FINANCIAL FEASIBILITY STUDY OF GREEN BUILDING INVESTMENT GRAHA CIMB NIAGA JAKARTA BUILDING WITH A LIFE CYCLE COST ANALYSIS APPROACH

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ABSTRACT

Global warming and climate change are undeniable global challenges. A phenomenon that cannot be underestimated. Temperature uncertainty, environmental damage, natural disasters to diseases that may arise due to global warming can be catastrophic. Green building is here to answer these challenges. Energy consumption in buildings is quite large and has an impact. The building aspect accounts for 35% and 38% of global energy use and carbon emissions, respectively. The amount of greenhouse gases is projected to reach 42.4 billion tons by 2035. The large initial cost comparison and ignorance of the benefits of green building causes investors to be reluctant to apply the Green Building concept. There is a need for an analysis of the life cycle cost (LCC) in the Green Building investment of the CIMB Niaga Graha Building so that the benefits of the Green Building concept are known. Graha CIMB Niaga is the first existing building in Indonesia to have a Green Building predicate with a Platinum level by BCAI Singapore. LCC analysis is expressed by Net Present Value of Savings (NPV), Savings Investment Ratio (SIR), Discounted Payback Period (DPP), Adjusted Internal Rate of Return (AIRR) and Sensitivity Analysis. Environmental gains are also expressed by NPV per 1 Greenhouse Gas (GHG) savings. The results showed that the investment was profitable and feasible. The profit is shown by the NPV parameter of Rp. 8,930,649,864 > 0, SIR of 2.69 > 1, DPP of 4.4 < 20, and AIRR of 43.88% greater than MARR of 11.72%. Investment is still profitable if the rate of increase in investment is below 163.44% or a decrease in electricity savings is below 61.58%. The results of the study also show that the investment is profitable and feasible in terms of environmental impact of Rp.410.039 per 1 GHG Savings.

Keywords: building energy efficiency; green building; life cycle cost; LCC; NPV; AIRR.

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INTRODUCTION

The concept of Green Building is present when changes in global warming become an issue that becomes a global challenge.

The building aspect in the research of Debrah, et al. (2021) accounted for 35% and 38% of global energy use and carbon emissions, respectively. The amount of greenhouse gases caused by buildings worldwide according to Darko et al. (2017) has been estimated to reach 42.4 billion tons by 2035. The large initial investment in implementing the green building concept compared to buildings that do not apply the concept causes many developers and investors not to apply the Green Building concept.

Lack of awareness and information about the benefits of implementing Green Building is the main obstacle for developers not to apply the Green Building concept according to Darko et al., (2017) and Azeem et al., (2017). Gaol and Rahmawati (2013) and Halil et al. (2016) said that there is a need for a financial feasibility study of a building to determine the financial feasibility of the building. The factors that influence building investment decisions with the Green Building concept and building costs with the Green Building concept need to be investigated by analyzing the costs of implementing green building according to Rizki Andini and Christiono Utomo (2014). Therefore, there is a need for research that discusses the analysis of life cycle costs in Green Building investment, thus showing the benefits that can upload investors' desire to invest with the Green Building concept. This research was investigated at the CIMB Niaga Graha Building.

Building investment is currently very profitable. Buildings and land with buildings on them are investment items that always increase every year. The increase in building investment is in line with

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the improving global economy. This is stated by Sabariah I, Syaiful S (2012) and Anwar S, Hayati NI (2013).

Natasasmita G et.al (2018) and Marguna A et.al (2012) suggest that investments with a high NPV will affect the selling value. Good financial control techniques will affect the selling value of the building, especially the buildings offered are very strategically located so that they will make important investments in the future. The condition of vacant land if it is located in the golden triangle of the trading area and the CBD is the target of investors to increase the value of their investment.

Estimate (realization) of payment receipts (payments in/cash in) and disbursement of payments (payments out/cash out). Thus, the estimated data is obtained, when (what months) the implementation period of the project in question requires operational funds. The cash flow plan is a work guideline in terms of finance, with cash flow it can be seen the amount of costs that must be provided for each time during the project implementation period and the overall funding of the project (Satoeti DR, Dwijendra NKA, 2021; Setiawan I, 2013).

Green Building Terms and Conditions at Graha CIMB Niaga

The predicate of an Environmentally Friendly Building (Green Building) was obtained by the CIMB Niaga Graha building. The predicate was obtained after PT. Grahaniaga Tatautama as the building manager was audited by the Building and Construction Authority International Of Singapore. Green Mark certification with Platinum level is obtained after meeting the applicable criteria. This predicate and certification is the first in Indonesia for the existing building category from BCAI Singapore.

Other regulations must be met by Graha CIMB Niaga in addition to meeting Singapore's Green Mark requirements. Graha CIMB Niaga needs to comply with DKI Jakarta Governor Regulation No. 38 which includes:

a. Energy Conservation and Efficiency (Able to achieve 10-25% energy conservation)
b. Water Conservation and Efficiency (Able to achieve water conservation of at least 10%)
c. Indoor air quality and thermal comfort (Air temperature in residential spaces is set as low as 25°C (twenty five degrees Celsius) and relative humidity in the range of 60% (sixty percent) ± 10% (approximately ten percent)
d. Operational/maintenance management (There are maintenance, care, monitoring and evaluation activities, so that the building is always in efficient performance.

Life Cicle Cost Analysis

Life cycle costs according to research by Dwaikat and Ali, (2014) are technically placed on engineering economic principles to calculate comparable costs and benefits by taking into account the time value of money at each stage of the life cycle. The calculations carried out cover several cost aspects, including: initial investment cost (starting costs, both design and installation), energy costs (electricity and water costs), and operation and maintenance costs (maintenance costs and maintenance costs).
Dwaikat and Ali, (2014) said that finding the present value of the amount of money in the future is known as discounting. The discount rate is based on an exchange rate that reflects the time value of money. Discount rate at least according to Bank Indonesia interest to find future equality and balance for a current amount of money. The change in cost can be calculated using the following equation.

$$F = P(1 + e)^n \quad (1)$$

Description
F = Future value of money
P = Present value of money
e = Percentage of increase in cost per year sought
n = Number of years between the initial year and the year sought

Investment Financial Feasibility Parameters

Payback Period according to Kniefel and Webb (2020) is the time required for the return of

investment to investors. The payback period is usually called the Simple Payback Period method by dividing the initial investment capital issued by the income received by investors for one year. Simple Payback Analysis is only suitable for calculating PP and Return on Investment (ROI) for a short time. All cash flows from Life Cycle Cost must take into account the time value of money. Discounted Payback Period is another type of Payback Period that takes into account the time value of money in calculating cash flows.

Conci et al., (2019) researched that the LCCA method in the building industry is to use Net Present Value (NPV) where future costs are presented back to the present value. Benefit Cost Ratio is a comparison of the value of benefits (benefits) and the value of costs (cost). Investment in the green building concept uses the Saving to Investment Ratio (SIR) as another type of BCR. Kneifel and Webb (2020) in their research say that SIR is a measure of the economic performance of a project that shows the relationship between savings and investment costs in a ratio and the value of SIR will have the following meaning:

a. SIR value is 1, then savings can return capital

b. The SIR value is worth more than 1, then the savings are greater than the investment

c. The SIR value is less than 1, so the investment costs are greater than the feature savings.

The formulation used can be seen in the following formula:

$$SIR = \frac{Savings}{Investment\ Cost} \quad (2)$$

Description

Savings = Saving Value

Investment Cost = Value of Investment Cost

The book research by Kneifel and Webb (2020) says that AIRR (Adjusted Internal Rate of Return) is another type of IRR that is used when calculating the benchmark basis and cash flow after savings. AIRR is represented by the rate of return that produces the NPV of cash inflows equal to the NPV of cash outflows. The NPV is the result of the discount rate, plan life, and the same base year. The criteria that must be met are as follows:

Criteria:

IRR > the interest rate applied to the investment, then the investment is feasible to implement

IRR < the interest rate applied to the investment, then the investment is not feasible to carry out

Sensitivity Analysis

Uncertainty can be anticipated in several ways. One of them is the sensitivity analysis according to Kneifel and Webb (2020). The parameters that will make crucial changes to the analysis output and how much these parameters can change will be known by the sensitivity analysis

Greenhouse Gas Analysis

Savings in electricity is correlated with the reduction of greenhouse gases. Savings on GHG (Greenhouse Gas) is equivalent to saving on electricity times the carbon emission factor. The JAMALI grid electricity system in the DKI Jakarta area has a carbon emission factor of 0.0008 tons CO2/kWh.

RESEARCH METHODS

The research is located at Graha CIMB Niaga Building Jl. Gen. Sudirman Kav. 58 Jakarta. The research was conducted starting from the study of literature and data collection. This research method is shown or described by a flow chart or flowchart as follows.

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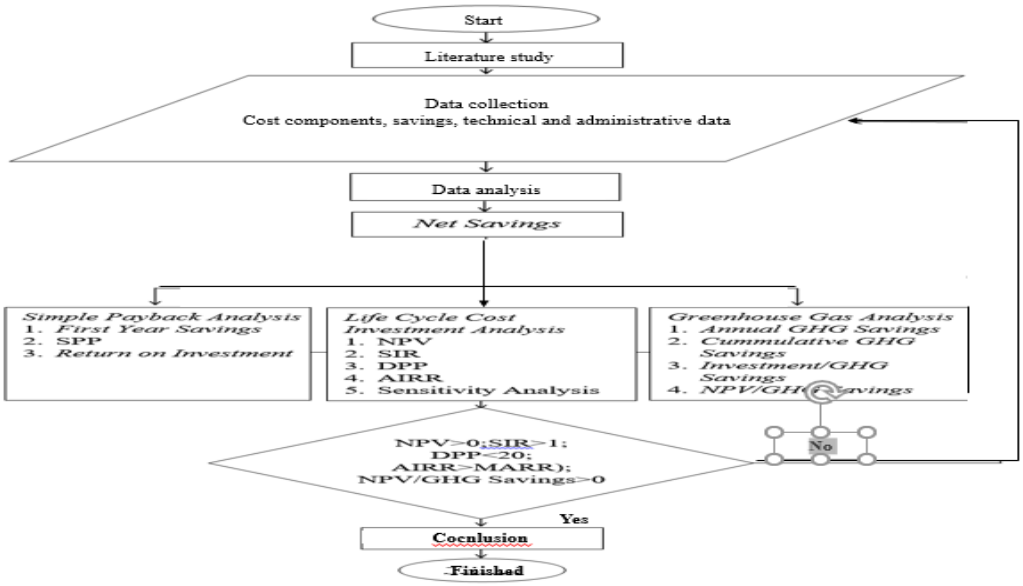

Figure 1. Research Flowchart

RESULTS AND DISCUSSION

Investment in CIMB Niaga's Graha Graha Green Building Features

PT. Grahaniaga Tatautama, who is officially the owner and manager of Graha CIMB Niaga, has carried out several investment stages. The first investment to achieve the title of Green Mark Gold. Second investment to achieve Green Mark Platinum. Green Mark Gold and Platinum were awarded in 2011 and 2013.

Table 1. Investments Made to Achieve Green Mark Gold Rating

Investment	Information	Price (Rp.)
Building Automation System Replacement, Cooling Tower and A/C System Updates	Energy Saving	Rp 2.336.724.000
Normalization of Temperature Control, Air Conditioning, and CO2 . Sensors	Meet indoor air quality	
BAS (Building Automation System) Control Panel	GM supervision system requirements	
Chiller Plan Efficiency Database Programming	Energy Saving	

Table 2. Investments Made to Achieve Green Mark Platinum Rating

Investment	Information	Total Price (Rp.)
Chiller brand T	Energy Saving	Rp 4.393.812.520
Variable Speed Drive (VSD)	Energy Saving	
Water sensor (sink and urinal) and double flush water tank	Water Saving	
Refrigerant Leak Detector (RLD)	Detect leaks in Chiller room	
Automatic CO2 and CO . sensors	GM Terms	
Flowmeter calibration	Cooling system support calibration	
Green Mark flowmeter sensor installation	GM Terms	

CO2 Sensor Panel and Parking and basement CO Sensor	To monitor indoor air quality in parking areas and basements

Implementation of CIMB Niaga's Graha Green Building

Investment costs are incurred in the early stages of development. Following is the implementation of Green Building Graha CIMB Niaga according to PT. Grahaniaga Tatautama in the Bulletin Editions VI, VII, IX, X, XVI, 22 and 23 and the statement of PT. Tatautama Grahaniaga:

Energy Conservation and Saving

Energy Efficiency Index Graha CIMB Niaga gradually meets the Green Mark Gold and Platinum requirements of 190 KWh/m2/year in 2010 and 152.23 KWh/m2/year in 2013. Graha CIMB Niaga also complies with DKI Jakarta Governor Regulation No. 38 and grouped in the Save category for offices because it has an Energy Efficiency Index below 210 points and is in the range 1. The greatest electricity efficiency is achieved by increasing the efficiency of the chiller plant system from 1.26 kW/RT, 0.87 kW/RT to 0.67 kW/RT. The saving and conservation of electricity performance from 2010 to 2015 is worth 1361,250 MWh per year according to BCAI Singapore (2015) and PT. Grahaniaga Tatautama.

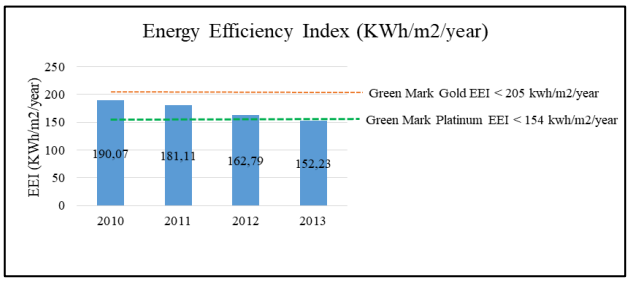

Figure 2. Energy Efficiency Index

Water Conservation and Saving

Savings and water conservation performance from 2010 to 2015 is worth 1042 m3/year according to BCAI Singapore (2015) and PT. Grahaniaga Tatautama. Water savings are carried out by monitoring automatic water meters and recycling rainwater, seepage, and AC condensate. Water saving meets minimum 10% water conservation requirements.

Figure 3. Rainwater Treatment, Seepage and AC Condensate

Indoor Environmental Quality and Thermal Comfort

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Room temperature is set at 24°C + 1°C, humidity CP13 is < 70% and room noise level meets SS CP13 40DBA - 50 dBA. GNTU conducts air quality audits every 2 years.

Sustainable Operation and Building Maintenance

The monitoring process has been carried out with the Building Automation System. The operation and maintenance process is carried out by treating waste, post-occupancy evaluation, providing access to public transportation, bicycle parking, green open spaces and routine monitoring. Regulation of the Governor of DKI Jakarta Province No. 38 has been fulfilled.

Life Cycle Cost Analysis

Calculation of cash flow net present value shows that the NPV value is Rp. 8,930,649,864. A positive NPV indicates that the savings and investment are feasible. Financial savings are declared feasible and profitable.

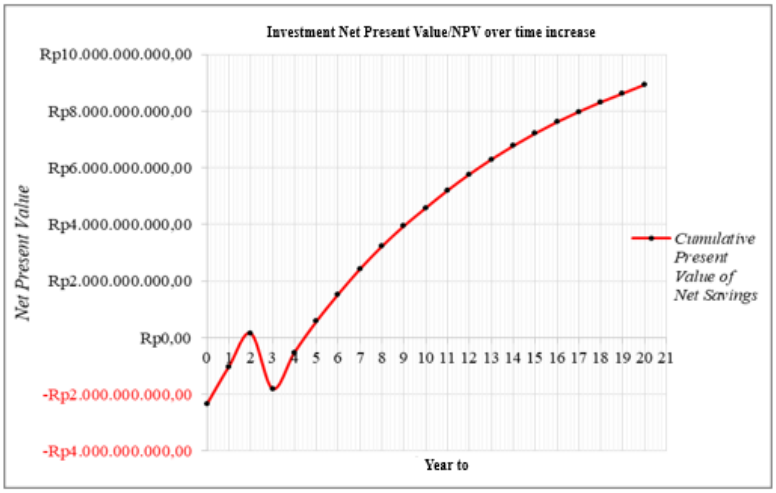

Figure 4. Cumulative Present Value of Net Savings

Investment Financial Feasibility Parameters

The financial feasibility of investing in the CIMB Niaga Graha building was investigated by taking into account NPV, SIR, DPP, AIRR. The calculation results show that the investment is feasible and profitable. The investment will return capital within 4.4 years with an AIRR rate of 43.88 greater than the minimum level determined by taking into account the deposit interest rate and risk (MARR)

Table 3. Recapitulation of Investment Financial Feasibility Parameters in Life Cycle Cost Analysis

Life Cycle Cost Investment Metrics			
Parameter	Cost	Condition	Information
Net Present Value (NPV)	Rp 8.930.649.863,82	NPV>0	Worthy
Savings to Investment Ratio (SIR)	2,69	SIR>1	Worthy
Discounted Payback Period (DPP)	4,40	DPP>20	Worthy
Adjusted Internal Rate of Return (AIRR)	43,88%	AIRR>MARR(11,72%)	Worthy

Greenhouse Gas Analysis

Greenhouse Gas Analysis is carried out by taking into account the Annual GHG Savings. The following is a recapitulation of the GHG (Greenhouse Gas) Saving Parameters. The calculation results show that the investment costs Rp249,558.56 per tonne of CO2 GHG and is profitable at Rp410,039.02 per tonne of CO2 GHG.

Table 4. Recapitulation of GHG (Greenhouse Gas) Saving Parameters

Greenhouse Gas Metrics			
Annual GHG Savings (ton CO_2)	20 Year GHG Savings (ton CO_2)	20 Yr Investment Cost / 20 Yr GHG	20 Yr Net Present Value / 20 Yr GHG
1089	21780	249558,56	410039,02

Sensitivity analysis

Sensitivity analysis is done by changing the value of an uncertainty parameter to then see how it affects investment. Parameters changed in the study are the rate of increase in investment and the level of decrease in electricity savings.

Sensitivity analysis of the rate of increase in investment.

The investment cost parameter is changed by 50%. Changes are made until it is known that the 20 Year Net Present Value is negative. The break-even point value is found using interpolation. The following is a detailed analysis of the sensitivity of the rate of increase in investment.

Table 5. Sensitivity Analysis of Investment Increase Rate

Investment rate	Investment rate increase	20 Year Net Present Value
100%	0%	Rp8.930.649.863,82
150%	50%	Rp6.198.573.381,66
200%	100%	Rp3.466.496.899,49
250%	150%	Rp734.420.417,33
300%	200%	-Rp1.997.656.064,84
350%	250%	-Rp4.729.732.547,00
263,44%	163,44%	Rp0,00

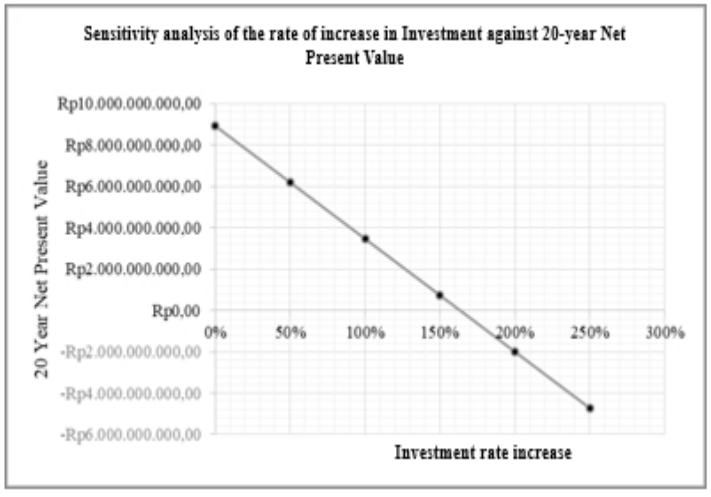

Figure 5. Sensitivity Analysis of Investment Increase Rate to 20-Year NPV

This value shows that the investment has an NPV of 0 when the rate of increase in investment increases 163.44% from the original investment. Even though the investment level increased by 1.5 times or 150%, the investment would still be profitable at an NPV of Rp734,420,417.33.

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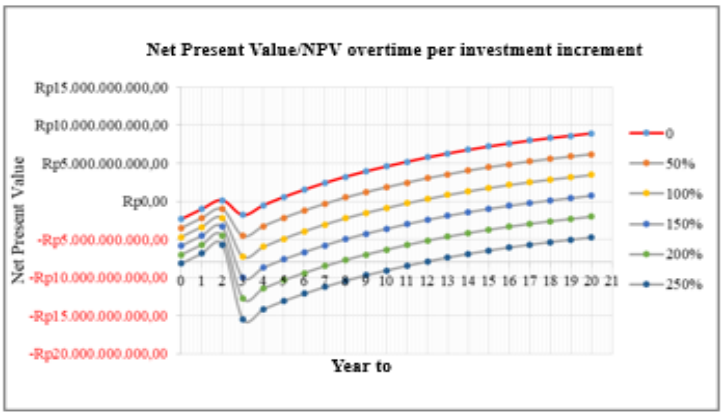

Figure 6. Net Present Value Over Time per Investment Increase Rate

Sensitivity analysis of the level of reduction in electricity savings.

The electricity saving parameter is lowered by 50%. Changes are made until a negative 20 Year NPV is found. The break-even point value is found using interpolation between the positive and negative 20 Year NPV. The following details the sensitivity analysis of the level of reduction in electricity savings.

Table 6. Sensitivity Analysis of the Decreased Rate of Electricity Savings

Reduced Electricity Savings	%	20 Year Net Present Value
0%	100%	Rp8.930.649.863,82
10%	90%	Rp7.480.434.841,32
20%	80%	Rp6.030.219.818,81
30%	70%	Rp4.580.004.796,30
40%	60%	Rp3.129.789.773,80
50%	50%	Rp1.679.574.751,29
60%	40%	Rp229.359.728,78
70%	30%	-Rp1.220.855.293,72
80%	20%	-Rp2.671.070.316,2
90%	10%	-Rp4.121.285.338,74
61,58%	38,42%	Rp0,00

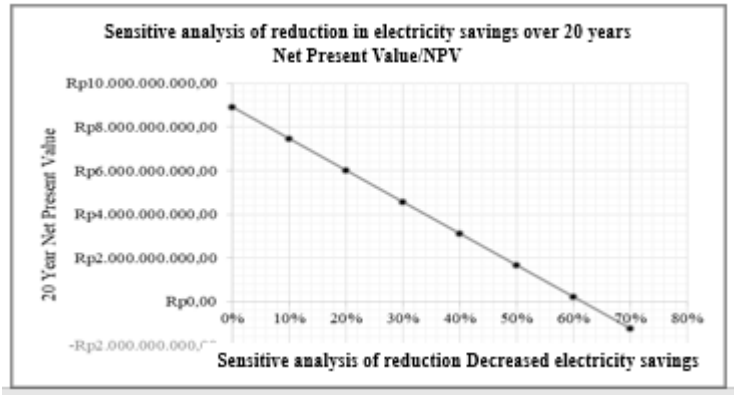

Figure 7. Graph of Sensitivity Analysis of Decreased Electricity Savings against 20-Year NPV

This value shows that the investment has an NPV equal to 0 when there is a decrease in electricity savings of 61.58% from the initial investment. The owner and manager must be careful if the performance of the green building feature decreases. The owner and manager must also be careful if the increase in electricity costs causes electricity savings to decrease by up to ±60%. The investment will experience an inappropriate condition if there is a decrease in electricity savings exceeding 61.58% of the initial investment.

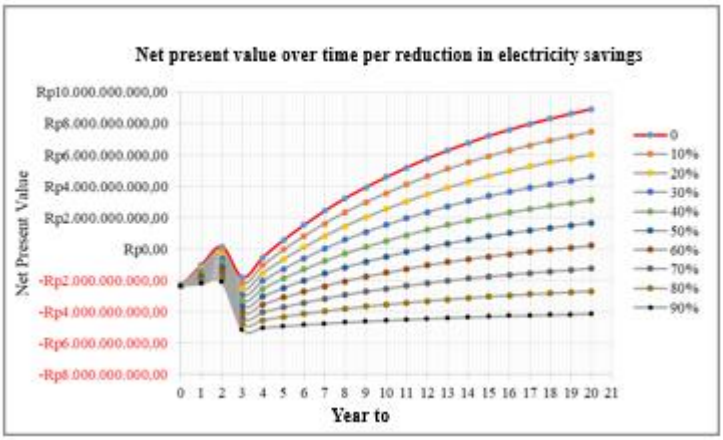

Figure 8. Net Present Value Over Time per Decrease in Electricity Savings

CONCLUSION

Investment in Graha CIMB Niaga is feasible and profitable when viewed during the life cycle based on NPV parameters of Rp. 8,930,649,864, SIR of 2.69 which exceeds 1, AIRR of 43.88% which exceeds MARR of 11.72%. The investment will return the capital within 4.4 years based on the DPP parameters. Investment will still be feasible and profitable if the rate of increase in investment does not exceed 163.55% and the decrease in electricity savings does not exceed 61.58%. The results also show that the investment is profitable in terms of environmental impact of Rp. 410.039 per 1 Greenhouse Gas (GHG) savings.

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