Optimum Planning of Hybrid Renewable Energy System Using HOMER

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Abstract- *World energy consumption is rising due to population growth and increasing industrialization. Traditional energy resources cannot meet these requirements with notice to their challenges, e.g., greenhouse gas emission and high lifecycle costs. Renewable energy resources are the appropriate alternatives for traditional resources to meet the increasing energy consumption, especially in electricity sector. Integration of renewable energy resources with traditional fossil-based resources besides storages creates Hybrid Renewable Energy Systems (HRESs). To access minimum investment and operation costs and also meet the technical and emission constraints, optimal size of HRES's equipment should be determined. One of the most powerful tools for this purpose is Hybrid Optimization Model for Electric Renewable (HOMER) software that was developed by National Renewable Energy Laboratory (NREL), United States. This software has widely been used by many researchers around the world. In this paper a review of the state-of-the-art of researches, which use HOMER for optimal planning of HRES, is presented.*

Keywords- Solar PV cells, Pongamia seed oil, Micro Hydro system, HOMER stimulation, Standalone HYBRID renewable energy system.

I. INTRODUCTION

Many remote location don't have access to electricity.Remote location has renewable energy sources such as solar, bio-fuel, hydro, wind etc. Current technology available needs to be integrated to meet the load requirements independently. Innovative concepts of connecting more than one renewable energy sources to make hybrid system needs to be envisaged. Controllers and system design for hybrid systems under various load conditions has to be designed. Performance study of the system under varying load conditions and varying amount of energy available from various sources has to be investigated and optimised. The current project involves stimulating of solar-wind-hydro-bio fuel hybrid system and suggesting an optimum model of hybrid system needed to tap RE sources in REVA University. The problem with the renewable energy resource is that the process involved to get them is expensive and lack of ideas to obtain them. In order to make the renewable resource as the stand alone system and efficient resource of energy its necessary to make some hybrid changes and grouping technology. HRES is a combination of renewable, traditional energy resources, and energy storages to meet the load locally in both grid connected and standalone modes. HRESs are used in standalone mode in remote and rural areas.

In this mode, due to uncertain nature of renewable resources, traditional energy resources and energy storages can be used as the back-up resources for them.

Therefore, HRESs have more reliability than only renewable energy systems in standalone mode. HRESs are used in grid connected mode in some places such as universities, hospitals, factories, and town. In this mode, when the grid electricity prices are low, the HRES meets the load from the grid and charges the energy storages with renewable resources. Then, during the periods in which the grid electricity prices are high, the HRES meets the load with its resources and sells the extra energy to the grid. In this manner, energy storages are discharged to meet the load or to sell energy to the grid. In this mode HRESs have more economical than only renewable energy systems. Therefore, HRES provides some advantages, e.g., increasing penetration of renew- able energy resources, decreasing Cost of Energy (CoE), reduction of greenhouse gas emission, and providing access to electricity for people in remote and rural areas. These advantages meet all three criteria of Sustainable Development (SD) including economic, environmental, and social aspects.

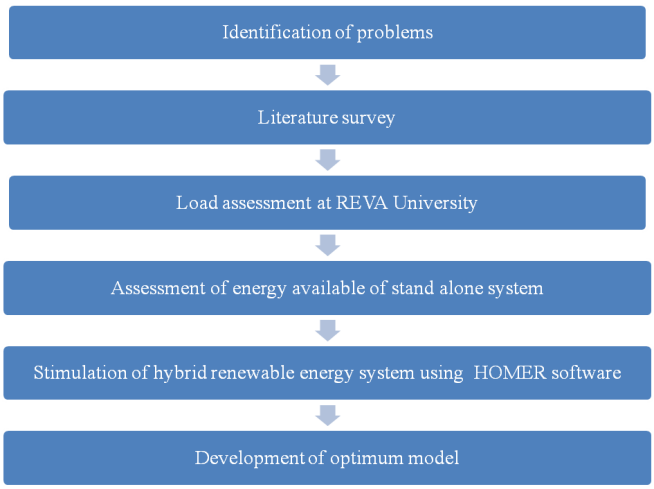
HOMER software is a powerful tool for designing and planning of HRES in order to determine optimal size of its components through carrying out the techno-economic analysis. Many resources such as WT, PV array, fuel cells, small hydropower, biomass, converter, batteries, and conventional generators are modelled in HOMER. HOMER also considers HRES in grid- connected and stand-alone modes. Fig. 1 shows the typical configuration of HRES designed in HOMER. Required input data for simulation with

HOMER and also a comprehensive frame work to show how optimal sizes of HRES's equipment is determined .

II. LITERATURE REVIEW

1. M.K.Deshmukh, et.al (1). The paper describes the methodologies to model HRES components, HRES designs & their evaluation. The paper concluded that HRES in existing power supply network in depth study is to be carried out to check feasibility and technical competitiveness. Penetration levels on network basis are the future of hybrid power system in power generation capacity of the country, as outlined in this paper.
2. Anurag Chauhan, et.al (2). They found out that uneconomical extension of the grid has lead to generation of electric power at the end user facility and has been provided to cost efficient. They concluded by saying Hybrid DC-AC coupled scheme is efficient and least cost scheme for IRES. Among various storage technologies sodium-sulphur and vanadium radar batteries are suitable storage option to make energy balance in integrated system.
3. Robinson.P, et.al (3). Energy demand always lags energy supply in developing countries, which results in energy crisis. The solution of this problem is utilization of renewable energy. The project indeed a unique system for optimum utilization of energy from different RE based systems. The project aims at the integration of renewable energy system at NIE-CREST. It has been achieved by integrating the solar photovoltaic systems and wind energy systems at NIE-CREST.
4. Omar Hafez, et.al (4). With the price of oil reaching its highest levels, renewable energy has become an important alternative as a power provider in rural system. Homer is used in the studies reported in this paper. This paper presents the optimal design and comparative studies for a diesel only, a fully RE based, a diesel renewable mixed.

III. METHODOLOGY



The main aim in the process of creating a hybrid renewable energy is to first assess the load in the particular block. Then the project carried out for power consumption parameters to calculate the energy consumed for a limited period of time. The account of the electricity used is with respective to number of hours the appliances run.

After that the graphs were plotted to find out the peak hours when the power is consumed to the maximum level.

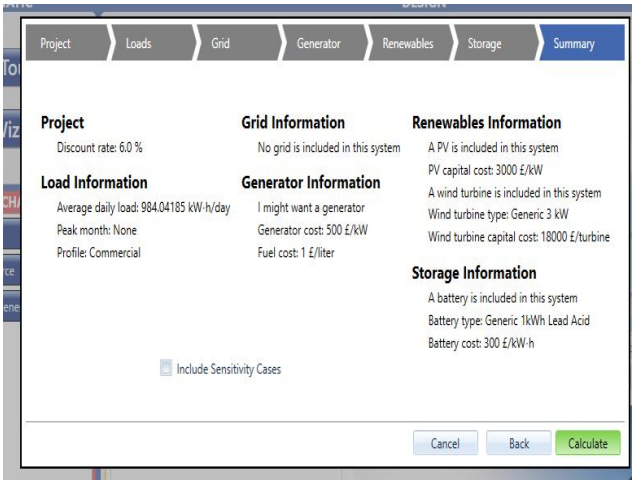
IV. DATA TABLES AND RESULTS

Solar radiation energy in a year with respect to all the months

Month	kWh/m²/d
January	5.519
February	6.397
March	6.876
April	6.656
May	5.885
June	4.59
July	4.36
August	4.46
September	5.054
October	4.907
November	4.883
December	5.130

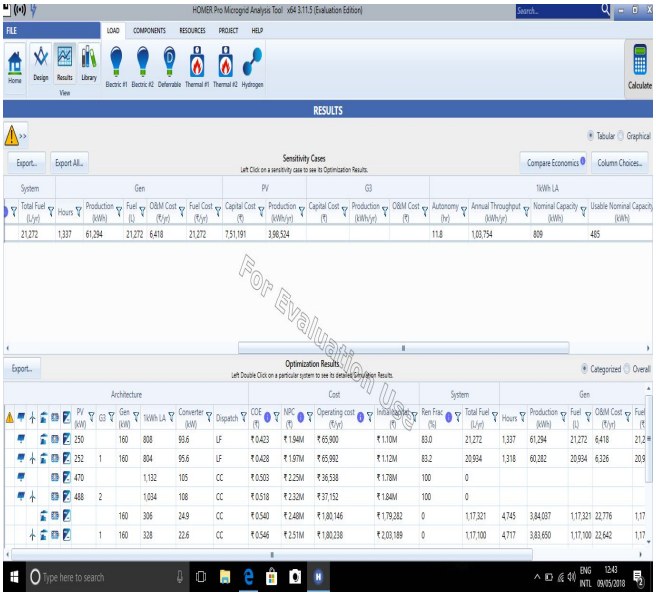
Month	Solar radiation (Kwh/m²/d)	Energy available from Solar PV-systems(kW-hrs/day)
January	5.519	1251.02
February	6.397	1450.83
March	6.876	1559.47
April	6.656	1509.58
May	5.885	1334.72
June	4.59	1041.01
July	4.364	989.755
August	4.46	1011.52
September	5.054	1146.24
October	4.907	1112.91
November	4.883	1229.76
December	5.13	1163.48
Annual average		1233.358

• HOMER software stimulation summary



The stimulation of HOMER software has been performed as per the daily power consumption in VISHWESVARIAH block. Load information of approx. 985 kilowatts was fed in the peak month of July and the profile is commercial. As per the generator information, HOMER automatically selected we might need a generator of optimum cost 45000 per kilowatt. The renewable energy available for grid are taken as PV solar energy and Wind energy of 1.35 lakhs per kilowatt and 6 lakh rupees per turbine, which would be the initial cost of setting up the system. Storage information has been considered as per the default setting on the software.

• HOMER stimulation results



As per the provided information about the profile, grid type, power consumption an optimum model on HOMER software was formed .This optimum model has the stimulated results of different type of cost, production, capacity, storage etc...This type of costs displayed on the screen like Cost of energy (COE), Net present cost (NPC), Operating cost (OC), Initial capital cost (ICC), (operating and maintaining cost), Fuel cost, Production cost. Solar PV available production possibilities region in the HOMER are displayed. Production of 3, 98,524 kWh/year is available in region which acts as a standalone system for the block. Dividing the power consumed per day in the block i.e.(398524kWh)/ (984 kWh) =405.004 days of unlimited power. This means the only solar energy can run till 365 days and more than that as the renewable energy system. Each and every cost required is displayed in the HOMER page for optimum stimulation of the calculated results. As the solar PV and Wind energy system calculation is not possible through manual method, so we used HOMER software foe their stimulation.