OPTIMIZATION OF GAS PIPELINE UTILIZATION FOR SECTION 2 PEMPING-TANJUNG UNCANG WITH THE PROVISION OF MINI LNG PLANT FOR KARIMUN REGENCY

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ABSTRACT

Investment evaluation is a crucial part of investment decisions to measure will the project generate profit for the company. There is four Capital Budgeting technique used to measure this investment evaluation in this project Net Present Value (NPV), Internal Rate Return (IRR), Discounted Probability Index (DPI), and Payback Period (PBP). From the evaluation, it was obtained that a positive NPV of 280.649, an IRR of 8,10% greater than the WACC of 4,21%, while the DPI of 1.25 and PBP of 3,25 years was faster than the duration of the 5 (five) year contract. Monte Carlo simulation used 1.000 times to calculate Probability NPV<0 with result Probability NPV<0 in this project is 0,17% meanwhile probability NPV>0 is 99,83%.In the sensitivity analysis, it is found that the increase in the cost of capital and the duration of the agreement are factors that are sensitive to project feasibility. From the results of the above calculations, it can be concluded that Optimization Of Gas Pipeline Utilization For Section 2 Pemping – Tanjung Uncang With The Provision Of Mini LNG Plant For Karimun Regency is Eligible to be accepted.
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Keywords: Capital Budgeting, Investment Evaluation, Sensitivity Analysis, uncertainty

INTRODUCTION

Energy is the basic necessity for the economic development of a country, energy exists in different forms in nature but the most important form of energy is electrical energy. The modern days are more dependent on the use of electrical energy which is almost become a part of our life. The greater the per capita consumption of energy in a country, the higher is the standard of living of its people. The number of customers per group and the energy sold per customer group from 2011 until 2019 have been shown in Table 1 and Table 2. The availability of electrical supply, in line with the increase in the number of customers served by PLN, in 2014, the number of PLN customers was 57 Million, increasing to 75 Million in December 2019. Meanwhile, the energy sales in 2019 were 245.518,17 GWh, increasing from 2014 was 157.992,66 GWh

TABLE I
NUMBER OF CUSTOMERS PER GROUP 2011-2019

Year	Household	Industry	Business	Social	government office warehouse	Lighting Public Road	Total	%
2011	42,577,542	50,365	2,049,361	963,766	120,246	133,865	45,895,145	8.15
2012	46,219,780	52,661	2,218,342	1,032,830	128,252	143,384	49,795,249	8.5
2013	50,116,127	55,546	2,418,431	1,110,450	137,762	157,892	53,996,208	8.44
2014	53,309,325	58,350	2,626,160	1,181,779	146,321	146,321	57,468,256	6.47
2015	56,605,260	63,314	2,894,990	1,261,516	156,782	156,782	61,138,644	6.39
2016	59,243,672	69,629	3,239,764	1,354,010	169,478	205,940	64,282,493	5.14
2017	62,543,434	76,816	3,579,364	1,460,546	182,874	225,249	68,068,283	5.89
2018	66,071,133	88,185	3,750,666	1,559,997	198,113	249,303	71,917,397	5.66
2019	69,619,877	104,922	3,829,553	1,662,926	211,947	276,389	75,705,614	5.27

TABLE 2
ENERGY SOLD PER CUSTOMER GROUP 2011-2019

Year	Household	Industry	Business	Social	government office warehouse	Lighting Public Road	Total	%
2011	65,111.57	54,725.82	28,307.21	3,993.82	2,786.72	3,067.52	157,992.66	7.26
2012	72.132,54	60.175,96	30.988,64	4.495,57	3.057,21	3.140,82	173.990,74	10,13
2013	77.210,71	64.381,39	34.498,38	4.939,04	3.260,71	3.250,78	187.541,02	7,79
2014	84.086,46	65.908,68	36.282,42	5.446,46	3.483,99	3.393,76	198.601,78	5,90
2015	88.682,13	64.079,39	36.978,05	5.940,98	3.717,16	3.448,11	202.845,82	2,14

2016	93.634,61	68.145,30	40.074,39	6.630,80	4.021,61	3.497,58	216.004,29	6,49
2017	94.457,38	72.238,37	41.694,79	7.095,37	4.121,26	3.526,55	223.133,72	3,30
2018	97.832,28	76.946,50	44.027,40	7.781,34	4.403,28	3.627,07	234.617,88	5,15
2019	103.733,4	3 77.878,6	5 46.901,2	5 8.621,8	3 4.750,2	9 3.632,7	1 245.518,17	4,65

Source: PLN (Persero)

A comparison between the number of customers and sales energy is shown in Fig. 1. As the only company has given the authority and responsibility by the state to provide electricity services, to provide 24/7 electricity with good quality, not blackout so that security of supply is the main key in service. Meanwhile, to move forward PLN is also responsible for realizing an electrification ratio of up to 100% in all regions of Indonesia and increasing per capita electricity consumption. in 2019 electrification ratio was 95.75%, with the household customers at 69.619.877. As seen in Table 3

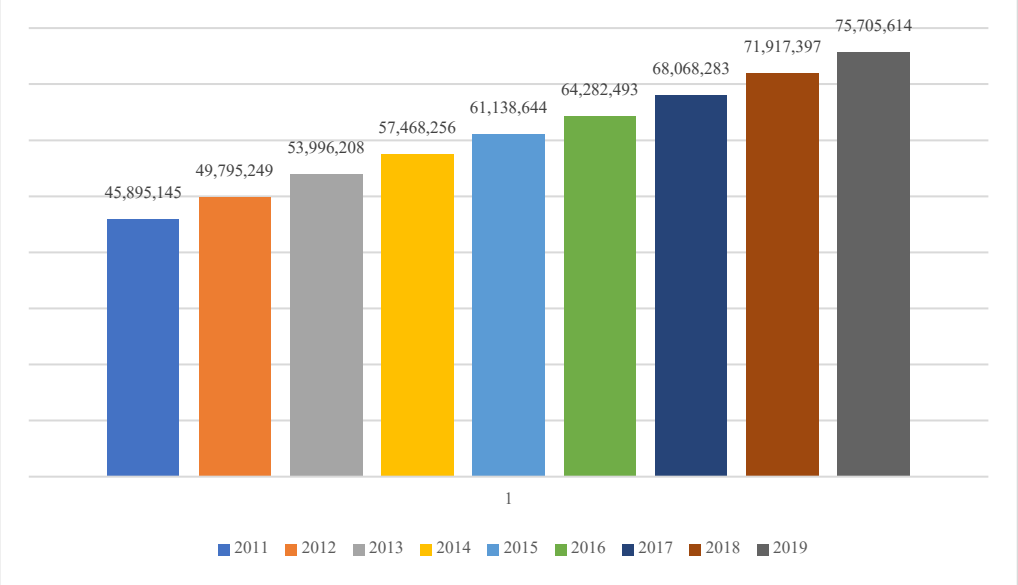

Fig. 1 Customer and Energy Sales PLN 2011-2019

Company Profile

As a subsidiary of PLN Batam, PT. Pelayanan Energi Batam (PT PEB) was involved in several strategic projects, built gas pipeline 13,5 KM from Pemping Island to plant gate Power Plant in Tanjung Uncang, has officially been completed with the commercial operation of the Pipeline System on 1 December 2016. In May 2019 this facility has become a vital national object (OBVITNAS) in accordance with KEPMEN ESDM No. 77K/90/MEM/2019. As the first subsidiary specialized in Gas Pipeline in PLN Group, PEB is expected to contribute to cost efficiency for PLN Group.

TABLE 3
THE RATIO OF ELECTRIFICATION AND ENERGY CONSUMED PER CAPITA 2019

PLN Operation	Population (x1,000)	Residential (x1,000)	Residential Customers	Electrification *) (%)	kWh Sold/Capita
UIW Aceh	5,352.10	1,307.63	1,303,772	99.70	519.70
UIW North Sumatera	14,718.71	3,595.45	3,552,268	98.80	743.53
UIW West Sumatera	5,512.51	1,271.77	1,237,848	97.33	624.96
UIWRiauandRiauArchipelago	9,168.23	2,282.82	2,082,344	91.22	871.82
- Riau	6,892.93	1,752.34	1,567,169	89.43	674.14
- Riau Archipelago	2,275.30	530.48	515,175	97.12	1,470.71
UIW South Sumatera, Jambi and Bengkulu	14,117.02	3,513.11	3,352,877	95.44	576.72
- South Sumatera	8,548.84	2,050.28	1,959,637	95.58	614.59
-Jambi	3,585.15	934.27	871,324	93.26	538.89
- Bengkulu	1,983.03	528.56	521,916	98.74	481.83
UIW Bangka Belitung	1,460.43	431.80	431,692	99.98	799.03

UID Lampung	8,496.16	2,208.39	2,104,183	95.28	551.55
UIW West Kalimantan	5,075.25	1,206.55	1,085,364	89.96	506.91
UIWSandCKalimantan	6,910.36	1,822.70	1,706,897	93.65	604.59
- South Kalimantan	4,242.39	1,155.72	1,140,948	98.72	664.52
- Central Kalimantan	2,667.97	666.98	565,949	84.85	509.29
UIWEastKalimantanandNorth	4,344.04	1,177.11	1,089,710	92.58	909.95
UIWN,CSulawesiandGorontalo	6,746.70	1,597.64	1,551,341	97.10	514.51
-NorthSulawesi	2,503.53	655.20	646,347	98.65	711.46
- Gorontalo	1,181.31	271.21	263,455	97.14	460.37
- Central Sulawesi	3,061.86	671.23	641,539	95.58	374.36
UIWS,SEandWSulawesi	12,906.24	3,192.06	2,941,794	92.16	566.61
- South Sulawesi	8,854.11	2,203.25	2,126,851	96.53	671.53
- Southeast Sulawesi	2,683.49	651.81	556,746	85.42	367.77
-WestSulawesi	1,368.64	337.01	258,197	76.61	277.71
UIWMalukuandNorthMaluku	3,021.74	671.94	576,204	85.75	349.68
- Maluku	1,777.78	382.31	332,898	87.08	292.01
-NorthMaluku	1,243.96	289.63	243,306	84.01	432.10
UIWPapuaandWestPapua	4,344.77	1,029.80	591,737	57.46	360.81
-Papua	3,370.01	791.45	389,406	49.20	313.84
-WestPapua	974.76	238.35	202,331	84.89	523.20
UIDBali	4,388.17	1,223.34	1,212,223	99.09	1,300.48
UIWWestNusaTenggara	5,189.05	1,465.40	1,427,162	97.39	375.82
UIWEastNusaTenggara	5,475.16	1,351.33	758,498	56.13	182.55
Outside Java	117,226.61	29,348.83	27,005,914	92.02	613.57
UIDEastJava	39,850.33	11,281.47	10,920,337	96.80	934.22
UIDCentralJavaandYogyakarta	38,539.15	10,940.94	10,767,414	98.41	721.00
-CentralJava	34,645.33	9,624.06	9,615,000	99.91	714.40
-D.I.Yogyakarta	3,893.82	1,316.88	1,152,414	87.51	779.74
UIDWestJava	49,293.52	14,399.01	14,184,861	98.51	1,032.27
UID Banten	12,804.48	3,793.82	3,792,240	99.96	1,841.88
UIDJakartaRaya	10,540.20	2,949.53	2,949,111	99.99	3,235.99
Java	151,027.68	43,364.77	42,613,963	98.27	1,149.40
Indonesia	268,254.29	72,713.60	69,619,877	95.75	915.24

Gas Pipelines System Pemping Island - Tanjung Uncang Batam map is shown in Fig. 2. Referring to the operating license. This gas pipeline system is operated and managed for its own interest in order to flow gas for a power plant owned by PT PLN Batam with the capacity of 2 X 40 MW and PLTG IPP 2 X 35 MW located in Tanjung Uncang. This gas pipeline system operates at pressure 550 – 710 psig (37-49 bar) maximum flowrate 125 mmscfd or equivalent 130 BBTUd with an average gas volume 768,8120 BBTU per month in 2019, as shown in Table 4.

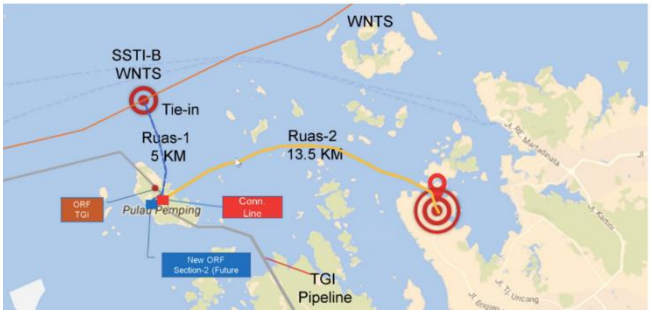

Fig. 2 Gas Pipelines System Pemping Island - Tanjung Uncang Batam

TABLE 4
REALIZATION GAS VOLUME 2019

Date	Nomination Gas			Stock Gas	Receipt Point Quantity (BBTU)			Delivery Point Quantity (88TU)			SRC (88TU) ·Delivery Point		
	PGN	PCJL	TOTAL	PCJL	PGN	PCJL	TOTAL	M·003A	M·0038	TOTAL	M·003A	M·0038	TOTAL
Month	(a)	(b)	(c)	(d)	(e)	(f)	(g)=(e) + (f)	(h)	(i)	(j)=(h) + (i)	(k)	(I)	(m)=(k) +(I)
Jan	221.8000	599.5000	821.3000	5.3837	221.5769	538.3431	759.9200	450.2024	315.3771	765.5794	446.9361	312.9516	759.8877
Feb	157.0000	460.4400	617.4400	7.7784	156.7523	460.1777	616.9300	378.5176	244.9724	623.4899	374.7936	242.1013	616.8950
March	215.4000	616.7000	832.1000	72.1654	214.5676	618.8024	833.3700	509.2095	321.0625	830.2720	511.2057	322.3621	833.5678
April	214.5000	585.1000	799.6000	76.8175	214.6053	584.3008	798.9061	513.1881	285.4086	798.5968	513.5219	285.2702	798.7921
May	223.6000	578.9000	802.5000	5.5043	222.1044	575.3736	797.4780	474.7720	321.5766	796.3485	475.2958	322.1829	797.4787
June	179.2000	519.5000	698.7000	8.0826	173.4104	499.9506	673.3610	368.2180	299.3431	667.5610	371.4267	302.0424	673.4691
July	299.8000	550.5000	850.3000	16.0763	287.1923	527.8145	815.0068	488.9775	323.1268	812.1044	490.5637	324.3428	814.9065
August	292.5000	558.0000	850.5000	16.6491	281.8000	537.4660	819.2660	488.8128	327.8701	816.6829	490.3385	328.8992	819.2377
Sep	209.9000	535.0000	744.9000	16.6071	198.1417	505.6483	703.7900	411.9612	290.5161	702.4773	412.7559	291.0454	703.8013
October	247.9000	604.5000	852.4000	5.5542	252.1477	616.7771	868.9248	354.7212	512.2313	866.9525	355.5874	513.3459	868.9333
Nov	296.3000	548.0000	844.3000	10.8274	280.6499	534.6901	815.3400	227.4099	586.2534	813.6632	227.8813	587.4563	815.3376
Dec	265.0000	501.5000	766.5000	18.9300	236.9519	486.5181	723.4700	165.3064	556.8697	722.1760	165.6546	557.7830	723.4376

In 2019 the average gas volume per day is summarized in Table 5.

TABLE 5
REALIZATION GAS VOLUME 2019

YEAR	MONTH	AVG BBTUD - DELIVERY POINT
2019	January	24.5125
	February	21.2722
	March	26.8892
	April	26.6264
	May	25.7251
	June	22.449
	July	26.2873
	August	26.427
	September	23.46
	October	28.0301
	November	27.1779
	December	23.3367
	Total	302.1934
	AVG BBTUD	**25.1828**

From Table 5, we can see there is still an excess of pipe capacity that can be optimized. Batam as the center of growth is one of the metropolises in Indonesia, which is geographically surrounded by small islands/hinterlands. In line with government programs to increase the electrification ratio, PLN Batam and PEB will carry out this mandate by ensuring that electricity can reach islands/hinterland areas that have not had electricity to this day so that the electrification ratio of KEPRI 100% electrified can be realized.

Therefore utilization of the excess pipe capacity can be optimized by increasing volume gas flow and process into LNG. LNG concept was developed to meet the needs of gas consumers who do not get piped gas rations, or who need gas with a volume that is not too large, such as small capacity power plants locates on various islands scattered throughout the country. Moreover, this concept is supported by the geographical condition of Indonesia which is an archipelago country so that it is impossible for the entire region to be connected by pipelines across the oceans because it is certain that it will require very big funds.

As an alternative substitute LNG price is cheaper than the price of diesel fuel so that it will reduce energy costs for people and industrial.

Most of the electricity needs for the industry are still supplied using diesel generators belonging to each industry, one of which is the Karimun Regency in Riau Islands Province. Electricity in Karimun Regency is managed by PLN by relying on PLTD. The presence of additional electrical power from generators whose fuel is efficient from LNG is certainly a haven for industries that are already operating on Karimun Regency and can channel energy, especially to remote areas or Hinterland, can be realized through LNG so that it contributes to the availability of electricity in the region. The development of the Karimun Regency is one of the investment opportunities. The island is about 23 miles from the Port of Tanjung Pelepas, Malaysia, and about 22.5 miles from the port facilities on Jurong Island, Singapore, and adjacent to the industrial growth center of Batam and Bintan

LITERATURE STUDY

Capital budgeting is the process of evaluating and selecting a long-term investment. This process is intended to achieve the firm's goal of maximizing shareholders' wealth [1].

A. *Discounted Cash Flow (DCF)*

Discounted Cash Flow (DCF) is a method of evaluating an investment by estimating future cash flow and taking into consideration of money **[2]** . The discounted cash flow (DCF) formula is shown in equation (1).

$$DCFt = \frac{NCF_t}{(1+r)^t} \quad (1)$$

Where :
DCFt= Net cash flow at the year of year t
r = Discount rate
t = Number of the year t = 0,1,2,3…..t

B. *Weight Average Cost Of Capital (WACC)*

A method to calculate MARR is the WACC approach with assuming the source of investment capital from debt and equity. The expected return for equity investor name cost of equity, the expected that lenders hope to make on their investment named cost of debt. For all financing that the company takes on, the composition of cost of financing will be a weighted average of the cost of equity and debt, this weight cost is named Weight Average Cost Of Capital [3]. WACC formula is described in equation (2).

$$WACC = \left[rd * (1 - tax) * D/(D+E) \right] + \left[re * E/D + E \right] \quad (2)$$

Where :
rd = cost of debt
re = cost of equity
D = Debt
E = Equity

C. *Capital Budgeting Technique*

Net Present Value (NPV) determines whether the project is an acceptable investment, NPV is the difference between the present value of cash inflow and the present value of cash outflow [4]. NPV formula is shown in equation (3).

$$NPV = \sum_{t=1}^{t=N} \frac{NCFt}{(1+r)^t} - Initial\ \ Investment \quad (3)$$

Where :
NCFt = Net Cash flow in t period
r = discount rate
N = life of the project

Decision criteria for NPV are as follows :
If NPV ≥ 0, accept the project
If NPV ≤ 0, reject the project

D. *Internal Rate of Return (IRR)*

Internal rate of return (IRR) is the discount rate that equates the NPV of an investment opportunity with 0 (because the present value of cash inflow equals the initial investment) [5].

IRR formula is shown in equation (4).

$$0 = \sum_{t=1}^{n} \frac{CFt}{(1+r)^t} - CF0 \quad (4)$$

Where :
CFt = Cash flow in period t
r = Discount rate
N = life time of the project
IRR = Internal rate of return of the project

When IRR is used to make accept – reject decisions, the decision is as follows :
If the IRR > Discount Rate, accept the project;
If the IRR < Discount Rate, reject the project;

E. *Profitability Index (PI)*

Profitability index is ratio accumulation net present value, net cash flow after initial investment divided by initial investment [6] as denoted in equation (5)

$$DPI = \frac{\sum_{t=1}^{t=N} \frac{NCFt}{(1+r)^t}}{IO} \quad (5)$$

Where :

NCFt	=	Net Cash flow in period t
r	=	Discount Rate
IO	=	Initial Investment
N	=	project life time

DPI criteria for an independent project are as follow :
If $DPI \geq 0$, then the project can be accepted
If $DPI \leq 0$, then reject the project

F. *Payback Period Analysis (PBP)*

Payback period analysis is when the period of time over which cash flow from the investment is expected to recover the initial outlay [7], with formula as explored in equation (6).

$$PBP = \sum_{t=1}^{t=N} NCFt \geq 0 \quad (6)$$

Where :

PBP	=	Payback period (*PBP*)
NCFt	=	Net Cash flow in t period
N	=	life of the project

Criteria in PBP indicator :
If the *PBP* < cut off time the project, accept the project
If the *PBP* > cut off time the project, reject the project

G. *Sensitivity Analysis*

Sensitivity analysis is the process of tweaking one key input or driver in a financial model and seeing how sensitive the model is to the change in that variable [8]. This sensitivity analysis is used to identify how significant each variable impacts to investment analysis parameter of the project. The main uncertainty factors in this project are :

1. Capital cost
2. Interest
3. Capital expenditure (CAPEX)
4. Lifetime project (month)

METHODOLOGY

To accomplish the study, there are several steps should be taken as shown in Fig. 3

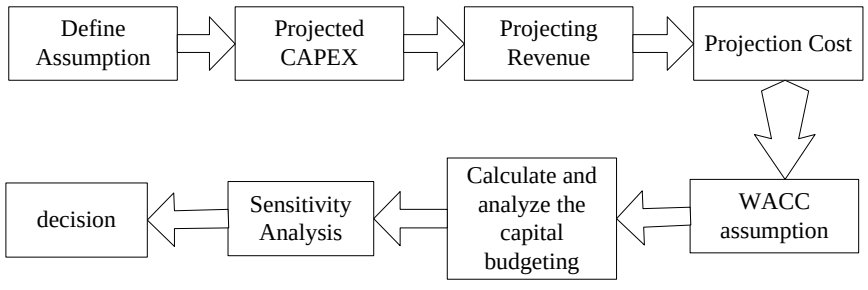

Fig. 3 Methodology of optimization of Gas Pipeline

The step for optimization of Gas Pipeline: 1. Define assumption, 2). Projected CAPEX, 3). Projecting Revenue, 4). Projection Cost, 5). WACC assumption refers to BPH Migas [9]. 5). Calculate and analyze the capital budgeting model indicators of the project; the results are Payback Period (PP), Net Present Value (NPV), Discounted Payback Period (DPP), Profitability Index (PI), and Internal Rate of Return (IRR) 6.) Sensitivity Analysis, 6). Making a decision refers to capital budgeting and sensitivity analysis.

Final Research is Optimization of Gas Pipeline Utilization For Section 2 Pemping – Tanjung Uncang With The Provision Of Mini LNG Plant For Karimun Regency project Optimize PEB pipa capacity, this project evaluated with capital budgeting technique: NPV, PP, IRR and PI

RESULT AND DISCUSSION

Based on the data provided, Capital Expenditure needs for this project is USD 1.359.316, Operational Expenditure is USD 308.936.per annum with 5 (five) years lifetime contract, Debt : Equity 70% : 30% , WACC 4,21 % , total revenue during the contract USD 2.367.242.

After defining several parameters for calculation with the result as shown in Table 6.

TABLE 6
INVESTMENT PARAMETER ANALYSIS

Parameters	**Criteria Indicator**	**Value/Result**
PBP	If the PBP < cut off time the project, accept the project	3,25
	If the PBP > cut off time the project, reject the project	Accept
NPV	If NPV ≥ 0, accept the project	USD 280.649
	If NPV ≤ 0, reject the project	Accept
PI	If DPI ≥ 0, then the project can be accepted	1,25
	If DPI ≤ 0, then reject the project	Accept
IRR	If the IRR > Discount Rate, accept the project	8,10%
	If the IRR < Discount Rate, reject the project	Accept

According to Table 6, all investment parameters Acceptable.
Sensitivity analysis is the process of tweaking one key input or driver in a financial model and seeing how sensitive the model is to the change in that variable. In this final project sensitivity analysis was used to identify how significant each variable impacted to investment analysis parameter of the project NPV, IRR, PI, and PBP. The main uncertainty factors in this project are shown in this table 7 and output will be presented in a tornado chart to evaluate sensitivity level.

TABLE 7
SENSITIVITY PARAMETER SCENARIOS

No	**Sensitivity Focus**	**Low**	**Base**	**High**
1	Capital Expenditure (CAPEX)	-10%	Base	10%
2	Interest Rate	4,53%	5,24%	5,92%
3	Life Time Project (month)	48	60	72
4	Debt: Equity Portion	80%:20%	70%:30%	60%:40%

Tornado chart to evaluate sensitivity level shown in Fig. 4

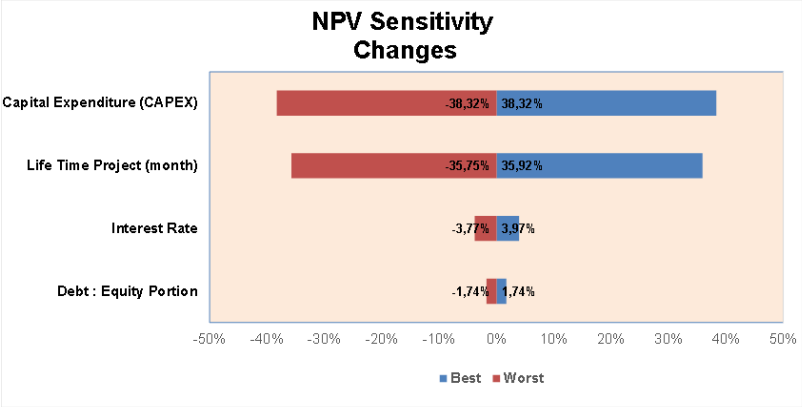

Fig. 4 NPV Tornado Chart Sensitivity

Fig.4 shows that CAPEX, LIFETIME PROJECT, and DEBT: EQUITY PORTION is the most sensitive parameter to NPV indicator, with an explanation below :

a. CAPEX under budget -10% this project show increase 38,32% and vice versa, meanwhile CAPEX over budget +10% NPV value will drop 38,32% from BASE assumption.
b. LIFE TIME PROJECT (MONTH) extended 1 (one) years from base assumption 5 (five) years NPV will increase 35,92%, meanwhile shortened 1 (one) years NPV will drop 35,75% from BASE assumption.

Other parameters have less sensitive to NPV calculation.

According to the result of the sensitives analysis calculation above, we provide Scenario analysis from the most significant impact on NPV as shown in Table 8

TABLE 8
SCENARIO ASSUMPTION

Assumption	Worst	Base	Best
Capital Expenditure (CAPEX)	1.359.316.20	1.235.742	1.112.167,80
Life Time Project (month)	48	60	96
Debt: Equity Portion	60,00%	70,00%	80,00%

CONCLUSIONS

According to DCF calculation with investment analysis method in Chapter 3, Optimization Of Gas Pipeline Utilization For Section 2 Pemping – Tanjung Uncang With The Provision Of Mini LNG Plant For Karimun Regency feasible and will generate profit for PEB. Optimization Gas Pipeline Utilization For Section 2 Pemping – Tanjung Uncang will reduce electrical energy costs for people and industries in the Karimun regency. In order to maximize profit for the company management, PEB must pay attention and mitigate all risks that will affect to reduce company profit margin, especially the most sensitive key factor CAPEX, Lifetime project, and Debt: Equity portion.

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