Modeling Design of 800 Watt Power Hybrid System in Lhokseumawe City Coastal Area

IOP Conf. Series: Materials Science and Engineering **536** (2019) 012056 doi:10.1088/1757-899X/536/1/012056

Modeling Design of 800 Watt Power Hybrid System in Lhokseumawe City Coastal Area

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Abstract. The increasing demand for electrical energy, resulting in more natural resources such as petroleum, natural gas and others. This is also caused by the lack of awareness of electricity energy savings for example turn on the lights during the day. There are several ways to save electric energy one of them by using Hybrid Power Generation. Hybrid power plant is a power plant that uses more than one energy source, such as by using solar and wind energy. In addition to the free use of solar this as an effort to reduce human dependence on coal, oil and natural gas whose source will be thinning when used continuously. Hybrid Power Generation System is the integration of renewable energy based power system. The main goal is to save fuel consumption and reduce emissions, especially CO2. The design and simulation of a hybrid power plant system utilizes wind and solar energy potential for small-scale (800 VA) housing units in the coastal area of Lhokseumawe city of Aceh Utara district. the proposed Hybrid Power Generation system is able to meet 100% of the electrical load for homes in the coastal area of Lhokseumawe city. The portion of solar energy is 50% and 50% comes from wind turbines. This study aims to explore solar energy and wind energy as a source of renewable electrical energy. In the implementation of testing used homer software to simulate the conditions of sunlight intensity and wind speed in the coastal area of Lhokseumawe city. The utilization of energy converted to direct current energy is converted to alternating current, the wind turbine used to power the electric generator combination of both energy sources will be applied to the residential electric needs in the coastal area of Lhokseumawe city.

1. Introduction

In general, residential areas in the coastal areas are residential fishermen with small-scale electricity needs (<1000 VA), the demand for electricity is met by State Electricity Company, whereas in general coastal areas have potential for renewable energy applications with sources areas with solar and wind energy as an alternative energy source. The sun is the main energy source that emits enormous energy to the surface of the earth. In bright weather conditions, the Earth's surface receives about 1000 watts of sun energy per square meter. The city of Lhokseumawe is the second largest city after the capital of Banda Aceh. The city that is in position 04º 54'- 05º 18' North Latitude and 96º 20'- 97º 21' east longitude, facing the Malacca Channel. The climate in the city of Lhokseumawe is included in the tropical climate with the weather forecast of Aceh province, Lhokseumawe cloudy weather, temperatures ranging from 23º C - 32º C with an average humidity of 60% - 95% and wind speed 27 knots from the east (weather forecast Province BMKG 2009). To support the utilization of renewable energy, this research is applying: i) efforts to conserve solar energy and wind energy as an

alternative source of electrical energy; and ii) diversification Efforts is a strategic effort to reduce dependence on petroleum in the effort to meet domestic energy needs (except the need that cannot be replaced with other forms of energy such as transportation and industrial feedstock should be economical savings and replace with the type of energy etc. Diversification will increase the diversification of the use of various types of energy in the country one of the most important is the utilization of solar energy and wind energy.

For the coastal area of Aceh, the speed has an average wind speed of 27 Knots. Conditions allow for converted into electrical energy. In this research, the design model of the power plant by using solar energy source and wind energy include:

- Designing a turbine model
- Design solar cells model
- Designing Hybrid Power Generation System model for simulation
    - Application 50% of wind turbine movement and 50% of solar cells
    - Design of Hybrid Power Generation System for houses in coastal areas with an installed capacity of 800 VA.

2. Research Method

2.1. Preliminary

Understanding Hybrid is generally the use of two or more power plants with different energy sources. The main purpose of the hybrid system combines two or more sources of energy (generating systems) so as to cover each other's weaknesses and can be achieved supply reliability and economic efficiency at a certain load. Hybrid Power Generation is one of the alternative generating systems appropriately applied to areas that are difficult to reach by large power systems such as State Electricity Company or diesel power plant networks. Hybrid power plants, which will supply the electrical energy needs either as home lighting or other electrical equipment needs such as TVs, water pumps, iron. With the combination of these energy sources, it is expected to provide a continuous power supply with efficient most optimal.

Some examples of the use of solar energy and wind energy are:

- Measurement of current and voltage on hybrid power systems using Atmega 8535 [1]
- Design of hybrid solar power generation system with electricity nets of state electricity company for an urban house [3].
- A hybrid power plant as an electrical solution in remote areas [2].

The ultimate goal of this research is to analyze the potential of solar energy and wind energy in the coastal area of Lhokseumawe city. Combining the two types of solar and wind power generators as a hybrid system designed to be a hybrid power system as renewable alternative energy, it is expected to meet the demand for electricity (880 VA) for the housing needs of people living in the coastal area of Lhokseumawe city.

2.2. Hybrid System

In this system, a simple hybrid generation scheme can be assumed as in Figure 1. The energy generated on this hybrid generation subsystem is not channeled directly to the load but is used to charge the battery bank. The large total energy load (ELT) that must be supplied by the entire system must be equal to the load energy itself (EL) plus the losses contained in the battery (ELB) and the network (ELJ), so that it can be formulated as follows:

$$ELT = EL + ELB + ELJ \quad (1)$$

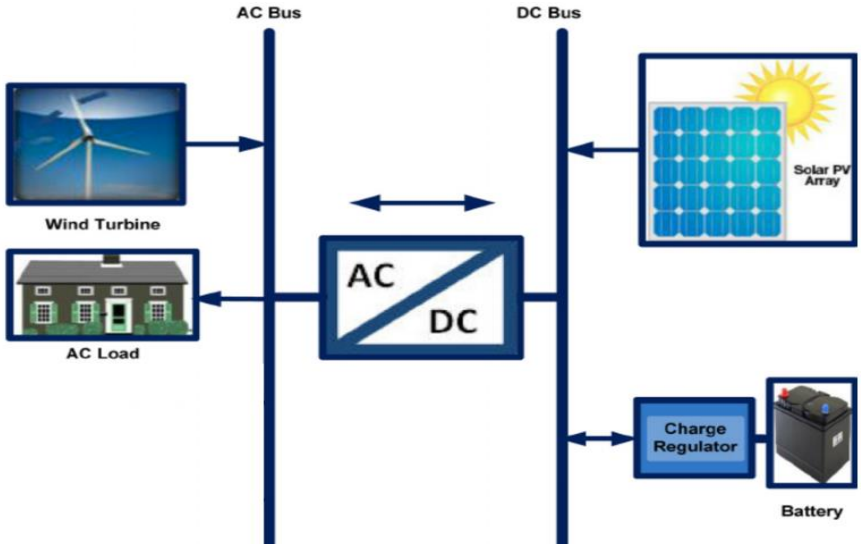

Figure 1. Hybrid power system (wind and solar power) schematic diagram

2.3. Calculation of System Components

In Hybrid system planning, there are supporting components that need to be considered include the capacity of wind turbines, solar cell, batteries, and converters. Here are the calculations are done in determining the capacity of the components used.

2.3.1. Solar cell

Determination of the size of solar cell panels with solar collector system serves to collect solar radiation energy and convert it into heat energy. System performance depends on many factors, including energy availability, ambient air temperature, characteristics and shape of absorber materials.

2.3.2. Wind Turbine

The determination of this wind turbine is carried out by reference to the base load of the load pattern to be supplied by the wind turbine. This wind turbine will work to supply the load at 24.01 o'clock to 06.00 o'clock with a maximum load of 1 KW. Taking into account the average wind speed of 3.29 m / s, then a 50% wind turbine (with a 300 W load capacity) is required to supply the load.

2.3.3. Battery

Battery capacity is calculated based on the capacity of the installed wind turbine, the operating voltage and the Depth of Discharge (DOD) of the battery by 20%. Because the wind turbine output voltage is a maximum of 100 VDC and 12 V battery voltage.

3. Results and Discussion

3.1. Test results

In the implementation of testing used homer software to simulate the conditions of sunlight intensity and wind speed in the coastal area of Lhokseumawe, sampled on the Ujongblang beach Lhokseumawe. The data is received from doing the simulation through HOMER software. The data is divided into solar panel data and wind turbine data. The received data are testing data of solar panel with loads, and the measured voltage, respectively for both solar cell and wind turbine.

A. Test results for a solar cell.
Input Summary
Project title: sunlight intensity
Author: Muhaimin
Notes: intensity of sunlight in Lhokseumawe
Project Location Location Lhokseumawe, Aceh, Indonesia
Latitude 5 degrees 10.87 minutes North
Longitude 97 degrees 8.48 minutes East
Time zone Asia/Jakarta
Load: Electric1 Data Source Synthetic
Daily noise 10%
Hourly noise 20%
Scaled annual average 11.249 kWh/d
Scaled peak load 2.3156 kW
Load factor 0.2024

B. Tests for Wind Speed
System control
Time step length in minutes
Multi-Year enabled No
Allow systems with multiple generators Yes
Allow systems with multiple wind turbine types Yes
Battery autonomy threshold 2
Maximum renewable penetration threshold 55
Warn about renewable penetration Yes

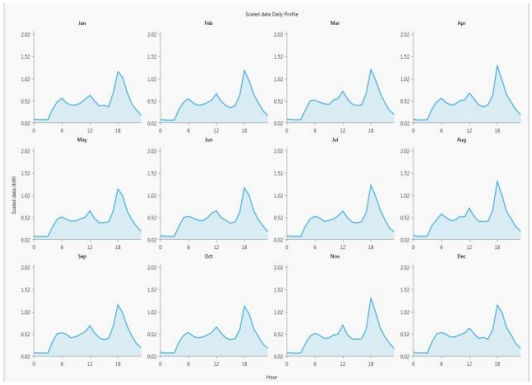
Figure 2. Solar energy and load per year

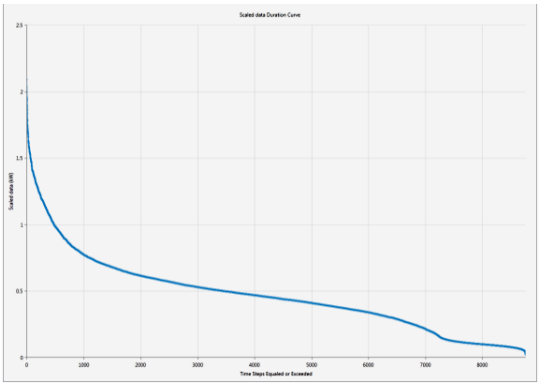
Figure 3. Measured DC voltage

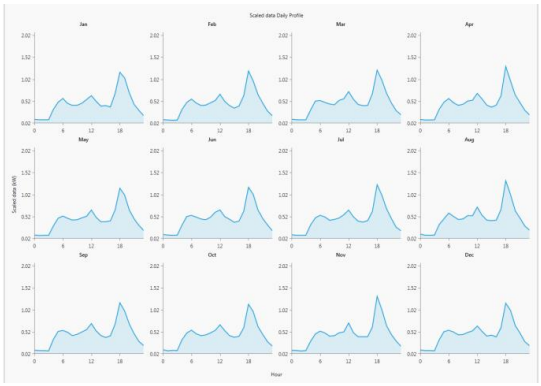
Figure 4. Wind speed and load per year

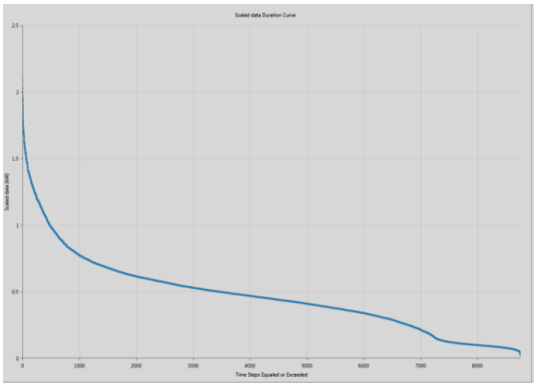
Figure 5. Measured DC voltage

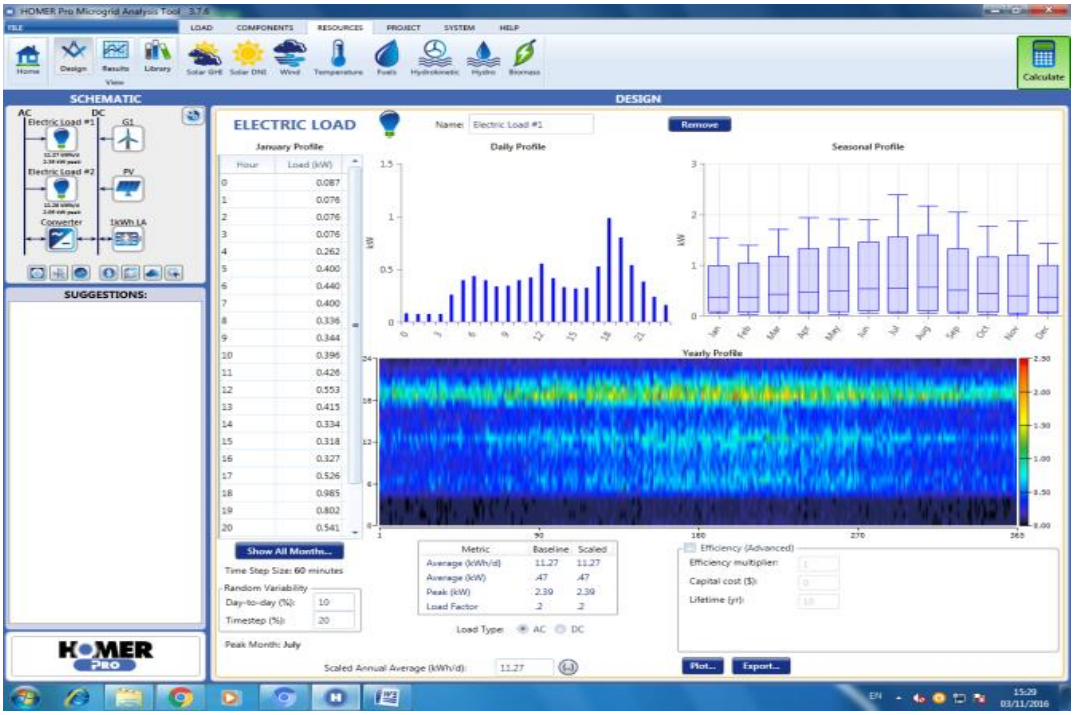

Figure 6. Data of hybrid solar panel and wind turbine

3.2. Discussion

3.2.1. Solar panel

The location was chosen for Ujong Blang Lhokseumawe beach test. Light intensity data obtained values from January to February between 3.415-4.415 kWh/m^2/day. Average Score Intensity of annual sunlight: 3.92 kWh/m^2/day. By simulating this solar intensity value into a solar power plant, the results are shown in figure 11. and Figure 13 obtained an average value of 11.26 kWh/day, the average value of 470 watts of electricity, peak power value of 2.09 kW.

3.2.2. Wind turbine

Wind power data obtained values from January to February between 2.560-4,590 m/s. Average Wind velocity is 3.52 m/s. By simulating this wind speed value into wind power, we obtained an average value of 11.26 kWh/day, an average rating of 470 watts of power, a peak power rating of 2.09 kW.

3.2.3. Hybrid solar panel and wind turbine

Data Average Values Annual sunlight intensity: 3.92 kWh/m^2/day up to 4.415 kWh/m^2/day and Average wind velocity 3.52 m/s combined to become a hybrid power plant, as shown in Figure 6. The simulation results obtained average value of 22.52 kWh/day, the average value of 940 watts electric power and peak electric power value of 4.18 kW.

4. Conclusion

From the test results can be concluded that the hybrid power plant using solar cells and wind turbines can be applied to 800-watt load, in accordance with the planning. Distribution of house electrical load capacity in coastal areas, for solar power plants to supply 470 Watt and wind power plants supply of 470 Watt.

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