Research Paper

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A Comparative Analysis Between Electricity Cost And Renewable Energy Cost for an 1800 Kw Load Using Homer Software

Engineering

KEYWORDS : Cost analysis, Homer optimization system, renewable energy sources, Hybrid power generation System.

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ABSTRACT

Economic analysis & environmental impacts of hybrid electric power generation through renewable energy sources like, Solar, Wind, diesel generator and battery storage system for 1800 kW load in telecommunication BSNL exchange office. The use of renewable energy sources in telecommunication system could help reduce the operating cost but high installation cost through the reduction in fuel consumption. Maximizing the use of renewable energy is beneficial in reducing the diesel generation cost. The proposed hybrid system is modeled for 1800 KW Load. As both wind and solar energy sources are inconsistent and non-stable. Hybridizing solar and wind power sources together with storage batteries to overcome inconsistent and non-stability periods of time without sun or wind provides a stable form of power generation.

INTRODUCTION

In India the power installed capacity is highly dominated by conventional power plants [1] which are responsible for creating the pollution in the environment [2]. On the other hand Solar, wind and other non-renewable energy sources are cheap, efficient and having minimum installation demands. Obtaining reliable and cost effective power solution for the Indian expansion of telecommunication areas presents a very challenging problem. Grids are either not available or their extension can be extremely costly in telecommunication area [14]. Although initial costs are low, powering these sites with generators require significant maintenance, high fuel consumption. Wind power with diesel and solar generation, Hybrid solar, wind and diesel is very reliable because the diesel acts as a cushion to take care of variation in wind speed and would always maintain an average power equal to the set point[11]. The ability to generate electricity is a building block of modern societies. The utilization of wind turbines to produce electricity has been practiced for over one hundred years. However the field of engineering concerned with the coupling of wind power and diesel generators has essentially just begun with increasing introduction of wind generators in wind diesel system ,system stability is becoming a crucial issue to the power company [16].

HYBRID SYSTEM

Hybrid energy system is a combination of different types of renewable energy conversion systems along with conventional in order to fulfill the load demand with more reliability now this diagram combine for solar\ wind ,fuel and power conditioning and load .the diagram combine for hybrid system used in this paper.

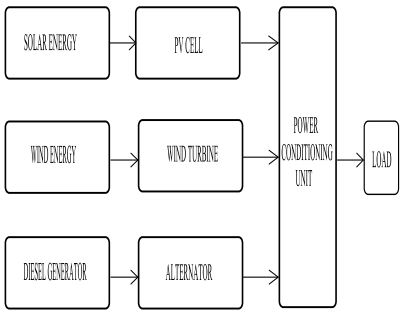

Fig 1 Hybrid system block diagram.

Hybrid system has been designed to fulfill the power requirement of the telephone exchange office located in Dist.Khargone. At this exchange office total 50000 subscribers are connected and the hourly power requirement. The total average value of load is 1800Kw/day.

MODELING OF HYBRID SYSTEM

The objective of design of simulation model of hybrid system is to minimize the total generation costs, while satisfied the specified load. HOMER optimize in such way to give the idea about the different selecting units such as it gives the idea about how many number of wind turbines, solar arrays, diesel generator and how many battery are used to fulfill the demand. On other words we can say that it also select the optimal generation system according to load demand.

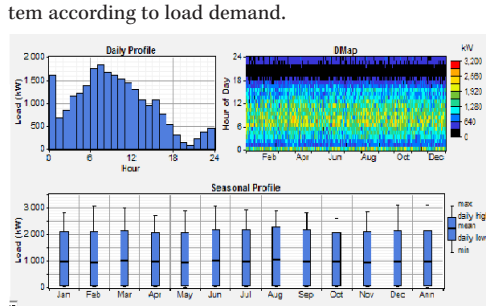

Fig. 2 load demand

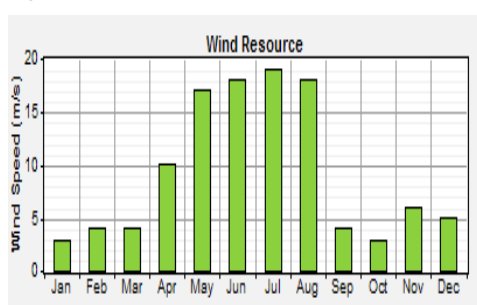

Fig. 3 Wind resources

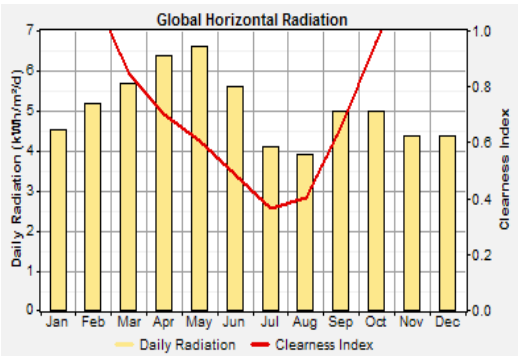

Fig. 4. Solar resources

EXPERIMENTAL ANALYSIS

In present work, results are taken for the standard input and output settings whose details are given below.

Here 3 units of Tubular 225 type AC wind generator of rating 0.4 KW have been used. The capital, replacement and operational cost considered are 63,322,400.00 Rs, 63,322,400.00 Rs, 759,868.80Rs/yr respectively.

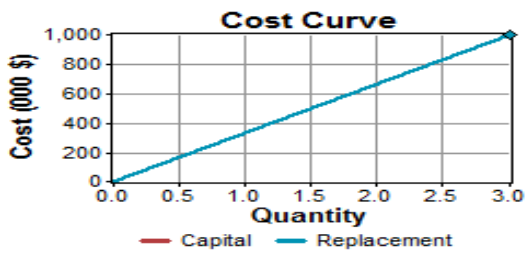

Fig.5: Wind turbine input

Here PV input rating of 500 KW has been used and the size of 40, 50,100 and 150kw are considered. The capital and replacement cost are taken for the present hybrid case i.e. 379,934.40 Rs and 316,612.00 Rs, respectively. As the solar radiations are freely available hence there is no operational cost is involved.

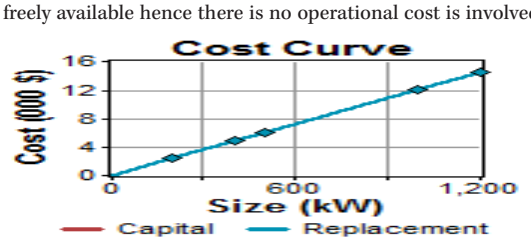

Fig. 5: PV inputs

Here generator of rating 100 kW of different sizes 50 and 100 kW is considered. 15000 hours are considered as lifetime of the generator with a minimum load ratio of 30%. The capital, replacement and operational cost considered are 6,332,240.00 Rs, 3799344.00 Rs, and31.66 Rs respectively. .

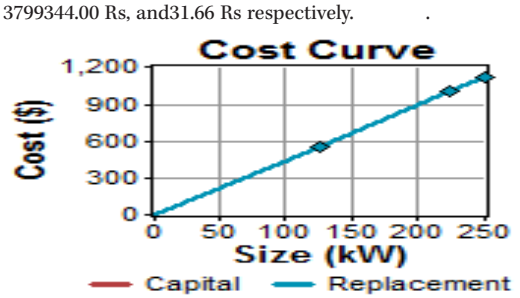

Fig.6 Generators input

Here battery quantity 300 has been used. The capital, replacement and operational cost considered are 31,661.20 Rs, 31,661.20 Rs 3,166.12 Rs/yr respectively.

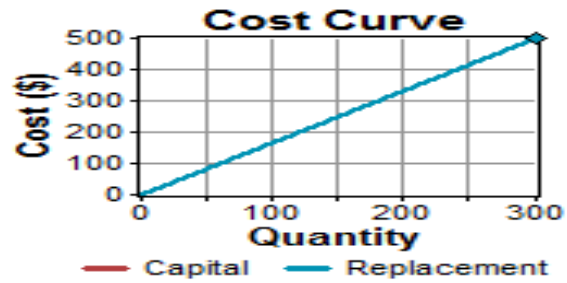

Fig. 7: Battery input

Here converter of rating 500 kW has been used. The capital and replacement cost considered are Rs 56990.16 Rs 56990.16 respectively.

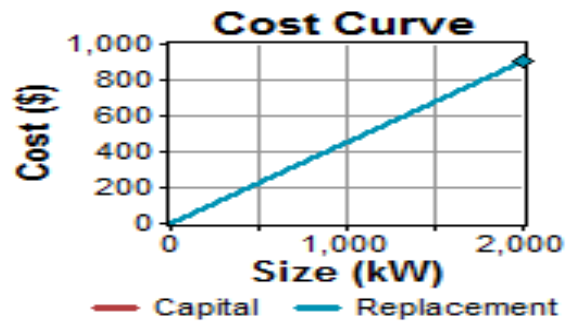

Fig. 8: Converters input

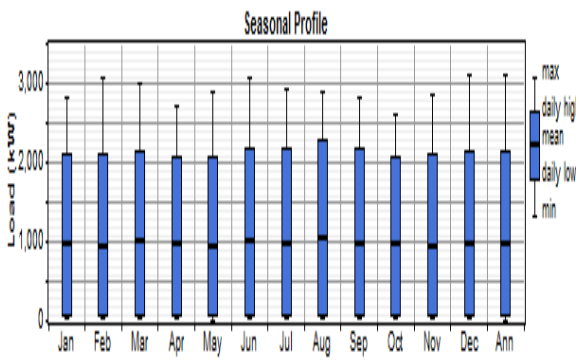

Fig.9: Seasonal Load Profile

OPTIMIZATION RESULTS

Homer software performs simulation in order to obtained the optimization results and suggested various combination as shown in below, the best optimal combination of energy system has been selected based on minimum Net Present Cost (NPC) which is Rs 232,669,990.21 Corresponding to the optimal value of NPC the per unit cost Of Energy Rs 24.82, it is less than diesel generator per unit cost, initial cost Rs76, 189,511.68 Rs/yr and operating cost Rs 12,240.979,.79 Rs/yr.

After optimization of hybrid system for the optimal combination the power generated through various components of the system to fulfill the load demand are summarized. the simulation results of optimal electrical production by HOMER for hybrid system. The Table 6.2 presents the individual component wise production i.e. through PV array is 300,966 Kwh/yr ,wind turbine is 595 Kwh/yr, generator one is 11700, generator three is 315,790,generator four is 182,999.

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Table 1: Electrical Production

Particular	Electrical production (Kwh/yr)
PV array	300,966
Wind turbine	595
Generator 1	11,700
Generator 3	315,790
Generator 4	182,999
Total	812,049
Excess electricity	10.942 (1.35%)
Unmet electric load	0.00103

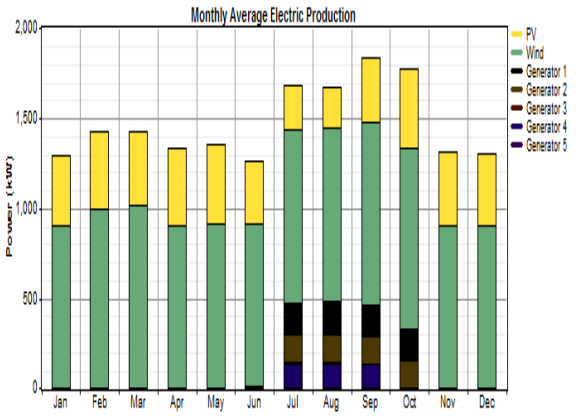

Fig.10: Electrical production

Above Fig.6.11 clearly shows that in order to meet the load demand the total power 812,049 Kwh/yr is generated by various hybrid system components in the different percentage. Out of which 0.303 % power is generated by renewable sources like solar and wind. Here 10,942 Kwh power is generated as excess electricity which is an 1.35% of the total generated power

Table 2: PV Output

Quantity	Value	Units	Quantity	Value	Units
Nominal capacity	648	Kwh	Energy in	150,726	Kwh/Yr
Usable nominal capacity	454	Kwh	Energy out	128,372	Kwh/Yr
Autonomy	5.42	Hr	Storage depletion	222	Kwh/Yr
Lifetime throughput	322,500	Kwh	losses	22,132	Kwh/Yr
Battery wear cost	0.002	Rs/Kwh	Annual throughput	139,239	Kwh/Yr
Average energy cost	0.183	Rs/Kwh	Expected Life	2.32	Year

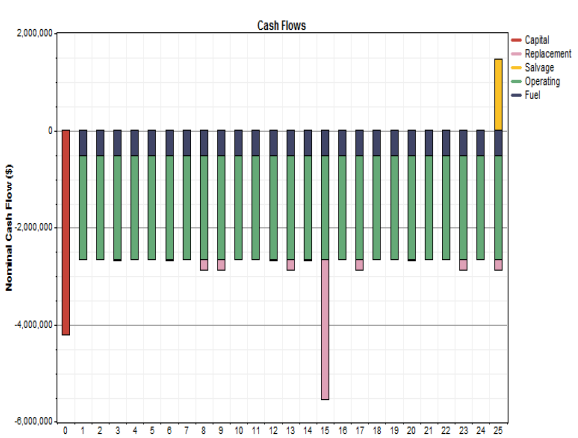

Fig.11.Cash Flow

Fig.12. Cash Flow Summary

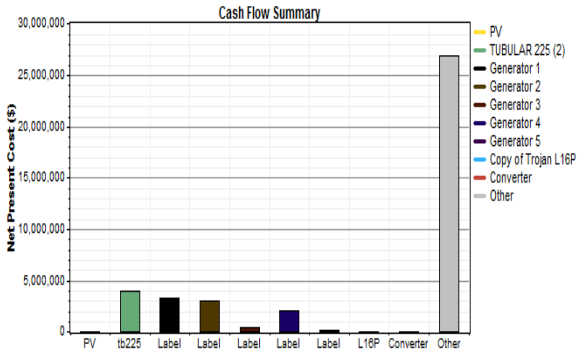

Table. 3: Wind turbine output

Quantity	Value	Units	Quantity	Value	Units
Rated capacity	1.20	kW	Minimum output	0.00	kW
Mean output	34	kW	Maximum output	164	kW
Mean output	825	Kwh/d	PV penetration	41.1	%
Capacity factor	22.9	%	Hours of operation	4,382	hr/yr
Total production	300986	Kwh/yr	Levelized cost	0.000521	Rs/Kwh

Optimal simulation results of PV shows that through 150 KW rated solar photovoltaic system the amount of power generated for a year is 300.966 Kwh per year with a mean output of 34 kW and 825 kWh/d. The capacity factor for this PV is 22.9 % with average hours of operation in a year is 4.382 hr/yr.

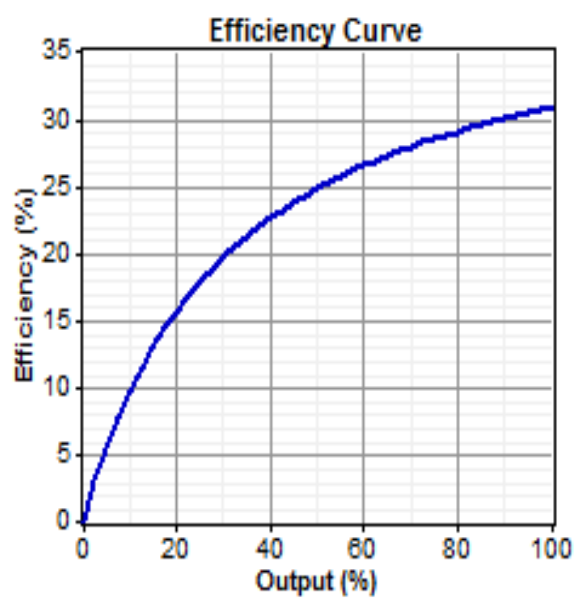

Fig. 13: Generator output

The output through wind turbine is 595 kwh/yr with a capacity factor of 5.66%.

Here 300 units of battery usable capacity 454 KWH and nominal capacity 648 KWH has been used respectively.

Table.4: Battery output

Quantity	Value	Units	Quantity	Value	Units
Total rated capacity	1.20	kW	Minimum output	0.00	kW
Mean output	0.07	kW	Maximum output	0.45	kW
Capacity factor	5.66	%	Wind penetration	0.0812	%
Total production	595	Kwh/yr	Hours of operation	5,626	hr/yr
			Levelized cost	196	Rs/kwh

VI. RESULTS AND DISCUSSION

Cost analysis for 1800 kW load in telecommunication sector. Minimization of operating cost.

VII. CONCLUSION

This dissertation successfully identified the optimal combination for the hybrid system, further results are analyzed on the basic cost and conclusion derived from the results can be summarized as given below:

- After simulation of optimization results HOMER has suggested total 20 possible optimal combinations of the different components of the hybrid system i.e. wind turbine, solar PV and diesel generator. Amongst these 20 solutions the best optimal solution is identified based on minimum value of NPC i.e. for the present system is Rs 232,669,990.21 with a per unit cost of energy Rs 24.82,it is less than diesel generator per unit cost Initial cost Rs 76,189,511.68 Rs/yr and Operating cost Rs 12,240,979.79 Rs/yr.

REFERENCE

[1] W.S. Fyfe, M.A. Powell, B.R. Hart, and B. Ratanasthien, "A global crisis: Energy in the future,", Nonrenewable Resources,pp.187-195,1993. | [2] Katyal Pranati, "Efficient utilization of wind-solar-grid hybrid system using buck-boost converte", European Journal of Scientific Research, ISSN 1450-216X vol. 94, vol. 2.issue 3 , 2013, pp.273-287. | [3] Sharma Ajay,Singh Anand , "Homer Optimization Based Solar PV; Wind Energy and Diesel Generator Based Hybrid System", International Journal of Soft Computing), vol.3, issue 1, 2013, pp.2231-2240 | [4] Kumar Sandeep, "A hybrid model of solar-wind Power generation system", International Journal of Advanced Research in Electrical ,Electronics and Instrumentation Engineering), vol. 2, issue 8, 2013, ISSN: 2278 – 8875 | [5] Maherchandani I J, Agarwa Chitranjan, "Economic Feasibility of Hybrid Biomass/PV/Wind System for Remote Villages Using HOMER", International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering ,vol. 1,issue 2, 2012, pp.2275-2275. | [6]Laxmi Jaya, "Modeling and control of hybrid photovoltaic wind Energy conversion system", International Journal of Advances in Engineering & Technology, 2012, pp. 2231-1963. | [7] Mahalakshmi M, "Modeling simulation and sizing Of photovoltaic/wind/fuel Cell hybrid generation system", International Journal of Engineering Science and Technology, vol. 4, 2012, pp. 975-982 | [8] Motin M. A, "Energy Efficient Modeling of Solar Wind Hybrid Power System for a Tourist Island", International Journal of Advanced Renewable Energy Research, vol. 1, issue1, 2012, pp. 1- 7. | [9] Rehman S, Mahbub A. M, "Feasibility study of a wind-pv-diesel hybrid power system",vol.3,issue 1,2012,pp.143-157 | [10] Bajpai Prabodh, "Sizing Optimization and Analysis of a Stand-alone WTG System Using Hybrid Energy Storage", Technologies, AIP Journal 20 vol. 2,issue 8,2011, ISSN (Online): 2278 – 8875. | [11] Hakimi S. M., "Optimal sizing of reliable hybrid renewable energy system considered various load types", AIP Journal of Renewable and sustainable energy 2011. | [12] Kumar Lal Deepak, "Optimization of PV/Wind/Micro-Hydro/Diesel Hybrid Power System in HOMER for telecommunication sector", International Journal on Electrical Engineering and Informatics, vol. 3,issue 3, 2011.,pp.238-253 | [13] Jha Ranjeet kumar , "Electricity for all (efa) through hybrid (solar tracker and wind) energy system", International Journal of Power System Operation and Energy Management, vol.1, issue 4, 2011, ISSN:.2231 – 4407, | .[14] Nema Pragya, Nema R.K, "PV-solar / wind hybrid energy system for GSM/CDMA type mobile telephony base station", International Journal of Energy and Environment (IJEE), vol. 1, issue 2, 2010, pp.359-366. | [15] Mohamed El Badawe, "Optimal Sizing and Modeling of a Hybrid Energy System for a Remote Telecommunication Facility", International Journal of Energy and Environment (IJEE), vol. 1, issue 2, 2010, pp .237-249. | [16] Shafiullah G.M, "Economic analysis of a renewable hybrid system", International Journal of Energy and Environment, vol.2.issue 1, 2009, pp.238-258. | [17] Singh Yandra, "Design and integration of renewable energy hybrid system", International Journal on Electrical Engineering and Informatics,, vol.3,issue 3, 2009, pp.138-149. |