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# SIMULATION OF SOLAR ENERGY SYSTEM USING HOMER PRO IN SPECIFIC LOCATION IN JODHPUR

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## ABSTRACT

Solar energy is responsible for all the weather systemThe sun provides us solar energy .There are a lot of ways from which we can use the energy coming from sun. The two main ways which are commonly usedare Solar thermal capture method and Photovoltaic method. When at smaller-scale we produce electricity from solar we prefer Photovoltaic method and for larger scale we use solar thermal capture method. Solar is one of the cheapest and very efficient source of power in the world, and the use of applications is increasing day-by-day and will continue to increase in upcoming years. Main merits of solar system is that it is a clean,cheap, effective renewable energy source. But sometimes due to bad weather or any reason we don't get enough energy so simulation is done by using HOMER Software. The optimal solution of the solar system is which is linked to the grid is obtained through simulation.

*Keywords*:**Simulation, merits, optimal solution**.

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## 1. INTRODUCTION

Energy is critical to the economic growth and social development of anycountry. Indigenous energy resources ought to be developed to the optimumlevel to reduce dependence on foreign fuels, subject to resolving the economic,environmental and social constraints. This led to an increase in research and development as well as investments in the renewable energy industry to meet the energy demand and to minimise the dependencyon fossil fuels. Wind and solar energy are becoming very popular due to having these factors such as abundance, availability and ease of harnessing the energy for electricalpower generation. It concentrateon the integrated hybrid renewableenergy system which consist of wind and solar energies. Many components of Libyahave the potential for the growth of the economic power generation, thus maps locations were used to identify whether both wind and solar potentials arehigh. The main point of this paper is to describe and evaluate a wind-solarhybrid power generation system for a selected location. Grid-tied power generationsystems use solar PV or wind turbines to produce electricityand supply the load by connecting to the grid.

In this study, the HOMER(Hybrid Optimization Model for Electric Renewable) computer modelling software was used to model the power system, its physical behaviour and itslife cycle cost. Computer modelling software was used to model the powersystem, its physical behaviour and its life cycle cost. The hybrid power systemwas designed for a building at the University of Al-Marj (MARJU). The use of simulations, the installation of ten 100-kW wind turbines and150-KW solar PV was evaluated. The main resources of energy which is used in Libya are oil and gas which produce highemissions of carbon dioxides and other gases, which harm the environment. The modern world emphasizesusing the renewable energy to generate electricity because of its low damage to the nature.

## II.WAYS TO USE SOLAR ENERGY

There are different ways to use solar energy. It is very cheap and clean renewable energy source since there is no waste product remains. The two main ways used are:

- Photovoltaic solar energy
- Solar thermal

In Photovoltaic (PV) solar system, sunlight is converted into electricity by using solar panels, and further can be used for different purposes, also gets stored in solar battery, or sent to electric grid.The conversion of the energy is done with the process called photovoltaic effect. In this effect the sunlight coming to the earth strikes a semiconductor material and releases the loosely bonded electrons and these released electrons moves andgenerate an electric current which can be captured with wires. The generated current is called direct current(DC) electricity and should be converted into alternating current using a solar inverter. This conversion is essential since our household appliances use AC current.

Another way to use the solar energy is solar thermal capture method in this we directly capture the incoming rays and use the heat of those rays in different ways. This way has a wider range of its use than the first one, but this way is not convenient for using at small scale than photovoltaic, since sometimes we can't get enough energy to make our device works so it is efficient for large scale production of solar energy.

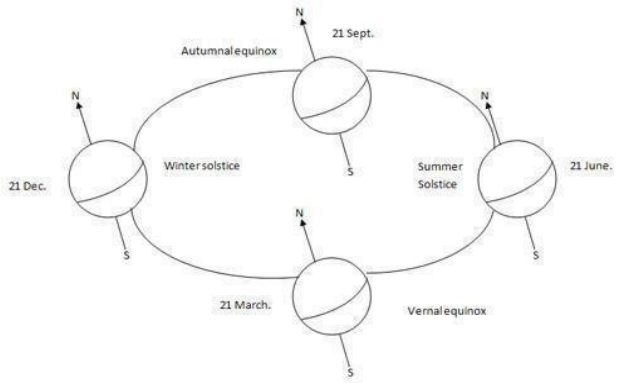



Fig.1Thermal Capturing Method

## III. SOLAR SYSTEM CONNECTED TO GRID

A grid-connected photovoltaic system or grid-connected PV system Is a process to generate electricity and the whole setup is connected to grid hence called grid-connected photovoltaic system. This whole setup consists of, a power conditioning unit, single or several inverters(to convert DC into AC), solar panel and grid connection equipment. Its range can varies from small residential and commercial roof up to the large production scale solar power stations. In the whole connections we don't use integrated battery solution, since they are quite costlyThese rooftop grid systems have capacity more than 10KW, and can fulfil the requirements of many at a time. They can also feedback the excess power to the grid and the excess power can be used by others the feedback is done through by a meter which used to monitor the power transferred. Hence it is convenient for the consumers because he have to pay for only electricity that is consumed but not for the electricity that is generated as the meter is feeding back the excess electricity to the grid. The generated DC current is converted into AC current through solar inverter. Inverter sits between the solar array and grid and also monitors the power transferred. Any failure in the wires or in transmission of power is also can be detected by inverter. An inverter connecting to malfunctioning power lines is automatically disconnected in order to safety purposes.

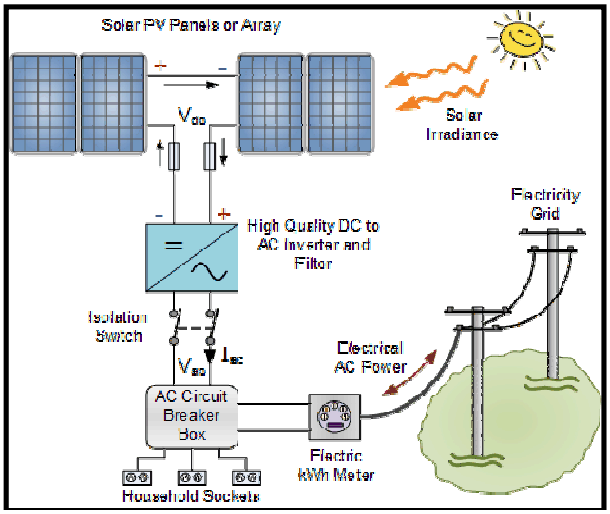



Fig.2 Grid Connected Solar System

## IV. SIMULATION SOFTWARE

HOMER stands for Hybrid Optimization Model for Electrical Renewable is a software application which is free of cost and developed by the National Renewable Energy Laboratory in the United States. This application is used to evaluate and to design financially and technically the systems for their

optimal usage. It connects our device to all the available energy resources to make the optimal use and in order to not let the energy be wasted t any cost. HOMER was first developed in 1993 for the purpose of their use in DOE(department of energy) but now use all over to simulate the energy sources.

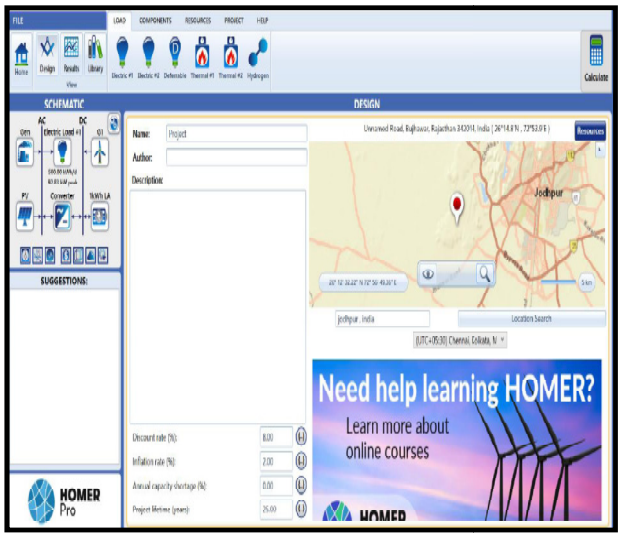



Fig.3Homer Pro

## V. SIMULATION AND RESULT

HOMER simulates the operation of a system by creating energy balance calculations each and every step (interval) of the year. For each time step, HOMER compares the electrical and thermal demand with the time step to the energy that the system will offer in the time step, and calculates the flow of energy to and from every part of the system. For systems that embody batteries or fuel-powered generators, HOMER additionally decides in anytime step the way to operate the generators and whether to charge or discharge the batteries.

HOMER performs these energy balance calculations for every system configuration that you just wish to think about. It then determines whether a configuration is possible, (i.e. it will meet the electrical demand beneath the conditions that you just specify), and estimates the value of putting in and operational the system over the period of the project. The system price calculations account for prices like capital, replacement, operation and maintenance, fuel, and interest.

HOMER professional has 2 improvement algorithms. The first grid search formula simulates all the possible system configurations outlined by the Search area. The new HOMER Optimizer uses a proprietary derivative-free formula to look for the least-costly system. HOMER then displays an inventory of configurations, sorted by web gift price (sometimes referred to as life-cycle cost), that you will use to check system style choices.

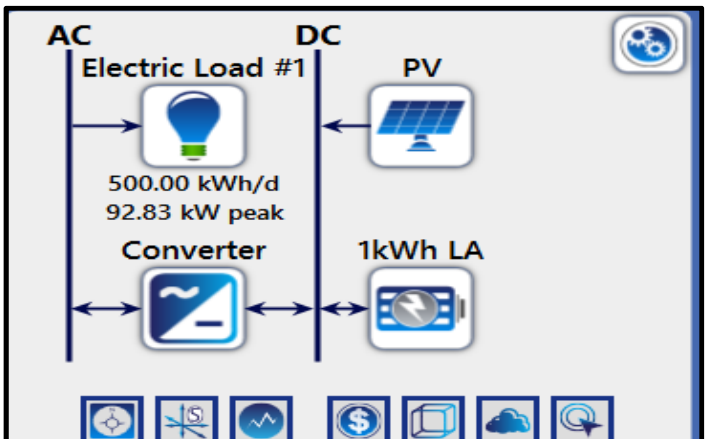



Fig.4Simulation of PV system

Table- 1 Optimization Table

| Architecture | | | | |
|---|---|---|---|---|
| | | G1 | 1kWh LA | Converter (kW) |
| | | 329 | 6,576 | 162 |

| System | | G1 | | |
|---|---|---|---|---|
| Ren Frac (%) | Total Fuel (L/yr) | Capital Cost ($) | Production (kWh/yr) | O&M Cost ($) |
| 100 | 0 | 2,303,000 | 554,161 | 23,030 |

### A. *Load Profile*

The load consumption data of the commercial building for a day. The readings are recorded in a periodic manner. As a case study, the average energy consumption of the

commercial classroom complex was scaled to 500 kWh/d with peak consumption of 270.09 kW in the present study.

### B. *Solar Radiation Data*

The resources for the selected renewable sources were collected using the Homer resources tool for any location. The collected data is used to estimate the performance of various components used in the designed hybrid Power system to fulfil the load requirements of a commercial classroom complex. As shown in Fig.2 the average solar radiation ranges from 4.988 kWh/m2 /d to 6.609kWh/m2/d over a year. Fig.3 depicts the monthly average wind speed ranging from 3.660 to 4.680 (m2/s).

### C. *PV panels*

The resources for the selected renewable sources were collected using the Homer resources tool for any location. The collected data is used to estimate the performance of various components used in the designed hybrid Power system to fulfil the load requirements of a commercial classroom complex. As shown in Fig.2 the average solar radiation ranges from 4.988 kWh/m2 /d to 6.609kWh/m2/d over a year. Fig.3 depicts the monthly average wind speed ranging from 3.660 to 4.680 (m2/s).

Table-2: Output of PV

| Quantity | Value | Units |
|---|---|---|
| Minimum Output | 0 | kW |
| Maximum Output | 90.6 | kW |
| PV Penetration | 90.8 | % |
| Hours of Operation | 4,385 | hrs/yr |
| Levelized Cost | 0.112 | $/kWh |

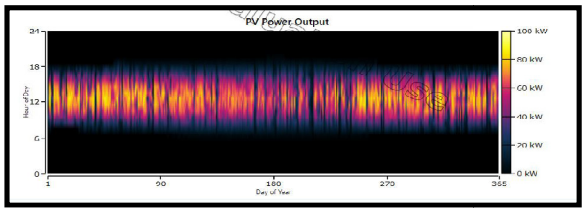



Fig.5 PV Power Output


Fig.6Cost Summary Outputs

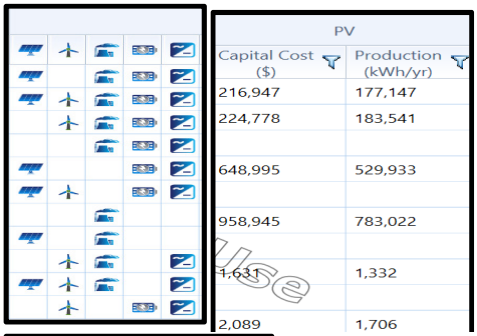
### D. *Changes In The Parameter of Solar Panel*

### E.

The parameter which we are changing in the solar panel is derating factor (%),

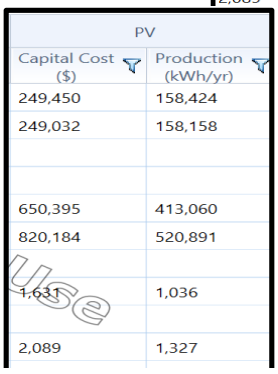
The deratefactor for soiling accounts for dirt, snow, or other foreign matter on the front surface of the PV module that reduces the amount of solar **radiation** reaching the solar cells of the PV module

Table-3OptimizationResult



| PV | |
|---|---|
| Capital Cost ($) | Production (kWh/yr) |
| 216,947 | 177,147 |
| 224,778 | 183,541 |
| 648,995 | 529,933 |
| 958,945 | 783,022 |
| 1,631 | 1,332 |
| 2,089 | 1,706 |





| PV | |
|---|---|
| Capital Cost ($) | Production (kWh/yr) |
| 249,450 | 158,424 |
| 249,032 | 158,158 |
| 650,395 | 413,060 |
| 820,184 | 520,891 |
| 1,631 | 1,036 |
| 2,089 | 1,327 |

As we known that , the efficiency of photovoltaic cells is not high as required. Efficiency of PV cells can be improved by selecting the locations which consisting these factors such as high solar irradiation, sunshine duration, mild temperature, low level air pollution and lowdust concentration, which is desire the most.

Some environmental parameters called as derating factors ,which decrease efficiencies of PV such as cloud, high temperature, high dust concentration, shadow, snow, humidity etc.

## VI.CONCLUSION

The application of HOMER pro software is for designing a micro-grid system using renewable energy sources and non-renewable energy sources for meeting the power requirements of unreached communities. The homersoftware is used to optimize the designed system and to increase the efficiency of the micro grid system. From the simulation and optimization result of the designed Hybrid(wind ,solar and other) micro-grid system, it can be concluded that, the hybrid option of wind turbine, solar PV and Diesel generator is very cost effective and reliable system than the other possible hybrid combos of solar PV-Generator, wind turbine-generator or generator operating independently to satisfy the power demand of the rural communities.

Micro grid system is for the hybrid Power system is designed using Homer Pro software.By initializing the Input load data, Sizing of system, Cost analysis and the respective output efficiency and the detailed output data is collected from the simulation tool. The following are the components of the designed micro grid: a flat plate PV wind turbine, Lithium Ion battery and Inverter to convert the DC power to AC load demand. Even though the COE is higher for hybrid system than the Grid, Due to the excess energy produced which give back to grid get payback from government which benefits by reducing the overall cost.

## VII. ACKNOWLEDGEMENT

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