Financial Feasibility of Small Scale Liquefied Natural Gas Carrier (SSLNGC) Investment: A Capital Budgeting Analysis For PT Bahtera Adhiguna Putera (BAg)

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Abstract.

Indonesia's target to achieve net zero emissions by 2060 requires a strategic shift from coal to cleaner energy sources, with Liquefied Natural Gas (LNG) serving as a key transitional fuel. PT Bahtera Adhiguna Putera (BAg), a subsidiary of PT PLN Energi Primer Indonesia (PLN EPI), plays a vital role in energy logistics but currently lacks the fleet capacity to transport LNG. To address this gap, this study evaluates the financial feasibility of investing a Small Scale Liquefied Natural Gas Carriers (SSLNGC) through a capital budgeting approach. The research uses both qualitative and quantitative methods. PESTEL analysis is applied to assess the external environment and operational readiness, while capital budgeting tools such as Net Present Value (NPV), Internal Rate of Return (IRR), Payback Period, and Weighted Average Cost of Capital (WACC) are used to evaluate financial performance. The study tests several financing structure which is using 100% internal cash for Scenario 1 and mixed financing for Scenario 2 which ratio is 20% internal cash and 80% SHL scenario. A sensitivity analysis is also conducted to identify the most critical variables affecting investment outcomes and to measure the project's financial resilience under different market conditions.The results show that the SSLNGC investment is both technically and financially feasible. The vessel's capacity is suitable for port depth limitations and LNG demand in the targeted region. Financially, the investment is feasible, and the most optimal financing structure is Scenario 2 because has smaller WACC, higher NPV values, higher IRR compared to the WACC, and a reasonable payback period, confirming the project's profitability. This also supported by the smaller value in the Scenario 2 sensitivity analysis calculation compared to Scenario 1.To keep the project profitable in the long term, BAg needs to ensure all the financial and operational key variables remain the same as the overall feasibility calculation is highly dependent on those variables.

Keywords: *Capital Budgeting analysis; Financial Feasibility and Small Scale Liquefied Natural Gas Carrier (SSLNGC).*

I. INTRODUCTION

In recent years, Indonesia's energy sector is going through a significant transformation as the government including the state-owned enterprises like PT Perusahaan Listrik Negara (Persero) / PLN and its subsidiary PT PLN Energi Primer Indonesia (PLN EPI) work towards reducing carbon emissions and increasing the share of cleaner energy sources in the national energy mix. Indonesian government's commit to achieve net-zero emissions by 2060 which requires a shifting from coal, use more cleaner energy, like Liquefied Natural Gas (LNG). This shows how urgent the supply of LNG to support the changes [1]. PLN's supply forecasting shows that coal availability is expected to decrease in the long term due to mining constraints and increasing environmental regulations. Thus, strategic investment is important for PLN and its subsidiaries to diversify the fuel sources and increase the use of LNG, ensure reliable and cost-effective delivery of LNG and support PLN's broader goals of reducing emissions and ensure the energy security [15]. As a subsidiary of PT PLN EPI under cluster 1 (The primary energy supply), PT Bahtera Adhigiuna (BAg) can support this transition plans by expanding its fleet including addition of an LNG carrier to highlights the gap ensuring the security of the supply in providing electricity. The procurement of new LNG vessels requires a large amount of capital. This study will explore whether BAg's financial capacity to fund this investment independently or mix by internal cash and shareholder loans from PLN.

This study will provide insight of the optimal financing structure, including the ideal percentage split between equity and debt that best suits BAg's financial health and risk profile. The proposed LNG investment in LNG is essential to bridge this gap.This study will be divided into 3 (three) main parts which are operational analysis, capital budgeting analysis, and financial risk assessment. The operational analysis will identify and evaluate the current and planned fleet capacity and also the daily operation. The capital budgeting analysis will focus on investment costs, funding sources, and financial sustainability. Lastly, the risk assessment will identify potential risks related to market conditions, and financial exposure, along with strategies to mitigate these risks and the most important data result, is the feasibility.Through this comprehensive approach, the study aims to provide a clear recommendation on the feasibility of LNGC investment. By matching BAg's strengths with PLN EPI's energy transition objectives, BAg also support Indonesia's move towards a more sustainable and secure energy future.

II. METHODS

The data used in this study is 2 kind of secondary data which is internal and external data. Internal secondary data is obtained from 2025 RUKN ESDM, 2025-2034 RUPTL PLN and BAg Roadmap 2024-2028. External secondary data is data related both directly or indirectly to the investment by other credible institution or organization. The data will also be gathered for CAPEX, OPEX, other variable related to capital budgeting analysis. Based on the key aspects that affects the environment of the investment, this study conduct PESTEL analysis for the external analysis. Following by vessel optimization, the findings will provide crucial data inputs and contextual factors that directly influence the financial calculations including determine the optimal LNGC capacity based on demand, daily operation and cost which will be used to calculate the project's cash flow. The collected data will be processed by analyzing data using Microsoft Excel software and Python version 3.9.5 software.

Capital Budgeting Analysis

Investment appraisal is the main tool used in capital busgeting analysis. This is a common method to determine whether it is worthwhile investment. In this study, this approach used to provide an objective insight that support the decision making on the project based on the economic feasibility, potential profitability and associated risks [3]. There are several key financial variables and metrics that will be used in capital budgeting analysis such as Capital Expenditure (CAPEX) represents the large, one-time cost to acquire assets and Operating Expenditure (OPEX) that covers the daily expenses of running the projects such as salaries and utilities. The study will also use Weighted Average Cost of Capital (WACC) as a discount rate. This rate reflects the minimum return investors expect and help figuring out how money's value changes over time. The other key are Net Present Value (NPV), Internal Rate of Return (IRR) and Payback Period that reflect the total profit and how long it will take to get the initial investment money back [4].

Sensitivity Analysis

The financial risk analysis is conducted by sensitivity test for all financing structure scenarios. The goal of this approach is to find all the potential impact and the possible problems that might occurred including develop strategies to deal with it. Also using a sensitivity test to pinpoint which variables have the biggest impact on the profitability. The test conducted by set a base and simulate the increasing and decreasing of the variable. A swing of ±20% is applied to each variable, one at a time while other variable remain at the current assumption. Thus, the most sensitive variable will be identified. This method is important for the management because it will tells them where to focus their risk mitigation efforts [3].

III. RESULT AND DISCUSSION

In this study, to examine the external factors alongside the financial metrics, PESTEL analysis is conducted.

Table 1. PESTEL Analysis

Political	The energy transition including LNG infrastructure has strong support from Government [5]. Thus, the investment is necessary and attractive.
Economic	The LNG ship and parts costs are tricky because the value of the U.S. dollar keeps changing. To handle the risk, government plan to switch various energy sources to avoid relying heavily on imports paid for in US dollars [6].
Social	Implementing project indirectly support securing electricity reliability which generate public acceptance and addresses energu eequity goals [7].
Technological	The investment leverages proven and efficient LNG technology for regasification and distribution [1].
Enviromental	The investment supports national and global climate change. The LNG investment contribute to carbon reduction by replacing high polluting diesel fuel [1].
Legal	The investment has high legal feasibility as it compliant with safety and environmental standards that is being maintained by the Goverments [5].

Following by vessel optimization, the financial feasibility of the SSLNGC investment in this study depend on several keys data such as the cluster area, ports to be served, the demand of each port, the LNGC capacities and its each speed, etc. The potential market are for BAg is identified as South Papua Cluster, the LNG source is Tangguh and it serve two PLTMG which are Timika and Merauke [1].

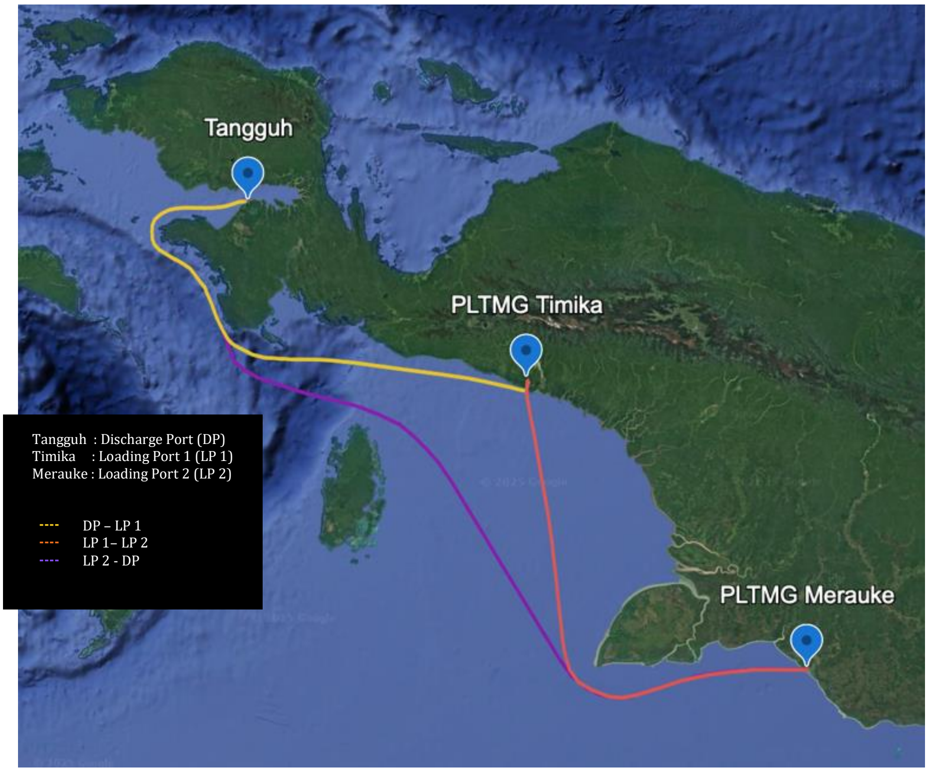

Fig 1. Roundtrip Route

Considering previous research about LNG demand for South Papua cluster. The defined roundtrip route is Tangguh as Loading Port (LP) - Timika as Discharge Port 2 (DP 2) – Merauke as Discharge Port 2 (DP 2) – Tangguh as Loading Port (LP). The most optimal LNGC capacity for the South Papua cluster is 6.000 m^3. To verify the recents findings research data, further analysis was conducted and will be used as the primary input for the financial feasibility assesment. In term of distance, the total distance of a roundtrip is 1.642,4 nm.To identify the daily demand, the total BBTU is converted to MMBTU by multiplied by 1.000 and then converted to cubic meter using a factor of 28,263682 [8]. The result show that the total demand is 890,5 m^3 per day. For the size of the LNG capacity, the small scale LNG carrier under 10.000 m^3 is suit the South Papua cluster due to the shallow water depth.

Table 5. Total Roundtrip

Route	SSLNGC	SSLNGC Capacity (m3)	Distance (nm)	Speed (knot)	Loading LP (hours)	Unloading DP1 (hours)	Unloading DP2 (hours)	Sailing Time (hours)	Roundtrip (hour)	References
A	B	C	D	E	F	G	H	I = D / E	J = F + G + H + I	
LP - DP 1 - DP 2 - LP	1	2.500	1.642,6	13,0	10,0	10,0	10,0	126,4	156,4	Capacity variety [9]
	2	3.000		12,0	10,0	10,0	10,0	136,9	166,9	Vessel speed [10]
	3	5.000		14,0	10,0	10,0	10,0	117,3	147,3	Loading period [11]
	4	6.000		13,4	10,0	10,0	10,0	122,6	152,6	Sailing time [12]
	5	6.500		13,0	10,0	10,0	10,0	126,4	156,4	Roundtrip Calculation [13]
	6	7.500		13,5	10,0	10,0	10,0	121,7	151,7	

Accommodating possible delay at port such as clearance, queeing and other port activities, the loading and unloading time at each port is set to 10 hours. [11]. The roundtrip includes sailing, loading, unloading and buffer time at each port. Moreover, to ensure supply remains stable despite challeng that might occure in operational activities including the probability of LNG evaporation, a 5% safety stock is added [14].

Table 6. Total Demand per Roundtrip

SSLNGC	SSLNGC Capacity (m3)	Roundtrip (hour)	Roundtrip (day)	Demand per Day (m3/day)	Safety Stock (%)	Demand per Roundtrip (m3/roundtrip)	Excess Demand	Unused Capacity
A	B	C	D = C / 24 hour	E	F	G = (EHI+ (E x F)) x D	D = C > B	E = B - C
SSLNGC 1	2.500	156,4	6,5	890,5	5%	6091,4	Yes	
SSLNGC 2	3.000	166,9	7,0			6501,6	Yes	
SSLNGC 3	5.000	147,3	6,1			5739,8	Yes	
SSLNGC 4	6.000	152,6	6,4			5944,4	No	55,6
SSLNGC 5	6.500	156,4	6,5			6091,4	No	408,6
SSLNGC 6	7.500	151,7	6,3			5909,1	No	1590,9

The result show that the most optimal Vessel is using SSLNGC with 6.000 m3 capacity. Other method for the vessel optimization that reconfirm the previous research and existing data is using Python to identify the most optimum vessel type capacity that will be used for this study.

Parameters

- demand[i]: Demand (in cubic meters) for each destination node i.
- ship[k]: Selected ship that being used in the calculation at its each combination.
- cap[t]: Capacity of ship type t.
- V[t]: Average cruising speed of ship type t (in knots).
- daily_cost[t]: Daily operational cost of ship type t (USD per day).
- p[i]: Port time at node i (in hours).
- route_dist[r]: Total sailing distance for base route r (in nautical miles).
- route_vis[r, i]: Binary parameter indicating whether route r visits node i.
- beta: Safety stock of 5% (Fauzi, I., 2024).
- Decision Variables
- The model includes several binary and continuous decision variables:
- s[k, t]: 1 if slot k is assigned to ship type t, 0 otherwise.
- z[k, r, mode]: 1 if slot k is assigned to route r under a specific mode, 0 otherwise.
- w[k, t, r, mode]: 1 if slot k simultaneously uses type t and route–mode combination (r, mode).
- f[i, k, t, r, mode]: Fraction of demand at node i served by slot k using ship type t on route r under mode mode

Decision Variables

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- f[i, k, t, r, mode]: Fraction of demand at node i served by slot k using ship type t on route r under mode mode.

Fig 2. Vessel Opmization Parameters and Decision Variables

The most optimal option is using SSLNGC 4 with a capacity of 6.000 m^3 as it can meet the demand per round trip and the remaining cargo is the smallest of all the options.

```
=== DEBUG SUMMARY ===
Total daily cost: 23800.60

-- Binary assignments (s, z, w) --
s: slot 2 uses type 4 (cap=6000.00, daily_cost=23800.60)
z: slot 2 chosen route r123 mode full
w: slot 2, type 4, route r123, mode full

-- Slot capacity diagnostics (should match solver LHS/RHS) --
Slot 1 summary:
  Slot 1, Type 1: cap*w-sum=0.00, adjusted_load=0.00, slack=0.00, w_sum=0.0
  Slot 1, Type 2: cap*w-sum=0.00, adjusted_load=-0.00, slack=0.00, w_sum=0.0
  Slot 1, Type 3: cap*w-sum=0.00, adjusted_load=0.00, slack=0.00, w_sum=0.0
  Slot 1, Type 4: cap*w-sum=0.00, adjusted_load=-0.00, slack=0.00, w_sum=0.0
  Slot 1, Type 5: cap*w-sum=0.00, adjusted_load=0.00, slack=0.00, w_sum=0.0
  Slot 1, Type 6: cap*w-sum=0.00, adjusted_load=0.00, slack=0.00, w_sum=0.0
Slot 2 summary:
  Slot 2, Type 1: cap*w-sum=0.00, adjusted_load=0.00, slack=0.00, w_sum=0.0
  Slot 2, Type 2: cap*w-sum=0.00, adjusted_load=0.00, slack=-0.00, w_sum=0.0
  Slot 2, Type 3: cap*w-sum=0.00, adjusted_load=0.00, slack=0.00, w_sum=0.0
  Slot 2, Type 4: cap*w-sum=6000.00, adjusted_load=5967.44, slack=32.56, w_sum=1.0
  Slot 2, Type 5: cap*w-sum=0.00, adjusted_load=0.00, slack=0.00, w_sum=0.0
  Slot 2, Type 6: cap*w-sum=0.00, adjusted_load=0.00, slack=0.00, w_sum=0.0

-- Per-node deliveries (adjusted with buffer) --
 Slot 2, type 4, route r123-full: node 2 fraction=1.000000, adjusted delivery=3269.12 m3
 Slot 2, type 4, route r123-full: node 3 fraction=1.000000, adjusted delivery=2698.32 m3

--- Trip Metrics (chosen ships only) ---
Slot 2 (Ship 4, Route r123-full): Trip time=6.38 days, Trip cost=151898.30 USD
Total trip cost across fleet = 151898.30 USD
Total daily cost: 23800.60

=== END DEBUG ===
```

Fig 3 Optimization Vessel Result

Capital Budgeting Analysis

Two financing structure scenario are used in this study. The Scenario 1 are based on BAg's historical investment data which is financing 100% from internal cash. The Scenario 2 is using general maximum loan financing structure which is 80% Share Holder Loan (SHL) and 20% internal cash [15]. In term of beta, for a private company like BAg, the value estimated using common financial valuation from public companies in the same industry. In this study, the beta is derived from SILO, BULL and SOCI. The unlevered beta is used for Scenario 1 with 100% financing from internal cash. The unlevered Beta is 0,46.The In this study, the audited financial statement is using BAg's recent audited financial statement. The beta for Scenario 2 is 1,09 which shows that BAg is relatively stable and less exposed to market risks, making it potentially a safer investment during periods of market uncertainty. In this study, there are several variables that used as key assumptions for capital budgeting analysis for the financial feasibility of the SSLNGC investment. The beta calculation is required as one of the key assumptions for the capital budgeting analysis. With historical data of 10 year Share Holder Loan (SHL) scenario at 9,87% and a 20 years financial modeling period.

Table 8. Key Assumption of Capital Budgeting Analysis

VARIABLES	
Rupiah to USD	Rp16.623/USD [16]
Time charter SSLNGC 6.000 m^3 specifically for the port	23.800,6 USD/day [13]
Risk free rate	6,18% [17]
Equity risk premium	6,87% [18]
Average peer company beta	0,46 [24]
SHL	9,87%
SHL period	10 years
Financial modeling	20 years
Marginal tax rate	22%

In this analysis, the cost of equity and cost of debt are calculated using the CAPM and after-tax debt cost formulas. Weighted Average Cost of Capital (WACC) in Scenario 2 show smaller value than in Scenario 1 with the 9,87% of Pre tax derived from BAg historical data.

Table 9. Key Assumption of Capital Budgeting Analysis

VARIABLE	% SHL % BAg		REFERENCES
	0% : 100%	80% : 20%	
Risk market premium (Rm)	6,87%	6,87%	Risk market premium [18
Pre tax cost of debt (Rd)	9,87%	9,87%	Tax rate [20]
Tax rate (Tc)	22,00%	22,00%	
Cost of Equity (Re)	9,34%	13,70%	
Cost of Debt (Ri)	7,70%	7,70%	
Weight of Equity (E/V)	100,00%	20,00%	
Weight of Debt (D/V)	0,00%	80,00%	
WACC	**9,34%**	**8,90%**	

The CAPEX of the SSLNGC 6.000 m3 investment include the vessel price [19], and other variable such as the economical lifetime, residual, debt and account receivable that are derived from historical data of BAg.

Table 10. The SSLNGC CAPEX

CAPEX	
SSLNGC Price in USD	37.449.749,93 USD [21]
SSLNGC Price in Rupiah	Rp625.000.000.000 [21]
SSLNGC capacity	6.000 m3 [21]
SSLNGC condition	New build [21]
Age of the carrier	0 years [21]
Economical life time	25 years
Remaining economical life time	25 years
Residual	7,5%
Debt period	30 days
Account receivable period	30 days

The operational expenditure (OPEX) is calculated on an annual basis to represent the yearly operating costs. In term of docking, it must be carried out every 30 months [22].

Table 11. The OPEX Per Year

VARIABLE		REFERENCES
Fuel cost (Rp)	Paid by the charterer	Fuel cost, port charge & fresh water cost paid by the charterer derived from BAg historical data.
Port charge (Rp)	Paid by the charterer	
Fresh water cost (Rp)	Paid by the charterer	Crew cost (Wages, provision & others) [23]
Crew cost (Wages, provision & others) (Rp)	11.081.157.529	Lubricating cost [21]
Lubricating cost (Rp)	7.822.709.518	Repair cost [23]
Repair, maintenance & sparepart cost (Rp)	6.148.867.494	Maintenance cost [21]
Insurance cost (Rp)	13.754.023.916	Sparepart cost [24]
Docking cost (Rp)	13.010.459.999	Insurance cost [21]
OPEX per year	**51.817.218.456**	Docking cost [23]

The results of the capital budgeting analyses in this study demonstrate that the investment is financially feasible under both financing structures. All Scenario show the same result of positive NPV and the IRR value that is greater than the WACC. The payback period is approximately ±7 years under all financing Scenario. The results show no significant gap between the payback periods in both Scenarios.

Table 12. Capital Budgeting Analysis

VARIABLE	FEASIBILE PARAMETER	%SHL : %INTERNAL	
		0% : 100%	80% : 20%
NPV	Feasible if NPV > 1 (Froziqin, M., F., et al,. (2022))	Feasible because NPV > 1 which is 101.6 billion Rupiah	Feasible because NPV > 1 which is 124.1 billion Rupiah
IRR	Feasible if IRR > WACC (Pranoto, A., et al, (2025))	Feasible because 11,5% IRR > 9,3% WACC	Feasible because 10,6% IRR > 8,9% WACC
PAYBACK PERIOD	Payback period < Economic life of the SSLNGC (Utama, B. R. (2024))	Feasible because 7,18 years < 20 years	Feasible because 7,09 years < 20 years

These results confirm that the investment is financially viable in both cases, but Scenario 2 provides stronger profitability and efficiency. The close call, however, is justified by the strategic security offered by the long term dedicated contract eliminates the volatility of the market by stabilizing the cash flow patterns of the payer. The captive market offered by the contract ensures demand security as well as revenue security [25]. In addition, the proposed project plays a critical role in the strategic requirements of the PLN Group in the sense that it ensures security of energy. A further evaluation considering the financial risk in using Scenario 2 for this investment is carried out using sensitivity analysis for all Scenario.In this study, the sensitivity analysis conducted to evaluate the sensitive variable that can affect the Net Present Value (NPV) of the SSLNGC investment for each of the scenarios. The results of sensitivity analysis highlight that the project's profitability is significantly more sensitive to changes in the Time Charter Price in all scenarios. Overall, the result in Scenario 2 that using the mix financing structure is more stable than Scenario 1 that using full internal cash.

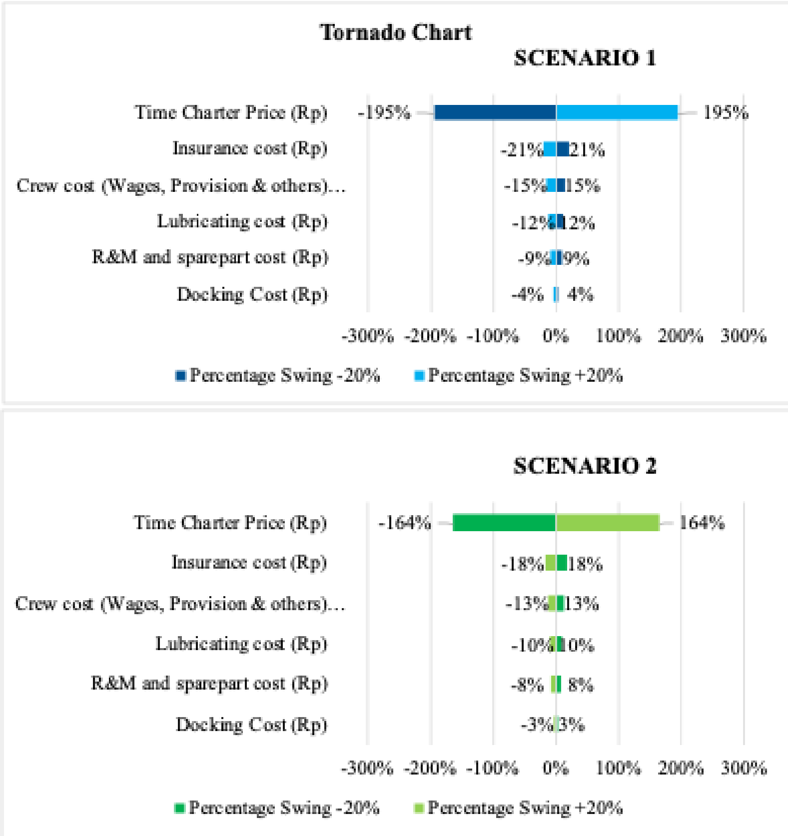

Fig 4. Tornado Chart Scenario 1 and 2

IV. CONCLUSION

The financial feasibility results of this study depend heavily on several key data driven and the available data which are the LNG demand, the LNG source and ports to be served, the Time Charter price, the vessel purchase and operational cost, the Rupiah/USD exchange rate, the rate and ratio of SHL debt used, and other key financial numbers used in the analysis. Any changes in these variables will directly change the feasibility results.In conclusion, the SSLNGC project is both technically and financially feasible, strategically not only aligned with national energy policies, but also has balances profitability, risk management, and environmental responsibility, positioning BAg as a major contributor to Indonesia’s clean energy transition. In term of the financing structure, BAg should conduct the investment under Scenario 2 which is 20% internal cash and 80% SHL. To lower the risks, BAg needs to secure a fixed, long term Time Charter Price, optimal SHL percentage, LNG demand and operational cost.In order to gain the most optimum revenue from the projects, there should be an Optimal Capital Structure analysis for the future research. The findings will help develop financial strategy for industries that has similar LNG carrier investments in the future.

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