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Simulation of a Hybrid Power Generation System (A Case Study of Oke Eda, Akure, Ondo State, Nigeria)

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Abstract: Demand for energy is increasing day by day in our society due to increasing number of residence and industries. Meeting this demand has been a major challenge for utility providers (power providers) over the years, which crippled our economy in the power sector. This project presents a study and a deep exploit of renewable energy source such as solar, wind, biomass, and other forms of renewable energy. The design of a complete hybrid renewable power system model for day to day load demand of Oke eda in Akure city using Hybrid Optimization Model for Electric Renewable (HOMER) and MATLAB (Matrix Laboratory) is a multi-paradigm numerical computing environment and proprietary programming language developed by MathWorks / Simulink, the sources of powers are photovoltaic (solar module) and diesel generator and the storage systems are batteries. The sizing, optimization and economic estimation of the model systems were performed using HOMER (hybrid optimization model for electric renewable) software and simulated using MATLAB. In addition, a comparison between the two different suggested power system configurations is illustrated in details. The control system handles the operations of the hybrid system by switching between the PV system and the diesel system and is intended to maximize the use of renewable system while limiting the use of diesel generator, which is allocated only when the demand cannot be met by the PV system. This project presents a review of renewable energy potentials in Nigeria to be tapped for useful and uninterrupted electric energy supply and provides a detailed analysis of the Quantum of electricity supply to Oke Eda, Akure and how to supplement for those lose hours in power supply (i.e. hours lost to power outage) via the combination of solar energy and diesel generator to augment for 20 hours of power unavailability in the community.

Keywords: Power Generation System, Simulation, Hybrid Power

1. Introduction

The power generation from the main grid to various consumers is not sufficient enough due to the low planning of power infrastructure and it has become a big problem in Nigeria. There is need for continuous operation of electricity in most of our everyday lifestyle to meet our various demands, the power supply to the residence of Oke Eda is most likely the worst case scenario. According to the data obtained from the power holding company in Nigeria, Benin electricity distribution company (BEDC) for the residence of Oke Eda, they are facing problem whereby the number of hours of power outage is more than power supplied. This project supplies the need for an alternate hybrid power energy to augment for the low supply of power from the power distribution company. The hybrid power system can be described as an electricity production system in which energy supply consist of a combination of two or more types of electricity generating sources (e.g., solar photovoltaic, fuel generator and others) the component utilized in the hybrid system considered in this project are solar photovoltaic panels and a diesel generator. A diesel generator can provide energy at any time, whereas energy from PV is greatly dependent on the availability of solar radiation. This makes the generator more reliable and the best for operation of energy backup when there is power outage [1].

In a developing country like Nigeria, electricity is a lacking infrastructure due to some economic reasons, severe modern energy shortage in rural areas where more than 80% of the population of the country lives. Access to electricity is one lowest in Africa. Despite current efforts to increase access, many communities will reach for years to come. Several parts of the country where there is blackout.

The development of backup hybrid standalone power systems is practicable for the town of Akure providing good possibilities due to the complementary nature of the resources in the area. This work emphasized on the development of an alternative power system using optimal design of HRES (Hybrid Renewable Energy System) and micro-grids as methodology. This optimization approach was adapted to analyze the area and find the optimal combination of standalone hybrid renewable energy system and micro-grids. This optimization approach can be obtain using the renewable technologies (e.g. photovoltaic, diesel generators, batteries) and generalizing this optimization method by considering the possibility of building transmission lines to interconnect the selected case study, and consequently find the optimal combination of hybrid renewable energy system and micro-grid [2].

1.1. Electricity in Nigeria

Figure 1. Showing the residence of Oke Eda (Google maps).

Nigeria is located between latitude 10°N and longitude 8°E. The country power supply is predominantly hydro and thermal. In Nigeria, thermal power plants constitute 79% of power generation while the remaining is from hydro. The hydro stations are affected by seasonal changes in water flow for effective performance of these hydro turbines. There is also irregular power supply in the country due to insufficient supply of natural gas to the thermal power plants. These problems led to the current situation where Nigerians looked for an alternative power supply using petrol and diesel power generating machines. Despite the populous nature of the country, these issues continue to decline the Nigeria's electricity sector when compared to different parts of the world. According to the IEA report of 2009, 80 million Nigerian do not have access to electricity. Homer simulation is a model for the need of feasibility study, in other words is a powerful software that simplifies the tasks of evaluating designs both off-grid and grid-connected power systems for a variety of applications, in order to use HOMER, user must provide model with input which describes technology options, components costs, and resources availability. It uses those inputs to simulates different systems. The residence of Oke Eda, Akure, Nigeria is showing in Figure 1 [3].

1.2. Definition of Terms

The definition of each component used in the simulation of this model is briefly stated below, and a clear difference of their working principle.

1.2.1. Solar Power / Photovoltaic (PV)

The solar power industry has seen sustainable growth over the past decade. This section of this project is going to explain the solar power. The current market condition of the solar cost will then be reported. The photovoltaic material (solar panel) that will be used for the proposed methodology is an industrial solar photovoltaic panel which is powerful enough to fit in for the loss of power during the main power grid power failure or cut off, the solar setup is supposed to provide the available backup power plan needed. Photovoltaic cells obtain energy from incident solar radiations. [4]. This effect describes the creation of a voltage due to light exposure. Power output of a photovoltaic cell varies with temperature and the induced voltage. In general, a photovoltaic cell is modelled as an electrical circuit, and the power output is calculated using the I-V curves for the material in question [5]. For each radiation and temperature condition there is a maximum efficiency voltage operation point for the photovoltaic cell. This operation point can be tracked with a device called Maximum Power Point Tracker (MPPT) that regulates the voltage in order to operate the photovoltaic cell efficiently. If the device is considered to be part of the system, the effect of varying can be neglected. Consequently, for tecno-economical performance analysis a simplified linear equation is commonly used. For simplicity, we follow an approach of [6] and assume that the power output does not vary with temperature or voltage. Additionally, the photovoltaic panel will be considered to be horizontal (no tilt angle).

1.2.2. Batteries

The output power from the wind turbine and PV panel varies with weather conditions throughout the day. Therefore it is not possible to meet the load demand all the time with individual PV or a wind turbine. This can be compensated using a battery between the DC bus of the hybrid system and the load which acts as a backup power supply during the power crisis. If an excess of energy is generated by the PV and wind turbine after meeting the load demand, that excess energy is stored by charging the battery, for future use [7].

Two main types of batteries used in hybrid systems are nickel-cadmium battery and lead acid battery. Nickel-cadmium batteries are expensive, have lower energy efficiency and limited upper operating temperature. Hence lead-acid batteries are most commonly used in the hybrid systems. The Depth of Discharge (DOD) is a measure of how much energy has been withdrawn from a storage device, expressed as a percentage of full capacity. For example, if the DOD of the battery as mentioned by the manufacturer is 50% then only 50% of the battery capacity will be consumed by the load. The state of charge (SOC) is the reserve of the depth of discharge (DOD). It indicates the present state of the battery in use. The battery cycle is a complete period of discharge and recharge. Generally, it is considered to be discharging from 100% to 20% DOD and then back to 100%. The expected number of cycles a battery can deliver is an indicator of its performance. The average depth of discharge is inversely proportional to the cycle life. When selecting a battery type, usually lead-acid battery is chosen. Generally, lead-acid batteries are more cost-effective than nickel-cadmium batteries, but the latter may be a better choice for greater battery ruggedness. Nickel-cadmium batteries can perform well under rigorous working conditions. The kind of batteries that is used in this proposed methodology will be further describe in the following chapter in which will be most suitable for the job [8].

1.2.3. Solar Charge Controller or Battery Charger

A charge controller or charge regulator is basically a voltage and/ or current regulator to keep batteries from overcharging, it regulates the voltage and current coming from solar panels going to the battery, series of panels generates different voltage, so if there is no regulation on the batteries will be damage from overcharging. Most batteries need around 14 to 14.5 to get fully charge depending on the battery in use. There are different types of solar charge controller out there used for varies of work, from industrial base charge control to a commercial charge controller. Industrial charge controller is a heavy duty charge controller for heavy duty solar panels, commercial or individual household based charge are used for less heavy duty panels. charge controller comes in all shapes, features, and price range. They range from the small 4.5-amp control, up to the 60 to 80-amp MPPT programmable controllers with interface according to [9].

1.2.4. Diesel Generators

There are various versions of generator that are available from smallest size to the biggest size, and from petrol usage to diesel usage, the amount of power each generated by each powerful generator are used in the simulation of the renewable energy source. Diesel generators are normally diesel engines coupled to generator. DG can generate at nominal power and the surplus energy (if any), can used to charge a battery bank. The DG is usually designed in such a way that it always operates between 80 and 100% of the kW rating, while running together with the battery bank or other renewable energy systems according to [10]. Diesel generators are well developed energy production systems used in traditional grids. In fact, they present more degrees of freedom in term of energy production compared to renewable sources. This project studies the characteristics of these generators: the control strategy, the power production, and the fuel consumption estimation. Moreover, considering the case of Oke Eda the number of these generator will be further analyzed in the next chapter.

1.2.5. Inverter (Converter)

Inverter is an electronic device that is used in electrical field to convert DC voltage to a voltage. In most cases, the input DC voltage is usually lower while the output is equal to the grid supply voltage of either 120 or 240 volts depending on the country. The inverter may be built as standalone equipment for applications such as solar power, or to work as backup power supply from the batteries which are charged separately. The other configuration is when it is part of a bigger circuit such as power supply unit, or a UPS. In this case, the inverter input DC is from the rectifier mains AC in the PSU, while from either the rectifier AC in the in the UPS when there is power, and from the batteries whenever there is a power failure. An inverter provides an AC voltage from DC power sources and is useful in powering electronic or in other term "load" at the AC main voltage. On addition they are widely used for in the switched mode power supplies inverting stages [3].

1.2.6. Current Market

There is enough solar energy potential in area of Oke Eda at Akure Nigeria. In some areas where solar energy is used to power up some equipment's, mostly solar energy is used in agricultural section and less than 1% energy is used. The current status of solar energy components and diesel generators in market at current state seems not too bad and can be used to implement this project and can generate enough power to supply the area.2009 [5].

1.3. Literature Review

Extensive research has been conducted over the years on alternating energy to replace fossil fuel based power generation due to the global effect of climate change. In general, all the infrastructure the capital needed to build important infrastructure, such as transmission lines and transportation links. Moreover, the small population being served makes these projects economically less attractive.

Ultimately, the lack of electricity or transportation negatively impacts basic and sensible services like health care and education according to [11]. Finally, considering that electricity is a fundamental service for socio-economic development, remote communities have had to rely on stand-alone power generation technologies; consequently, small diesel fueled stationary power plants are the prevailing power source in remote communities around the globe. Photovoltaic cells obtain energy from incident solar radiations. This effect describes the creation of a voltage due to light exposure. Power output of a photovoltaic cell varies with temperature and the induced voltage John A. Duffie and William A. Beckman. Solar Engineering of Thermal Processes. [12].

1.3.1. Hybrid Renewable Energy Systems

"Several alternatives solutions have been explored to reduce the loss of power in the remote area. However, there have been particular method in fixing the loss of power in using the solar energy system into hybrid renewable energy system" according to Ashok, 2007, optimized model for community based hybrid energy system. This has been motivated by the recent progress and development of renewable energy and energy storage technologies. These hybrid systems combine renewable and conventional energy technologies to generates electricity, and can take advantages of the local resources (e.g. solar) to reduce, or eliminate, loss of power from the main grid of electricity (hydroelectricity). Nonetheless, due to the non-linear performance of renewable energy technologies and the stochastic nature of renewable resources, finding the optimal design for these systems is a challenging problem. Consequently, several optimization techniques have been proposed to find the optimal configuration of hybrid renewable energy system for individual communities. Nigeria is endowed with sufficient renewable energy resources to meet its present and future development requirements. However, hydropower is the only sustainable resource currently exploited and connected to the grid. Interest in renewable energy development and dissemination in Nigeria is driven by, among other things, the recent increase in oil prices, and the unavailability of electricity to majority of the population and the high cost and energy losses associated with grid extension. The government has made efforts through several power reform programmes and policies to attract private participation, thus encouraging renewable energy RE development. [13].

1.3.2. Optimization Techniques

The optimization methods used to analyze hybrid renewable energy system are focused on some problems: to find the optimal hybrid renewable energy system configuration. For instance, Dennis Barley and Byron Winn. 1996. Authors developed a dispatch strategy that is virtually cost effective as the ideal predictive strategy (i.e. assuming perfect-knowledge of future and climate conditions). However, this is an unrealistic scenario because it is not yet possible to have perfect-knowledge of future load and climate condition. Optimum operation of a small autonomous system with unconventional energy sources" develop a dynamic programming to determine the optimal generation schedule and battery storage policy, Liu et al. was successful in investigating the performance of photovoltaic array under various circumstances and climatic conditions. The aim was to optimize the size and slope of PV array in the system. Under four climatic zones, tropical, sub-tropical, hot arid and warm temperature, the performance of the PV system is studied and an optimized condition was reached using HOMER software. Finally, it was concluded that PV system can effectively bring down the electric bills and to alleviate carbon dioxide emission. Elhassan et al. uses Homer software to develop an efficient power system of sustainable and reliable renewable energy to meet domestic power needs and the total life-cycle cost. This literature review will explore previous literature on solar power, wind power, power cells and the feasibility of renewable energy system. The solar power section will look at the types of solar power, the current conditions of the solar industry, and how government policies are helping that industry. The power cells portion of the literature review will explain how power cell work and explore their cost and benefits. Lastly, the feasibility of renewable energy system section will a brief overview of previous case studies of renewable energy system in the remote area. [14].

2. Methodology

The methodology schematic diagram of the hybrid renewable system shown in Figure 4 consist of a PV/diesel generator. The project lifetime is estimated at 25 years. HOMER performs the simulation for a number of prospective designed configurations. after examining every design, it selects the one that meets the load with the system constraints at the least life cycle cost. HOMER performs its optimization and sensitivity analysis across all mentioned components and their resources, technical, cost parameters, system constraints and sensitivity data over a range of exogenous variables. Later the load profile is mathematically solving to give out necessary and number of diesel generators needed to supplement for the loss of power daily.

In this chapter, the components of the hybrid system are discussed. A diesel generator (DG) to supply the load. PV harnessing the sun (solar) power, and the battery as storage device and in other way the generator also charges the battery when the sun is down at night. The hybrid energy system integrates various renewable combinations of PV, diesel generator applicable depending on availability. In general, there can be 2 to 1 combinations, where 'n' is the type of renewable energy resources. A parallel hybrid configuration of these components is used in this approach with battery storage and diesel generators as backup sources. The criterion of selecting the best alternative energy system combination for the case study is based on the trade-off between reliability, cost and minimum use of diesel generator sets. For different renewable combinations, the output of the optimal sizing and operation is a set of component sizes for a given application together with recommendations for system operation. The component sizes are restricted to that available in the markets. From the cost comparisons of different combinations, the most economical system is selected which ensures power supply continuity. Basic power modules of alternative power system considered for the Oke Eda are solar PV with diesel or battery backup.

2.1. Design Analysis

The analysis that goes along with the system configuration and data optimization pertaining to the studied area. The simulation software includes MATLAB (matrix laboratory) and HOMER (hybrid optimization model for electric renewable), are used for the achievement the project. The analysis of each of the components are carefully analyze and simulated and resources obtained from simulation software's.

2.1.1. Solar Radiation Profile for Oke Eda

Figure 2 shows the solar radiation intensity profile over one year for Oke Eda. In this study, the solar resource data for Oke Eda was obtained from the average of NASA surface meteorology solar energy website. The data was collected for latitude 7.2496⁰ North, and longitude 5.2053⁰ East.

2.1.2. Input Parameters

The electricity used data input for the Homer software came from the bimonthly electricity bills in Akure city is received. The average electricity use for each month was then split evenly to form daily electricity consumption. These electricity consumption was then split evenly to form hourly consumption of the resort.

These data received input to the Homer software for analyses and optimization between these selected resources. To optimize for the best power backup for the time of power outage in Oke eda residence.

2.1.3. PV Array Data

The PV array simulation declared that the capital cost was 413$ and the replacement costs was same price as the capital cost. The maintenance cost was considered about 25$/yr., which is a low value. The lifetime for this system was estimated about 25 years and the derating factor of 90% was selected.

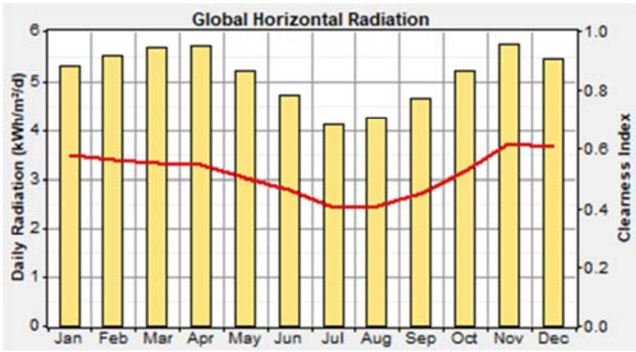

Figure 2. *Solar Radiation resources for Oke eda, Akure.*

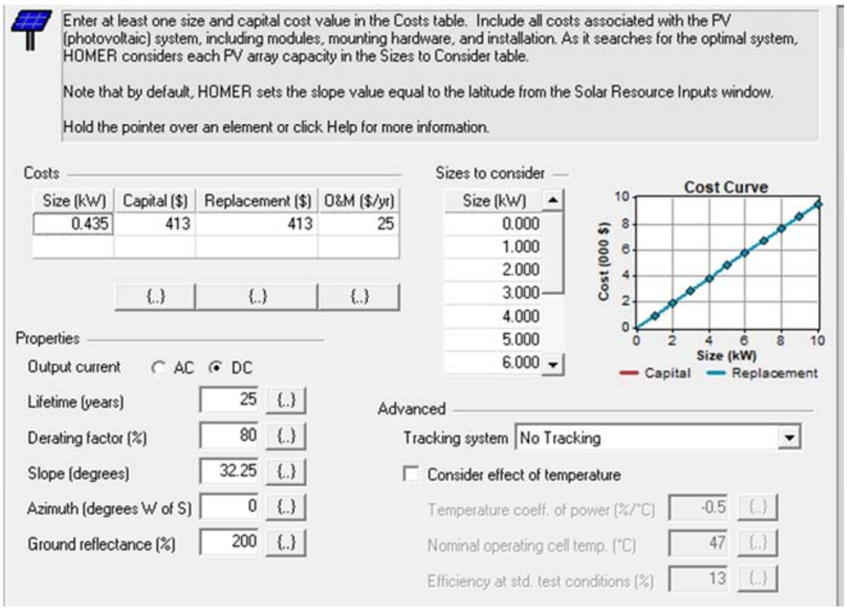

Figure 3. *Photovoltaic solar input.*

2.1.4. Storage Device

A storage device is needed for the connected alternative hybrid system. The model defined that the energy from solar panels can be stored in a battery to be used whenever the solar radiation is low or when the solar cells electricity generation is not enough. This condition can be found during cloudy or rainy days. Also, the battery can be used as an energy source during the night period, as well as it is used to store the excess energy. The description of the selected battery is given below. The battery configuration is input into the HOMER software to fully analyze the working effect conditions.

Battery type: Vision 6FM200D
Nominal capacity: 200Ah
Nominal voltage: 12V
Numbers of battery: 150

2.1.5. Diesel Generator

For the power supply without interruption, 520kw diesel generator must be used. The PV system works together with the generator to fulfill the load demand. Figure 4 shows the generator considered by HOMER in the simulation.

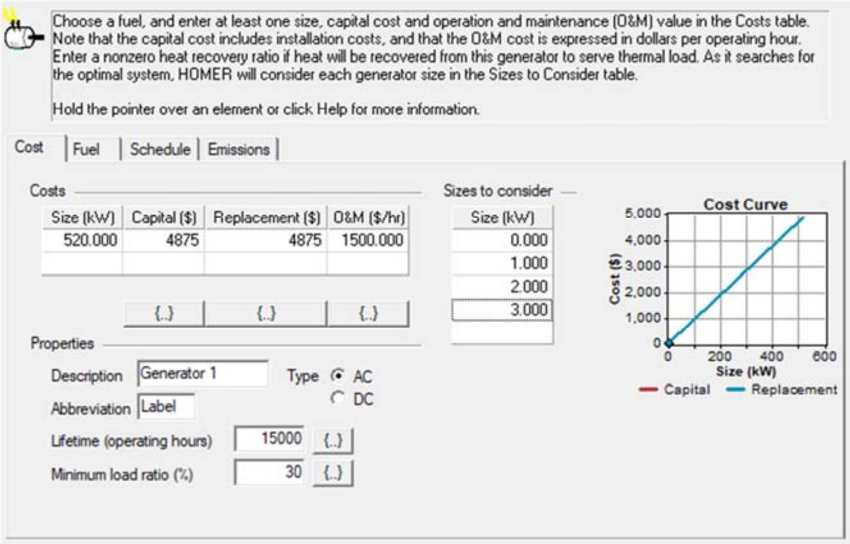

Figure 4. *Diesel Generator input.*

2.2. Selection of Materials

2.2.1. Component of the Power Generation System

Depending on the project location, a hybrid power system was chosen to fit in for the lost hour of no electricity as backup. The selected system consists of PV module and Diesel generator. Solar energy is most abundant green energy supply while the diesel generator was taken to confirm continuous supply of power. Hence, the components of the alternative power system were:

1. Solar photovoltaic system.
2. Diesel Generator.
3. Storage device.
4. Converter
5. Charge controller

2.2.2. Complete Model of the Power Generation System

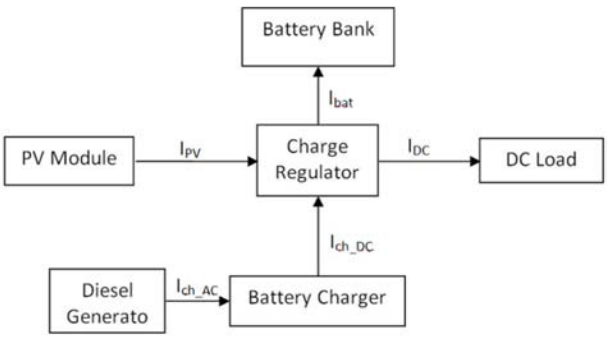

Figure 5. *Schematic diagram of the hybrid system (Ani, 2013).*

The Figure 5 shown below represent a complete model of the hybrid system consisting of a solar PV module and a diesel generator. As the generating schemes contributing to the hybrid operation, storage device and converter for storing and conversion of power produced from the solar panel.

2.2.3. Hybrid Energy System Configuration

The hybrid system model is the core of the simulation. Apart from correct pricing and optimization, the quality and accuracy of the model and its implementation in the algorithm, greatly determines the usefulness of the simulation results. Figure 5 shows the schematic diagram of the hybrid system. Embedded power generation is defined as the interconnection of several distributed generators (PV panels and diesel generator) and a set of batteries. In this project, a hybrid energy system is based on a generalized three-bus configuration. The three buses are a direct current (DC) bus, an alternate current (AC) bus, and a load bus. Technologies that generate DC current– PV and battery – are connected to the DC bus (VDC). Technologies that generate AC current, i.e. diesel generators, are connected to the AC bus (VAC). Only AC appliances are used and are connected to the load bus (IAC). An inverter, or a DC-to-AC converter, is used to convert DC current (Iinv_DC) to AC current (Iinv_AC) (from the DC bus to serve the AC load). A battery charger is used to convert AC (Ich_AC) current from diesel generator to DC (Ich_DC) current to charge the battery. A charge regulator is used to control the charge and discharge current from the battery. To serve the load, electrical energy can be produced either directly from PV (IPV), diesel generator (Id), or indirectly from the battery (Ibat). The energy generated from all generating technologies (PV and diesel generator) can be directed to serve the load and charge the battery.

Below is the average of the electricity used for each day and showing the current supplied at a particular time and day.

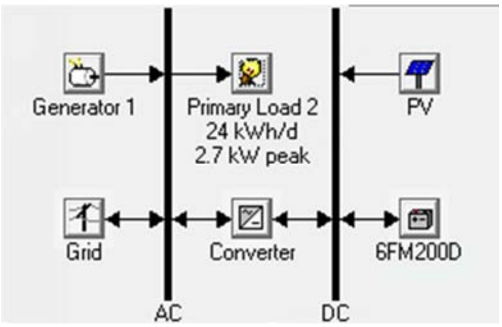

Figure 6. *Complete model of the hybrid system.*

Table 1. *Daily current supplied.*

days	current	voltage	power factor
1	567	220	0.8
2	925	220	0.8
3	626	220	0.8
4	786	220	0.8
5	557	220	0.8
6	834	220	0.8
7	292	220	0.8
8	620	220	0.8
9	926	220	0.8
10	556	220	0.8
11	211	220	0.8
12	1098	220	0.8
13	1164	220	0.8
14	1044	220	0.8
15	1046	220	0.8
16	1083	220	0.8
17	762	220	0.8
18	1074	220	0.8
19	1069	220	0.8
20	1044	220	0.8
21	1087	220	0.8
22	1082	220	0.8
23	868	220	0.8
24	1231	220	0.8
25	1080	220	0.8
26	1112	220	0.8
27	1184	220	0.8
28	1329	220	0.8
29	1257	220	0.8
30	2114	220	0.8
31	1756	220	0.8
total	30384	6820	

The obtained data from the power holding company in Nigeria BEDC was calculated and its average is then fully observed and noticed that during the hours of no electricity, the alternative hybrid power energy can fully function. Now to calculate for the load profile and to get the total backup power plan needed.

2.4. Load Profiles

P = power (in watts)
I = current (in Ampere)
V = voltage (in Volts)
Cos Ɵ = Power factor
P = IVCOSƟ
I = 134 (total average of current in Oke Eda community)
V = 220
Cos Ɵ = 0.8
So we have:
P = 134 X 220 X 0.8 = 23,584watts
Converted to kilowatt we have "23.584".
The hourly supply of electricity to the community is 23.584kilowatts.
The daily supply is 23.584 X 24hrs = 576kilowatts.

From the data obtained for BEDC, we observed that majorly electricity supply to this area is 4hrs daily, so we are to augment for 20hrs of power outage.

We have: 20hrs X 23.584 = 480kW
Considering tolerance
2 X 24Kw = 48Kw
Real power = 520Kw

The hybrid power system consisting of diesel generator, PV system, it is observed that the output needed from the diesel generator is 520kW and same goes for the PV system considering the tolerance.

2.5. Bill of Engineering Measurement and Evaluation

Cost Analysis

In Ondo State, the electrical distribution company charges residential at ₦31.26 per kilowatt for one hour (kWh). The kilowatt supplied to this community is 23.584 kW.

3. Results

At the end of this design, the output of the project is to augment for the 20 hours' electricity supply in the case of study (Oke Eda, Akure Ondo state) with the help of Homer software. The best backup alternative system suitable for the area is PV (photovoltaic system) shown in Figure 7.

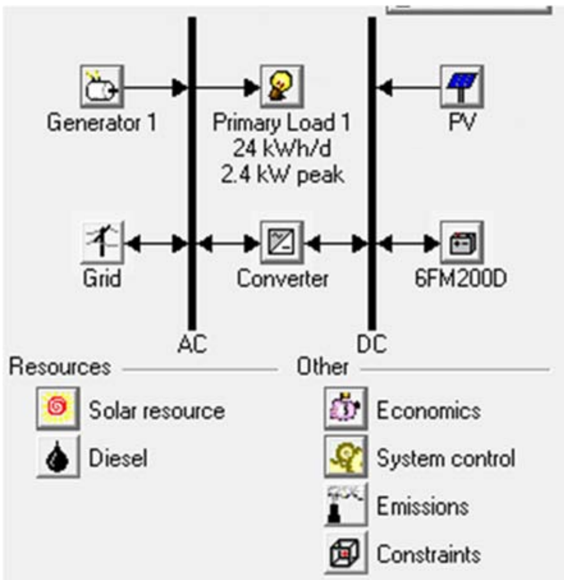

Figure 7. *Overall hybrid connection to grid.*

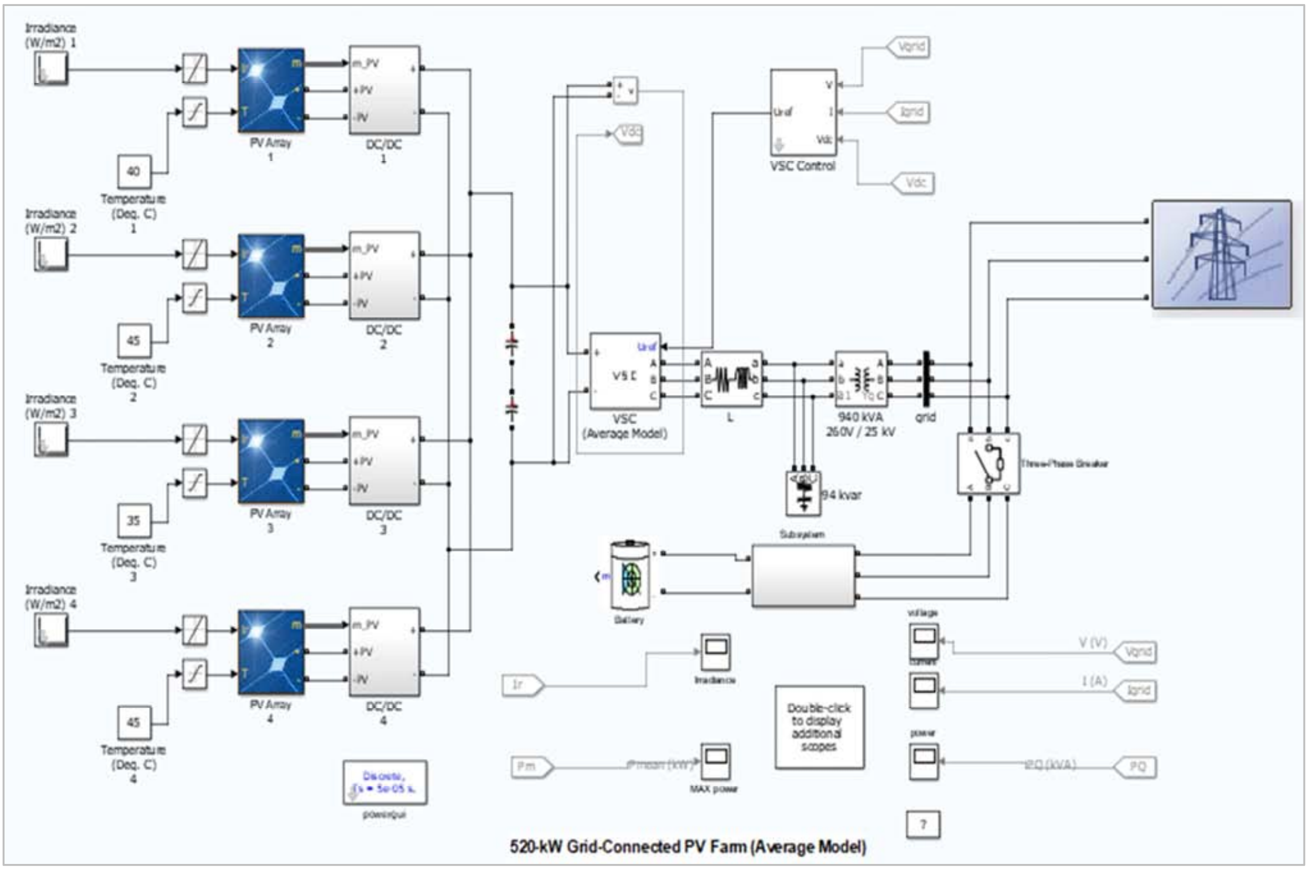

Figure 8. *Matlab model of the solar connection and transmission.*

Optimization Results

In optimizing for the best option of hybrid renewable energy system. With the data evaluation obtain above. The optimization result from HOMER Analysis as shown in Figure 8.

PV (kW)	Label (kW)	6FM200D	Conv. (kW)	Grid (kW)	Initial Capital	Operating Cost ($/yr)	Total NPC	COE ($/kWh)	Ren. Frac.	Diesel (L)	Label (hrs)
10			1	1000	$ 10,549	6,820	$ 97,733	0.873	0.73		

PV (kW)	Label (kW)	6FM200D	Conv. (kW)	Grid (kW)	Initial Capital	Operating Cost ($/yr)	Total NPC	COE ($/kWh)	Ren. Frac.	Diesel (L)	Label (hrs)
150			1	1000	$ 143,468	11,073	$ 285,015	2.545	0.98		
150	1		1	1000	$ 143,478	11,073	$ 285,023	2.545	0.98		0
150		300	1	1000	$ 886,268	63,868	$ 1,702,714	15.205	0.98		
150	1	300	1	1000	$ 886,278	63,868	$ 1,702,721	15.205	0.98		0

Figure 9. *Optimization Result from Homer.*

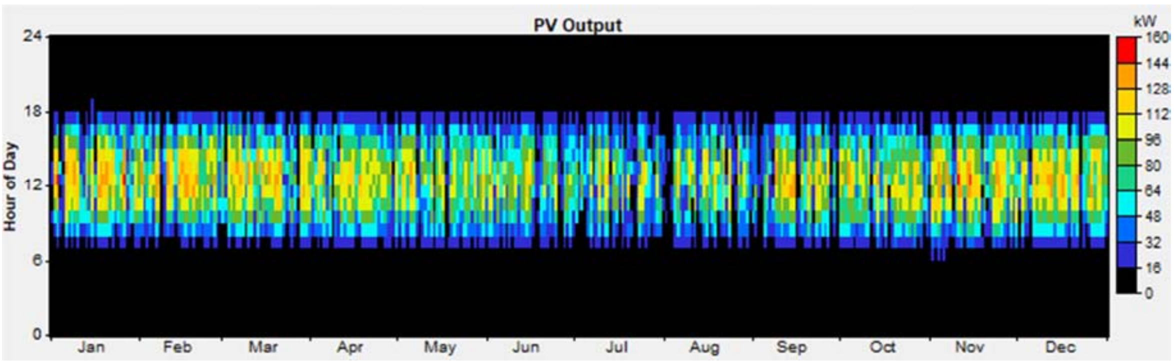

Figure 10. *Working hours of the PV.*

Pollutant	Emissions (kg/yr)
Carbon dioxide	2,759
Carbon monoxide	0
Unburned hydrocarbons	0
Particulate matter	0
Sulfur dioxide	12
Nitrogen oxides	5.85

Figure 11. *Emission output.*

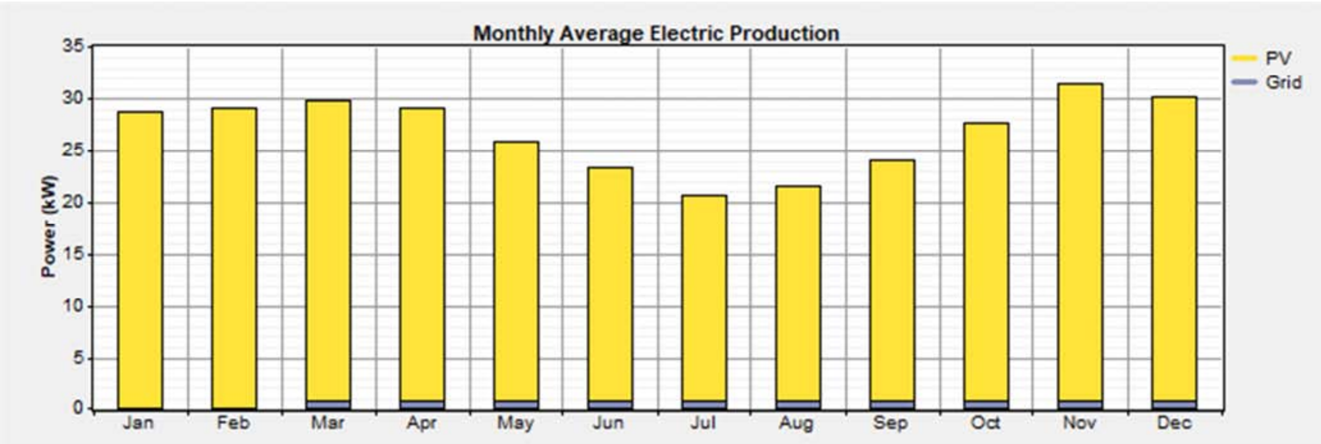

Figure 12. *Monthly average of electrical production.*

The irradiance of the in which the sun shines, connected to the filter to give exact numbers of solar panels, since the panel are set to different temperatures.

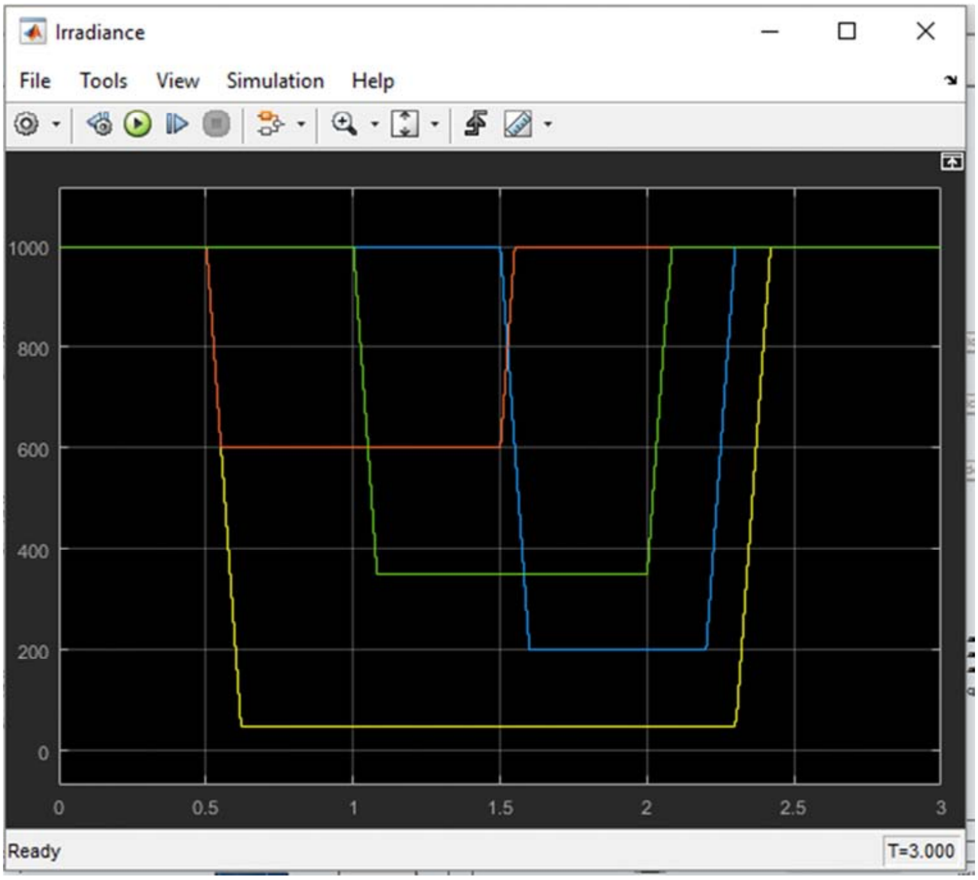

Figure 13. *Showing the irradiance.*

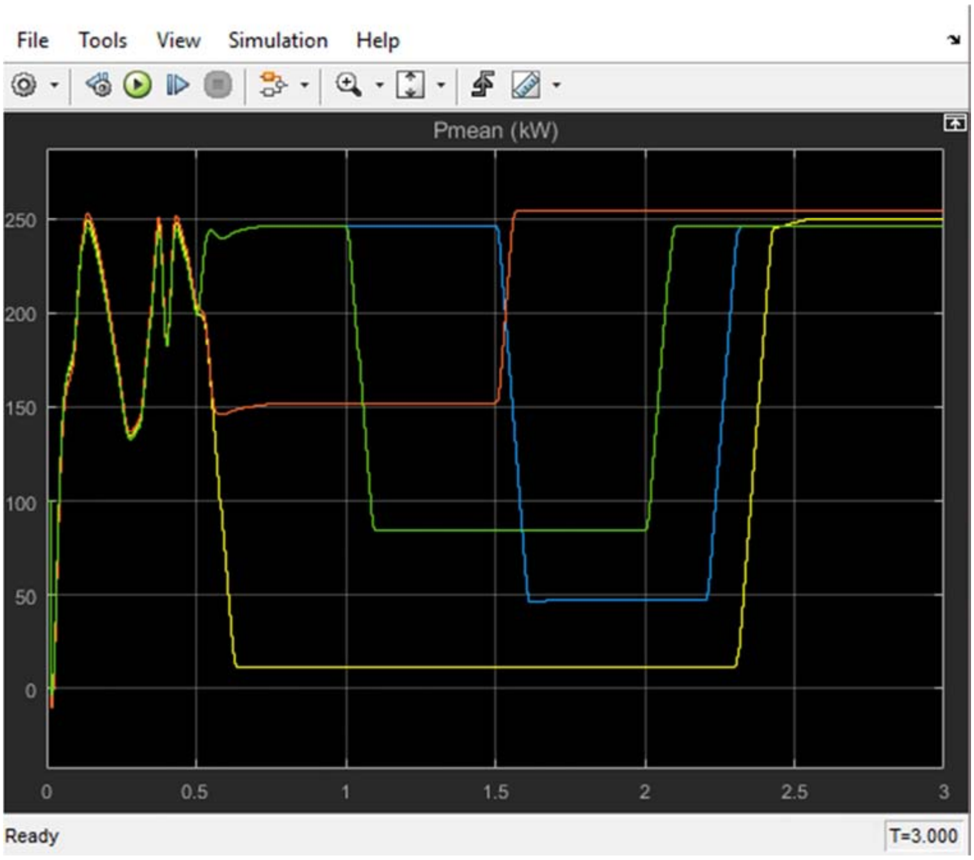

Figure 14. *Max power.*

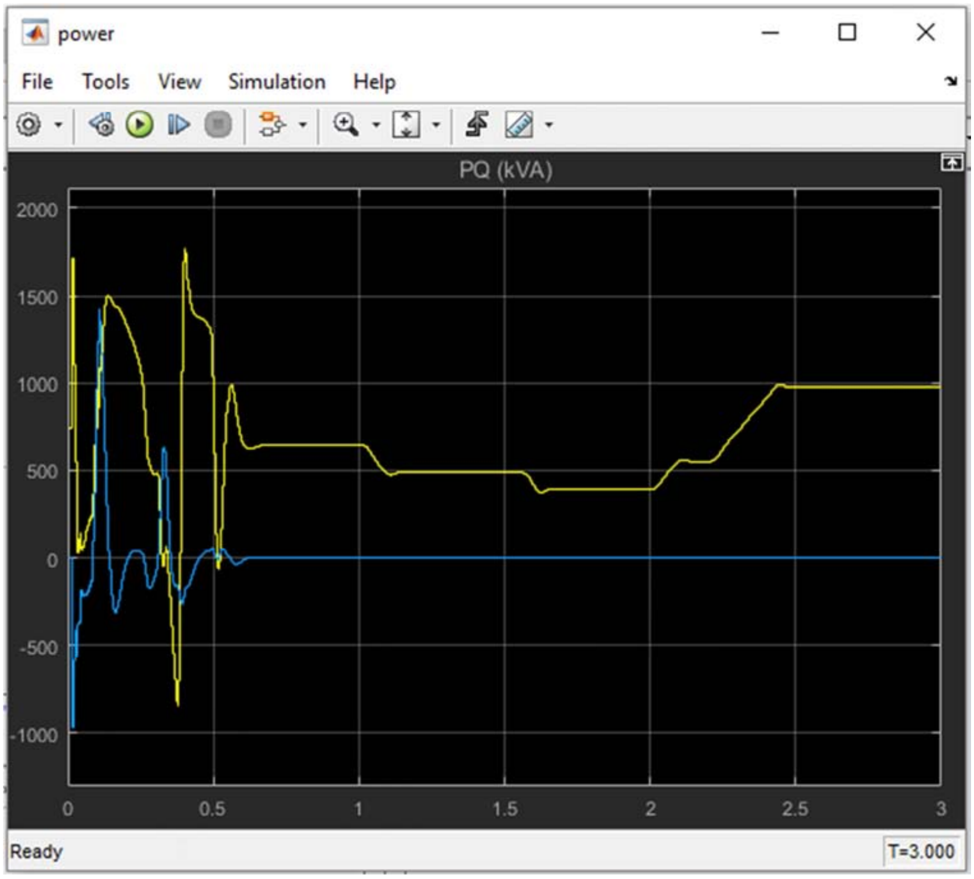

Figure 15. *Generated max power.*

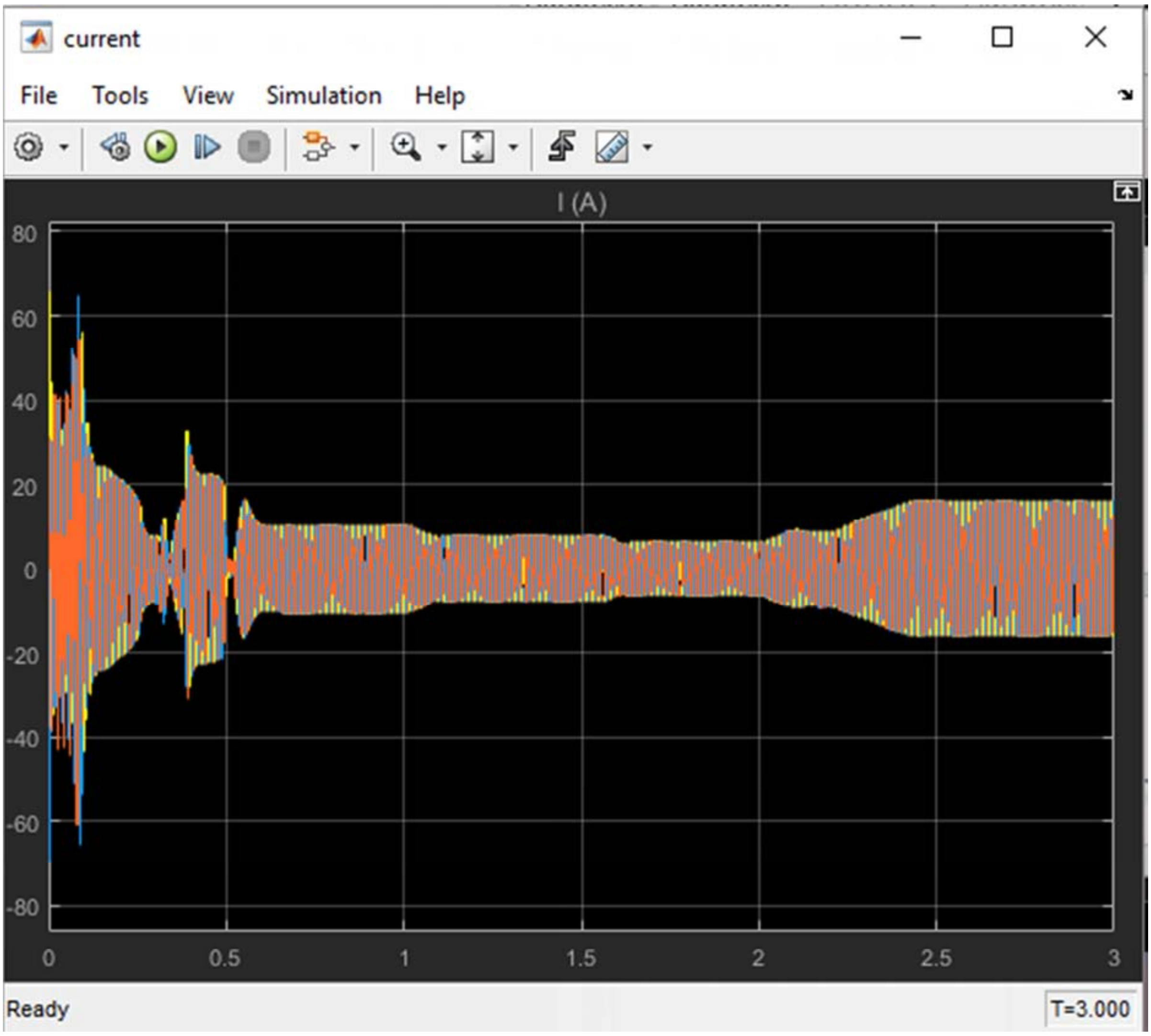

Figure 16. *Power, voltage and current electricity output.*

4. Discussions

Irradiance (the rate which the sunshine, it is connected to the filter to give the exact irradiance of the solar panel. Since the temperature varies so the values are set at different temperature as 40^0, 45^0, 35^0, 45^0 respectively. The temperature also has a filter to give us the exact temperature of the PV array. A DC/DC booster is connected to the PV arrays in order to give us the energy generated from PV. The booster is connected together on a bus (wire) then to an inverter to connect to an inductive resistor. A 52KVA is connected to test the power generated. From the inductive resistor, it is connected to a 260KVA transformer, so from the transformer to a converter to the distribution grid for proper usage. Figure 9 shows the optimization result when all component is link and simulated together in Homer and reveals the working hours of the PV system as shown in Figure 10.

The emission and pollution generated by the renewable energy system is shown in Figure 11, and giving a steady production of electricity through various month as shown in Figure 12, the model simulated on the MATLAB software and its output in which various electricity power peak is observed as shown in Figure 13 temperature settings Figure 14, generated max power Figure 15, and Figure 16 the power, voltage and current stating the electricity output when power to the community.

5. Conclusion and Recommendation

5.1. Conclusion

The optimization of a hybrid system for powering whole of Oke eda residence with 520 kW has been simulated using HOMER software. The obtained results indicate that the best total Net Percent Cost (NPC) can be achieved by using 350 batteries when the size of the used converter is 12kW, the diesel generator of 520kW and with 5.931l/h, and 0.453kW PV size. On the other hand, standalone system scheme for powering Oke eda requires 0.450kW PV size, 300 batteries and a converter of 9 kW. The generator system needs 400kW with 36.04l/h of diesel.

5.2. Recommendation

The following are hereby recommended:

1. The project can be expanded further by designing a suitable renewable energy equipment that can be correctly better in terms of the terrain and cost effectiveness which can augment for 24 hour's power outage in this community (Oke Eda, Akure).
2. The project can be implemented by the residents in this community so enjoy steady and stable power supply which is economical which can as well give Benin Electricity Distribution Company Plc. (BEDC) an opportunity to distribute utility to other communities and increase hourly supply so as to improve the standard of living economically.

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