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Driving The Energy Transition: Comparative Investment Analysis of Owned and Leased Electric Motor Systems as Replacements for Diesel Pump Drivers in Oil Transportation Infrastructure

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Abstract

The oil transportation sector faces growing challenges from diesel fuel price volatility, increasing operational expenditures, and reliability concerns in diesel-driven pumping systems. PT Pertamina Gas, particularly in the Operation Central Sumatera Area, continues to rely on diesel pump drivers for crude oil transportation, resulting in cost uncertainty, intensive maintenance requirements, and exposure to mechanical downtime. This study aimed to compare the economic feasibility and long-term cost implications of ownership and leasing models for electric motor implementation as a replacement for diesel pump drivers. A mixed-methods approach was applied, combining quantitative financial analysis, lifecycle cost analysis, sensitivity analysis, breakeven analysis, and qualitative strategic assessment. The financial evaluation employed NPV, IRR, Payback Period, Profitability Index, and Life Cycle Cost over a 15-year project horizon with a WACC of 11.16%. The results indicated that the ownership model provided the strongest long-term value, with an NPV of Rp 23,494.2 million, an IRR of 47.95%, a Payback Period of 2.08 years, and a Profitability Index of 3.42. Ownership also demonstrated lower lifecycle costs, with a present value of Rp 13,285 million compared to Rp 40,744.7 million for the leasing model. Long-term leasing was not recommended due to negative NPV and escalating lease payments, whereas short-term leasing was justified only as a tactical bridging option when incremental throughput exceeded the breakeven threshold. This study concluded that ownership should be adopted as the primary long-term strategy to enhance cost efficiency, asset control, operational reliability, and to support the Pertagas energy transition agenda.

INTRODUCTION

The national oil and gas industry faces challenges arising from changes in energy markets, driven by global price fluctuations and increasing demands for operational efficiency (Alagoz & Alghawi, 2023; Botão et al., 2023; Dongo & Relvas, 2025; Ekechukwu & Simpa, 2024; Kiamansouri, 2025; Omotoye et al., 2024). In this context, evaluating energy price indicators is essential for assessing economic risks and supporting investment planning, particularly for oil and gas infrastructure that continues to rely on liquid hydrocarbons (Ichsan et al., 2022). Indonesia's domestic oil and condensate prices reflect fluctuations in the light liquid hydrocarbon market derived from gas field production. These fluctuations are influenced by global energy price movements, supply–demand dynamics, and national oil and gas policies (Setiawan et al., 2021). Gas condensates, such as Senoro Condensate, hold strategic value due to their light characteristics, high economic potential, and sensitivity to international market dynamics (Benarimo et al., 2023). Price volatility demonstrates the economic risks faced by oil and gas infrastructure and serves as an important consideration in investment planning and energy efficiency strategies (Adi, 2022).

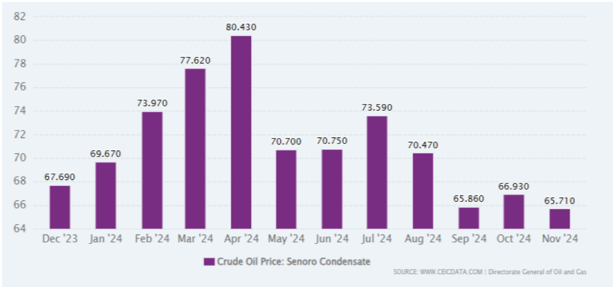

Figure 1. Indonesia Crude Oil Price: Senoro Condensate 2023–2024

Source: CEIC, Directorate General of Oil and Gas (2025)

Figure I. illustrates the price fluctuations of Senoro Condensate from December 2023 to November 2024. The price increased significantly from USD 67.69/barrel in December 2023 to a peak of USD 80.43/barrel in April 2024. This increase was influenced by pressures in the global energy market and changes in demand for light liquid hydrocarbons. Following this peak, prices underwent a correction and continued to fluctuate, gradually declining to USD 65.86/barrel in September 2024. Subsequently, prices remained relatively stable within the range of USD 65–67/barrel until November 2024.

What was Indonesia's Indonesia Crude Oil Price: Senoro Condensate in Feb 2025?

LAST	PREVIOUS	MIN	MAX	UNIT	FREQUENCY	RANGE
▼ 67.920 Feb 2025	▲ 71.120 Jan 2025	61.130 Jun 2023	81.580 Sep 2023	USD/Barrel	monthly	Oct 2022 - Feb 2025

Figure 2. Indonesia Crude Oil Price: Senoro Condensate February 2025

Source: CEIC, Directorate General of Oil and Gas (2025)

Figure 2 shows that the price of Senoro Condensate in February 2025 was recorded at USD 67,920 per barrel, which was lower than the January 2025 price of USD 71,120 per barrel. The lowest price during the period from October 2022 to February 2025 was USD 61,130 per barrel in June 2023. In September 2023, the price peaked at USD 81,580 per barrel, demonstrating significant volatility. This range of fluctuations indicates that fossil energy prices are likely to remain unstable in the medium term, directly affecting operational cost uncertainty for oil and gas infrastructure reliant on diesel (Hersaputri et al., 2024).

The primary challenges for maintaining operational sustainability are the reliability and efficiency of pumping systems. Reliance on diesel pump drivers complicates energy cost predictability and reduces overall system efficiency (Osetrov et al., 2022). Diesel engines have relatively low thermal-to-mechanical energy conversion efficiency, are prone to unplanned shutdowns, and require intensive maintenance, resulting in higher operational costs (Milojević et al., 2025). Over the long term, these factors may reduce the reliability of oil transportation infrastructure and increase operational risk (Mohammad et al., 2025).

From both technical and economic perspectives, replacing diesel-driven pump systems with electric motors represents a viable solution. Investing in electric motor systems involves shifting the cost structure from predominantly fuel-based operational expenditures (OPEX) to a combination of initial capital expenditure (CAPEX) and long-term electricity costs (Mylonopoulos et al., 2024). Factors affecting investment feasibility include the choice between ownership and leasing models, electrical infrastructure requirements, energy consumption, and maintenance costs over the asset's lifecycle (Putra et al., 2025).

PT Pertamina Gas (Pertagas) faces operational challenges due to its reliance on diesel pump drivers, which introduces volatility in fuel and maintenance costs, increases the risk of downtime, and affects long-term operational efficiency and reliability. These factors also reduce system efficiency and complicate cost planning over time.

To address these challenges, Pertagas is considering a strategic transition from diesel engines to electric motors. Electrification offers multiple benefits, including improved energy efficiency, lower operational costs, reduced maintenance requirements, enhanced asset reliability, and alignment with national goals, such as Indonesia's Net Zero Emission (NZE) 2060 commitment. This transition requires significant investment decisions, particularly regarding the optimal acquisition model:

owning electric motors or leasing them from a third-party provider. Each model has distinct financial, operational, and risk implications. Ownership requires higher initial CAPEX but provides long-term savings, whereas leasing reduces upfront investment but introduces vendor dependency and contractual constraints. Accordingly, a comparative investment analysis is critical to determine the most feasible and strategically aligned option for Pertagas (Charisma et al., 2024; Wulandari et al., 2022; 유사, 2024).

Pertagas was selected as the case study because it represents a capital-intensive midstream oil transportation company facing rising operational costs due to energy price volatility. The company operates extensive and complex oil transportation infrastructure supported by continuous pumping systems that rely heavily on diesel pump drivers. This dependence results in high fuel costs, continuous maintenance requirements, and potential equipment failure due to wear on rotating components. These conditions have become increasingly critical amid declining crude oil throughput, which pressures operating margins and necessitates more efficient investment decisions.

Pertagas is also undergoing a transition phase in which replacing diesel pumps with electric motors is a tangible strategic option. Consequently, investment choices, particularly between ownership and leasing, directly impact capital structure, long-term cost efficiency, asset control, and risk allocation. Historical operational, maintenance, and energy usage data provide a solid foundation for comprehensive investment analysis, making Pertagas a representative case for examining comparative investment feasibility in energy-intensive infrastructure within the framework of industrial electrification and the energy transition.

This study was driven by the need to evaluate the transition from diesel-driven pumps to electric motor systems in crude oil transportation operations at PT Pertamina Gas. Based on identified operational challenges and the proposed electrification strategy, the research addressed two primary questions: (1) how the economic feasibility compares between ownership and leasing models for electric motor implementation while considering operational and strategic business factors, and (2) how long-term cost implications differ between the two models regarding capital expenditure (CAPEX), operational expenditure (OPEX), maintenance costs, operational savings, and asset lifecycle efficiency. Accordingly, the objectives of this research were to analyze the comparative economic viability of ownership and leasing models from operational and strategic perspectives and to evaluate their long-term financial implications by examining investment costs, operational efficiency, maintenance requirements, and lifecycle performance.

METHOD

Research Design

The research design employed in this study applied a mixed-methods approach by integrating quantitative and qualitative analyses. This approach was used to comprehensively evaluate the investment feasibility of replacing diesel pump drivers with electric motor systems in the oil transportation infrastructure of PT Pertamina Gas (Pertagas). The combination of methods enabled the assessment of economic performance while capturing technical, operational, and strategic considerations associated with the transition.

Quantitative Research

The quantitative approach was used to evaluate and compare the economic feasibility of ownership and leasing models for electric motor implementation as alternatives to diesel pump drivers in crude oil transportation operations. Quantitative analysis was conducted through financial modeling and lifecycle cost evaluation to determine the most feasible investment alternative from an economic perspective.

The financial analysis applied several investment feasibility indicators, including Net Present Value (NPV), Internal Rate of Return (IRR), Payback Period (PP), Profitability Index (PI), and Life Cycle Cost (LCC). These indicators were used to assess long-term financial performance, investment profitability, cost efficiency, and investment recovery capability throughout the project lifecycle.

The quantitative analysis compared ownership and leasing investment schemes based on differences in capital expenditure (CAPEX) structure, operating costs, maintenance responsibilities, lease payments, overhaul costs, electricity consumption, and lifecycle cost implications. The ownership model focused on direct asset investment and long-term operational efficiency, whereas the leasing model emphasized operational flexibility and reduced initial capital requirements.

In addition, sensitivity analysis was conducted to evaluate investment feasibility under varying operational and financial conditions. The variables analyzed included diesel price fluctuations, electricity tariff changes, CAPEX variations, operating hours, lease fee escalation, and discount rate adjustments. This analysis assessed the potential impact of uncertain business and operational conditions on investment performance.

Furthermore, the quantitative analysis considered operational and economic risks that could influence long-term investment performance and financial sustainability. The results of the quantitative analysis were subsequently used as the primary basis for comparing the investment feasibility of ownership and leasing alternatives for electric motor implementation.

Qualitative Research

The qualitative approach was employed to support the technical, operational, and strategic evaluation of electric motor system implementation in crude oil transportation infrastructure. The qualitative analysis provided contextual insights into operational conditions, implementation challenges, infrastructure readiness, maintenance considerations, and organizational capabilities that could influence investment decisions between ownership and leasing models.

Qualitative data were obtained through interviews, expert discussions, operational observations, and document reviews involving personnel with relevant expertise and operational experience. The interview process involved selected respondents from operational, maintenance, engineering, and managerial functions who had direct knowledge of crude oil transportation operations, diesel pump driver performance, maintenance activities, electrification implementation, and operational reliability.

The qualitative approach was also used to identify strategic and operational factors related to infrastructure readiness, technical capabilities, operational capacity, maintenance challenges, and implementation risks associated with electric motor systems. Information obtained from interviews and expert discussions was utilized to support internal business analysis regarding organizational capability and operational readiness for electrification implementation.

Furthermore, qualitative analysis supported internal and external business evaluations using strategic frameworks, including PESTEL, Porter’s Five Forces, Resource-Based View (RBV), and VRIO analysis. The findings from the qualitative analysis were subsequently integrated into SWOT analysis to identify the strengths, weaknesses, opportunities, and threats associated with ownership and leasing investment alternatives.

To improve the reliability of the analysis, qualitative findings were validated through triangulation among interview results, operational data, maintenance records, technical documentation, and supporting company reports. The integration of qualitative findings with quantitative financial analysis provided a comprehensive evaluation of investment feasibility and strategic suitability for electric motor implementation in crude oil transportation operations.

Strategic Business Analysis

In addition to quantitative and qualitative approaches, this study incorporated strategic business analysis to evaluate external and internal factors influencing investment decisions related to electric motor implementation in crude oil transportation infrastructure. This analysis ensured that investment decisions were not based solely on financial feasibility but also considered organizational capabilities, industry conditions, operational readiness, and external business environments related to industrial electrification and energy transition.

External business analysis was conducted using the PESTEL framework and Porter’s Five Forces framework. The PESTEL framework was applied to evaluate macro-environmental factors, including political, economic, social, technological, environmental, and legal aspects that could influence electrification investment decisions. This analysis focused on factors such as energy transition policies, fuel price volatility, industrial electrification trends, environmental sustainability pressures, technological developments, and regulatory conditions within the oil and gas sector.

RESULTS AND DISCUSSION

SWOT Analysis

SWOT Matrix

SWOT analysis integrates external environment assessment (PESTEL, Porte’s Five Forces) with internal resource evaluation (RBV and VRIO) to identify strategics factors influencing electrification investment decision. This frameworks examines Pertagas internal strengths and weakness against external opportunities and threats, enabling comprehensive evaluation of electrification investment feasibility and optimal implementation approach between ownership or leasing, considering prganizational capabilities, competitive challenges, and financial implication. The SWOT analysis is shown on.

Table 1. SWOT Matrix

STRENGTHS (S)	**WEAKNESSES (W)**
S1. Geographic monopoly through 262 km owned pipeline infrastructure.	**W1.** Diesel engine reliability issues (BS 77 MTBF 291 hours, BS 139 MTBF 1,623 hours)
S2. Industry leading financial performance	**W2.** Operating costs vulnerability to diesel fuel price volatility (16.4% projected increase 2025 – 2027)
S3. Operational excellence (100% plant availability, 100% equipment availability)	**W3.** Toll fee disadvantage ($5-6 dollar per barrel)
S4. Experienced workforce (>10 years average experience)	**W4.** Limited electric motor operational experience
S5. Market leadership (57.69% market share, growing 8.16% year over year)	**W5.** Technology transition risk during implementation
S6. Strong reputation (Zero LTI, PROPER awards, 4.46/5.00 customer satisfaction)	**W6.** Capital allocation constraints (competing investment priorities)
S7. Parent company financial backing (USD 658.3 M cash available)	
OPPORTUNITIES (O)	**THREATS (T)**
O1. Government lifting target 1 million bopd by 2029 – 2030 signals production recovery	**T1.** Intense competitive rivalry (declining production 2020 – 2024 : 708 MBOPD to 578 MBOPD)
O2. Electric motor technology maturity provides proven reliability and efficiency	**T2.** High threat of customer switching (easy access to competitor pipelines, ports, or trucking)
O3. Regulated electricity tariff stability (7.5% CoV) vs diesel volatility (25.3% CoV)	**T3.** Rising diesel costs threaten margin compression
O4. ESG compliance requirements favor clean technology adaption	**T4.** Competitor price advantage enables aggressive market positioning
O5. Leasing option provide CAPEX flexibility and risk transfer mechanism	**T5.** Regulatory approval complexity (stringent BoD criteria : NPV > 0, IRR > 11.16%, payback <15 years)
O6. Ownership model enables asset control and long term cost optimization	**T6.** Diesel supplier power through Pertamina monopoly and volatile pricing.

SWOT matrix shows electrification investment leverages Pertagas strengths (financial capacity, operational excellence, market position) to capitalize on opportunities (technology maturity, cost stability, ownership vs leasing flexibility) while addressing critical weaknesses (diesel engine reliability, cost volatility, limited electric motor experience) and mitigating threats (competitive pressure and margin erosion). Strategic alignment demonstrates electrification necessity with ownership and leasing comparison determining optimal investment structure.

Strategic Implications

Strategic analysis confirms electrification investment necessity for Pertagas competitive survival. External environment presents critical pressure, diesel cost inflation (16.4% OPEX projected 2025 – 2027) and intense competitive rivalry ($5-6 per barrel toll fee disadvantage) threaten 57.69% market share and operating margin. Internal assessment demonstrates execution capability through financial resources, experienced workforce, and operational excellence. However, diesel technology vulnerability creates critical weakness requiring immediate intervention. SWOT integration validates electrification as strategically necessary, not just an upgrade. Analysis proceeds to ownership versus leasing comparative evaluation to determine optimal investment structure.

Comparative Investment Analysis

Ownership vs Leasing Comparison

Strategic analysis validate electrification investment necessity addressing diesel vulnerability and competitive pressure. Financial resource assessment shows adequate company liquidity supporting ownership model. However, competing investment priorities create capital allocation constraints while leasing offers CAPEX flexibility and risk transfer mechanism, warranting comparative evaluation determining optimal investment structure balancing financial efficiency against long term asset control and cost optimization objectives.

CAPEX

The capital expenditure analysis compares initial investment requirements between ownership and leasing models. Ownership requires full equipment acquisition cost while leasing eliminates initial capital outlay, creating fundamentally different cash flow profiles affecting investment feasibility and organizational financial planning.

a. Ownership Model

The ownership CAPEX cover comprehensive project implementation costs totaling Rp 9.701.771.000. Investment breakdown demonstrates standard EPC project structure with material procurement representing the largest component at 43.2% of total investment, followed by installation and commissioning activities at 38.6%. The detail cost structure showing in Table IV.4. Ownership CAPEX Breakdown

Table 2. Ownership CAPEX Breakdown

Component	Cost (Rp)	Percentage
1. Preparation	48,518,000	0.5%
2. Engineering Design	81,014,000	0.8%
3. Civil Construction	640,269,000	6.6%
4. Electrical Capacity Addition	547,924,000	5.6%
5. Material Procurement	4,195,258,000	43.2%
6. Installation, Configuration, Integration, and Commissioning	3,747,045,000	38.6%
7. Site Reinstatement dan Reporting	23,871,000	0.2%
8. General Affair	417,871,000	4.3%
TOTAL CAPEX	**9,701,771,000**	**100%**

Source : Internal Company Data

This investment provides permanent asset ownership with 15 years economic life, offering long term cost control and operational.

b. Leasing Model

The leasing model eliminates initial CAPEX, requiring zero initial capital expenses. The lessor responsible all equipment acquisition, installation, and commissioning costs, transferring to monthly operational expenses. This structure preserves capital for alternative investment while converting fixed assets into operational flexibility.

A critical adavantages lies in eliminating long lead item risks, enabling immediate deployment. In otherside, ownership procurement requires 18 months lead times for engineering design, equipment fabrication, factory testing, and installation. The leasing model compresses implementation timeline to 4-6 months, accelerating benefit realization and reducing diesel exposure during transition period.

OPEX

Operating expenditure analysis show fundamental cost structure differences between diesel and electric motor systems, with electrification delivering substantial annual savings through fuel efficiency, reduced maintenance requirements, and increasing reliability. The OPEX comparison include fuel / energy costs, maintenance expenses, spare part consumption.

a. Diesel Engine OPEX (Current State)

Current diesel engine operations spending annual costs Rp. 10,502,405,150, dominated by volatile fuel expenses representing 65.3% of total OPEX. The cost structure reflects typical of internal combustion engine systems which is high fuel consumption, intensive maintenance requirements, and significant spare part replacement. Detailed OPEX shown in Table IV.5. Diesel Engine OPEX Breakdown.

Table 3. Diesel Engine OPEX Breakdown

Cost Component	Annual Cost (Rp)	Percentage
1. Fuel	6,863,458,041	65.3%
2. Maintenance	1,115,040,050	10.6%
3. Spare Parts	643,567,000	6.1%
4. Labor	1,880,340,059	17.9%
TOTAL	**10,502,405,150**	**100%**

Source : Internal Company Data

Fuel costs show high volatility, with historical diesel fuel prices ranging from Rp 11,386 per liter (2021) to Rp 21,848 (2023), reflecting swing of crude oil price. This unpredictability creates significant budgetary risk and operational cost uncertainty. BS 77 consumes 14.02 liter/hour while BS 139 units consume 19.70 liter/hour each, totaling 427,071 liters annualy at 2025 average price of Rp 16,071 per liter. Maintenance intensity remains high due to diesel engine wear characteristics, requiring frequent oil changes, filter replacements, and component replacement averaging 2-3 monthly per station.

b. Electric Motor OPEX (Projected State)

Electric motor operations project annual costs of Rp 2,267,933,210, a 78.4% reduction versus diesel baseline. Electricity costs replace fuel expenses at lower rates due to electric motor efficiency (92-95%) compared to diesel engine (Altarawneh et al, 2020) and stable PLN industrial tariff of Rp 1,444.70 per kWh, stable for five consecutive years (2021 – 2025). The projected cost structure is detailed in Table 4 Electric Motor OPEX Breakdown.

Table 4. Electric Motor OPEX Breakdown

Cost Component	Annual Cost (Rp)	Percentage
1. Electricity	174,593,151	7.7%
2. Maintenance and Spare Parts	213,000,000	9.4%
3. Labor	1,880,340,059	82.9%
TOTAL	**2,267,933,210**	**100%**

Source : Internal Company Data

Annual electricity consumption for BS 77 and BS 139 at 120,850.8 kWh, calculated based on actual operating flow rates under VSD (Variable Speed Drive) control. The actual throughput are derived from current operational data :

- Flow BS 77 : 4,375 BOPD (28.97 m3/h)
- Rated flow : 85.944 m3/h
- Flow BS 139 : 6,651 BOPD (44.03 m3/h)
- Rated flow : 58.287 m3/h
- Actual Flow Rate Conversion – BS 77 :

$$Q_{BS77} = \frac{4{,}375\ BOPD\ x\ 0.158987\ m^3/bbl}{24\ hours} = \frac{695.57}{24} = 28.97\ m^3/h$$

$$\%Capacity_{BS77} = \frac{Q_{actual}}{Q_{rated}} x\ 100\% = \frac{28.97}{85.944} x100\% = 33.7\%$$

- Actual Flow Rate Conversion – BS 139 :

$$Q_{BS139} = \frac{6{,}651\ BOPD\ x\ 0.158987\ m^3/bbl}{24\ hours} = \frac{1{,}057.36}{24} = 44.03\ m^3/h$$

$$\%Capacity_{BS139} = \frac{Q_{actual}}{Q_{rated}} x\ 100\% = \frac{44.03}{58.287} x100\% = 75.6\%$$

VSD Power Reduction

- VSD Power Reduction

$$\frac{P_{actual}}{P_{rated}} = (\frac{Q_{actual}}{Q_{rated}})^3$$

$$P_{actual,BS77} = 107.38\ kW\ x\ 0.337^3 = 107.38\ x\ 0.0383 = 4.11\ kW$$

$$P_{actual,BS139} = 99.92\ kW\ x\ 0.756^3 = 99.92\ x\ 0.4323 = 43.19\ kW$$

This operation condition with single unit operation per station consistent with current throughput levels, and the second unit maintained as standby. The combination of VSD results in lower electricity consumption. This demonstrates one of the key efficiency advantages of VSD controlled electric motor systems over diesel engine.

c. Leasing OPEX Structure

Under the leasing model, OPEX structure transforms significantly with all in monthly lease payments of Rp 443,488,675 (year 1 – 2) covering equipment rental, operation and maintenance. This lease payment escalates 6.0% each 2 years, reflecting contractual costs escalation. Labor costs of Rp 1,880,340,059 remain unchanged as OCSA operators continue managing daily operations and monitoring.

Table 5. Total lease payment increases through project lifetime as presented in Table 4. Year Lease Payment Schedule.

Period	Projected Monthly Payment (Rp)	Projected Annual Payment (Rp)	Cumulative (Rp)
Year 1-2	443,488,675	5,321,864,100	10,643,728,200
Year 3-4	470,098,158	5,641,177,896	22,926,083,992
Year 5-6	498,304,047	5,979,648,564	35,885,380,120
Year 7-8	528,202,290	6,338,427,480	49,562,234,680
Year 9-10	559,894,427	6,718,733,124	62,999,700,928
Year 11-12	593,487,893	7,121,854,716	77,243,410,360
Year 13-14	629,097,167	7,549,166,004	92,341,742,368
Year 15	667,043,000	8,004,516,000	100,346,258,368

Source : Internal Company Data

Life Cycle Cost

Life cycle cost analysis compares total economic expenditure between ownership and leasing alternatives across the 15 year project horizon. This methodology separates initial investment, operating costs, tax, and terminal values to reveal cummulatives cost under each structure using present value approach at the discount rate of 11.16%.

The general LCC formulas is expressed as :

LCC=CAPEX+PV (OPEX)+PV (Replacement Cost)+PV (Disposal Cost)

Where :

a. CAPEX : Initial investment cost
b. PV (OPEX) : Present value of annual operating costs
c. PV (Replacement Cost) : Present value of equipment replacement / overhaul costs
d. PV (Disposal Cost) : Present value of asset disposal / decommissioning costs

For this comparative analysis, the formula adapts to accommodate differences between ownership and leasing structures :

a. Ownership LCC

$$LCC = CAPEX + PV\ (Differential\ OPEX) - PV\ (Salvage\ Value)$$

Where :

a. CAPEX : Rp 9,701,771,000

b. Differential Annual OPEX includes :
c. Salvage Value : Rp 970,177,100
d. Discount Rate : 11.16%

b. Leasing LCC

$$LCC = PV\ (Lease\ Payments)$$

a. Lease Payment Year 1-2 : Rp 5,321,864,100 / year (All in)
b. Escalation : 6.0% every 2 years
c. No salvage value (equipment returned to lessor)
d. Discount Rate : 11.16%

The ownership and leasing models demonstrate fundamentally different cost profiles over the project lifetime, as detailed in Table 6 Life Cycle Cost Summary Comparison

Table 6. Life Cycle Cost Summary Comparison

Cost Component	Ownership	Leasing	Differential
Initial Investment (Year 0)	Rp 9,701.8 M	-	Rp 9,701.8 M
Annual Differential OPEX (Year 1)	Rp 5,710.6 M savings	Rp 5,321.9 M payment	-
Cummulative Lease Payments (15 Years)	-	Rp 100,346.3 M	(Rp 100,346.3 M)
Cummulative Differential OPEX (15 Years)	Rp 85,658.5 M	-	Rp 85,658.5 M
Salvage Value Recovery (Year 15)	(Rp 970.2 M)	-	(Rp 970.2 M)
Total Lifetime Cost (Undiscounted)	Rp 17,054 M	Rp 126,347.5 M	(Rp 109,293.5 M)
Present Value of Costs (LCC)	Rp 13,285.0 M	Rp 40,744.7 M	(Rp 27,459.7 M)
Cost Multiple vs Ownership	**1.0 x**	**3.1 x**	

Notes : Differential LCC methodology excludes labor costs (Rp 1,880.3 M annually) identical across scenarios.

The present value cost differential of Rp 27.5 billion quantifies the economic premium paid for leasing's capital preservation and operational risk transfer benefits. The 3.1x present value cost multiple demonstrates that while leasing eliminates initial capital requirements, cumulative payments substantially exceed ownership costs over the project lifetime.

Financial Feasibility Analysis

Financial feasibility analysis evaluates investment viability through standardized capital budgeting metrics, determining whether electrification generates acceptable returns relative to capital cost and organizational hurdle rates. This section employs net present value (NPV), internal rate of return (IRR), payback period, and profitability index methodologies to assess value creation potential and guide investment structure selection between ownership and leasing alternatives.

A critical methodological considerations must be acknowledged conducting comparative financial analysis. The leasing model requires zero initial expenses, making payback period and profitability index methodolically inapplicable, as both metrics fundamentally require an initial investment as their basis of instrument.

Therefore, comparative evaluation between ownership and leasing is conducted exclusively through NPV and IRR, which remain valid regardless of initial capital requirement. Payback period and profitability index are presented solely for ownership model as supplementary financial information.

Net Present Value (NPV)

Net present value (NPV) represents the fundamental criterion for investment decision making, measuring total value creation in present value terms by discounting all future cash flows at the project's cost of capital. A positive NPV indicates the investment generates returns exceeding the required rate, creating shareholder value, while negative NPV signals value destruction warranting project rejection. The NPV calculation aggregates the life cycle cost projection from Section IV.1.4.4. with operational savings to determine net value generation. The NPV formula is expressed as :

$$NPV = \Sigma \left[\frac{CFt}{(1+r)^t}\right] - Initial\ Investment$$

Where :

a. CFt : After tax cash flow in year t
b. r : Discount rate (WACC : 11.16%)
c. t : Year number (0 to 15)
d. Initial investment : CAPEX for ownership, zero for leasing

a. Ownership Model NPV

The ownership model demonstrates substantial value creation across the 15 year investment horizon, as detailed in Table 6 Ownership Model NPV Analysis. Initial capital expenditure of Rp 9,701,771,000 generates consistent annual after tax cash flows averaging Rp 4,667.7 million during years 1 – 10, incorporating the depreciation tax shield of Rp 213.4 million and Rp 4,454.2 million during years 11 – 15, following full asset depreciation. Year 15 includes additional salvage value recovery Rp 970.2 million, yielding after tax cash flow Rp Rp 5,424.4 million in terminal year. The complete NPV analysis is presented in Table 7 Ownership Model NPV Analysis (Rp Millions)

Table 7. Ownership Model NPV Analysis (Rp Millions)

Year	CAPEX	Savings	Depr	After Tax CF	PV Factor	Present Value	Cummulative CF
0	(9,701.8)	-	-	(9,701.8)	1	(9,701.8)	(9,701.8)
1	-	5,710.6	213.4	4,667.7	0.8996	4,199.1	(5,034.1)
2	-	5,710.6	213.4	4,667.7	0.8093	3,777.5	(366.4)
3	-	5,710.6	213.4	4,667.7	0.7281	3,398.3	4,301.3
4	-	5,710.6	213.4	4,667.7	0.6551	3,057.1	8,969.0
5	-	5,710.6	213.4	4,667.7	0.5894	2,750.2	13,636.6
6	-	5,710.6	213.4	4,667.7	0.5303	2,474.1	18,304.3
7	-	5,710.6	213.4	4,667.7	0.4771	2,225.7	22,972.0
8	-	5,710.6	213.4	4,667.7	0.4292	2,002.2	27,639.7
9	-	5,710.6	213.4	4,667.7	0.3862	1,801.2	32,307.3
10	-	5,710.6	213.4	4,667.7	0.3474	1,620.4	36,975.0
11	-	5,710.6	213.4	4,667.7	0.3125	1,391.0	41,429.3
12	-	5,710.6	213.4	4,667.7	0.2811	1,251.4	45,883.5
13	-	5,710.6	213.4	4,667.7	0.2529	1,125.8	50,337.7
14	-	5,710.6	213.4	4,667.7	0.2275	1,012.7	54,792.0
15*	-	5,710.6	213.4	5,424.4	0.2047	1,109.5	60,216.4
				Total PV		**23,494.2**	

*Year 15 includes salvage value of Rp 970.2 M

The positive NPV of Rp 23,494.2 million confirms strong value creation, indicating the investment generates returns substantially exceeding the 11.16% cost of capital. The NPV equivalent to 2.4 times the initial investment demonstrates exceptional capital efficiency, with each rupiah invested generating Rp 2.41 in present value returns.

b. Leasing Model NPV

The leasing model shows critical time horizon in value creation, with financial performance different between short term and long term. To evaluate this period of leasing, NPV calculated in 2 horizon.

Short Term Horizon NPV

The cash flow pattern for this horizon includes zero initial investment and consistent positive after tax cash flow during Year 1-2.

Table 8. Leasing Model Short Term NPV Analysis (Rp Millions)

Year	Savings	Lease Payment	Net CF	After Tax CF	PV Factor	PV
0	-	-	-	0	1.0	0
1	5,710.6	(5,321.9)	388.7	303.2	0.8996	272.7
2	5,710.6	(5,321.9)	388.7	303.2	0.8093	245.4
				Total PV		**518.1**

The positive short term NPV of Rp 518.1 million confirms leasing generates value during the initial contract period, validating leasing as a financially viable alternative for short duration operational requirements where speed of deployment takes precedence over financial optimization.

Long Term Horizon NPV

Extending the investment horizon to full 15 year project life shows proggresive financial deterioration as the 6.0% each 2 year escalation mechanism decreases economic benefit. The complete cash flow analysis presented in Table 9.

Table 9. Leasing Model Long Term NPV Analysis (Rp Millions)

Year	Savings	Lease Payment	Net CF	After Tax CF	PV Factor	Present Value
0	-	-	-	0.0	1	0.0
1	5,710.6	(5,321.9)	388.7	303.2	0.8996	272.7
2	5,710.6	(5,321.9)	388.7	303.2	0.8093	245.4
3	5,710.6	(5,641.2)	69.4	54.1	0.7281	39.4
4	5,710.6	(5,641.2)	69.4	54.1	0.6551	35.4
5	5,710.6	(5,979.6)	(269.1)	(209.9)	0.5894	(123.7)
6	5,710.6	(5,979.6)	(269.1)	(209.9)	0.5303	(111.2)
7	5,710.6	(6,338.4)	(627.9)	(489.7)	0.4771	(233.5)
8	5,710.6	(6,338.4)	(627.9)	(489.7)	0.4292	(210.1)
9	5,710.6	(6,718.7)	(1,008.2)	(786.4)	0.3862	(303.5)
10	5,710.6	(6,718.7)	(1,008.2)	(786.4)	0.3474	(273.0)
11	5,710.6	(7,121.9)	(1,411.3)	(1,110.8)	0.3125	(343.8)
12	5,710.6	(7,121.9)	(1,411.3)	(1,110.8)	0.2811	(309.3)
13	5,710.6	(7,549.2)	(1,838.6)	(1,434.1)	0.2529	(362.5)
14	5,710.6	(7,549.2)	(1,838.6)	(1,434.1)	0.2275	(326.1)
15	5,710.6	(8,002.1)	(2,291.6)	(1,787.4)	0.2047	(365.8)
				Total PV		**(2,369.1)**

The negative NPV of Rp 2,369.1 million indicates value destruction, with escalating lease payments progressively exceeding savings from Year 5 onward. The NPV comparison across investment structures and time horizons summarized in Table 10. NPV Comparison Summary.

Table 10. NPV Comparison Summary

Metric	Ownership	Leasing (Short Term)	Leasing (Long Term)	Optimal Choice
Initial Investment	Rp 9,701.8 M	-	-	Leasing
NPV	Rp 23,494.2 M	Rp 518.1 M	(Rp 2,369.1 M)	Ownership
NPV per year	Rp 1,566.3 M	Rp 259.1 M	(Rp 157.9 M)	Ownership
Suitable Application	Permanent	Temporary/Tactical	-	-

Internal Rate of Return (IRR)

Internal rate of return (IRR) represents the discount rate at which an investment’s net present value equals zero, measuring the project’s inherent rate return rate independent of external cost of capital assumptions. A project with IRR exceeding the WACC generates positive NPV and creates value, while IRR below WACC indicates value destruction. The IRR is determined by solving for the rate (r) that satisfies :

$$0 = \Sigma \left[\frac{CFt}{(1+IRR)^t}\right] - Initial\ Investment$$

Where :

a) Cft : After tax cash flow in year t
b) IRR : Internal rate of return
c) t : Year number (0 to 15)

a. Ownership Model IRR

Using the cash flow stream form Table IV.8, value of IRR is 47.95%. This IRR exceeds WACC, indicating the investment generates returns over four times the rquired cost of capital.

b. Leasing Model IRR

The leasing model shows critical time horizon dependency, with financial viability concentrated in initial contract period. To comprehensively evaluate leasing suitability across different operational scenarios, IRR is calculated for 2 distinct horizons : short term (year 1-2) and full project horizon (year 1-15).

Short term horizon IRR (Years 1-2)

During the initial 2 year lease period, the cash flow series consist of zero initial investment at Year 0 and equal positive after tax cash flows of Rp 303.2 million in Years 1 and 2. The absence of a negative initial cash flow renders conventional IRR computational inapplicable, as the sign change prerequisite required for IRR solution is not satisfied (Brealey et al, 2020 ; Ross et al, 2022). Given that the 2 period cash flows are equal, the periodic yield embedded in the cash flow stream is derived using the annuity rate formula, which solves for the periodic rate that equates the present value of equal periodic payments to the reference payment amount (Brealey et al, 2020). An implicit yield can be derived using the RATE function, which solves for the periodic rate that equates the present value of an annuity to one period cash flow :

$$Implicit\ Yield = RATE\ (n, CF, -CF)$$

Where :

a. n : Number of periods (2 years)
b. CF : Equal periodic after tax cash flows (Rp 303.2 M)
   Year 0 : Rp 0 (no initial investment)
   Year 1 : Rp 303.2 M (after tax cash flow)
   Year 2 : Rp 303.2 M (after tax cash flow)

Implicit Yield = 61.80%

It is important to note that this implicit yield differs from conventional IRR in that it doesn't represent a return on an explicit capital expenses. Rather, it measures the internal yield generated by the cash flow stream relative to itself, serving as a complementary indicator to NPV in assessing short term leasing financial performance.

Full horizon IRR (Years 1-15)

In contrast to the attractive short term performance, extending the investment horizon to full 15 year project life shows fundamental financial unsuitability. The cash flow modest positive flows in year 1-4, and transitioning to negative flows form year 5 onward until years 15. The 15 year cash flow produces negative IRR.

The IRR differential between 2 year horizon and 15 year horizon shows critical strategic insight, leasing financial viability is time bounded, optimal for short duration applications but unsuitable for permanent installations. Table 11 summarize this performance divergence.

Table 11. IRR Summary

Model	Horizon	IRR	Vs WACC	Interpretation
Ownership	Years 0-15	47.95%	> 11.16%	Exceeds Hurdle Rate
Leasing	Years 1-2 (implicit yield)	61.80%	> 11.16%	Exceeds Hurdle Rate
Leasing	Years 1-15	Negative	-	NPV = (Rp 2,369.1 M)

The IRR analysis confirms as the superior investment structure for permanent electrification, delivering consistent returns far exceeding the hurdle rate across the full project life. Leasing demonstrates favorable implicit yield in the short term horizon but unsuitable for permanent installation.

Payback Period (PP)

Payback period represents the duration required for cumulative after tax cash flows to fully recover the initial investment. A shorter payback period indicates faster capital recovery and lower exposure to long term investment risk. The payback period is calculated as :

$$PP = Full\,Years + \frac{Remaining\,Unrecovered\,Insvestment}{Cash\,Flow\,in\,Recovery\,Year}$$

Where :

a. Full Years : Number of complete years before full recovery
b. Remaining Unrecovered Investment : Outstanding investment balance at end of last incomplete year
c. Cash Flow in Recovery Year : After tax cash flow in the year recovery is achieved

It is important to note that payback period analysis is applicable only to the ownership model. By definition, payback period requires an initial capital expenses as its fundamental basis of calculation. The leasing model involves zero initial investment, therefore the condition for payback period doesn’t exist.

The ownership model shows rapid capital recovery relayive to its 15 year economic life. Using the after tax cash flow stream from Table 12, cumulative cash flow analysis tracks the progressive recovery of initial CAPEX.

Table 12. The cumulative cash flow progression is shown in Table 10 Ownership Model Payback Period Analysis.

Year	After Tax CF	Cummulative CF	Recovery Status
0	(9,701.8)	(9,701.8)	Unrecovered
1	4,667.7	(5,034.1)	Unrecovered
2	4,667.7	(366.4)	Unrecovered
3	4,667.7	4,301.3	Recovered

Payback period calculation is :

$PP = 2 + \frac{366.4}{4{,}667.7} = 2.08 = 2\,years\;1\,month$

The ownersip model recovers its entire initial investment within 2 years and 1 month, representing exceptional capital efficiency relative to the 15 year project life.

IV.1.5.4. Profitability Index (PI)

Profitability index measures the relative value creation efficiency of an investment by expressing the ratio of present value of future cash flows to initial capital expenses. Unlike NPV which measures absolute value creation, PI provides a normalized metric enabling assessment of value generated per unit of capital invested. An investment is considered viable when PI exceeds 1, indicating that present value returns surpass initial capital requirements. The PI formula expressed as :

$$PI = \frac{PV\,of\,future\,cash\,flows}{Initial\,Investment}$$

Where :

PV of Future Cash Flows : sum of all discounted after tax cash flows over project life

Initial Investment : initial capital outlay at year 0

As established in section IV.1.5, profitability index is presented solely for the ownership model. The leasing model is excluded from this analysis due to the absence of initial capital expenses.

The ownership model demonstrates exceptional capital efficiency across the 15 year investment horizon. Present value of future cash flows derived from the NPV analysis in section IV.1.5.1, where total discounted cash flows of Rp 23,494.2 million represents the net value creation above initial investment recovery. Adding back the initial investment yields toal present value of future cash flows of Rp 33,195.9 million. The PI calculation is presented in Table 13. Ownership Model Profitability Index.

Table 13. Ownership Model Profitability Index

Metric	Value
PV of Future Cash Flows	Rp 33,195.9 M
Initial Investment (CAPEX)	Rp 9,701.8 M
Profitability Index (PI)	3.42
PI Threshold	>1
Assessment	Viable

$$PI = \frac{33{,}105.6}{9{,}701.8} = 3.42$$

The ownership model generates a profitability index of 3.42, substantially exceeding the minimum viability threshold of 1. This result indicates that every Rp 1 of capital invested generates Rp 3.42 in present value returns.

Sensitivity Analysis

Sensitivity analysis evaluates how ribust the investment feasibility results are when key parameters change. This study uses On At A Time (OAT) methodology, varying each of four parameters independently at +10%, +20%, and +30% from baseline while others remain constant (Paudel & Adhikari, 2025 ; Garcia – Maza et al, 2025).

The four parameters, diesel fuel price, electricity tariff, ownership CAPEX, and lease escalation rate, are treated as independent variables. No correlation testing is required because each parameter has a fundamentally different price setting mechanism such as, diesel price follows global commodity market, electricity tariff is government regulated, CAPEX is a fixed project estimate, and lease escalation rate is a contratctually agreed term. Variables driven by entirely different mechanisms have no causal basis for correlation.

Sensitivity analysis compares the ownership model against leasing long term as a reference. Leasing short term is excluded because it is not a long term financial investment decision, it is tactical response to a specific operational trigger. Its financial justification is therefore addressed separetly through breakeven analysis (Brealey et al, 2020 ; Ross et al, 2022).

IV.1.6.1. Diesel Price

Diesel fuel price represents the largest and most volatile component of the investment savings baseline, accounting for 65.3% of current diesel OPEX. Historical data from 2021 to 2025 confirms significant price volatility, ranging from Rp 11,386 per liter in 2021 to Rp 21,848 per liter in 2023, a swing of nearly 92% over four years, justifying the ±30% sensitivity range applied. The sensitivity results are presented in Table 14 Diesel Fuel Price Sensitivity Analysis.

Table 14 Diesel Fuel Price Sensitivity Analysis

Scenario	Fuel Price (Rp/liter)	NPV Ownership (Rp Million)	Δ NPV Ownership	NPV Leasing Long Term (Rp Million	Δ NPV Lease Long Term
-30%	11,250	22,500.7	-33.7%	(3,362.6)	-141.6%
-20%	12,857	26,316.6	-22.5%	453.2	-94.4%
-10%	14,464	30,132.5	-11.2%	4,269.1	-47.2%
Baseline	**16,071**	**33,948.3**	**-**	**8,085.0**	**-**
10%	17,678	37,764.2	11.2%	11,909.9	47.2%
20%	19,285	41,580.1	22.5%	15,716.7	94.4%
30%	20,892	45,395.9	33.7%	19,532.6	141.6%

The ownership model demonstrates strong resilience. Even under the most adverse scenario of a 30% price decline, ownership NPV remains strongly positive at Rp 22,500.7 million, confirming financial viability across every prie scenario tested.

Although the leasing model uses electric motors rather than diesel, it is also affected by diesel price movements. This is because leasing financial justification rests on the savings generated by avoiding diesel operating costs. When diesel prices decline, savings becomes smaller. However, lease payments do not decline in parallel, they continue running and increase every 2 years through the contractual escalation mechanism, squeezing the model from both sides simultaneously.

As a result, the leasing long term model exhibits diesel price sensitivity 4.2 time greater than ownership, NPV changing □141.6% per □30% price movement versus only □33.7% for ownership. A 20% or greater price decline causes leasing long term NPV to turn negative while ownership NPV remains strongly positive. This asymmetry represents a fundamental structural vulnerability of the leasing model.

Electricity Tariff

Electricity tariff has remained perfectly stable at Rp 1,444.70 per kWh for 5 consecutive years from 2021 to 2025, reflecting the regulated nature of Indonesian industrial electricity pricing. Sensitivity is evaluated to quantify potential exposure to future regulatory adjustments. Results are presented in Table 15 Electricity Tariff Sensitivity Analysis.

Table 15 Electricity Price Sensitivity Analysis

Scenario	Tariff (Rp/kWh)	NPV Ownership (Rp Million)	Δ NPV Ownership	NPV Leasing Long Term (Rp Million	Δ NPV Lease Long Term
-30%	1,011.3	34,239.5	0.9%	8,376.2	3.6%
-20%	1,155.8	34,142.5	0.6%	8,279.1	2.4%
-10%	1,300.2	34,045.4	0.3%	8,182.1	1.2%
Baseline	**1,444.7**	**33,948.3**	**-**	**8,085.0**	**-**
10%	1,589.2	33,851.3	-0.3%	7,987.9	-1.2%
20%	1,733.6	33,754.2	-0.6%	7,890.8	-2.4%
30%	1,878.1	33,657.1	-0.9%	7,793.9	-3.6%

Electricity tariff presents negligible risk for both models. A 30% tariff increase reduces ownership NPV by only 0.9% and leasing long term NPV by only 3.6%, confirming that electricity cost is not a material risk driver for either investment model. This finding validates one of the core strategic advantages of electrification, transitioning from volatile fuel costs to government electricity pricing dramatically reduce energy cost risk. From a tariff risk perspective, electrification is clearly the safer long term choice regardless of the investment model selected.

Lease Escalation

Lease escalation rate evaluates the impact of contractual cost escalation onleasing long term model performance. The baseline rate of 6.0% per 2 year period reflects prevailing contractual terms. This parameter has zero impact on ownership NPV, ownership economics are entirely independent of any leasing contractual terms, which represents a long term structural advantage of ownership. Results are presented in Table 16 Lease Escalation Rate Sensitivity Analysis.

Table 16. Lease Escalation Rate Sensitivity Analysis

Scenario	Escalation Rate	NPV Ownership (Rp Million)	Δ NPV Ownership	NPV Leasing Long Term (Rp Million	Δ NPV Lease Long Term
-30%	4.2%	33,948.3	-	9,533.5	17.9%
-20%	4.8%	33,948.3	-	9,059.6	12.1%
-10%	5.4%	33,948.3	-	8,576.8	6.1%
Baseline	**6.0%**	**33,948.3**	**-**	**8,085.0**	**-**
10%	6.6%	33,948.3	-	7,583.9	-6.2%
20%	7.2%	33,948.3	-	7,073.5	-12.5%
30%	7.8%	33,948.3	-	6,553.4	-18.9%

Lease escalation rate demonstrates moderate sensitivity on leasing long term NPV, with ±18.9% change per ±30% escalation movement. Within the tested range, leasing long term NPV remains positive across all scenarios. However, this result must be read alongside the diesel price sensitivity findings, when diesel prices decline while rates simultaneously increase, leasing long term viability erodes rapidly. This combination represents the critical compounding risk scenario for leasing long term financial performance.

CAPEX Variation

CAPEX sensitivity evaluates impact of procurement cost uncertainty on ownership model performance. Equipmet price fluctuations, foreign exchange movements affecting imported components, and supply chain disruptions represent realistic sources of CAPEX variation. CAPEX variation has zero impact on leasing model NPV, as all equipment acquisition costs are structurally borne by the lessor, this is one of the structural advantages of the leasing arrangement. Results are presented in Table 17 CAPEX Sensitivity Analysis.

Table 17. CAPEX Sensitivity Analysis

Scenario	CAPEX (Rp M)	NPV Ownership (Rp Million)	∆ NPV Ownership	NPV Leasing Long Term (Rp Million	∆ NPV Lease Long Term
-30%	6,791.2	36,424.7	7.3%	8,085.0	-
-20%	7,761.4	35,599.3	4.9%	8,085.0	-
-10%	8,731.6	34,773.8	2.4%	8,085.0	-
Baseline	**9,701.8**	**33,948.3**	**-**	**8,085.0**	**-**
10%	10,671.9	33,122.9	-2.4%	8,085.0	-
20%	11,642.1	32,297.4	-4.9%	8,085.0	-
30%	12,612.3	31,471.9	-7.3%	8,085.0	-

CAPEX variation demonstrates moderate and manageable sensitivity on ownership NPV. Even with 30% cost overrun, ownership NPV remains strobgly positive at Rp 31,471.9 million, retaining 92.7% of baseline values. This resilience reflects the dampening effect of the short payback period of 2.08 years, which concentrates value recovery within the early project years and reduces the proportional impact of initial investment variations on total 15 year NPV.

Key Sensitivity Drivers

The tornado charts show the ownership and leasing long term models have different sensitivity profiles. In the ownership models, diesel price or annual saving is the most dominant driver of NPV, followed by WACC, CAPEX, and electricity tariff as shown in Figure IV.7. Tornado Chart NPV Ownership.

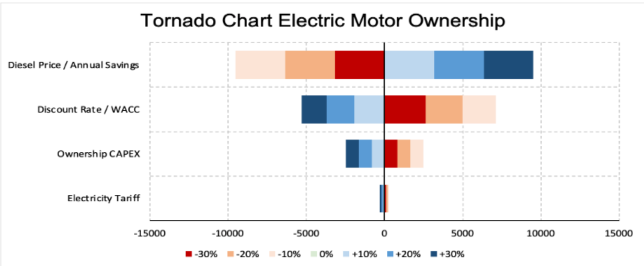

Figure 3. Tornado Chart NPV Ownership

This indicates that ownership feasibility is mainly determined by avoided diesel costs, while CAPEX and electricity tariff risks remain relatively manageable. In the leasing long term model, the most influential variable is lease payment, followed by diesel price or annual saving, lease escalation, WACC, and electricity tariff as shown in Figure 3. Tornado Chart NPV Leasing Long Term.

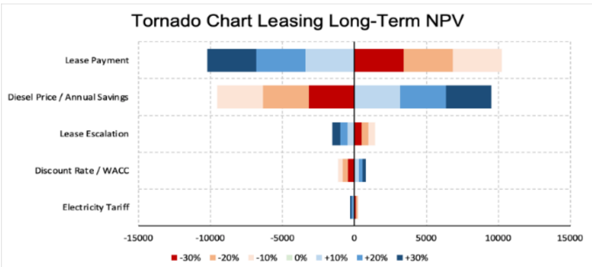

Figure 4. Tornado Chart NPV Leasing Long Term

This confirms that long term leasing is more exposed to contractual payment structure than asset investment costs. Shor term leasing is no included in the tornado chart because it is not evaluated as a long term investment altenative, but as a tactical deployment option. Therefore, its justification is analyzed separately through breakeven analysis based on incremental value and deployment speed advantage.

Breakeven Analysis (Leasing Short Term)

While the preceding sensitivity analysis addresses the long term investment decision between ownership and leasing long term, leasing short term represents a fundamentally different decision. It is not a competing alternative to ownership over a 15 year horizon, it is a tactical deployment solution activated by a specific operational trigger, such as throughput volume surge that exceeds the design capacity of the existing diesel pump system.

Because leasing short term is an operationnaly driven decision, its justification is not evaluated through NPV comparison. Instead, breakeven analysis answers the relevant strategic question :

"What is the minimum incremental throughput volume required to justify the cost of leasing short term, compared to waiting 12 months for ownership deployment?"

The operational trigger condition is defined by the maximum allowable discharge capacity of the existing pump system at each booster station, as specified in the pump datasheets. Tabel 18 present the relevant design parameters for BS 77 and BS 139.

Table 18. Pump Design Capacity

Parameter	BS 77	BS 139
Rated Discharge Capacity	85.944 m^3/h	58.287 m^3/h
Max Discharge Capacity	78.131 m^3/h	52.988 m^3/h
Max Capacity (BOPD)	11,793 BOPD	7,999 BOPD
Rated Motor Power	107.38 kW	99.92 kW
Diff. Head	268.986 m	486.004 m
Pump Eff.	48.94%	64.80%

Source : Specification Data Sheet Sulzer

The maximum discharge capacity represents the absolute operational ceiling under the existing diesel driver configuration. Throughput demand exceeding this threshold cannot be reliably sustained by the diesel pump system, creating unserviceable overflow volume that makes lost revenue.

Current operationa data establishes the following baseline conditions :

$$Q_{current,BS77} = \frac{4{,}375\ BOPD\ x\ 0.158987\ m^3/bbl}{24\ hours} = 28.97 \frac{m^3}{h} (37.1\%\ of\ \max capacity)$$

$$Q_{current,BS139} = \frac{6{,}651\ BOPD\ x\ 0.158987\ m^3/bbl}{24\ hours} = 44.03 \frac{m^3}{h} (83.1\%\ of\ \max capacity)$$

BS 77 operates at 37.1% of maximum capacity, providing substantial headroom of 7,418 BOPD (the volume surge trigger condition is therefore not active at BS 77). BS 139, operates at 83.1% of maximum capacity with a remaining headroom of only 1,348 BOPD, making it highky susceptible to the volume surge trigger.

A projected incremental volume of 2,500 BOPD is anticipated from migration of crude oil transportation in the Jambi – Sout Sumatra corridor to the Pertagas mainline. This volume enters exclusively through BS 139, bringing total projected demand to :

$$Q_{projected,BS\ 139} = 6{,}651 + 2{,}500 = 9{,}151\ BOPD$$

$$Overflow_{BS\ 139} = Q_{projected} - Q_{max} = 9{,}151 - 7{,}999 = 1{,}152\ BOPD$$

The overflow of 1,152 BOPD represents throughput that cannot be served under the diesel system and constitutes permananetly lost revenue unless electrification is implemented. Electric motor deployment this constraint by enabling BS 139 to operate beyond the diesel design ceiling through superior motor efficiency and elimination of diesel driver mechanical limitations.

Ownership deployment requires an estimate 18 month lead time. Leasing short term requires only 6 months as the lessor bears all equipment procurement responsibilities. The resulting 12 month deployment gap represents the window during which leasing short term can be operational and capturing revenue from overflow volume while ownership is still the procurement process.

$$Revenue\ Lost\ Per\ Month = 1{,}152\ BOPD\ x\ Rp\frac{97{,}600}{bbl}x\ 30\ days = Rp\ 3{,}372.4\ Million$$

Every month of delay in serving the 1,152 BOPD overflow represents Rp 3,372.4 million in unrecovered revenue, making the 12 month deploymenet speed advantage of leasing short term a highly financial consideration.

Each barrel of overflow volume served generates revenue at a tariff of USD 6.1 per barrel, equivalent to Rp 97,600 per barrel. Total recoverable revenue during the 12 month deployment gap :

$$Revenue_{gap} = 1{,}152\ BOPD\ x\ Rp\frac{97{,}600}{bbl}x365\ days = Rp\ 40{,}472\ Million$$

The annual base lease payment of Rp 5,321.9 million is fully tax deductible as an operational expenses. After tax net lease cost during the 12 month gap :

$$Lease\ Cost_{after\ tax} = Rp\ 5{,}321.9\ x\ (1 - 0.22) = Rp\ 4{,}151.1\ Million$$

The breakeven threshold volume is derived as :

$$Breakeven\ Volume = \frac{Lease\ Cost_{after\ tax}}{Tariff\ x\ 365\ days} = \frac{Rp\ 4{,}151{,}054{,}000}{Rp\frac{97{,}600}{bbl}x365} = 118\ BOPD$$

The breakeven analysis confirms overwhelming financial justification for leasing short term deployment under volume surge conditions at BS 139. The actual overflow of 1,152 BOPD is 9.75 times above the minimum threshold of 118 BOPD, meaning even if actual volume surge realization is 90% lower than projected, leasing short term remains financially justified.

IV.1.7. Risk Analysis

Risk analysis identifies, assesses, and mitigates key risks associated with electric motor electrification investment at BS 77 and BS 139. Fifteen risks across three categories (technical, operational, and economic) are evaluated using 5x5 risk matrix combining likelihood (1-5) and impact (1-5) dimensions, producing risk score that determines risk level classification with threshold, low (1-4), medium (5-9), high (10-14), very high (15-19), and extreme (20-25).

Figure IV.7 presents the consolidated risk assessment across all 15 identified risks. Before mitigation, 2 risks are classified as High, there are power supply interruption (score 12) and diesel price decline (score 12), while the remaining 13 risks are classified as Medium or Low. Following implementation of identified mitigation actions, average risk score decreases by 57% from 7.9 to 3.4, with no risks remaining at High Level or above.

ID	Risk	L Before	I Before	Score Before	Level Before	L After	I After	Score After	Level After	Reduction
T1	Motor-pump compatibility mismatch	2	3	6	Medium	1	2	2	Low	↓ 67%
T2	VFD integration failure	2	4	8	Medium	1	3	3	Low	↓ 62%
T3	Electrical harmonic disturbance	3	3	9	Medium	2	2	4	Low	↓ 56%
T4	Protection system incompatibility	2	4	8	Medium	1	3	3	Low	↓ 62%
T5	Motor underperformance vs diesel basel	2	3	6	Medium	1	2	2	Low	↓ 67%
O1	Power supply interruption (PLN outage)	3	4	12	High	2	3	6	Medium	↓ 50%
O2	Operator skill gap — electric motor syst	3	3	9	Medium	2	2	4	Low	↓ 56%
O3	Unplanned downtime during commissioni	3	3	9	Medium	2	2	4	Low	↓ 56%
O4	Maintenance support availability	2	3	6	Medium	1	2	2	Low	↓ 67%
O5	SCADA integration failure	2	4	8	Medium	1	3	3	Low	↓ 62%
E1	Diesel price decline below assumption	3	4	12	High	2	3	6	Medium	↓ 50%
E2	PLN tariff escalation above projection	2	2	4	Low	1	2	2	Low	↓ 50%
E3	CAPEX overrun during procurement	3	3	9	Medium	2	2	4	Low	↓ 56%
E4	Lease escalation exceeds contract term	1	3	3	Low	1	2	2	Low	↓ 33%
E5	Currency depreciation on imported equip	3	3	9	Medium	2	2	4	Low	↓ 56%
AVERAGE				7,9	Medium			3,4	Low	↓ 57%

Figure 5. Risk Summary

Figure 5 and Figure 6 illustrates the migration of all 15 risks ID across th 5x5 matrix before and after mitigation. Before mitigation, risks are concentrated in the Medium to High zone. After mitigation, all risks migrate to Low zone, confirming that proposed mitigation strategies substantially reduce the overall risk profile to an acceptable level for investment approval.

F. RISK MATRIX — After Mitigation					
Impact \ Likelihood	1 Rare	2 Unlikely	3 Possible	4 Likely	5 Almost Certain
5 Catastrophic	5	10	15	20	25
4 Major	4	8	12	16	20
3 Moderate	3 T2, T4, O5	6 O1, E1	9	12	15
2 Minor	2 T1, T5, O4, E2, E4	4 T3, O2, O3, E3, E5	6	8	10
1 Negligible	1	2	3	4	5

Figure 6. Risk Matrix After Mitigation

Likelihood Scale	
1 — Rare	Never occurred in exploration/pipeline industry
2 — Unlikely	Occurred in similar industry but not in Pertagas
3 — Possible	Occurred in Pertagas/OCSA previously
4 — Likely	Occurred several times in OCSA
5 — Almost Certai	Occurs routinely every year in OCSA

Impact Scale	
1 — Negligible	Financial loss <Rp 10 M | Minor disruption | No project impact
2 — Minor	Financial loss Rp 10–100 M | Downtime <1 day | NPV reduced <10%
3 — Moderate	Financial loss Rp 100–1,000 M | Downtime 1–30 days | IRR < WACC
4 — Major	Financial loss Rp 1,000–10,000 M | Downtime >1 month | NPV significantly negative
5 — Catastrophic	Financial loss >Rp 10,000 M | Permanent stoppage | Project fails completely

Figure 7. Scale of Likelihood and Impact

Business Solution

Based on the strategic, financial, sensitivity, breakeven, and risk analysis, the proposed business solution is to implement electric motor ownership as the primary long term strategy for replacing diesel pum drivers. Ownership provides stronger financial feasibility, lower lifecycle cost, and better asset control. Meanwhile, short ter, leasing may be used only as a tactical bridging option when additional throughput must be captured before ownership deployment is completed.

Recommended Investment Strategy

Ownership as the Primary Long Term Strategy

Ownership is recommended as the primary long term strategy for electric motor implementation because it provides the strongest financial and strategic value for Pertagas. The ownership model generates the highest NPV, strong IRR, short payback period, and superior life cycle cost performance compared to long term leasing. Although ownership requires higher initial CAPEX, the investment is financially justified by substantial diesel cost savings, lower maintenance requirements, and improved operational efficiency over the 15 year project horizon.

From s strategic perspective, ownership also provide a better asset control, flexibility in operation and maintenance, and lower dependency on third party providers. This is important for crude oil transportation infrastructure, where reliability are critical. Sensitivity analysis further confirms that ownership remains financially viable even under adverse scenarios, including diesel price decline, CAPEX increase, electricity tariff increase, and WACC changes. Therefore, ownership should be selected as the permanent investment model to support long term cost optimization, operational reliability, and energy transition objectives.

Short Term Leasing as a Tactical Bridging Strategy

Short term leasing is recommendedonly as a tactical bridging strategy under specific operational conditions, particularly when incremental crude oil volume exceeds the existing diesel pump capacity before ownership deployment is completed. Leasing offers faster implementation because equipment procurement and installed are handled by the lessor. Therfore, short term leasing can help capture additional revenue during the ownership lead time gap, but it should not replace ownership as the long term investment strategy.

Leasing Long Term is Not Recommended

Long term is not recommended because its recurring lease payment and escalation gradually reduce the economic benefits generated from diesel cost savings. Although leasing avoids initial CAPEX, the long term NPV becomes weaker than ownership and is highly exposed to lease payment structure and diesel price movements. Therefore, leasing should not be used as a permanent electrification model, as it limits long term cost optimization, asset control, and strategic flexibility.

Implementation Plan

The electric motor implementation project is recommended to be executed after ownership model is approved as the primary long term investment strategy. The implementation plan must ensure that the transition from diesel engine to electric motor can be conducted without disrupting crude oil transportation operations. The plan should also consider the possibility of short term leasing as a temporary bridging option if additional throughput occurs before the ownership model is fully deployed.

The implementation plan consists of several steps, including :

a. Technical and Operational Validation
b. Investment Approval and Final Investment Decision (FID)
c. Engineering, Procurement, and Construction (EPC)
d. Testing and Commissioning

CONCLUSION

This study concluded that the ownership model was the most economically feasible and strategically preferable option for the long-term implementation of electric motors in crude oil transportation operations at PT Pertamina Gas. The financial evaluation demonstrated that ownership provided superior investment performance, achieving an NPV of Rp 24,494.2 million, an IRR of 47.95%, a payback period of approximately 2.08 years, and a profitability index of 3.42, all of which exceeded the company's WACC/hurdle rate of 11.16%. Although the ownership model required higher initial capital investment, it delivered substantially greater lifecycle cost efficiency through lower operating and maintenance costs, annual operational savings of approximately Rp 5,710.6 million, and a total lifecycle cost significantly lower than that of the leasing alternative. In contrast, while short-term leasing remained financially viable as a temporary solution to accommodate incremental production during the ownership implementation period, long-term leasing became economically unattractive due to recurring lease payments that substantially increased total project costs. Therefore, ownership was recommended as the long-term investment strategy, whereas leasing should only be considered as a short-term tactical bridging option under specific operational conditions.

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