	0,02	(1,88)	(3,61)	(7,29)	(5,41)	(6,72)	(6,20)	(3,53)	(0,46)
Less: export royalty	USD M	(323)	0,03	(8,91)	34,33)	(69,22)	(51,28)	(63,43)	(58,57)	(33,30)	(4,38)
Net revenue	**USD M**	**1.082**	**0,04**	**69,09**	**110,43**	**222,76**	**165,08**	**204,36**	**188,72**	**107,29**	**14,12**

Capital Expenditures

Preparation for Pit J mining operations begins in 2023 with several investment categories: Infrastructure, Sustainability, Exploration, and Land. Infrastructure includes a water monitoring point (WMP), creek diversion, and construction of an access road to the mine. The land itself includes land acquisition to the government because the Pit J area includes the KHDTK area and payment of land residents own.

Table 3. Capital Expenditures of Each Alternative

Capex	Unit	Alt 1	Alt 2
Infrastructure	USD millions	10,00	19,50
Sustainable	USD millions	2,39	5,66

Exploration	USD millions	4,17	5,90
Land	USD millions	0,71	1,01
Total	**USD millions**	**17,27**	**32,07**

Operational Expenses

PT BC conducts the mining process by appointing other parties, such as mining contractors, from the mining process in the pit, coal processing, and other indirectly related work activities. In each phase of activity, there are different mining contractors based on their respective expertise.

Mining costs consist of the scope of work involved in overburden removal, coal getting, and transportation. The work value per unit of material mined is influenced by the transportation distance from the loading front to the disposal or coal stockpile. The transportation distance also affects the variable fuel used. The mining cost parameters described previously are divided into several tiers according to the price of coal used.

Table 4. Contractor Mining Rate

Overburden Removal	**Tier based on price**	**48**	**52**	**60**
Overburden charge rate	$/bcm	1,500	1,569	1,688
Waste Fuel Ratio	Lt/bcm	0,82	0,82	0,82
Contract Waste Ditstance	kn	1,30	1,30	1,30
Waste Overhaul Rate	$/bcm/km	0,29	0,30	0,31
Waste Overdistance Fuel Ratio	lt/bcm/km	0,24	0,24	0,24
Coal Getting				
Coal getting charge Rate	$/bcm	2,12	2,15	2,15
Coal Fuel Ratio	Lt/bcm	0,85	0,85	0,85
Contract Coal Distance	kn	13,00	13,00	13,00
Coal Overhaul Rate	$/bcm/km	0,09	0,09	0,09
Coal Overdistance Fuel Ratio	lt/bcm/km	0,04	0,04	0,04

Other operating costs include coal processing at the coal processing plant (CPP) in the form of coal reduction activities up to 50 mm in size, coal handling in the form of coal transportation to the port, and coal loading to the barge to the transhipment point, and general and administrative costs. Other costs assume the current contract value used by PT BC.

Table 5. Other Cost Assumptions

Processing and Handling Cost

Processing Cost	unit	value
Coal crushing	$/t	0,35
Coal treatment, fuel & lubrication	$/t	0,14
Repair maintenance	$/t	,22
Lab analysis and others	$/t	0,03
Hauling to Port		
haul to port - rate excl fuel	$/ton/km	0,04
coal haulafe to port fuel ratio (FR)	lt/ton/km	0,02
Barging		
coal barging - rate exc fuel	$/ton	0,54
coal barging fuel ratio (FR)	$/ton	0,47
Trans-shipping		
Transhipment	$/ton	1,52
stevedoring, Superintending	$/ton	0,54
Other cost		
Employee cost	$/bcm	-
Others G&A	Lt/bcm	1,90
Selling expence	kn	0,03
Selling commision	$/bcm/km	1,50%

Tax and Depreciation

PT BC applies a tax of 45% during the Coal Contract of Work until 2025, after which it changes to 22% when its mining license is extended by 2 x 10 years with IUPK status. The IUPK status is also subject to non-tax state revenue (PNBP) of 10% under PP No. 15 of 2022, with a proportion of 4% for the central government and 6% for the local government.

Depreciation uses the straight-line method during the mining process, with no salvage value, because all used assets will be given to the government at the end of the mining period. PT BC does not register intangible assets, so there is no amortization.

Table 6. Assets Depreciation Scenario

Year		**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**
Alternatif 1											
Infrastructure	USD M	4,00	2,00	4,00	-	-	-	-	-	-	
Sustainable	USD M	-	0,13	0,24	0,48	0,37	0,47	0,43	0,25	0,03	-

Exploration	USD M	0,50	0,77	0,77	0,73	0,70	0,70	-	-	-	-
Land	USD M	0,11	0,30	0,30	-	-	-	-	-	-	-
Depreciation	USD M	-	0,98	1,73	1,94	2,15	2,44	2,59	2,71	2,74	-
Alternatif 1											
Infrastructure	USD M	5,00	2,50	12,00	-	-	-	-	-	-	-
Sustainable	USD M	-	0,26	0,57	1,07	0,84	1,04	0,96	0,59	0,28	0,05
Exploration	USD M	0,50	0,77	0,77	1,61	0,70	1,56	-	-	-	-
Land	USD M	0,11	0,30	0,60	-	-	-	-	-	-	-
Depreciation	USD M	-	1,05	2,79	3,17	3,43	3,95	4,19	4,39	4,52	4,57

Project Cashflow

Calculating each component, including revenue, operating cost, CAPEX, tax, and depreciation, will produce a project cash flow, as illustrated in Table IV.6.

Table 7. Project Cash Flow Pit J Bin 8

		Aternative 1								
Parameter	**Total**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**
Revenue	1.081,85	-	69,09	110,43	222,76	165,08	204,36	188,72	107.29	14,12	
Operating Expenses	(848,32)	0,44	(59,79)	(141,88)	(199,22)	(132,07)	(144,41)	(114,89)	(53,78)	(2,72)	
Capital Expenditures	(17,27)	(4,61)	(3,20)	(5,31)	(1,21)	(1,07)	(1,17)	(0,43)	(0,25)	(0,03)	
EBITDA	216,25	(4,17)	6,10	(36,76)	22,32	31,95	58,78	73,39	53,27	11,36	-

Depreciation	(17,27)	-	(0,98)	(1,73)	(1,94)	(2,15)	(2,44)	(2,59)	(2,71)	(2,74)	
Amortization	-	-	-	-	-	-	-	-	-	-	
EBT	198,98	(4,17)	5,12	(38,49)	20,39	29,80	56,34	70,81	50,56	8,62	-
Tax Paid	(49,64)	-	(3,78)	-	-	(4,52)	(13,11)	(16,02)	(10,94)	(1,26)	
EAT	149,33	(4,17)	1,33	(38,49)	20,39	25,27	43,23	54,79	39,62	7,36	-
Government Retribution	(20,10)	-	-	-	(2,67)	(2,77)	(4,65)	(5,68)	(3,88)	(0,45)	
Add back Depretitation	17,27	-	0,98	1,73	1,94	2,15	2,44	2,59	2,71	2,74	
Cash flow	146,51	(4,17)	2,31	(36,76)	19,65	24,65	41,02	51,69	38,45	9,65	-

Aternative 2

Parameter	**Total**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**
Revenue	1.273,88	-	69,09	133,09	246,01	190,31	226,86	209,91	128,01	60,37	10,23
Operating Expenses	(956,18)	0,54	(59,83)	(162,06)	(212,52)	(139,32)	(149,03)	(120,98)	(72,88)	(34,43)	(5,68)
Capital Expenditures	(32,07)	(5,61)	(3,83)	(13,94)	(2,68)	(1,54)	(2,60)	(0,96)	(0,59)	(0,28)	(0,05)
EBITDA	285,62	(5,07)	5,43	(42,91)	30,82	49,45	75,23	87,97	54,55	25,67	4,50

Depreciation	(32,07)	-	(1,05)	(2,79)	(3,17)	(3,43)	(4,19)	(4,19)	(4,39)	(4,52)	(4,57)
Amortization	-	-	-	-	-	-	-	-	-	-	-
EBT	253,55	(5,07)	4,38	(45,70)	27,64	46,02	71,28	83,78	50,16	21,14	(0,08)
Tax Paid	(65,15)	-	(3,75)	-	-	(10,75)	(18,95)	(18,95)	(10,62)	(4,32)	(0,06)
EAT	188,41	(5,07)	0,63	(45,70)	27,64	35,27	54,60	64,83	39,54	16,82	(0,14)
Government Retribution	(25,55)	-	-	-	(3,71)	(3,89)	(5,91_	(6,72)	(3,77)	(1,53)	(0,02)
Add back Depretitation	32,07	-	1,05	2,79	3,17	3,43	3,95	4,19	4,39	4,52	4,57
Cash flow	194,92	(5,07)	1,68	(42,91)	27,11	34,81	52,64	62,30	40,16	19,81	4,41

Weighted Average Cost of Capital of The Project

PT BC self-finances its mining operations so that the funding proportion is 100% equity and 0% debt. Therefore, the WACC value will equal the cost of equity (Ke) used. The cost of equity calculation uses the capital asset pricing model method, using the following data assumptions.

Table 8. Data Assumptions for Cost of Equity

Parameter	References	Period	Value
Country Risk	10 years government bond yield	As of Jan 2024	6,59%
Default spread	Damodaran	As of Jan 2025	2,07%
Beta	Using similar risk company (PEFINDO)	As of Jan 2026	0,9778
Mothly market of Return	as JKE monthly changes	As of Jan 2027	0,89%
Market rate of Return (Rm)	Calculation of JKSE Changes on Jan 2024	As of Jan 2028	11%

The following is the calculation of the cost of equity:

$Rf = country\ risk - default\ spread$

$Rf = 6{,}59\% - 2.07\% = 4{,}52\%$

$Cost\ of\ Equity\ (Ke) = Rf + \beta * (Rm - Rf)$

$Cost\ of\ Equity\ (Ke) = 4{,}52\% + 0{,}9778 * (11\% - 4{,}52\%) = 11{,}07\%$

Since PT BC has 100% funding sources from equity, the WACC used is 11.07%.

Discounted Cash Flow of The Project

The discounted cashflow calculation uses cashflow data for each production alternative discounted using a WACC of 11.07% to obtain the project's net present value.

Table 9. Discounted Cash Flow Valuation of Pit J

Parameter	unit	Alt 1	Alt 2
NPV	USD M	65,8	88,4
IRR	%	60	65
Payback Period	years	4,77	4,55

Sensitivity Analysis of The Project

Sensitivity analysis was conducted by changing the value of one of the variables in the economic valuation to understand further the variables that most affect the economics of the Pit J mine. Changes in variable values ranged from -20% to +20% to determine changes in project NPV.

Table 10. Sensitivity Analysis of Alternative 1

Sensitivity table - NPV		-20%	20%
Coal Price	$65,78	5,59	124,38
		-20%	20%
Royalty Cost	$65,78	94,17	37,09
		-20%	20%
Brent Price	$65,78	81,18	50,35
		-20%	20%
Mining Cost	$65,78	97,70	33,36
		-20%	20%
Production Achievement	$65,78	20,28	110,47
		-20%	20%
General & admin cost	$65,78	69,84	61,73
		-20%	20%
Capital Expenditures	$65,78	67,81	63,75

Table 10. Sensitivity Analysis of Alternative 2

Sensitivity table - NPV		-20%	20%
Coal Price	$88,37	19,34	156,03
		-20%	20%
Royalty Cost	$88,37	121,38	54,99
		-20%	20%
Brent Price	$88,37	105,02	71,52
		-20%	20%
Mining Cost	$88,37	123,83	51,46
		-20%	20%
Production Achievement	$88,37	33,17	142,52
		-20%	20%
General & admin cost	$88,37	93,04	83,67
		-20%	20%
Capital Expenditures	$88,37	92,03	84,64

Scenario Analysis of The Project

Scenario analysis uses the three most influential variables in sensitivity analysis, namely coal price, production achievement, and mining cost, to identify each alternative's best and worst scenarios. It requires historical data, and if assumed data is used, it must be based on organizational agreements or technical recommendations.

Table 11. Scenario Analysis of Alternative 1

Input Variable	**Corresponding Input**				
	Mostliikely	**Worst**	**Remark**	**Best**	**Remark**
Coal Index Price (US$/ton) ICI3	80,31	36,40	Lowest Price period 2020-2023	180,84	Higest price periode 2020-2023
Production Achievement (%)	100%	-10%	Lowest production achievement in Binungan 8 (2020)	5%	Maximum production increased (RKAB policy)
Mining Cost changes (%)	0,00	7%	Cost increased 7%	-10%	Cost decreased 10%
Project Financial Performance					
PV (million US$)	65,8		-118,4		471,3
IRR%	60%		-44,40%		877%

PBR (Years)	4,77	0	1,12%

Table 12. Scenario Analysis of Alternative 2

Input Variable	Corresponding Input				
	Mostliikely	Worst	Remark	Best	Remark
Coal Index Price (US$/ton) ICI3	80,31	36,40	Lowest Price period 2020-2023	180,84	Higest price periode 2020-2023
Production Achievement (%)	100%	-10%	Lowest production achievement in Binungan 8 (2020)	5%	Maximum production increased (RKAB policy)
Mining Cost changes (%)	0,00	7%	Cost increased 7%	-10%	Cost decreased 10%
Project Financial Performance					
PV (million US$)	88,4		-20,7		556,6
IRR%	65%		-		742%
PBR (Years)	4,55		0-		1,15%

Business Solution

The results of the project value valuation using discounted cash flow show that both technical alternatives for mining Pit J Binungan 8 are feasible because they have a positive economic value. Alternative 2 of Pit J has better economic value parameters with an NPV of 88.4 USD million, an IRR of 65%, and a payback period of 4.55 years.

Sensitivity analysis of several variables that affect the NPV value of the Pit J Binungan 8 project shows that the price of coal is the most influential variable. Because the coal variable cannot be controlled and is uncertain for long-term projects, the price is modeled with coal forward using stochastic methods statically and dynamically.

Implementation Plan & Justification

The implementation plan refers to Alternative 2's baseline plan starting in 2022 and ending in 2032. Implementation will be divided into stages: planning, work area preparation, and mining to post-mining reclamation. The detailed implementation plan will be explained in Table IV.17.

Table 13. Implementation Plan for Pit J Alternative 2

Stage	Activities	DIC	Year									
			2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032

Mine Plan	Mine Scheduling	Mine Plan	
	Feasibility study	Mine Plan	
Site Preparation	Socialization and society engagement	External	
	Land Acquisition	Legal	
	Land Permit	License	
	Equipment mobilization	Mine Contractor	
	Exploration	Geology	
	Infrastructure construction	Civil Infrastructure	
Mining Activities	Land clearing	Mine Operation	
	Top soil removal	Mine Operation	
	OB removal	Mine Operation	
	Coal Getting	Mine Operation	
	Coal Hauling	Mine Operation	
	Coal Processing	Mine Operation	
	Coal barging and	Mine Operation	

	transhipment		
	Reclamation	Mine Operation	
	CRS	External	
Post Mining Activities	Revegetation	Environment	
	Mine Closure	Mine Closure	
	Equipment demobilization	Mine Contractor	

CONCLUSION

Based on the analysis using the discounted cash flow method, the two technical alternatives for Pit J Binungan 8 are feasible, as they have a positive net present value (NPV). Alternative 1 has an NPV of 65.8 million USD, an internal rate of return (IRR) of 60%, and a payback period of 4.77 years. Alternative 2 has an NPV of 88.4 million USD, an IRR of 65%, and a payback period of 4.55 years. Coal price is the most sensitive variable affecting NPV. Scenario analysis shows that the worst-case scenario occurs when coal prices drop during the COVID-19 pandemic, and the best-case scenario occurs during the Russia-Ukraine aggression that increases coal demand in Europe. The NPV of the base alternative for the worst-case scenario is -118.4 million USD and for the best-case scenario is 471.3 million USD. The NPV of the high alternative for the worst-case scenario is -120.7 million USD and for the best-case scenario is 556.6 million USD. Alternative 2 is recommended for the Pit J Binungan 8 mining plan.

The recommendations are divided into two perspectives: practical/managerial implications for stakeholders as outlined in the proposed implementation plan and suggestions for future research. Given that coal prices are highly sensitive and uncontrollable, it is recommended to project coal prices dynamically to assess long-term price uncertainty risks. This is important as coal prices affect various aspects such as heavy equipment service provider contract rates and royalties when PT BC's license status changes to IUPK. Additionally, the company is advised to use probabilistic methods like Monte Carlo and real options for project economic evaluation, as well as other optional modelling methods like fuzzy payoff or binomial lattice for future research.

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