Homer Optimization Based Solar PV; Wind Energy and Diesel Generator Based Hybrid System.

Ajay Sharma, Anand Singh, Manish Khemariya

Abstract: Through this Paper we are introducing a new Design Idea Of Optimized PV-Solar And Wind Hybrid Energy System , Mobile Base Station Over Conventional Diesel Generator For A Particular Site In village imaliya (bhanpur) . The aim of this paper to generate electricity and transferring it mobile tower with extra electricity begging transfer to village . For this particular hybrid system ,we are taking the meteorological data of Solar Insolation and hourly wind speed, for village imaliya (bhanpur) (Longitude 77o.41'and Latitude 23o.29') and through the study of pattern of load consumption of mobile base station and we have designed a modeled for optimization of the hybrid energy system using HOMER software. The hybrid energy system is a combination of wind, solar, diesel generation and batteries. Hybrid Optimization Model for Electric Renewable (HOMER) software is used for the analysis of sizing and sensitivity, performed in order to obtain the most feasible configuration of a hybrid renewable energy system.

Index-Hybrid system,PV,Wind,DG.HOMER

I. INTRODUCTION

Obtaining reliable and cost effective power solutions for the worldwide expansion of telecommunications into rural and remote areas presents a very challenging problem. Grids are either not available or their extensions can be extremely costly in remote area. Although initial costs are low, powering these sites with generators require significant maintenance, high fuel consumption and delivery costs due to hike in fuel prices. A sustainable alternative to power remote base station sites is to use renewable energy sources. Recent research and development of Renewable energy sources. Have shown excellent potential as a form of contribution to conventional power generation systems. In order to meet sustained load demands of mobile base station during varying natural conditions, different energy sources and converters need to be integrated with each other for extended usage of alternative energy For Indian remote location, one of the most alternative solution . of renewable energy sources such as wind-solar Hybrid Energy System for mobile base station. The use of the stand-alone solar-wind with diesel backup system for the power supply of remote areas may give an economically attractive alternative for mobile telecom sector over the use of conventional diesel generators in near future. The gives the design idea of wind, solar photovoltaic hybrid energy system.

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Based on the energy consumption of mobile base station and the availability of renewable energy sources, it was decided to implement an innovative stand alone Hybrid Energy System combining small wind turbine-generator, solar photo-voltaic panels, battery storage, advance power electronic equipment and existing diesel generators. In the last few decades the world is experiencing higher prices of oil, which had caused several oil crises since early 70s. Also, the world is experiencing many environmental issues related to usage of fossil fuel. Communication technology is one of the fastest growing technologies during these days. The telecommunication companies are continuously challenged to provide uninterrupted services to rural and remote areas where there is no reliable electrical power supply available. Therefore, renewable energy systems are becoming increasingly popular in those industries to provide uninterruptible power to remote areas. Currently in most cases the telecommunication stations use diesel generators connected with backup batteries to provide power. As a result, telecommunication companies are now attempting to provide uninterruptible power by using renewable energy resources. Currently this system uses diesel generator and batteries for power generation and we are proposing to improve the efficiency and operational costs of this system by integrating renewable energy sources using a wind turbine and a Photovoltaic (PV). In this case wind and PV are considered as the main power sources for the system and diesel generator and a battery bank are also integrated as a backup power supply. The diesel generator is treated as a mechanism to provide long-term power storage and the battery is used as a backup for short-term power storage. Sizing the system has done by Homer then modeling has done in Simulink.

II. HOMER SIMULATION MODEL.

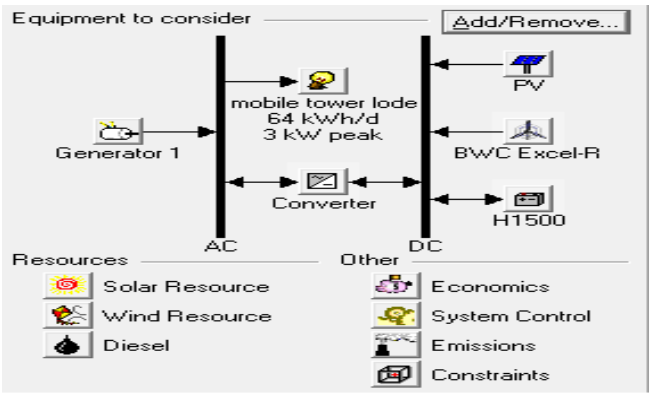


Fig.1 system implementation in Homer (PV-Photovoltaic, BWC Excel-R-Wind turbine, H1500-Battery, Generator 1-Diesel generator

III. SYSTEM SIZING

The Hybrid Energy System Sizing Is Done In Hybrid Optimization Model For Electrical Renewable (HOMER) Software And A System Implementation. The Proposed System Comprises Primary Renewable Sources (Wind/PV) Which Are Placed With A Standby Secondary Non-Renewable Sources (Diesel Generator/Batteries), And Converter Is Included In The System To Connect Between AC And DC Links. The HOMER software is used to determine the best optimal sizing and pre-feasibility study of the system. Sensitivity analysis is considered when designing the system.

A. Wind Turbine

Two wind turbines from Bergey Wind Power having the model BWC-Excel-R are used in this system. Each turbine has rated capacity of 7.5kW and provides DC. The Cost of one unit is considered to be, capital cost is estimated as $15000, replacement cost is estimated as $13000, and annual operation and maintenance cost is estimated as $15. the simulation program find an optimum solution, lifetime of a turbine is taken to be 15 years.the power curve in show in fig .2 and the wind resource show in fig.3.

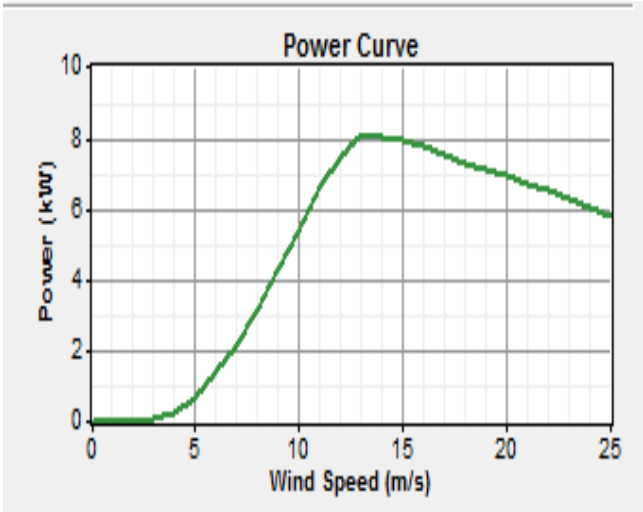


Fig . 2 Power curve

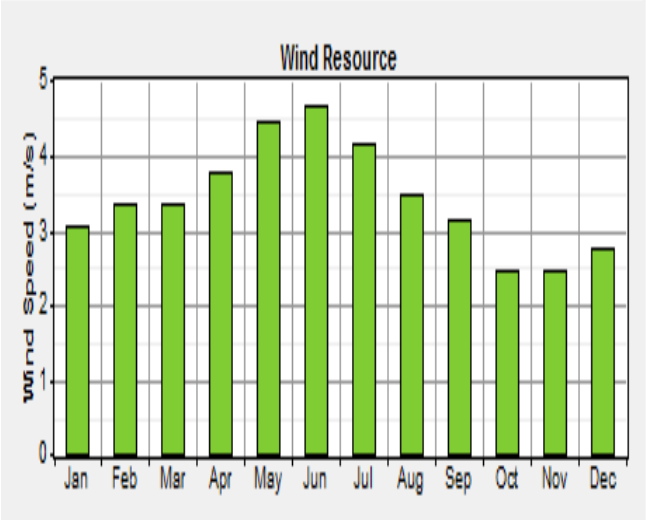


Fig. 3 Wind resource

B .Photovoltaic Array

Solar PV modules are connected in series parallel. When the sunrays strike the Solar PV panels, it produces electricity. A 1 kW solar energy system's installation, and replacement costs are taken approximate as $5000 and $3000, respectively. The lifetime of a PV is taken to be 20 years.

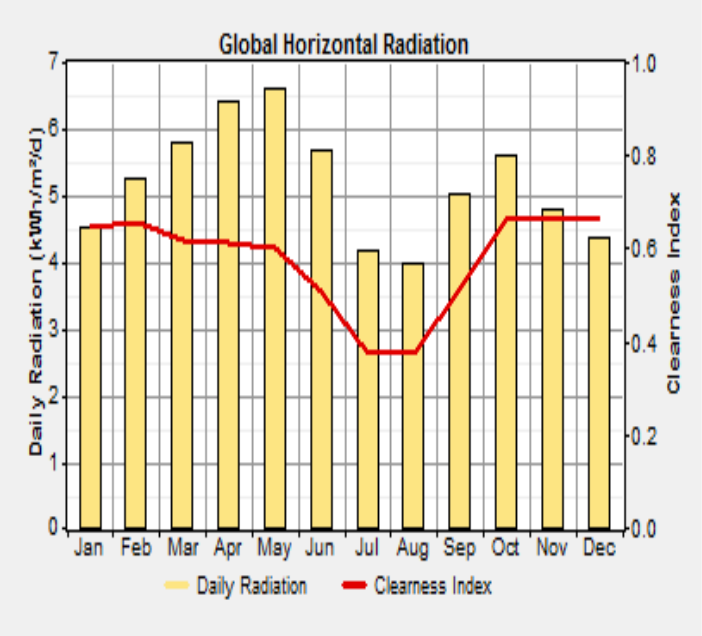


Fig. 4 Monthly solar radiation

C. Diesel Generator

The fuel consumption per year is approximate 1400 Litter for 1kW Diesel Generator. The 0.500 kW diesel generator capital cost, replacement cost, operation-maintenance cost are 200$, 150 $, 0.010$. The lifetime of a diesel generator operating hour 15000.

D. Battery

The battery type Hop-picker 12 Opzs 1500. Nominal space 2V ,1500 AH , 3KWH . These batteries are replaced every 10 years. The one battery initial capital cost, replacement coast, and maintenance and operation coast of $700, $500, and $5 respectively.

E. Power Converter

A converter is included in order to maintain the flow of energy between the AC and the DC bus.

The conventional load is DC type, but generated power from diesel generator is AC type. The size of the convertor that is used in this system is 3kW. The initial capital cost and replacement cost and operation-maintenance cost are $2000, $1500 and 20 respectively.

IV. SIMULATION RESULT

The Monthly Average Electric Production Of The System. Photovoltaic Production Is 37%, Diesel Generator Production Is 34%, And Wind Turbine Is 28%.The Monthly Average Electricity Production of Hybrid Energy System for mobile telephony base station.

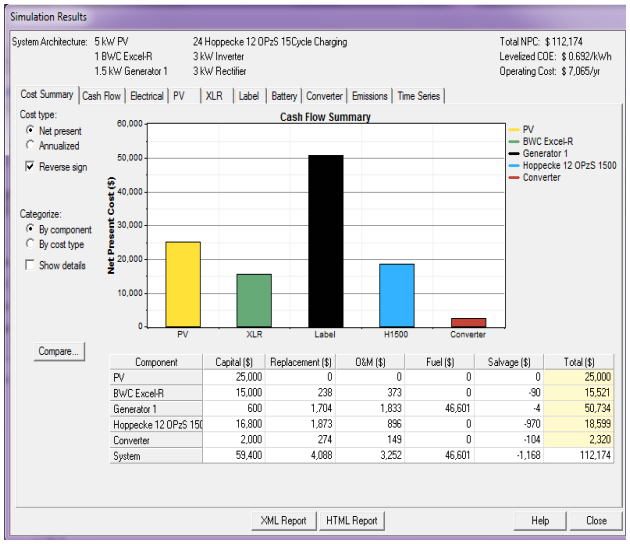


Fig. 5 Case flow summaries

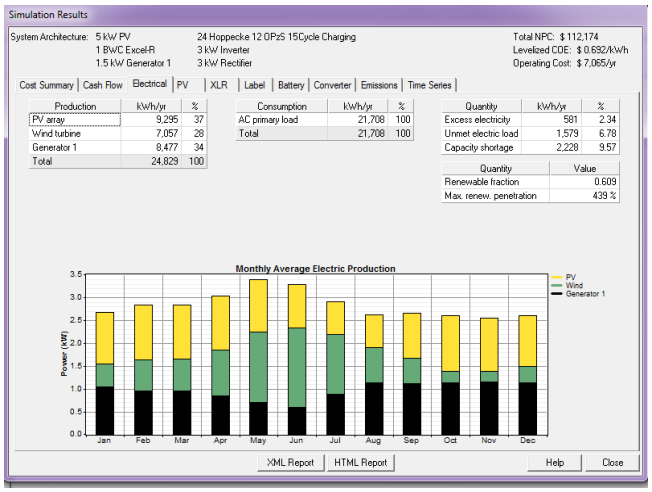


Fig. 6 Annual electricity productions by different hybrid system

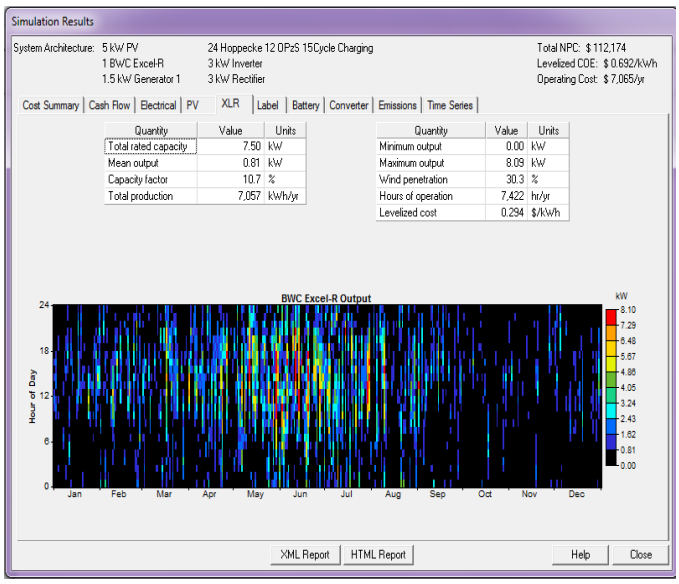


Fig.7 BWC Excel –R-output

A. SIMULATION TIME SERIES

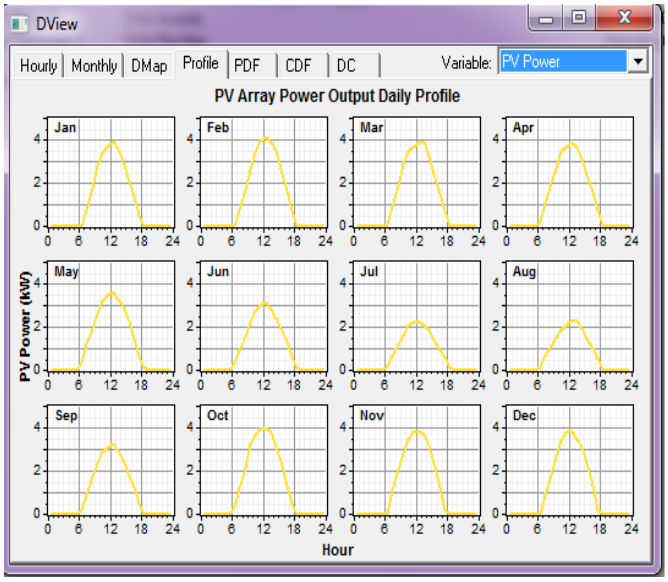


Fig .8 PV array power output daily profile

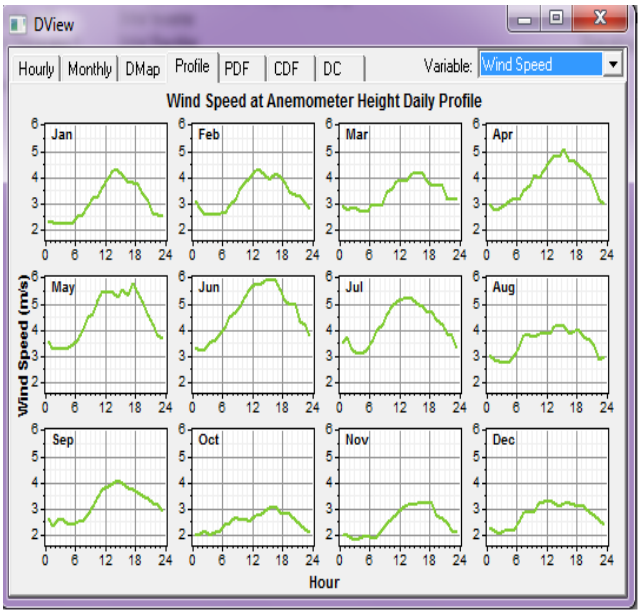


Fig.9Wind speed at anemometer height daily profile

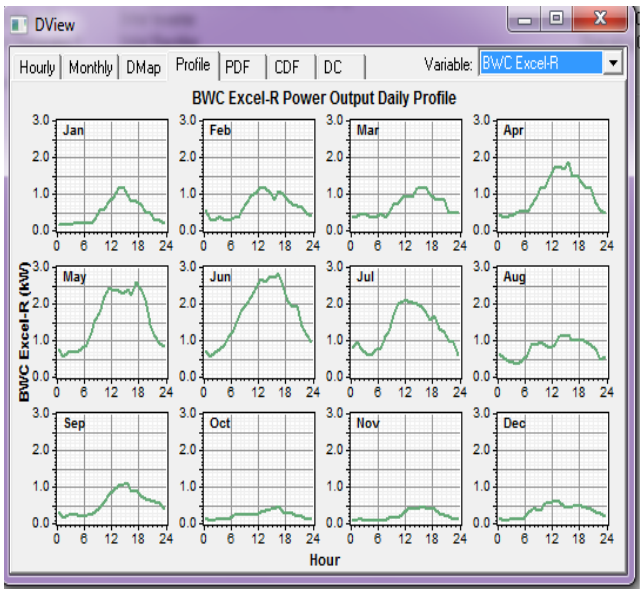


Fig.10 BWC Excel –R- power output daily profile

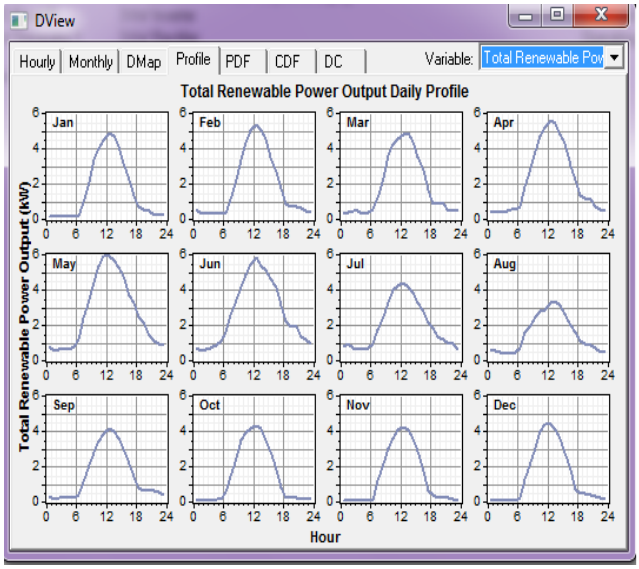


Fig .11Total renewable power output daily profile

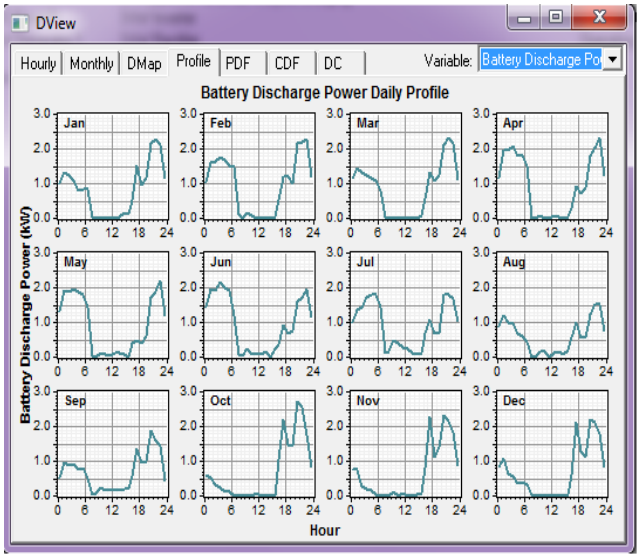


Fig.14 Battery discharge power daily profile

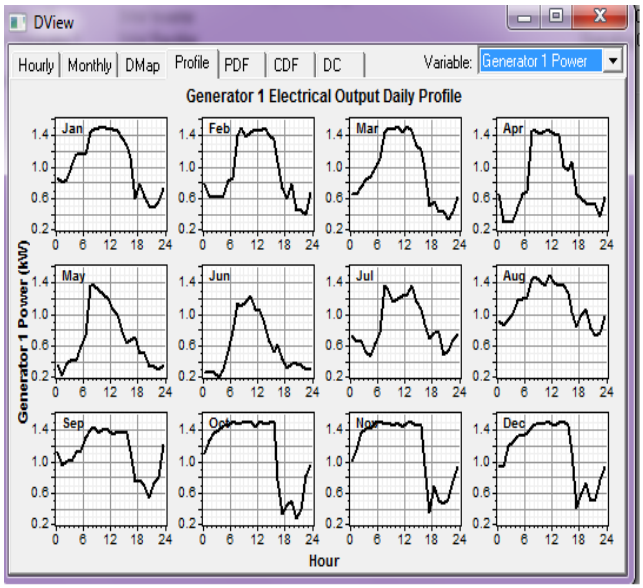


Fig.12 Generator 1 electrical output daily profile

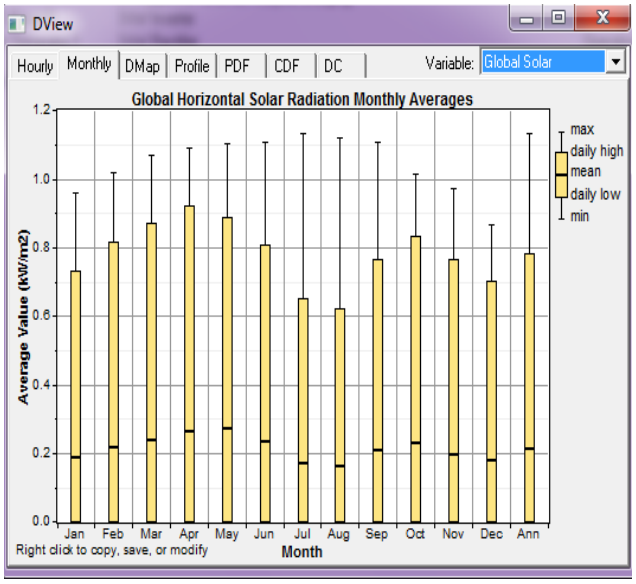


Fig 15 Global horizontal solar radiation monthly averages

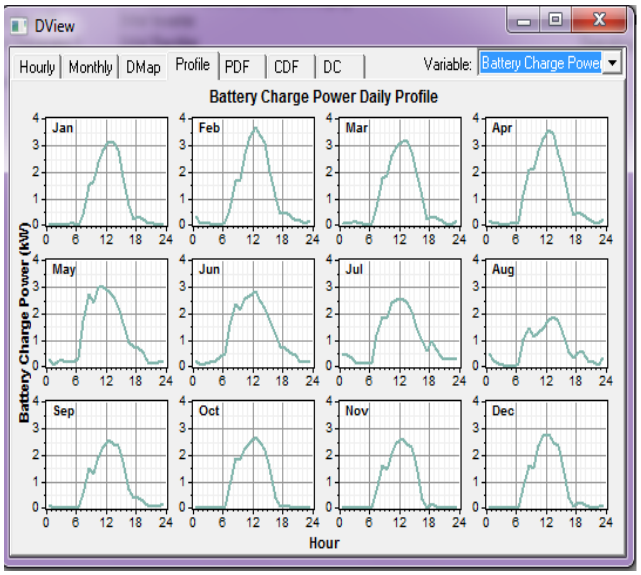


Fig.13Battery charge power daily profile

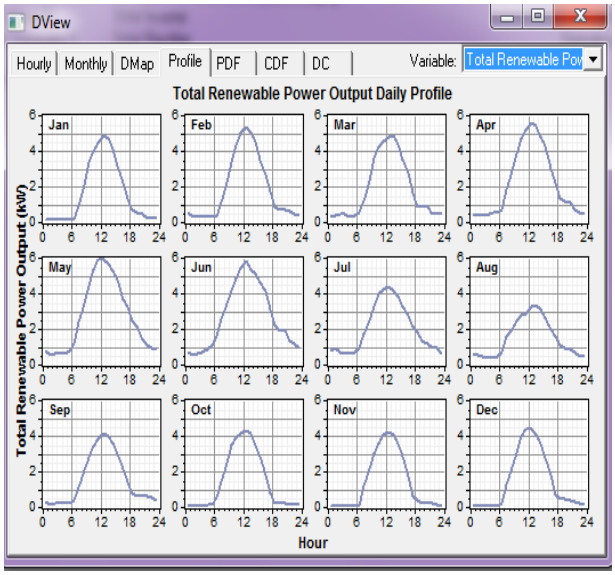


Fig 16 Total renewable power output daily profile

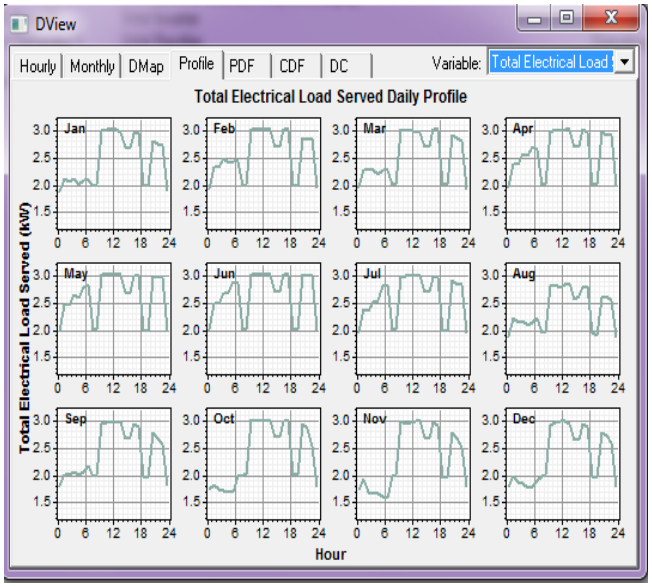
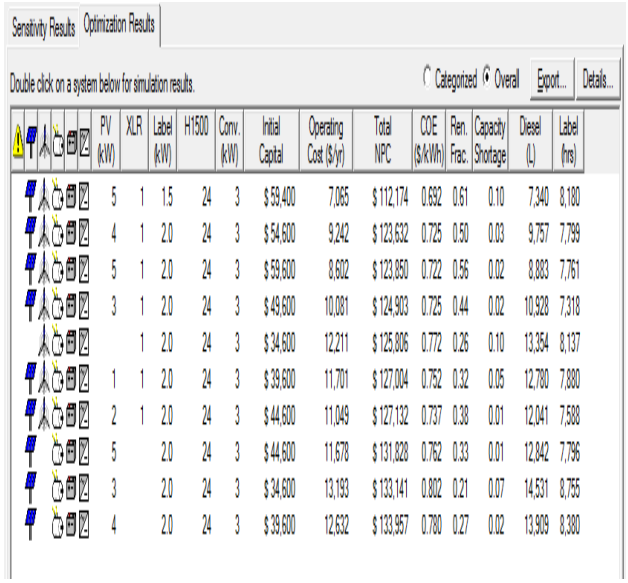


Fig 17 Total electrical lode served daily profile

V. OPTIMIZATION RESULT

HOMER Software Performs Several Simulations In Order To Obtain The Optimal Hybrid System. Four Sensitivity Variables Are Considered In This System And They Are Wind Speed, Solar Irradiation, Load, And Diesel Price And Each Of These Variables Has Three Different Values. The Optimization Results The Best Optimal Combination Of Energy System Components Are Two 7.5kw BWC-Excel-R , 1 KW PV-Array And 2 00.500 KW Diesel Generator. Total Net Present Cost (NPC), Capital Cost And Cost Of Energy (COE) For Such A System Is $112174,$ 59400 And 0.692$/Kwh, Respectively For One Year. The optimization result in show in fig 18.



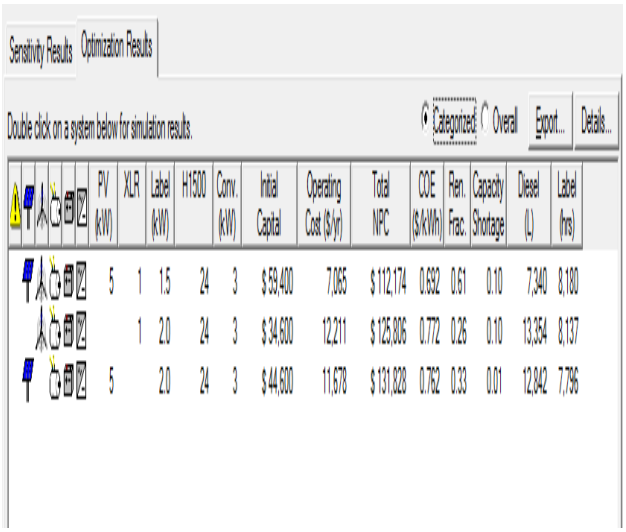


Fig 18 Optimization Results Of Hybrid Energy System For Mobile Telephony Base Station

VI. CONCLUSION

This paper presented a proposed hybrid power system for a remote telecommunication site in imaliya (bhanpur). System sizing and designed system configuration is presented. In India more than 2 billion peoples are sell phone. To provide better network services sell phone operator installed new sell phone base stations. Power is main issue for remote or isolated areas base station, because grid extension is not feasible. This sites proposed renewable base hybrid system is most viable solution. These solutions of power supply to the telecom base station are cost effective and available throughout the year. The circumstance of each sites are studied in order to decide the feasible combination of alternative energy resources. Alternate power solutions are not commonly used in tower telecommunication system today but are actively evaluated for remote and isolated areas over worldwide. With the help of above pre-feasibility study the solar and wind hybrid energy system are most viable power solution for sell phone base station in Indian sites over conventional diesel generator**.** Although the net present cost is high but the running and maintenance cost are low as compared to the diesel generator power solution. The Monthly Average Electric Production of The System. Photovoltaic Production Is 37%, Diesel Generator roduction Is 34%, And Wind Turbine Is 28%.Total Net Present Cost (NPC), Capital Cost And Cost Of Energy (COE) For Such A System Is $112174,$ 59400 And 0.692$/Kwh, Respectively For One Year Its payback time is around 20 years.

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