Hybrid Power Generation Using Solar And Wind With GSM Technology

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Abstract-As the conventional fuel resources are depleting day by day and increasing need of renewable clean energy establishment in power production needs to address issues related with it. This paper addresses economic comparison for solar, wind and hybrid solar-wind generation for two different cases. In this paper we evaluated two different cases. In case-I, we have evaluated economics of solar system and wind system individually and solar-wind hybrid system for a specific load and a specific location. In case-II, We have evaluated cost comparison of individual solar, wind and hybrid system for five different locations of major Indian cities for a specific load 5000 kW per day. The standalone and hybrid optimization simulation model was developed and economic analysis was done using the renewable energy software HOMER.

Keywords- HOMER, hybrid system, solar, wind, GSM technology.

I. INTRODUCTION

Solar and wind energy are very important part of non-conventional resources in India. In renewable energy standalone and hybrid system are generally used as potential power generation candidates. Hybrid generation is combination of two or more than two nonconventional resources or it may be combination of renewable and conventional resources. Hybrid system is capable to overcome discontinues nature of non-conventional energy. The use of renewable energy source like solar energy and wind energy can be explored as a feasible option for replacing diesel backup. The more suitable form of renewable energy in today's world is the solar energy and wind energy. The solar electric system converts sun radiation into dc electricity. The wind energy is utilized for power generation by converting the kinetic energy of wind in to rotational motion by using a wind turbine. The solar wind energy is clean energy, environmental friendly resources.

Rachit et.al [1] simulated & optimised PV system, wind turbine, diesel generator, battery backup & converter for their measurement & instrument laboratory. They have checked technical & economical criteria for that integrated system; found solar PV is the best optimal solution. Supriya et.al [2] used Hybrid Optimization Model for Multiple Energy Resource (HOMER) software for simulation and optimal planning of sizing of difference components of hybrid system.

Ajay Sharma et.al [3] used standalone solar wind with diesel backup system for the power supply of remote areas for mobile telecom sector. It may given an economically alterative for mobile telecom sector over the use of conventional diesel generator is near future. For optimizing hybrid system for different locations for globalize sector, we have used HOMER, it is found to be one of the most universally used software for the optimization and sensitivity analysis of hybrid systems. The inputs required for the analysis are solar radiation, wind velocity, temperature data, load profile, system control and economic factors.

In this paper we have used HOMER evaluation version software to simulate the solar power generation system, wind power generation system and also the solar-wind hybrid power generation system. We have taken the data of solar radiation, wind speed, load profile. We have selected economic factors of NASA in HOMER software, and we have obtained the optimized result from the software. We have worked on two different cases in case 1 we have compared standalone solar standalone wind standalone and solar wind hybrid for a particular location and for a fixed load of 8 kW. In case 2 we have evaluated economy for all the three system for five major cites of India.

II. ANALYSIS METHOD

For the optimal planning of sizing of different components of system the simulation software HOMER is used. It performs various functions such as the energy balance calculation for each system configuration. PV system, wind turbine, PV wind and wind hybrid system along with battery are the components

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chosen for analysis. For these systems, the meteorological data of solar radiation and monthly wind speed are taken, for New Vallabh Vidhyanagar, Gujarat, India.

III. CASE-I

In case-I, We have find economics and optimal solution of power generation for a specific load of 8 kW and specific location. We have taken New Vallabh Vidhyanagar, INA. We have simulated and find optimal results for standalone PV, standalone wind and solar-wind hybrid system.

The hybrid power generation using solar and wind with GSM technology the place selected for application new Vallabh Vidhyanagar where we have considered a system consisting of Photovoltaic Cell, Wind Turbine, Converter, Battery, Charge Controller, Load, GSM. Optimum result is obtained on the basis of comparison from the analysis of result three different system based on input energy respectively solar system, wind system, solar-wind hybrid system. New Vallabh Vidyanagar, India (22^0 31.3'N, 72^0 55.0'E)

New Vallabh Vidyanagar

Figure 1 Location of new Vallabh Vidhyanagar

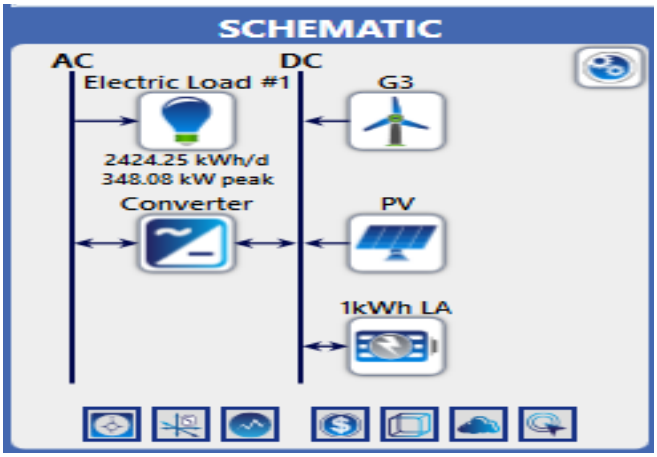

Figure 2 HOMER schematic diagrams

Fig 2. Shows the schematic for this project. The size of wind generator is 3 kW, size of solar panel is 5 kW, battery used is generic 9 kWh lead acid battery and converter used is generic 9 kW converter.

3.1 WIND

Wind turbine rated capacity of 8 kW. Price of single unit is included. Capital cost is estimate as 3809.5$ and replacement cost is estimated at 1270$ and yearly operation and continuity cost is 170$. The simulation and optimum solution life time is 20 years. In this, the converter is taken same for solar, wind and hybrid system for the simulation.

Capacity	Capital	Replacement	($/M)	Life	Efficiency
8 kW	3809.5$	1270$	170$	20	50%

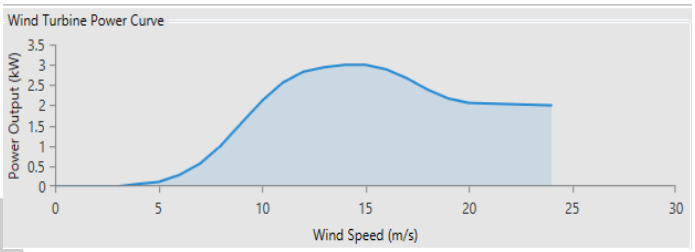

Figure 3 Graph of wind speed v/s power output

This graph presents power output (kW) vs wind speed. Wind turbines power curve shows how much power it will produce depending wind speed at standard atmospheric conditions [4]

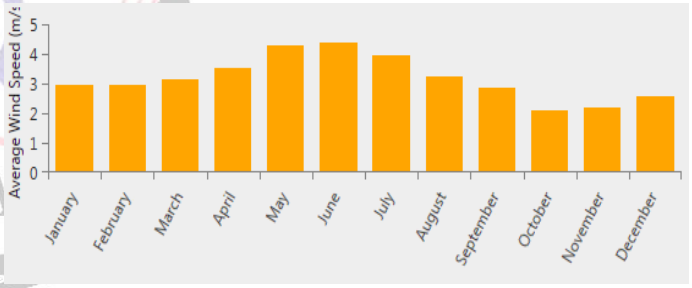

Figure 4 average wind speed v/s month

This graph represents average wind speed vs month average wind speed show maximum wind velocity and month show that maximum velocity availabel in which month.

3.2 PV CELL

Solar PV cells are connected in series parallel when sunrise is sky solar cell is produced electricity. 8 kW solar energy setup installation and replacement cost are 3968.28$ and 1210.365$. The life of solar cell is 25 years. In this, the converter is taken same for solar, wind and hybrid system for the simulation.

Capacity	Capital	Replacement/after 10 years	($/M)	Life	Efficiency
8 kW	3986.28 $	1210.36$	10.317 $	25 years	90%

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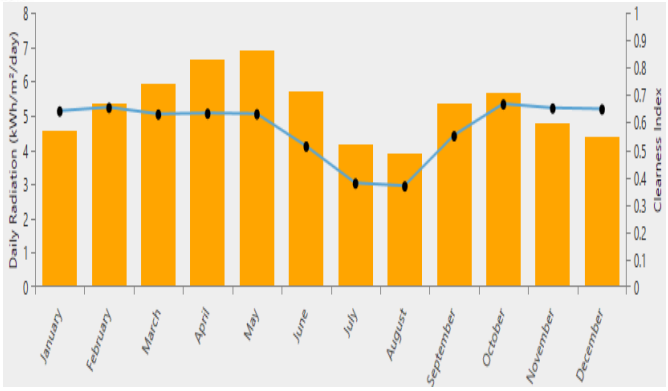

Figure 5 Solar daily radiation v/s month

This graph represents how much radiation in 12 month and present pick load in month duration [4]

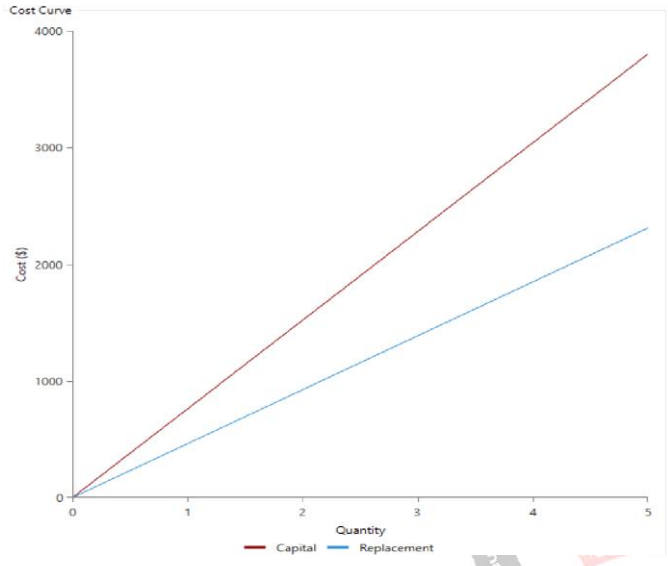

Figure 6 Cost v/s quantity

This graph Represent Cost vs Quantity in cost present (cost of PV panel) and quantity present (panel rate) [4] in this PV cell HOMER software is compatible for the system.

3.3 BATTERY

Storage battery is got the generic form of the lead acid battery. This is given in simulation software tool library. This battery standard base impact load capacity. In this taken load 750 ac kW and voltage is 12 v for each battery and each battery stored 1 kW. This battery replaced every five year. The one battery initial capital cost of 793.65$. In this, the battery is taken same for solar, wind and hybrid system for the simulation.

3.4 CONVERTER

Converter is used in order to convert energy between ac and dc or vice versa. The habitual load is ac and generated power is dc type. The size of converter is 9 kW. And maintenance cost are 317.46$ and 23.80$ respectively. In this, the converter is taken same for solar, wind and hybrid system for the simulation.

Capacity (KW)	Capital (Rs)	Replacement (Rs)
9	317.46$	23.80$

3.5 SIMULATION RESULT

The monthly middling production of solar cell system and wind turbine is 30% monthly average electricity it is based on hybrid system as per location.

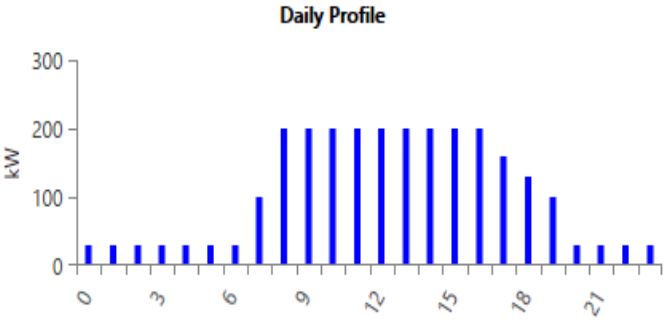

Figure 7 KW v/s hour

This graph represents kW vs hour. This data take for commercial sector and this graph Measured load data is in habitually available, sources often synthesize load data by specifying typical daily load profiles and. This process produces one year of hourly load data [4]

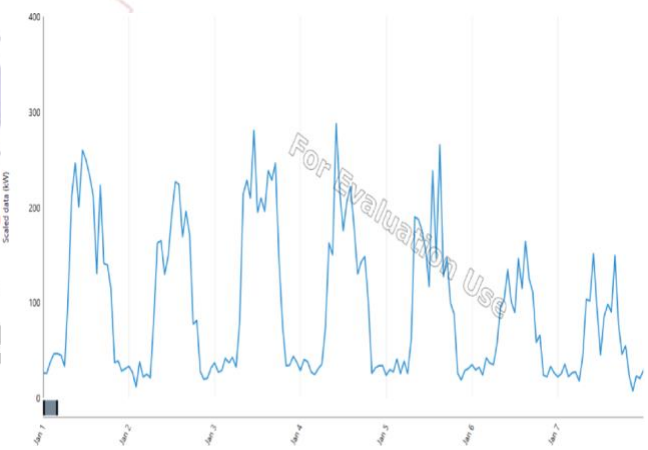

Figure 8 Scaled data (kW) v/s month

This graph represents Scaled data (kW) vs Date & time scale the baseline data multiplies each of the baseline values by a common factor that results in a yearly annual average value.

Quantity	Capital ($)	Replacement ($)	O&M($/year)
1	793.65$	14.126$	5$

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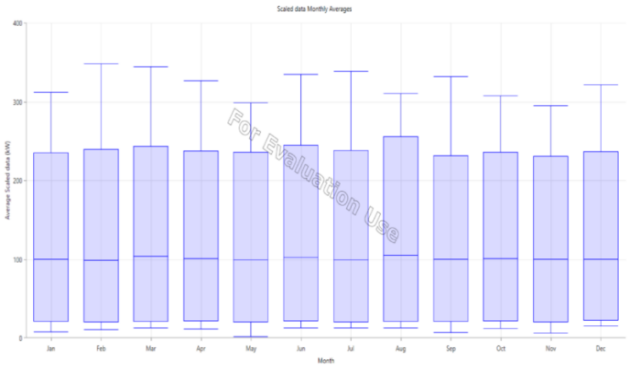


Figure 9 Average scaled data (kW) v/s month

This graph represent Avg. scale vs month The drop-down menu contains commercial sector These load diagram show different ordinary overall magnitude scale the average load[4]

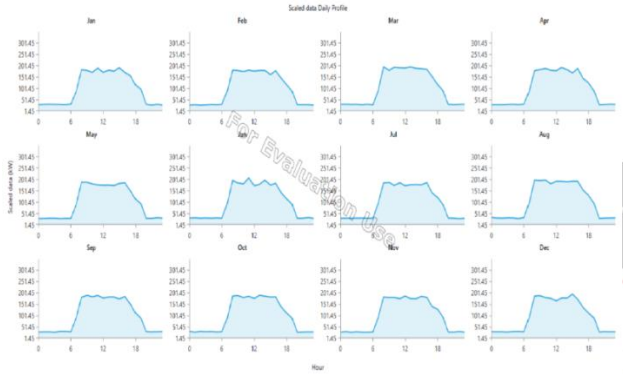


Figure 10 Scaled data (kW) v/s hour

This graph represent Scaled data vs hour the baseline data HOMER multiplies each of the baseline values by a common factor that results in an annual average value which is equal to the value that is specified[4]

The simulation procedure for the solar system and wind system is the same.

3.6 OPTIMIZATION RESULT

Software performs various counterfeit optimal hybrid system. The sensitivity sporadically are considered in this system and wind speed, solar radiation and load. The Best optimal combination of energy system components are 8 kW PV array, 8 kW wind turbine.

- **COE= cost of economy**
  The cost of energy is the total annualized cost divided by the total load served. The total annualized cost is almost independent of the interest rate.

- **NPC= net present cost**
  The net present cost (or life-cycle cost) of a component is the present value of all the costs of installing and operating the component over the project lifetime, minus the present value of all the revenues that it earns over the project lifetime

Table 1 Optimization Result for Wind System

Wind turbine	electrical load	Converter	Battery	cost/COE(cost of economic)	Cost/NPC(Net present cost)
8 kW	8 kW	9kW	9kW	1.86666	150000

Table 2 Optimization Result for Solar System

solar power	electrical load	Converter	Battery	cost/COE(cost of economic)	Cost/NPC(Net present cost)
8kW	8kW	9kW	9kW	1.64501	29704

Table 3 Optimization Result for Solar Wind Hybrid System

Solar & wind power	electrical load	converter	Battery	cost/COE(cost of economic)	Cost/NPC(Net present cost)
8kW	8 kW	9kW	9 kW	1.8599	10152.52

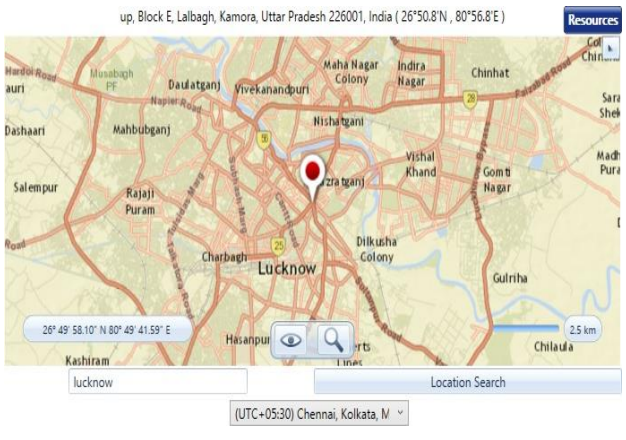
IV. CASE-II

The hybrid power generation using solar and wind technology the five states selected for application. Where we have considered a system consisting of Photovoltaic Cell, and Wind Turbine, Optimum result is obtained on the basis of comparison 1 load for five cities.

Electrical energy requirement for cities shown below is discussed here.

1. Lucknow
2. Ahmadabad
3. Surat
4. Pune
5. Hyderabad

Lucknow



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Max Solar radiation in Lucknow city 70%	Max wind available in Lucknow city 30%	Battery backup 00
160+72*0.7 11250kW	16072*0.2 3214 kW	16072*0.1 1607a/h

Location	Specification	Load type, Outcomes
Lucknow	Solar cell 6350 kW Wind turbine =2721kW Battery backup 0	• Primary electrical load 9072 kWh/day • Peak load 5000 kW
		• Hybrid system was designed and analyzed for Lucknow city. • For optimize operation pv of 6350kW with wind 2712 kW.

4.1 Calculation

➢ **Solar**

Capital cost =2462400.00$
Replacement cost=1385100.00$
Life =25 years
Cost of Economy (COE) =Capital cost/ Replacement cost=16/9=1.7777

➢ **Wind**

Capital cost =3078000.00$
Replacement cost=1846800.00$
Life =25 years
Cost of Economy (COE) =Capital cost/ Replacement cost =20/12=1.8181

➢ **Lucknow city**

Solar

Capital cost =1723680.00$
Replacement cost=1231200.00$
Life =25 years
Project life=10 years
Cost of Economy (COE) =Capital cost/ Replacement cost =11, 200, 0000/8, 000, 0000=1.4

Wind

Capital cost =923400.00$
Replacement cost=307800.00$
Life =25 years
Cost of Economy (COE) =Capital cost/ Replacement cost =6/2=3.111

Table-4 5000kWh/day for 5 cities

Lucknow	Solar radiation 5000*0.7 3500 kW	Wind available 5000*0.3 1500 kW	Coe of solar 1.4	Coe of wind 3.11
Ahmadabad	5000*0.7 3500 kW	5000*0.2 1000 kW	1.4	2.66
Surat	5000*0.6 3000 kW	5000*0.3 1500 kW	2.0	2.66
Pune	5000*0.7 3500 kW	5000*0.2 1000 kW	1.4	2.66
Hyderabad	5000*0.7 3500 kW	5000*0.2 1550 kW	1.4	2.66

Battery take in all five city 10%= 5000*0.1=500

However the cost of economy (COE) is less for standalone solar system, looking to the net present cost for the hybrid system is found better for this case.

V. CONCLUSION

As the threat of the extinction of the conventional energy reserves will end in the near future as the need of the energy is rocketing new heights and with the growing environmental concerns, the need for the alternative source of energy is now compulsion. The renewable sources include Wind, Solar, Biomass, Tidal etc. One of the fastest increasing energy sources are the solar and the wind energy.In this study we have examined the power generation with the Solar, Wind and Hybrid of solar and wind energy at new Vallabh Vidhyanagar, Anand, Gujarat and other five locations which are Hyderabad, Pune, Surat, Ahmadabad and Lucknow. As per the load provided by the Government of India we have compared the three systems i.e. Solar, Wind and the Hybrid system by the comparing factors such as Cost, Maintenance, and Installation etc. The data were then simulated in the HOMER software to get the optimum hybrid configuration. The results from the simulation showed that the cost of the solar system is 3968.25$, the wind system cost 3809.52$and the hybrid system cost around 7777.77$ but the efficiency of the hybrid system is far greater as compared the other two systems. The initial cost of the Hybrid system is more, but the reliability of the hybrid system is far more. Hence the Hybrid system is the best option for any load.

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