Economic Analysis of Investment Feasibility in the Planning of the Construction of 50 MW Solar Power Plant (PLTS) in Capital of Indonesia, Kalimantan

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Abstract. The scenario in electrifying the Capital of the Archipelago (IKN) Indonesia will carry the concept of Green, Smart and Beautiful. In its application, energy that will be utilized through new and renewable energy (EBT) based power generation sources without emissions, one of which is the use of 50 MW Solar Power Plants. This study aims to analyze investment feasibility and calculate the reduction emissions resulting from the installation of this system. Research methods carried out through simulations and literature studies, simulations using homer applications and library studies sourced from IKN, PLN, ESDM documents. The simulation uses 8000 solar panels. From the simulation results, it produces panel production of 5,140,8520 kwh / year, with a capacity of 385 wp / panel. An investment of Rp. 41,179,167652 means a cost saving of Rp. 5,320,438,200/year at a price of Rp. 1,035/kwh. Pay back period for 8 years with an NPV value of 1.45, BCR of 1.20, NPV value of 0.89 or > 0 and IRR=0 means that investment in terms of economic calculations is feasible. Carbon reduction yield of 421 tons of CO2 / year.

Keywords: energy econom; solar panels; investment

1 Introduction

Energy is a quantity owned by every object, but the energy contained by each of these objects exists that can be utilized directly and some require an energy conversion process first[1]. One form of energy that is often used for human life in modern times is electrical energy. Along with the development of the times, there is a reverse process for electrical energy, namely the increasingly unbalanced use of electrical energy with its generation [2].

This is due to the increasing use of electrical energy in daily activities, therefore it is necessary to take appropriate measures to regulate the use and preservation of such energy[3]. One of the government's efforts towards energy conservation is with energy conservation actions which are basically cost reductions through energy management strategies [4]. Energy conservation can be achieved through the use of energy-saving technologies in the provision, both from renewable energy sources and non-renewable energy sources and applying an energy-saving culture in energy utilization[5]. The application of energy conservation includes planning, operating, and supervising the use of energy [3].

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The need for energy continues to increase while the supply is decreasing, requiring energy conservation activities, which is a form of correct and efficient energy management [6]. Energy conservation actions are through energy audits. Energy audit is a search for energy resources from entry to end users to find leaks and make recommendations that will improve the energy utilization system of a facility[7].

National electricity consumption continues to show an increase in line with increasing access to electricity or electrification and changes in people's lifestyles. National electricity consumption continues to increase[8]. In 2015 the consumption was only 910 kilowat hours (kWh) per capita. Then it increased to 1,084 kWh/capita in 2019[9]. This increase is in line with the electrification ratio which also shows an increase. The ratio went from 84.35% in 2014 to 98.89% in 2019[9]. Access to electricity in almost all parts of Indonesia has reached more than 95%, only East Nusa Tenggara is still 85% and Maluku is 92%. Then, Central Kalimantan, Southeast Sulawesi, and Papua are also still 94%[10].

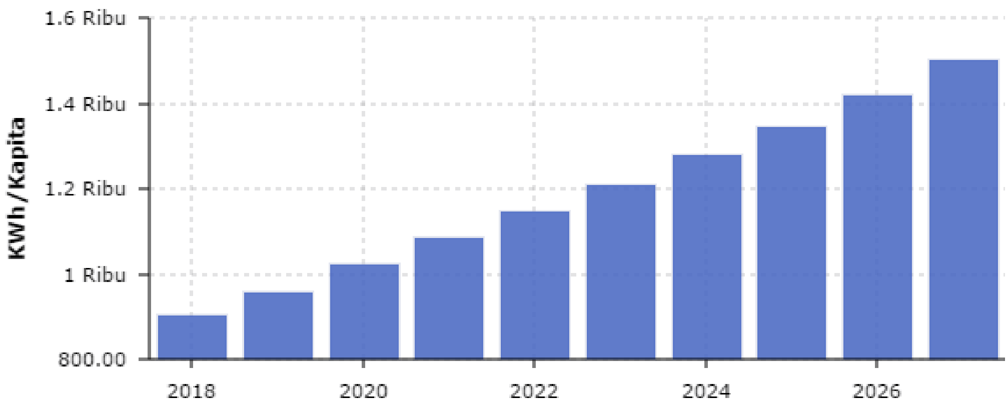

Fig 1. Indonesia's electricity consumption projection per capita for 2018-2027[11]

The current building mostly uses energy derived from commercial electrical energy such as from PT. PLN, where the company utilizes fossil energy to produce electrical energy which will then be supplied to consumers[12]. Energy use in a building can be calculated from the amount of energy used per squared meter (IKE = Energy Consumption Intensity) and the type of energy used in the building. The amount of IKE is very dependent on the technology used in the building, especially those technologies that use electrical energy [13]. The technology in question is for the purposes of building functions, both the business sector, the industrial sector, the building sector, and offices. In addition, the household sector includes electric motors, lighting lamps, AHU (Air Handling Unit) or HVAC (Heating, Ventilation and Air-Conditioning), computers, and others [2].

The high level of greenhouse emissions and the reduction in the amount of fossil energy, encourage the world and of course the government in maintaining energy security and independence, this is stated in PP No. 79 of 2014 concerning the National Energy Policy with a minimum target of a new renewable energy mix of 23% by 2025 and by 31% by 2050 [14] . With all the potential resources owned by Indonesia, this target is very likely to be realized.

The total potential of renewable energy that can be utilized in Indonesia is 417.8 GW from various variations of NRE with such a large potential, Indonesia is only able to realize the use of NRE for power generation of 10,467 GW or 14.69% of the total generating capacity equivalent to 71 GW in 2020[11]. The lack of NRE utilization for electricity due to the lack of support and attention to the use of NRE causes NRE plants to be difficult to compete with fossil plants, especially coal, and hinders the development of renewable energy[15].

The condition of fossil energy reserves such as coal, oil and gas that continue to decrease is expected to be exhausted within the next 11 to 70 years [6]. With all the threats to energy security, the Indonesian government should be able to anticipate by further increasing the use of new and renewable energy (NRE)[16]. The potential of new renewable energy resources that are most likely to be utilized in terms of numbers include; hydropower, Ocean Thermal Energy Conversion (OTEC), solar power and biomass [8].

For this reason, efforts are needed to utilize technology that is able to advance the use of new and renewable energy that is environmentally friendly. Solar Power Plant (PLTS) is one of the uses of solar cell technology that supports the use of new and renewable energy, with the sun as the primary energy source[17].

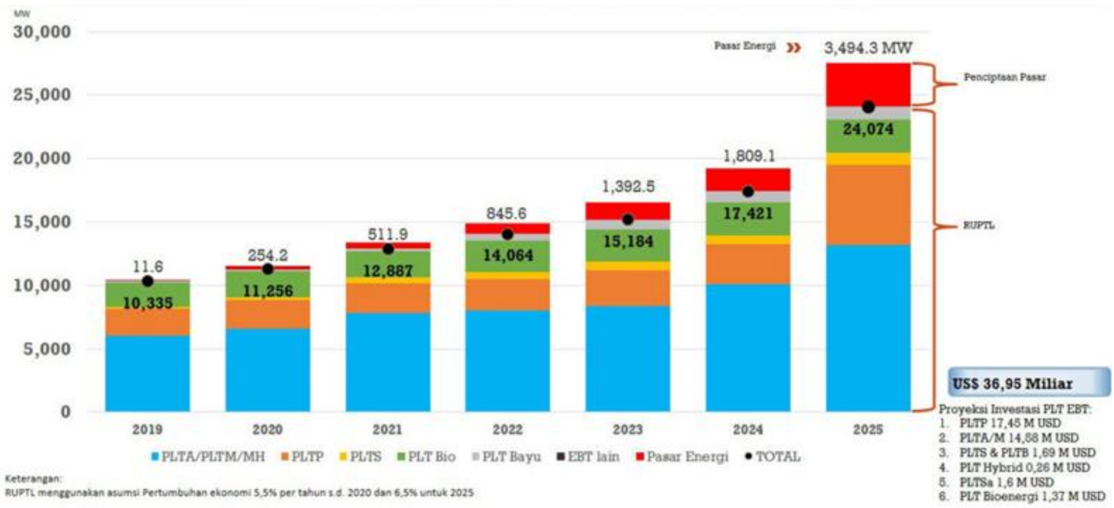

Fig 2. Prospects for the development of NRE-RUPTL and energy market creation strategies

The potential utilization of solar power plants (PLTS) in Indonesia is very large considering that Indonesia is on the equator which maximizes key factors such as intensity and angle of irradiation[18]. By choosing the right system, solar power plants are able to provide many benefits both functionally and economically [19].

In order to prepare IKN's electrical energy sources, PLN is currently building electricity infrastructure in the form of 4 150 kiloVolt (kV) High Voltage Air Lines (SUTT), namely Maloy-Kobexindo, Bukuan-Kalimantan Ferro Industry (KFI), Batulicin-ITP, and Selaru-Sebuku to accommodate the needs of High Voltage Consumers (Summit)[11].

Pln's scenario in electrifying IKN will carry the concept of Green, Smart and Beautiful. Later, IKN electricity will be realized through new and renewable energy (EBT) based power generation sources that are zero emissions and equipped with Public Electric Vehicle Charging Stations (SPKLU), thus creating a new urban ecosystem that is environmentally friendly. The smart concept includes Zero Down Time (ZDT), Distribution Automation System (DAS), Smart Grid and Smart Meter. While the concept is beautiful, including distribution with underground cables and a futuristic design[20].

In accordance with the Electricity Supply Business Plan (RUPTL) for NRE electricity supply in the National Capital City, PLN will prepare a Solar Power Plant (PLTS) spread over 50 megawatts (MW) and a 70 MW Bayu Power Plant (PLTB) in Tanah Laut in the early stages[9]. Currently, the analysis of development investment has not been carried out, therefore before development is carried out, it is necessary to have a calculation whose conclusions can provide recommendations to the government.

Therefore, in an effort to use NRE in IKN, an economic analysis is needed on the construction of a 50 MW solar power plant through the underground cable (UGC) distribution channel or a more detailed beautiful concept so as to encourage the creation of a Green, Smart and Beautiful concept in the State Capital Area, Kalimantan[11].

2 Material And Methods

The data from this study is sourced from PLN, IKN, ESDM. The secondary data is then processed using homer software to determine the potential output of solar panels. In determining the calculation of investments using the following equation.

Net Present Value **(NPV)**

$$\textbf{NPV}= \sum_{t=0}^{n} \frac{At}{(1+k)^t} \quad (1.1)$$

Where,

k = *discount rate used*

At = Cash flow in period t

t = Time period

n = Investment life

The decision-making criteria for whether an investment proposal is worthy of acceptance or worthy of rejection are as follows:

NPV > 0 = The project is viable

NPV < 0 = The project is not feasible

Benefit – Cost Ratio **(B-CR)**

If the analysis is carried out against the present

$$BCR = \frac{PWB}{PWC} \; or \; \frac{\sum_{t=0}^{n} Cb_{t\,(FBR)t}}{\sum_{t=0}^{n} Cc_{t\,(FBR)t}} \quad (1.2)$$

If the analysis is carried out on the annual

$$BCR = \frac{EUAB}{EUAC} \; or \frac{\sum_{t=0}^{n} Cb_{t\,(FBA)t}}{\sum_{t=0}^{n} Cc_{t\,(FBA)t}} \quad (1.3)$$

To find out whether an investment plan is economically feasible or not after going through this method is If:

$\mathrm{BCR} \geq 1$ then feasible investment

BCR < I then the investment is not worth (unfeasible)

Payback Period **(PBP)**

$$k_{(PP)} = \sum_{t=0}^{n} \quad \mathrm{CFt} \geq 0 \qquad (1.4)$$

Where,

K = payback period

CFt = *cash flow period to t*

If the cash flow benefit component and its cost have been discounted, then the formula becomes:

$$PBP = Tp - 1 + \frac{\sum_{t=0}^{n} \quad Ii \sum_{t=0}^{n} \quad Bicp-1}{Bp} \qquad (1.5)$$

Where,

PBP = $Payback\ period\ PBP$

$Tp - 1$ = the year before there was

Ii = the amount of investment that has been discounted

$Bicp - 1$ = the amount of benefits that have been discounted before the payback period

Bp = benefit on the payback period of being located

Internal Rate of Return **(IRR)**

$$\mathrm{IRR} = \sum_{t=0}^{n} \quad \left[\frac{A_t}{(1+r)^t}\right] = 0 \qquad (1.6)$$

Where,

r = interest rate

At = *cash flow*

n = the last period during which cash flow is expected

3 Results And Discussion

The results of data processing are as follows.

Table 1. Data processing results

Item	Result	Description
Potensi PLTS (MWp)	50	Potential
Potential PLTS (MWp)	8000	Processed data
385 wp module installed (pcs)	1,669	Processed data
PV Out (Kwh/year/pcs	3,080	Processed data
Total capacity / year (KWp)	5,140,520	Processed data
Production per year (Kwh)	1,035	Processed data
Selling Price of PLTS /kwh (Rp) (80% dr price of PLN)	5,320,438,200	Processed data
Investment (Inc. PPN 11%)	41,179,167652	Processed data
Pay Back Period (year)	8	Processed data
Reduction CO^2 (ton)	421	

From the existing potential, with a module of 385 wp / pcs obtained capacity per year which is 5,140,520 kwh, it is assumed that the price per kwh is 1,035 then the income is Rp. 5,320,438,200 / year. The investment spent in this development planning is Rp. 41,179,167,652. Pay back period for 8 years. The resulting CO2 reduction is 421 tons of CO2 / year.

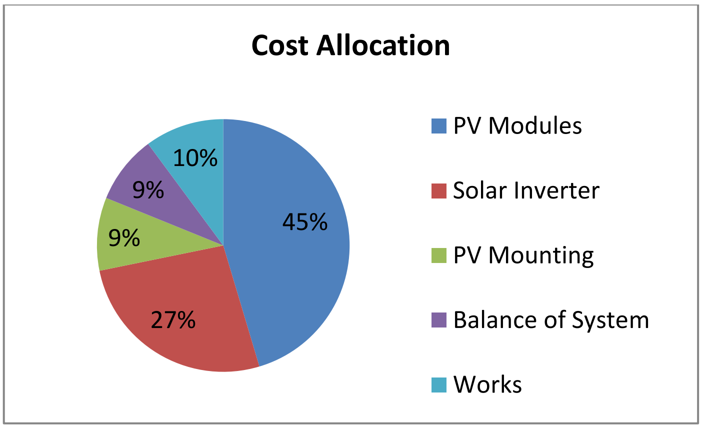

Fig 3. Percentage of investment allocation.

The largest percentage of cost allocations is on the purchase of solar panels at 45% and the smallest costs on frame and system construction work expenditures at 9%.

4 Conclusions

Some of the things that can be inferred from this study are:

1. Panel production is 5,140,8520 kwh / year, with a capacity of 385 wp / panel.
2. Investment of Rp. 41,179,167652 means cost savings of Rp. 5,320,438,200/year at a price of Rp. 1,035/kwh.
3. Pay back period of 8 years
4. The NPV value of 1.45 means that investment in terms of economic calculations is feasible.
5. Carbon reduction yield of 421 tons of CO2 / year.
6. BCR of 1.20 value , NPV 0.89 or > 0 and IRR=0 .

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