International Journal of Sustainability in Research (IJSR)
Vol. 1, No. 2 2023: 73-92

Using HOMER Simulation Method for Renewable Energy Power Generation Design in South Sumatra Indonesia

Rifki Arif[1]*, Yanuar Z. Arief[2], Sinka Wilyanti[3], Agung Pangestu[4], Rosyid R. Al-Hakim[5]
[1,2,3,4]Department of Electrical Engineering, Jakarta Global University
[5]Department of Informatics, Universitas Harapan Bangsa
***Corresponding Author:** Rifki Arif rifki.arif@student.jgu.ac.id

ARTICLEINFO

Keywords: Controller Homer Load Following, Generic Biogas, Renewable Energy, Sustainable Development Goals

Received : 22, May
Revised : 23, June
Accepted: 25, July

ABSTRACT

South Sumatra Province is one of the provinces that has abundant natural resources and the largest is coal. The implementation of the case study was carried out in the cities of Palembang, Pagar Alam and Lubuk Linggau using homer software with components Controller Homer Load Following, Generic Biogas Genset (Size-Your-Own), Peimar SG300MBF, Bergey Excel 6-R, Surette 6 CS 25P, Princeton DRI-100 Converter, Hydro Natel Freejet Fi-7A49 kW. Typical load profile determination assuming 100 houses in a village that have a daily load of 10.50 kWh or 3,832.50 kWh/year/house. After the simulation, it was concluded that the combination of an effective and efficient power generation system is Hydro / Solar / battery / converter (HSbc) in Pagar Alam City with energy production of 48,809 kWh / year. A reliable and sustainable Power Generation System is obtained in Hydro / battery / converter (Hbc). Net Present Cost and the highest carbon emissions are found in diesel power plants when compared to other renewable energy power plants.

DOI: https://doi.org/10.59890/ijsr.v1i2.155
https://journal.multitechpublisher.com/index.php/ijsr

INTRODUCTION

The need for energy in people's lives is currently increasing along with increasing population growth, increasing technology and industrial growth (Al Hakim, 2022b; Al Hakim, Ropiudin, et al., 2021). Most of the energy we use now comes from fossils, is non-renewable and will run out if we use it continuously (Al Hakim, 2022a). So that humans are required to look for other energy sources that as far as possible these energy sources can be renewed or renewable (Al Hakim, 2020; Al Hakim, Arief, et al., 2021; Arief et al., 2021).

South Sumatra Province is one of the provinces in Indonesia that has abundant natural resources and the biggest one is coal (Lusiagustin & Kusratmoko, 2017). The increase in mining activities in South Sumatra Province directly and indirectly contributed to the increase in energy demand in areas that have mining activities (Nurjanah et al., 2021). The increase in population, increase in occupancy, increase in stalls or shops, and increase in lighting from one place to another has made South Sumatra Province one of the locations for the construction of the biggest coal power plant.

Meanwhile, according to Indonesian Government Regulation noted that the energy sources and/or energy resources are intended for development capital for the greatest possible prosperity of the people, by optimizing their utilization for national economic development, creation of added value in the country and absorption of manpower (Al Hakim et al., 2022). Regarding to the energy optimalization problems in South Sumatra, that needs to be improving the used of new and/or renewable energy, instead of the coal power plants used, this study tried to:

1. Simulate a renewable energy hybrid power generation system using a combination of solar photovoltaic (PV) system, micro hydro, wind turbine, and biomass generator in rural areas around the three cities of Palembang, Pagar Alam, and Lubuk Linggau in South Sumatra Province.
2. Analyzing the performance of a combination of renewable energy power generation systems that can meet sustainable and reliable electricity needs using HOMER (Hybrid Optimization of Multiple Energy Resources) software.
3. Comparing combined renewable energy power generation systems with diesel power plants, in terms of finances (tecno-economic) and carbon emissions.

LITERATURE REVIEW

Related Works

There are several studies that related to support this study can be seen in the following Table 1.

Table 1. Related Work Compilation.

Study Site	Simulation Components	Optimal Components	Ref.
Gunung Kidul, Yogyakarta (ID)	Solar PV, Wind Turbine, Battery	Solar PV, Battery	(Kamelia et al., 2017)
Saik Village, Riau (ID)	Solar PV, Diesel Generator, Micro Hydro, Battery	Solar PV, Diesel Generator, Micro Hydro, Battery	(Kunaifi, 2015)
Manado, North Sulawesi (ID)	Solar PV, Diesel Generator, Wind Turbine, Battery	Solar PV, Battery	(Arota et al., 2013)
Pulau Panjang, Riau (ID)	Solar PV, Diesel Generators, Battery	Solar PV, Battery	(Irawan et al., 2013)
Pangandaran, West Java (ID)	Solar PV, Wind Turbine, Wave Turbine, Battery	Solar PV, Wind Turbine, Wave Turbine, Battery	(Akbar et al., 2019)
Tambang Beach, Malang, East Java (ID)	Solar PV, Wind Turbine, Battery	Solar PV, Wind Turbine, Battery	(Ansori et al., 2017)

Comparing to the related work compilation (Table 1), this study is in the three different cities: Palembang, Pagar Alam, and Lubuk Linggau (South Sumatra Province, ID). Besides, this study tried to be using this simulation components: Solar PV, Hydro, Wind Turbine, and Biogas Genset. Based on the Table 1, this study assigns categories to several variables related to the topics chosen in this study. In previous research (Table 1), it was concluded that the use of renewable energy can reduce environmental pollution and carbon emissions carried out in several provinces in Indonesia. In addition, this study would analyze the combination design of a renewable energy power plants using HOMER software within the study site is in South Sumatra Province (based on three different cities), where there are abundant natural resources both fossil and non-fossil, especially coal mining. There are many ex-mining lands that are no longer used and, in the future, probably can be used as land for the development of renewable energy power plants.

According to Indonesian Government Regulation that concerning to energy, what is meant by renewable energy is energy that comes from renewable energy sources, namely energy sources that are produced from sustainable energy sources if managed properly, including geothermal, wind, bioenergy, solar, water flows and falls, and the movement and temperature

differences of the sea layers (Al Hakim et al., 2022). In this section would explain four renewable energy generation sources that used in this study cases, including hydropower plant (HPP), solar power plant (SPP) or photovoltaic power plant (PV-PP), biomass generation or biomass power plant (BPP), and wind power plant (WPP).

Hydropower Plant (HPP)

Hydropower plant (HPP) also known as hydropower is one of the sustainable power plants that relies on the water (hydro) potential. HPP is very suitable for use in peak types where this type is for large peak load conditions and is used when network disturbances occur. This power plant is environmentally friendly energy, free of carbon emissions, and does not cause pollution which results in the greenhouse effect. This power plant has less emission gas than other power plants, that is previously reported for the average greenhouse gas emission intensity is 18.5 gCO2-eq/kWH. HPP is also claimed to be the cleanest source of electricity compared to other energy sources. Besides, HPP have a fairly long lifespan, which is around 50-100 years (Silva & Castillo, 2021).

Meanwhile, instead of a power plant, HPP also can be a water tourism object. Dams used for HPP can also be used simultaneously for tourism and educational facilities. The tourism potential of the reservoir can be exploited by the community to generate economic benefits. The existence of HPP can open jobs for the surrounding community thereby increasing the indigenous community's economy. Besides, the water stored in the dam can be used for other purposes besides electricity generation, namely for irrigation and water reserves. As a source of irrigation, the water contained in the dam can be used for agriculture, both rice fields and fields around the dam area (Branche, 2017; Fanaian et al., 2015; Tahseen & Karney, 2017).

Photovoltaic Power Plant (PV-PP)

Solar power plant or photovoltaic power plant (SPP or PV-PP) is a power plant that utilizes energy from sunlight to produce electrical energy. The sun is the main energy source that radiates enormous energy to the earth's surface. In clear weather conditions, the earth's surface receives about 1000 watts of solar energy per square meter. So that it can be said that the source of all energy is solar energy (Al Hakim, 2020, 2022a).

The main component of a SPP is a photovoltaic solar panel that can convert solar energy into electrical energy so that it can be used for daily electricity needs. The electric current generated by photovoltaic solar panels is direct current (DC) electricity, so other components such as an inverter are needed to convert this direct current (DC) into alternating electric current (AC). SPP is a system used to generate electrical energy by utilizing solar energy or heat from the sun which is absorbed by solar panels through a photovoltaic process (Al Hakim, Pangestu, et al., 2021; Kurniasari et al., 2023).

Solar energy is energy obtained by converting solar (sun) thermal energy through certain equipment into resources in other forms. It can be utilized in a variety of different ways, fuel oil is the result of photosynthesis, hydroelectric

power is the result of rain circulation, wind power is the result of temperature differences between regions and solar cells (photovoltaic cells) which promise a bright future as a source of electrical energy. The concept of a SPP is simple, namely converting sunlight into electrical energy.

Biomass Power Plant (BPP)

Biomass is like fossil energy, which comes from living things. Biomass is an organic material produced through a photosynthetic process, either in the form of a product or waste. Examples are plants, trees, sweet potatoes, grass, manure, feces, agricultural waste, and so on.

Biomass used as an energy source is generally waste after its primary product is taken and has low economic value. The advantages of biomass energy sources are renewable so that they can provide sustainable energy sources. The potential of biomass in Indonesia is very large. Animal and plant waste is an abundant raw material in this country.

The use of waste as fuel will provide three advantages, namely increasing overall energy efficiency, saving costs, and reducing landfills, especially in urban areas where land is narrower than rural areas. One way to produce energy through biomass is to burn it. However, biomass can also be converted or converted into other forms such as methane gas (biogas), ethanol, and biodiesel. Ethanol and biodiesel can even be used as fuel (biofuel) for transportation.

Wind Power Plant (WPP)

Wind power plant (WPP) or windmill or wind turbine, is a power generation device that uses wind as an energy source to generate electricity (Almihat & Kahn, 2022). WPP is an alternative energy source that is environmentally friendly. This device consists of rotor, main fin, generator, tail fin, controller, battery or accumulator, and DC to AC inverter (Al Mubarok et al., 2018; Almihat & Kahn, 2022; Kalamaras et al., 2019; Suroso et al., 2017). WPP work very simply: first, the wind blows then the fins moving the generator shaft, the generator rotates to generate electricity. Electricity is channeled through the cable into the controller to charge the battery or accumulator (Balachander et al., 2021).

WPP is a generator with intermittent energy sources, producing electrical energy in fluctuating amounts. In operation, a backup generator is needed as a supporting generator to anticipate when there is a decrease in wind speed below the turbine design limits (Balachander et al., 2021). So that for each region with different system characteristics, different studies are also needed to assess the feasibility of the WPP project, especially for large-scale power plants.

METHODOLOGY

Study Locations and Variables

The research begins with the identification of the location where the research will be carried out. Then proceed with the collection of data related to the electrical load and load profile of the location that has been determined as a typical load profile of people in South Sumatra Province, Indonesia (Figure 1)

within the description of latitude and longitude for all cities, respectively (Table 2). Then a literature study was carried out related to the electricity system development plan in South Sumatra Province with reference to the 2021-2030 Electricity Supply General Plan (RUPTL) document, 2017 National Energy General Plan (RUEN), as well as 2019-2019 National Electricity General Plan (RUKN).

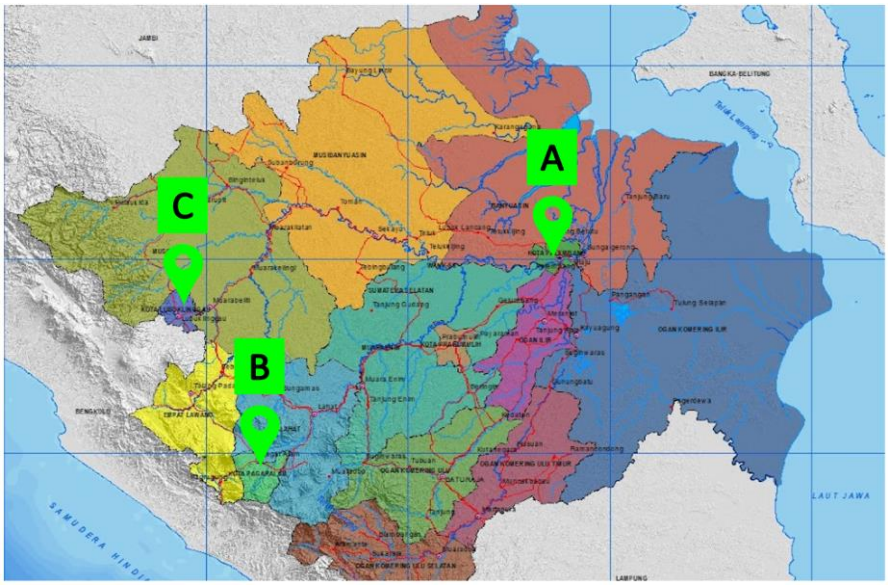

Figure 1. Study location in three different cities at Sumatra Province, Indonesia.

Table 2. Description of study locations.

Location Legend	Location (City)	Latitude	Longitude
A	Pulo Kerto, Palembang City	03°01'44.45" S	104°40'06.22" E
B	Burung Dinang, Pagar Alam City	04°07'47.22" S	103°11'34.31" E
C	Sidorejo, Lubuk Linggau City	03°16'21.27" S	102°49'49.81" E

Then, the secondary data collection is carried out for the needs of parameter data input in the model to be made. After that, the selection of components according to the generation capacity required to meet the load profile is carried out. Then a simulation will be carried out using HOMER Software to get a combination of generating systems that are in accordance with the research objectives.

Meanwhile, the Y variable (the dependent variable) is a renewable energy power plant that will be built at a predetermined location. As for variable X (independent variable), namely the factors that influence the reliability of renewable energy power plants in South Sumatra Province. So that an analysis of case studies can be carried out from the model that has been made using

HOMER Software to obtain a combination design plan for a renewable energy power plant with the most optimal utilization of renewable energy sources.

HOMER Load Following Setup

The setup is selected as the program to control the system in HOMER Software when the generator is in operation, the program generates only enough power to meet the main load. Lower priority purposes such as charging storage batteries or servicing deferred loads are left to renewable sources. Generators may still be able to upgrade and supply power to the grid if it is economically profitable. The setup capture can be seen in Figure 2.

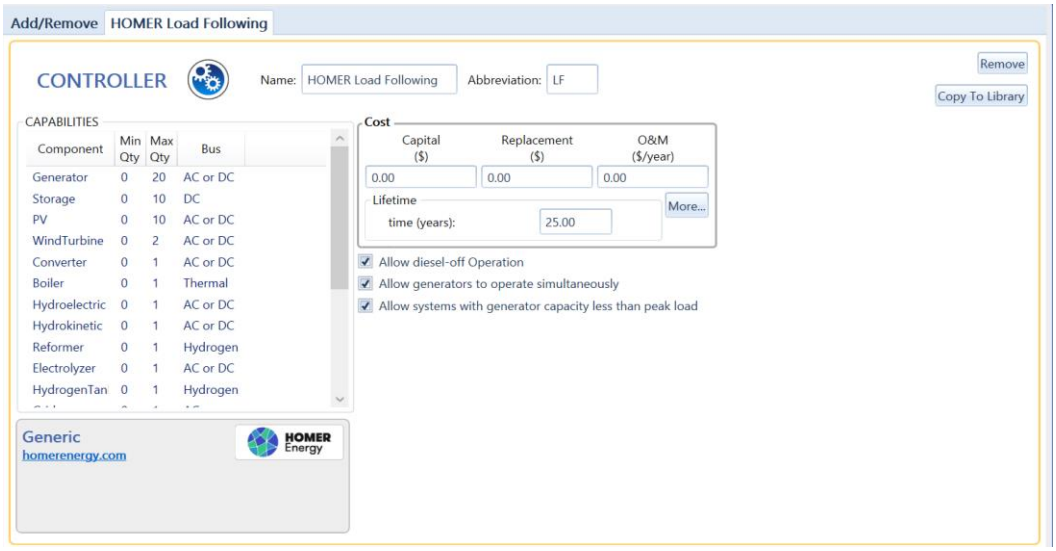

Figure 2. HOMER Load Following setup.

Generic Biogas Genset (Size-You-Own) Setup

The selection of a Generic Biogas Generator (Size-Your-Own) was carried out so that the generator capacity can be set at 50 kWh, 100 kWh, 200 kWh and 500 kWh according to the supply of available energy plants in the Palembang, Pagar Alam and Lubuk Linggau areas. The setup capture can be seen in Figure 3.

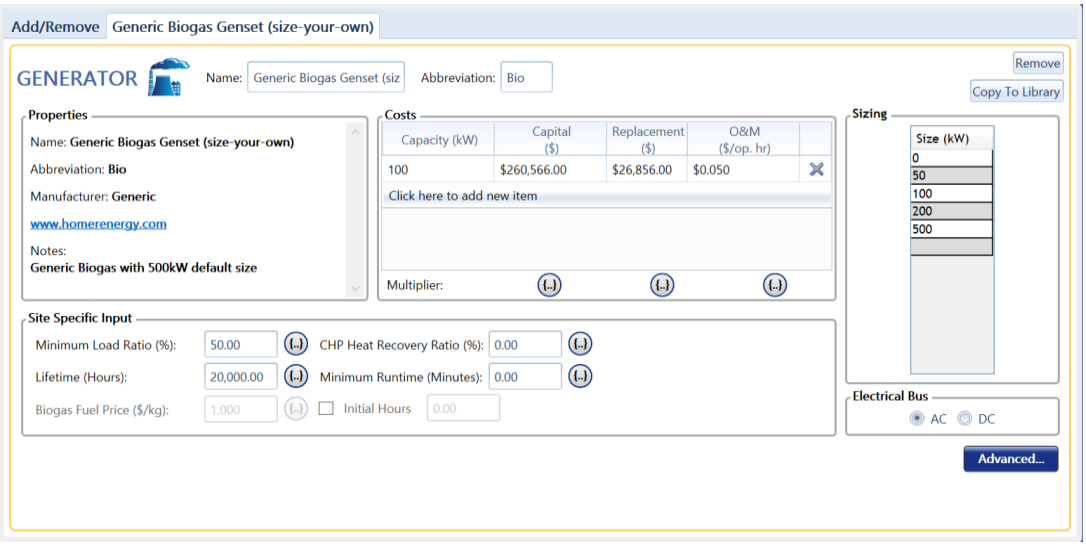

Figure 3. Generic Biogas Genset (Sixe-Your-Own) setup.

Peimar SG300MBF Setup

For solar power plants, the Peimar SG300MBF was chosen, where this solar panel has a generating power of 50 kW, with a flat type panel, operating temperature of 25oC and an efficiency of 19.1% making Peimar SG300MBF the right choice of solar panels for the research being carried out. Besides, the main problem is that there is a lot of land that can be used as the development of solar power plants, so even now many rooftop solar panels have been installed as a form of community support for green energy. The setup capture can be seen in Figure 4.

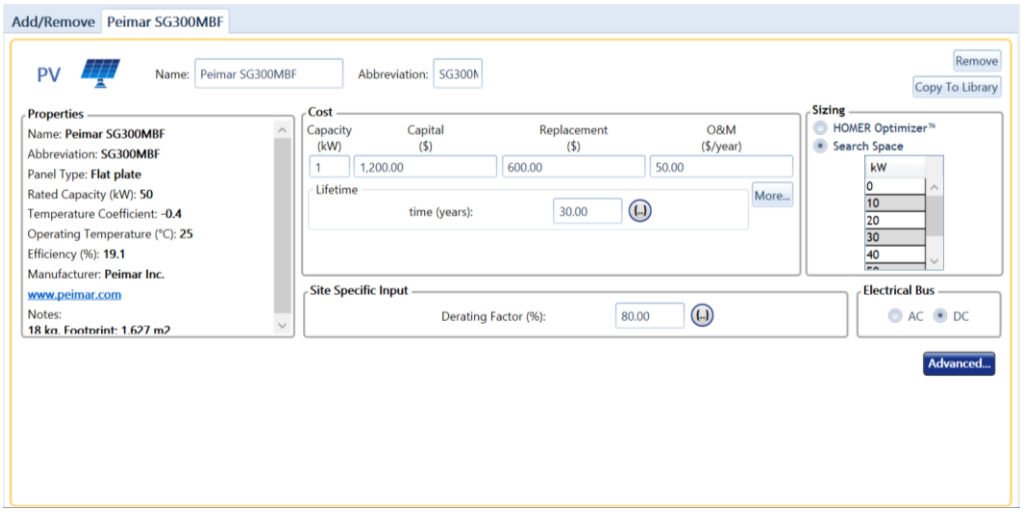

Figure 4. Peimar SG300MBF setup.

Bergey Excel 6-R Setup

The selected wind / wind power plant is the Bergey Excel 6-R, this is done because this type of turbine has a generation capacity of 6 kW which is ideal for energy generation in homes, plantations, and small businesses. This type has an extra-large rotor and ultra-low cut-ins that can operate at low wind speeds. The setup capture can be seen in Figure 5.

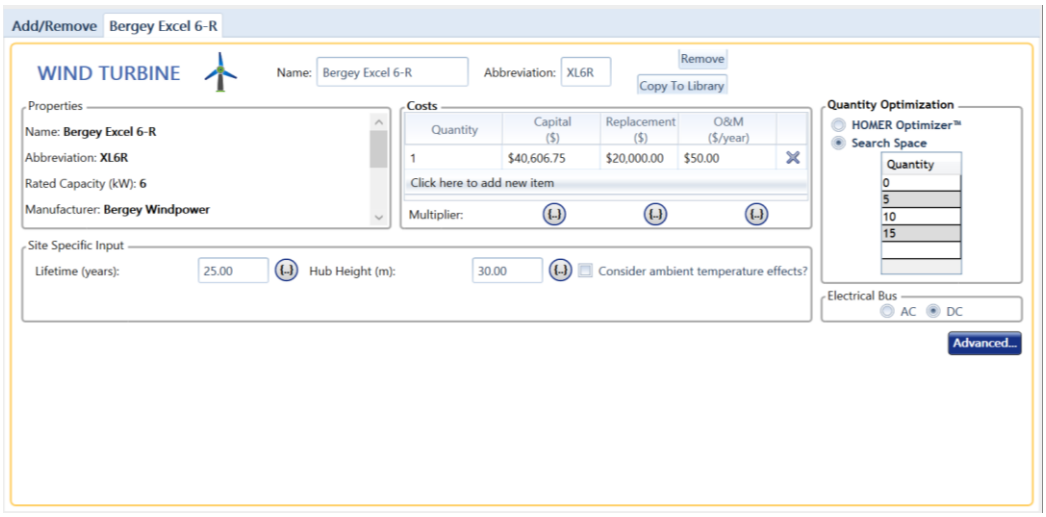

Figure 5. Bergey Excel 6-R setup.

Surette 6 CS 25P Setup

The generated power storage in this study will be received by Surette 6 CS 25P, this battery is a Kinetic Battery Model with a capacity of 6.91 kWh. Of course, to accommodate the generated energy, the availability of 50, 100, 150, 200, 250 to 300 units will be regulated. The setup capture can be seen in Figure 6.

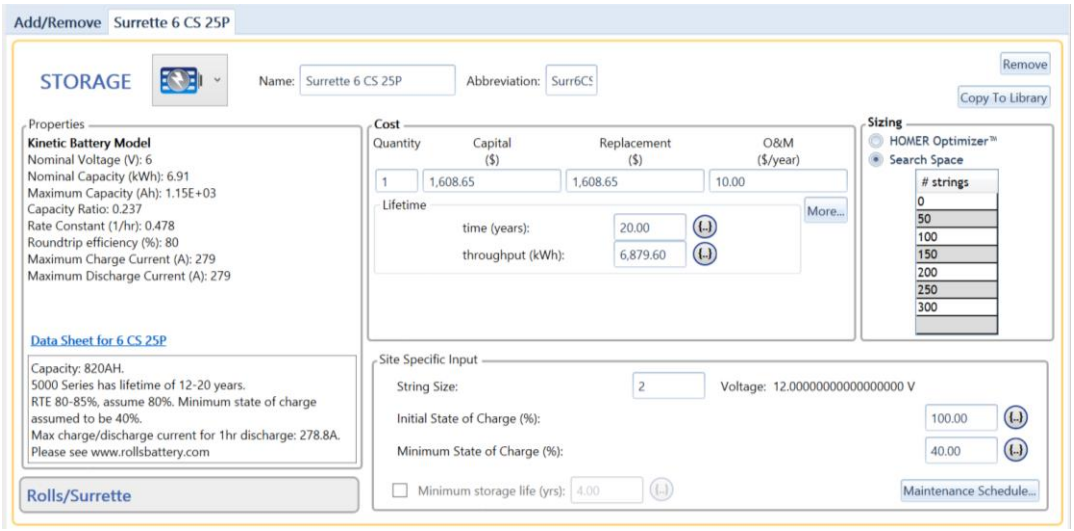

Figure 6. Surette 6 CS 25P setup.

Princeton DRI-100 Converter Setup

Converter is an important component in the generation of renewable energy electricity to convert direct voltage (DC) into alternating electric voltage (AC) and adjust the voltage changes according to system requirements, this needs to be done because the average renewable energy power generation unit uses direct voltage (DC). The setup capture can be seen in Figure 7.

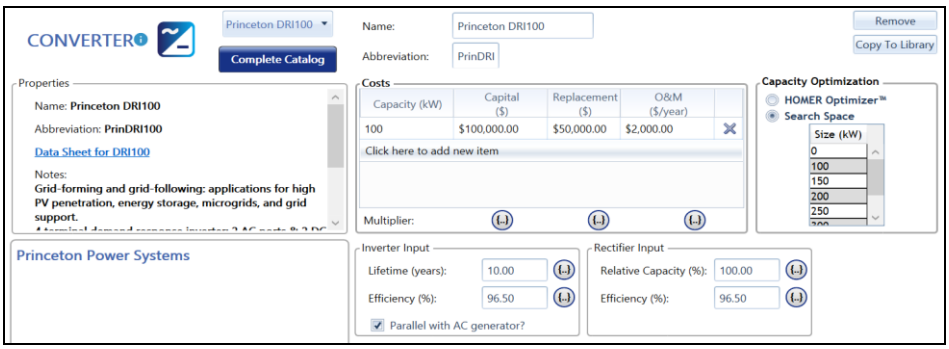

Figure 7. Princeton DRI100 setup.

HydroNatel Freejet Fi-7A49 kW Setup

The choice of Hydro Natel Freejet Fi-7A49 kW is because it is a product from Natel Energy, a company based in Alameda Point that is developing small-scale water turbines that can capture water discharge to produce electricity without dams. With a generation capacity of 49.1 kW, it is only natural that the Hydro Natel Freejet Fi-7A49 kW is the right choice for this study. The setup capture can be seen in Figure 8.

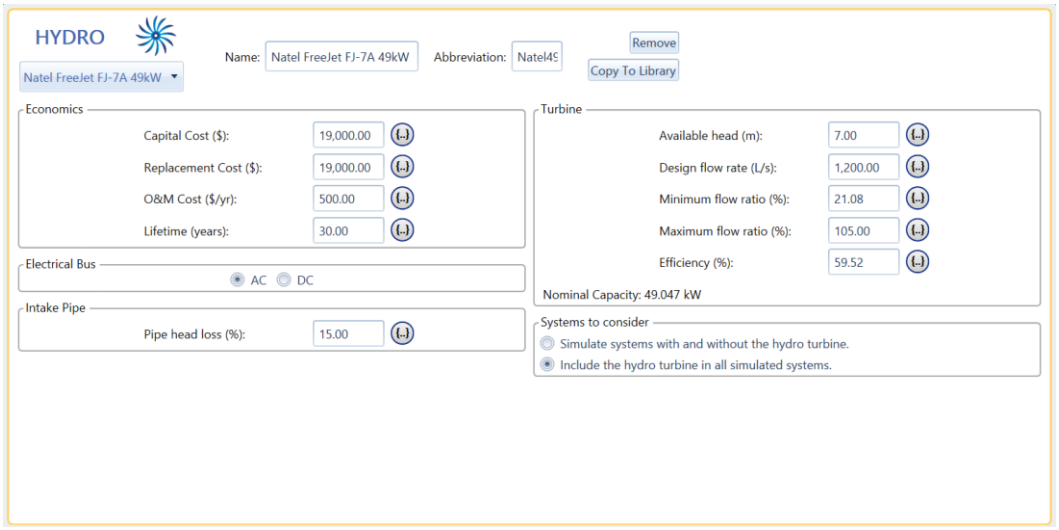

Figure 8. Hydro Natel Freejet Fi-7A49 kW setup.

Data Analysis

In research the method of analysis is one of the important things. The analytical method is important for identifying relevant variables so that research results are in accordance with the objectives. Data analysis methods are generally divided into qualitative data analysis methods and quantitative data analysis methods. Quantitative data analysis methods are carried out by processing data through statistical or mathematical methods, the advantages of this method are conclusions that are more measurable and comprehensive (Russo & Stol, 2021). Table 3 shows the explanation of data analysis in this study.

Table 3. The schemes of data analysis.

Research Problems	**Input**	**Process**	**Tool**	**Output**
What is the design model to simulate an optimal renewable energy generation system in South Sumatra Province?	Archive data	Simulation	*Homer Software*	Power plant development planning model with the use of renewable energy
How to analyze the performance of a combination system of renewable energy power plants that meet sustainable and reliable	Model	Case study, Simulation	*Homer Software*	Recommendations for renewable energy power plants with 8 (eight) combinations

electricity needs?				
How do renewable energy generation systems compare to diesel power plants in terms of carbon emissions?	Model	Case study, Simulation	*Homer Software*	The results of a comparison of carbon emissions between biogas and diesel energy power plants

RESEARCH RESULT

Renewable Energy Sources Result

At three different research locations, namely: Palembang, Pagar Alam, and Lubuk Linggau in South Sumatra Province, four renewable energy power plants have been identified and determined to be used as a comparison at the research location, namely:

- **Hydropower Plant:** Using the Natel Freejet Fj-7A 49 kW which has a generating capacity of 49 kW for 1 unit.
- **Solar Power Plant:** Using Peimar SG 300MBF with a capacity of 50 kW with a search space of 0, 10, 20, 30, 40 and 50 kW to suit the electrical load and supply / supply of solar energy in the research area.
- **Wind Power Plant:** Using Bergey Excel 6-R which has a capacity of 6 kW with a search space of 0, 5, 10, 15 units to suit the electrical load and supply / supply of wind energy in the research area.
- **Biogas Power Plant (as a Biomass Power Plant):** Using a Generic Biogas Generator with Your Own Size type determined by the researcher with a capacity of 100 kW, but in this study several sizes have been adjusted so that they can adjust to the electrical load and supply of Biogas energy available in the research area, namely: 0, 50, 100 , 200 and 500 kW.

HOMER Model Result

After testing using HOMER Software, at least 8 (eight) combinations of results were obtained from measurements in the cities of Palembang, Pagar Alam, and Lubuk Linggau, there are (Figure 9, 10, 11, respectively):

a. *Hydro/battery/converter* (HBC)

b. *Hydro/Solar/battery/converter* (HSbc)

c. *Hydro/Biomass/battery/converter* (HBbc)

d. *Hydro/Biomass/Solar/battery/converter* (HBSbc)

e. *Hydro/Wind/battery/converter* (HWbc)

f. *Hydro/Wind/Solar/battery/converter* (HWSbc)

g. *Hydro/Wind/Biomass/battery/converter* (HWSbc)

h. Hydro/Wind/Solar/Biomass/battery/converter (HWSBBbc)

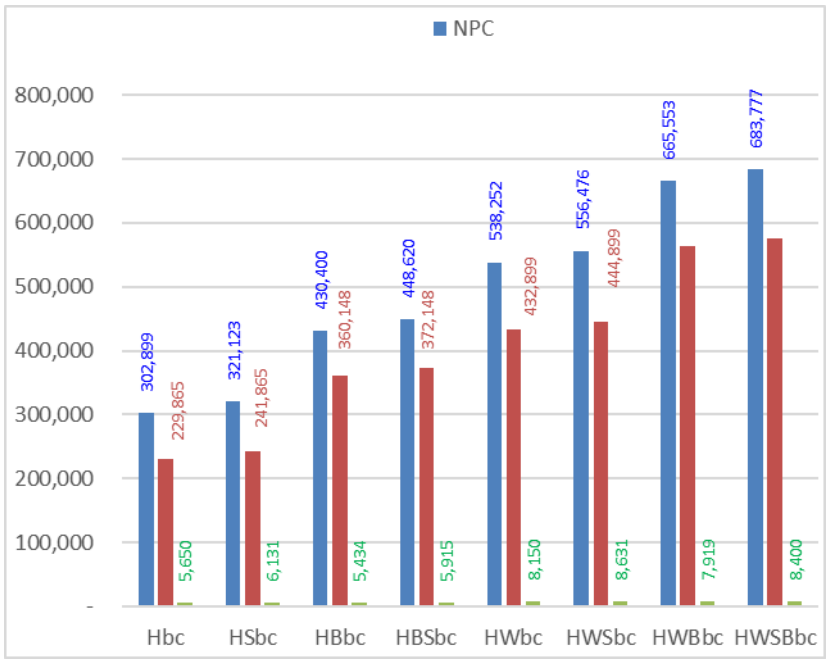

Figure 9. NPC, Initial Cost, and Operating Cost of Palembang City.

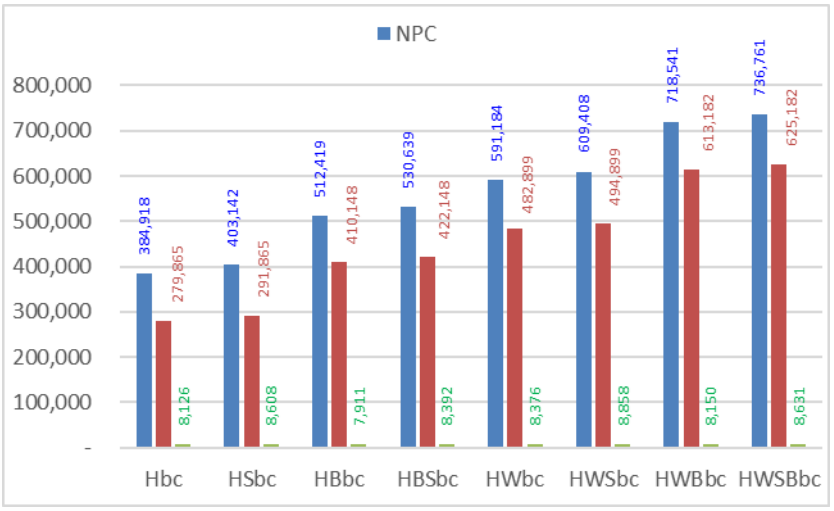

Figure 10. NPC, Initial Cost, and Operating Cost of Pagar Alam City.

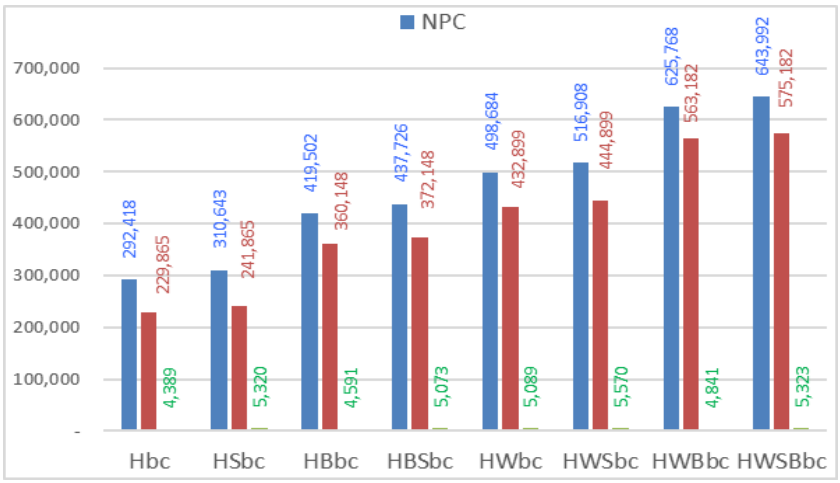

Figure 11. NPC, Initial Cost, and Operating Cost of Lubuk Linggau City.

To get a techno-economic analysis of the design of a renewable energy power plant. Need to be determined related to the value of the discount rate, inflation rate, and project lifetime which will be the input of the economic value in the data analysis, as shown in the following Table 4.

Table 4. Program Coefficient.

Description	Mark	Units
Exchange Rate USD – IDR	USD 1	IDR 14,000
Diesel Fuel Prices	USD 1.0 / Liter	IDR 14,000
Nominal Discount Rate	8	%
Inflation Rate	2	%
Project Lifetime	25	Year

Electricity Cost Model Result

Costs generated from electricity generation or commonly referred to as the Cost of Electricity (COE) calculated per kWh from testing using Homer Software is as the following Figure 12.

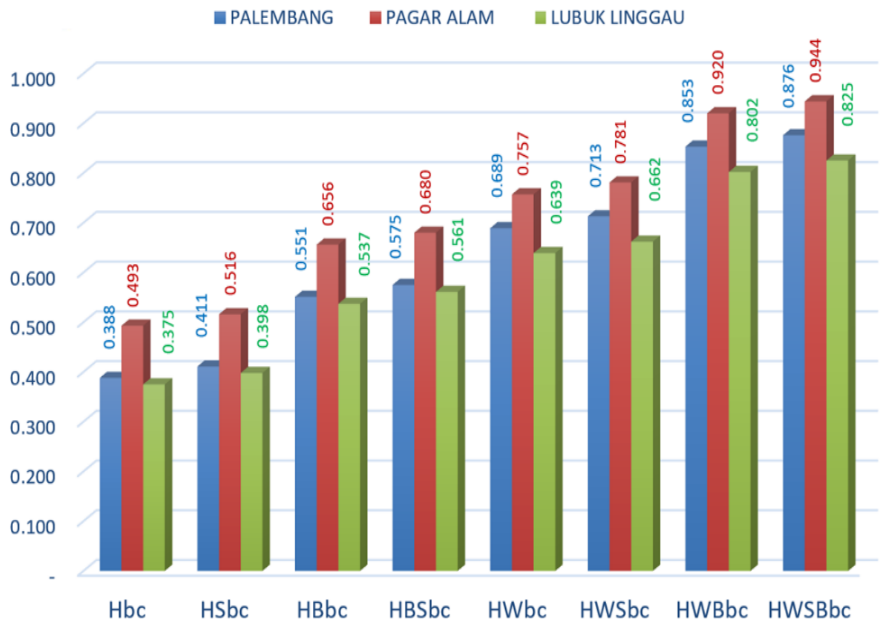

Figure 12. Cost of Electricity Model Result.

Energy Production Model Result

From the tests carried out using Homer Software, for 8 (eight) combinations of results from measurements in the cities of Palembang, Pagar Alam, and Lubuk Linggau, the production of electrical energy was obtained as the following Figure 13.

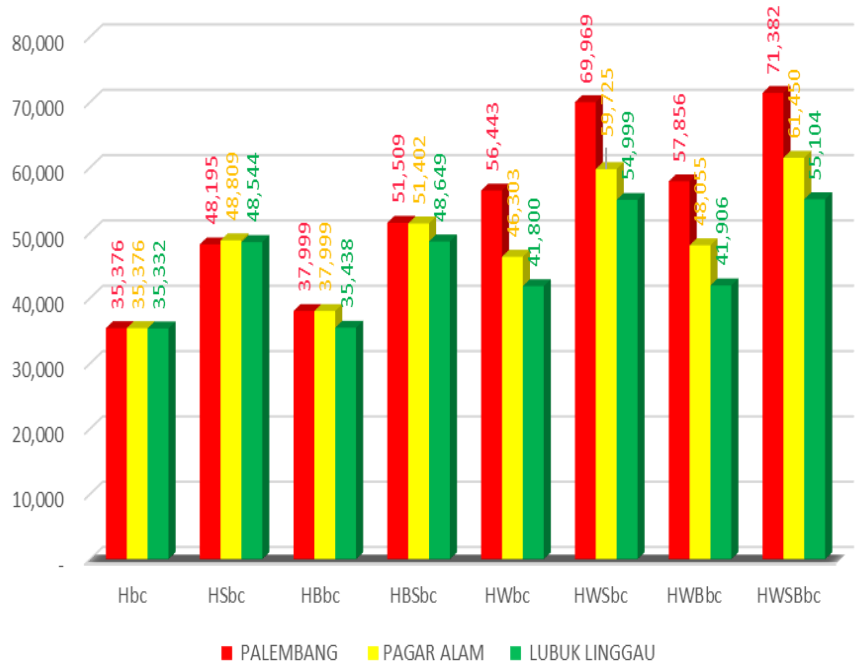

Figure 13. Energy Production Model Result.

Comparative Model for the Renewable Energy Generation and Carbon Emission with Diesel.

Tests were carried out from the design model of a renewable energy power plant with a diesel power plant. So, the comparison result can be seen in the following Figure 14. Besides, the design model also completely tested of a biogas power plant with a diesel power plant. So that the amount of carbon emissions produced by the biogas power plant is lower than the diesel power plant can be seen in Table 5.

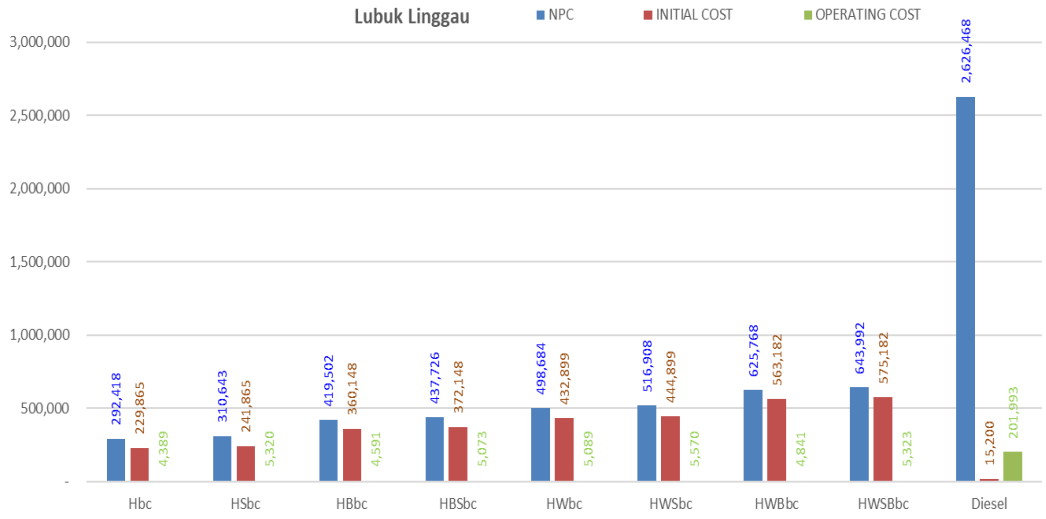

Figure 14. Comparison of Renewable Energy Generation with Diesel.

Table 5. Comparison Result of Carbon Emissions of Biomass with Diesel.

Quantity	Biomass Generator (Kg/year)	Diesel Generator (Kg/year)
Carbon Dioxide	124	530,208
Carbon Monoxide	1.4	570
Unburned Hydrocarbons	0	22.1
Particular Matter	0	22.1
Sulphur Dioxide	0	1,317
Nitrogen Oxide	0.86	3,816

DISCUSSION

The combination of an effective and efficient power generation system is Hydro/Solar/battery/converter (HSbc) or hydroelectric power combined with solar energy in Pagar Alam City with an energy production of 48,809 kWh/year. This is in accordance with the General Electricity Supply Plan (RUPTL) for 2021-2030 on page A-89 where it is planned to develop a Hydroelectric Power Plant in Endikat with an energy projection of 36 MW and page III-26 where it is recommended to use ex-mining land that is in the province of South Sumatra as a land for developing a solar power plant which is projected to be 27 MW.

A reliable and sustainable power generation system is obtained from hydro/battery/converter (Hbc) due to hydropower is energy that is

environmentally friendly, free from carbon emissions, and does not cause pollution which results in the greenhouse effect. PLTA is also very suitable for use in peak types where this type is for large peak load conditions and is used when network disturbances occur.

Meanwhile, for the Net Present Cost, the highest was found in a diesel power plant worth USD$ 2,626,468 compared to other renewable energy power plants with an NPC of around USD$ 290,000 – 643,000 and the highest Operating Cost was in a diesel power plant of USD$ 201,993 compared to other renewable energy power plants with an NPC of around USD$ 4,300 – 5,800. The carbon emissions produced in diesel power plants are also the highest compared to biomass power plants.

CONCLUSIONS AND RECOMMENDATIONS

After planning, designing which is then testing, several conclusions can be drawn on the renewable energy combination design in South Sumatra Province using homer software, including:

1. The effective and efficient power generation system is hydroelectric power that hybrid with solar energy in Pagar Alam City with an energy production of 48.809 kWh/year.
2. Hydro/battery/converter (Hbc) is the most reliable and sustainable power generation that is environmentally friendly, free from carbon emissions, and does not cause pollution which results in the greenhouse effect.
3. The highest Net Present Cost (NPC) in a diesel power plant would be estimated about USD$ 2,626,468, and the highest Operating Cost (OC) was in a diesel power plant of USD$ 201,993. Besides, the carbon emissions produced in diesel power plants are also the highest compared to biomass power plants.

Because the Renewable Energy Combination Design in the province of South Sumatra uses Homer software, there are several suggestions for future further research, including:

1. The data used for input to the system is primary data, which is obtained directly from the research location.
2. Need more specific data from the Central Bureau of Statistics if you want to get more optimal results.
3. There needs to be a special class to learn this Homer software because of its high level of sensitivity.

ADVANCED RESEARCH

Based on the study limitations, here some suggestions for further research in the future:

1. Using HOMER software with wide cases study.
2. Using time series data for the data collection.
3. Using machine learning as well as other statistical analyses for the best modeling or predicting results.

ACKNOWLEDGMENT

The authors would thank Research Management Center, Jakarta Global University, for their support.

REFERENCES

Akbar, A. W., Hiron, N., & Nadrotan, N. (2019). PERENCANAAN SISTEM PEMBANGKIT LISTRIK DENGAN SUMBER ENERGI TERBARUKAN (HOMER) DI DAERAH PESISIR PANTAI PANGANDARAN. *Journal of Energy and Electrical Engineering (JEEE)*, *1*(1). https://doi.org/10.37058/JEEE.V1I1.1191

Al Hakim, R. R. (2020). Model Energi Indonesia, Tinjauan Potensi Energi Terbarukan untuk Ketahanan Energi di Indonesia: Sebuah Ulasan. *ANDASIH Jurnal Pengabdian Kepada Masyarakat*, *1*(1), 11–21. http://www.jurnal.umitra.ac.id/index.php/ANDASIH/article/view/374

Al Hakim, R. R. (2022a). Energi Terbarukan dan Tidak Terbarukan. In M. Sari & R. M. Sahara (Eds.), *Teknologi Pertanian* (pp. 16–26). PT. Global Eksekutif Teknologi.

Al Hakim, R. R. (2022b). Perilaku Harian dan Profil Demografi Mempengaruhi Kenaikan Tagihan Listrik Selama Covid-19 di Indonesia: Pendekatan SEM-PLS. *AKUA: Jurnal Akuntasi Dan Keuangan*, *1*(1), 68–76. https://doi.org/10.54259/akua.v1i1.217

Al Hakim, R. R., Arief, Y. Z., Pangestu, A., & Jaenul, A. (2021). Perancangan Media Interaktif Energi Baru Terbarukan Berbasis Android. *Seminar Nasional Hasil Riset Dan Pengabdian Ke-III (SNHRP-III 2021)*, 144–150. https://snhrp.unipasby.ac.id/prosiding/index.php/snhrp/article/view/182

Al Hakim, R. R., Ariyanto, E., Arief, Y. Z., Sungkowo, A., & Trikolas, T. (2022). Preliminary Study of Juridical Aspects of Renewable Energy Draft Law In Indonesia: An Academic Perspectives. *ADLIYA: Jurnal Hukum Dan Kemanusiaan*, *16*(1), 59–72. https://doi.org/10.15575/adliya.v16i1.14063

Al Hakim, R. R., Pangestu, A., Jaenul, A., Sinaga, D. W., Saputra, E. Y., & Arief, Y. Z. (2021). IMPLEMENTASI PLTS DI DESA PULISAN, SULAWESI UTARA, INDONESIA SEBAGAI PERWUJUDAN PROGRAM DESA ENERGI. *Prosiding Seminar Nasional Penelitian Dan Pengabdian 2021, "Penelitian Dan Pengabdian Inovatif Pada Masa Pandemi Covid-19,"* 762–767. http://prosiding.rcipublisher.org/index.php/prosiding/article/view/220

Al Hakim, R. R., Ropiudin, Muchsin, A., & Lestari, F. S. (2021). Analisis Kenaikan Tagihan Listrik Selama Pendemi Covid-19 Berdasarkan Perilaku Konsumtif Energi Listrik di Indonesia. *JURNAL CAFETARIA*, *2*(1), 25–35.

https://doi.org/10.2020/akuntansi.v2i1.279

Al Mubarok, A. G., Djatmiko, W., & Yusro, M. (2018). Design of Arduino-based small wind power generation system. *E3S Web of Conferences*, *67*, 01006. https://doi.org/10.1051/E3SCONF/20186701006

Almihat, M. G. M., & Kahn, M. T. (2022). Wind Turbines Control Trends and Challenges: An Overview. *International Journal of Innovative Research and Scientific Studies*, *5*(4), 378–390. https://doi.org/10.53894/IJIRSS.V5I4.910

Ansori, A., Susila, I. W., Siregar, I. H., & Haryuda, S. I. (2017). Pembangkit Listrik Hybrid Solar Cell dan Turbin Angin di Pantai Tamban Kabupaten Malang. *Otopro*, *12*(2), 74–81. https://doi.org/10.26740/OTOPRO.V12N2.P74-81

Arief, Y. Z., Suhaidi, M. S., Mubarakah, N., Raksmey, M., Sukmana, I., & Al Hakim, R. R. (2021). Simulation of Heat Transfer Characteristics on Palm Oil as Electrical Insulating Material Using Finite Difference Method. *2021 5th International Conference on Electrical, Telecommunication and Computer Engineering (ELTICOM)*, *5*, 19–23. https://doi.org/10.1109/ELTICOM53303.2021.9590126

Arota, A. S., Kolibu, H. S., & Lumi, B. M. (2013). Perancangan Sistem Pembangkit Listrik Hibrida (Energi Angin Dan Matahari) Menggunakan Hybrid Optimization Model For Electric Renewables (HOMER). *Jurnal MIPA*, *2*(2), 145–150. https://doi.org/10.35799/JM.2.2.2013.3193

Balachander, K., Suresh Kumaar, G., Mathankumar, M., Manjunathan, A., & Chinnapparaj, S. (2021). Optimization in design of hybrid electric power network using HOMER. *Materials Today: Proceedings*, *45*(Part 2), 1563–1567. https://doi.org/10.1016/J.MATPR.2020.08.318

Branche, E. (2017). The multipurpose water uses of hydropower reservoir: The SHARE concept. *Comptes Rendus Physique*, *18*(7–8), 469–478. https://doi.org/10.1016/J.CRHY.2017.06.001

Fanaian, S., Graas, S., Jiang, Y., & van der Zaag, P. (2015). An ecological economic assessment of flow regimes in a hydropower dominated river basin: The case of the lower Zambezi River, Mozambique. *Science of The Total Environment*, *505*, 464–473. https://doi.org/10.1016/J.SCITOTENV.2014.10.033

Irawan, A., Saleh, C., & Bachtiar, I. K. (2013). *Studi Perencanaan Pembangkit Listrik Hibrida di Pulau Panjang Menggunakan Software HOMER*. Universitas Maritim Raja Ali Haji.

Kalamaras, E., Belekoukia, M., Lin, Z., Xu, B., Wang, H., & Xuan, J. (2019). Techno-economic Assessment of a Hybrid Off-grid DC System for

Combined Heat and Power Generation in Remote Islands. *Energy Procedia*, *158*, 6315–6320. https://doi.org/10.1016/J.EGYPRO.2019.01.406

Kamelia, L., Kharisma, K., & Fadhil, A. (2017). Analisis Perencanaan Secara Ekonomi Pembangkit Listrik Tenaga Hibrid Terbarukan (Studi Kasus: Kabupaten Gunung Kidul Yogyakarta). *TELKA - Jurnal Telekomunikasi, Elektronika, Komputasi Dan Kontrol*, *3*(1), 13–27. https://doi.org/10.15575/TELKA.V3N1.13-27

Kunaifi, K. (2015). Program Homer untuk Studi Kelayakan Pembangkit Listrik Hibrida di Propinsi Riau. *Seminar Nasional Informatika (SEMNASIF)*, *1*(2).

Kurniasari, E. N., Rusmayadi, G., Wianto, T., & Mahyudin, I. (2023). PERUBAHAN IKLIM DAN POTENSI ENERGI SURYA DI WILAYAH MONSUN. *EnviroScienteae*, *19*(1), 89–98. https://doi.org/10.20527/es.v19i1.15750

Lusiagustin, V., & Kusratmoko, E. (2017). Impact of sand mining activities on the environmental condition of the Komering river, South Sumatera. *AIP Conference Proceedings*, *1862*, 30198. https://doi.org/10.1063/1.4991302/649880

Nurjanah, S., Dewi, T., & Rusdianasari. (2021). Dusting and Soiling Effect on PV Panel Performance: Case Study Open-pit Mining in South Sumatra, Indonesia. *2021 International Conference on Electrical and Information Technology (IEIT)*, 251–256. https://doi.org/10.1109/IEIT53149.2021.9587351

Russo, D., & Stol, K. J. (2021). PLS-SEM for software engineering research: An introduction and survey. *ACM Computing Surveys*, *54*(4), 78. https://doi.org/10.1145/3447580

Silva, S. N., & Castillo, J. Á. del. (2021). An Approach of the Hydropower: Advantages and Impacts. A Review. *Journal of Energy Research and Reviews*, *8*(1), 10–20. https://doi.org/10.9734/JENRR/2021/V8I130201

Suroso, Priswanto, & Ropiudin. (2017). Analysis of 1.2 kW Wind Power Generation using 24 V DC Bus with Energy Storage System for Hybrid Solar Thermal-Wind Power Generation. *Journal of Engineering and Applied Sciences*, *12*(19), 5043–5049.

Tahseen, S., & Karney, B. W. (2017). Reviewing and critiquing published approaches to the sustainability assessment of hydropower. *Renewable and Sustainable Energy Reviews*, *67*, 225–234. https://doi.org/10.1016/J.RSER.2016.09.031