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Optimisation of Hybrid Energy System in Kumbakonam using Homer

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Abstract : As days passing the amount of energy required is increasing rapidly due which the fossile fuels are deploying highly in order to reduce the usage of that we can use hybrid system which provides an alternative way to that, due to high capital cost most of them are not preferred to use this but this will serve more benefits than the conventional one. This paper presents the optimal economic solution for hybrid system. Here we use HOMER to serve this problem.

1. Introduction

Electric power availability, Now-a-days is a major part in the development of a nation. The energy produced by conventional sources raises the green house gas emission, which may be the key source for global warming. so to overcome this, electrification of renewable energy source is the only way. Among various renewable energy sources PV(solar energy) is environmentally friendly but purely depends on climatic conditions. Hence this problem can be solved by experimenting with various systems which are eco friendly and intern known as hybrid systems[1,2].

It can be practically proved that a combined model of solar and wind system is known as integrated renewable energy and is one of the best alternatives of oil produced energy. The paper discusses the deterioration of various hybrid models and to determine which hybrid model is effective and worth useful to the mankind.

2. Load Profile

An institution in kumbakonam requires 10kw daily with peak of 1.55kw to run. The load profile is shown in below figure

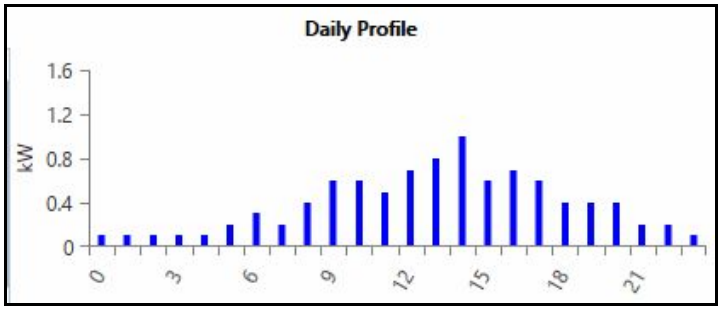


Fig1: Daily Load profile

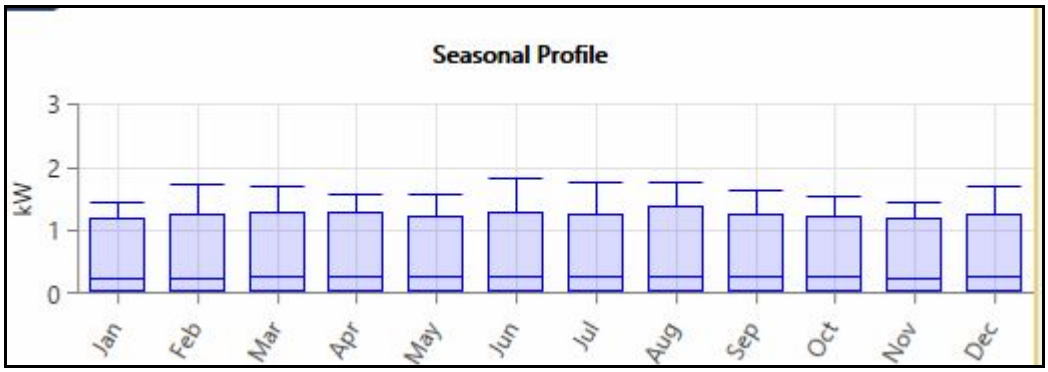


Fig2 : Seasonal Load profile

Load will be varied simultaneously, being an educational institution it require more energy during 7.00-18.00 and then it will be reduced gradually during night times

3. Resources

3.1 Solar

Kumbakonam has an annual average of 5.18 Kwh/m^2 /day which is appropriate for using solar energy. Solar radiation for different months is shown below[3][4]

Table 1 : Daily Solar radiation

Month	Clearance Index	Daily Radiation
January	0.577	5.057
February	0.631	5.984
March	0.611	6.230
April	0.588	6.190
May	0.568	5.954
June	0.497	5.139
July	0.498	5.165
August	0.482	5.031
September	0.521	5.329
October	0.497	4.77
November	0.522	4.631
December	0.528	4.482

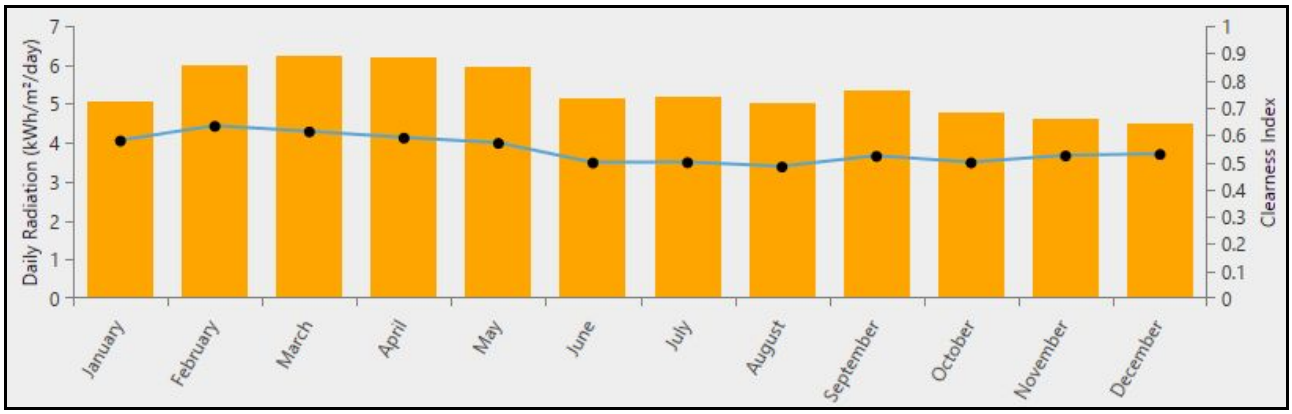


Fig 3 : Solar radiation

3.2 Wind

Adding a turbine with pv system will give a promising results due to availability of high wind speed which varies between 2.7-4.18 m/s[3][4]

Table 2: Average wind speed in m/s

Month	Average speed
January	2.73
February	3.37
March	3.6
April	3.91
May	4.06
June	4.18
July	3.9
August	3.66
September	3.25
October	2.96
November	2.53
December	2.7

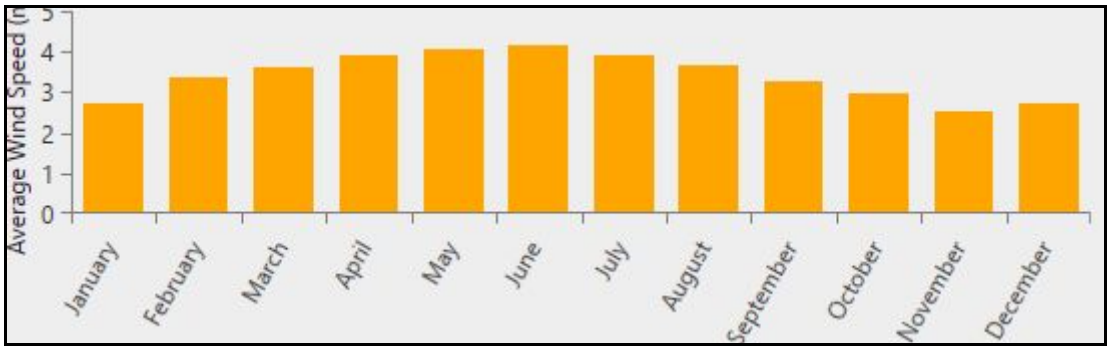
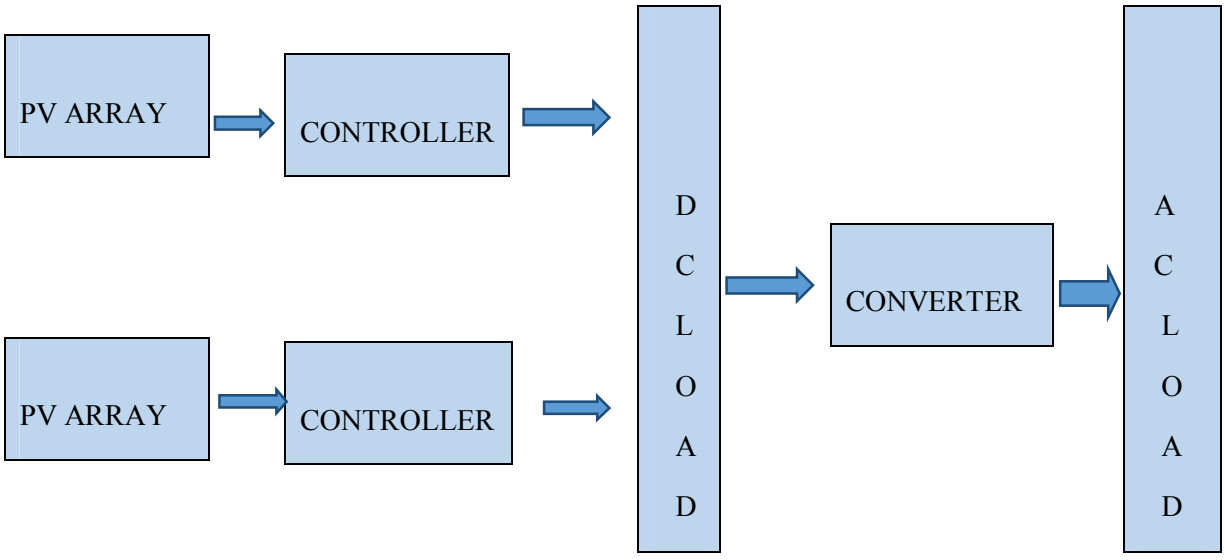
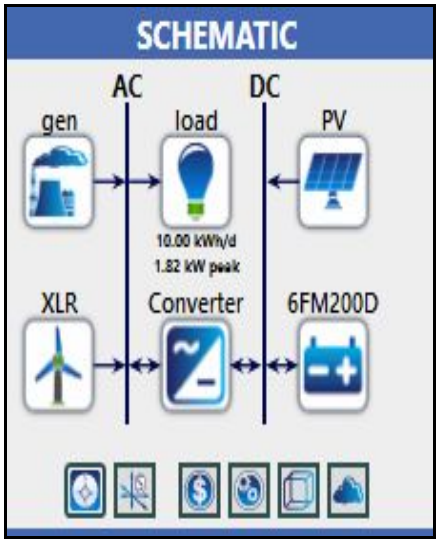


Fig 4 : Average wind speed for a year

4. Block Diagram



5. Simulation Model



5.1 Components of System

PV panels
Turbine
Power converter
Battery
Generator

5.2 Control Parameters[5]

Working life of plant – 20 years
Price of diesel – Rs 50
Wind Turbine – BWC EXCEL-R[6]
Cost- Rs 21,00,000
Replacement cost- Rs 19,00,000
Working life – 20 years
PV modules [7]
Cost- Rs40,000/Kw
Replacement cost – Rs 20,000/Kw

6. Results and Discussion

By simulating through the homer we obtained three feasible solutions from 1500 simulations

6.1 System1

Architecture									Cost				System	gen			PV		XLR
				PV (kW)	XLR	gen (kW)	6FM200D	Converter (kW)	Dispatch	COE (₹)	NPC (₹)	Operating cost (₹)	Initial capital (₹)	Ren Frac (%)	Hours	Production	Fuel (L)	Capital Cost	Production	Capital Cost
				20.0		2.00	4	20.0	CC	₹41.56	₹1.94M	₹48,977	₹1.31M	100	5	7	3	800,000	30,231	
				20.0	1		4	10.0	CC	₹85.24	₹3.98M	₹64,729	₹3.15M	100				800,000	30,231	2,100,000
				20.0	1	1.00	4	10.0	CC	₹85.72	₹4.00M	₹64,375	₹3.18M	100	0	0	0	800,000	30,231	2,100,000

Best one among them consists of PV, dieselgenerator. The initial capital cost can be calculated to be Rs 1,31,000 and operating cost is Rs 48,977 [8]. In this system the major power is supplied by pv and rest will be provided by diesel generator. The cash flow for each equipment is shown below

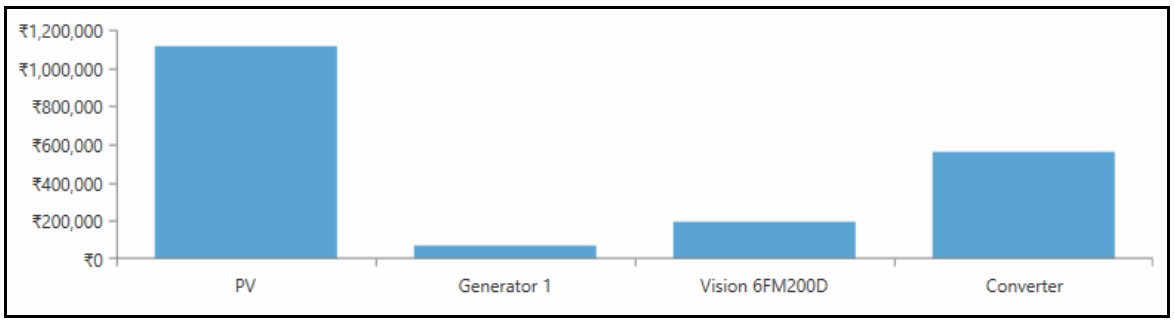


Fig 5 : Cash summary for system 1

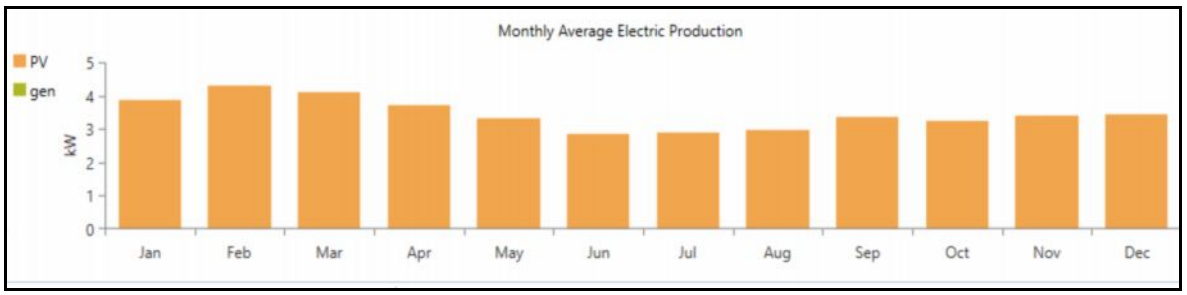


Fig 6 : Amount of power produced by each resource

Emission of harmful gases evolved during conventional power generation has also reduced greatly. Emission of gases from system1 is shown below

Carbon Dioxide	6.85 kg/year
Carbon Monoxide	0.02 kg/year
Unburned Hydrocarbons	0.00 kg/year
Particulate Matter	0.00 kg/year
Sulfur Dioxide	0.01 kg/year
Nitrogen Oxide	0.15 kg/year

6.2 System2

Another system which is taken for analysis is system2 which consists turbine, PV panels. This is the one in which the renewable fraction is 100 %. The solar and wind alone can meet the load at all time in this system with battery units, so that fuel cost is reduced greatly[8]. The initial capital cost of the system is Rs 315000. Emission of gases will be zero due to absence of diesel generator. The cash summary of system2 is shown below

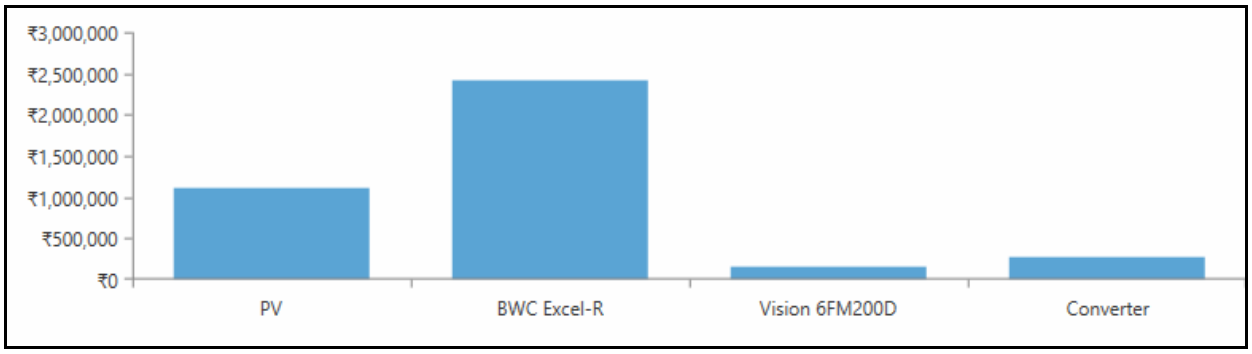


Fig 7 : Cash summary for system 2

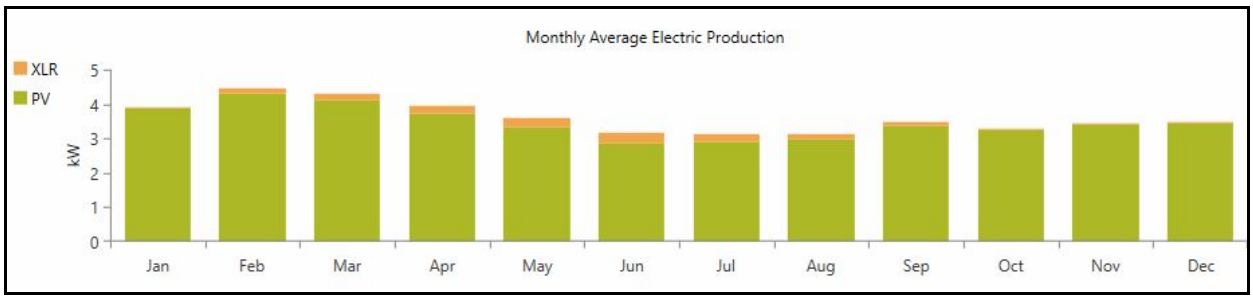


Fig 8 : Amount of power produced by each resource

6.3 System 3

This system comprises of all types of energy systems ie solar, wind, diesel. Among them pv contributes more followed by wind and diesel[8]. Initial capital cost of the system3 is Rs 3,18,000. The cashflow of the system is shown below.

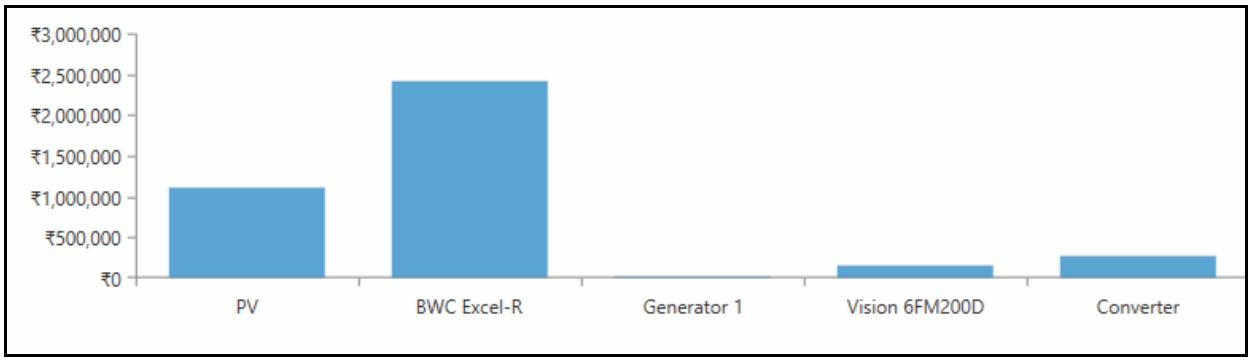


Fig 9 : Cash summary for system 3

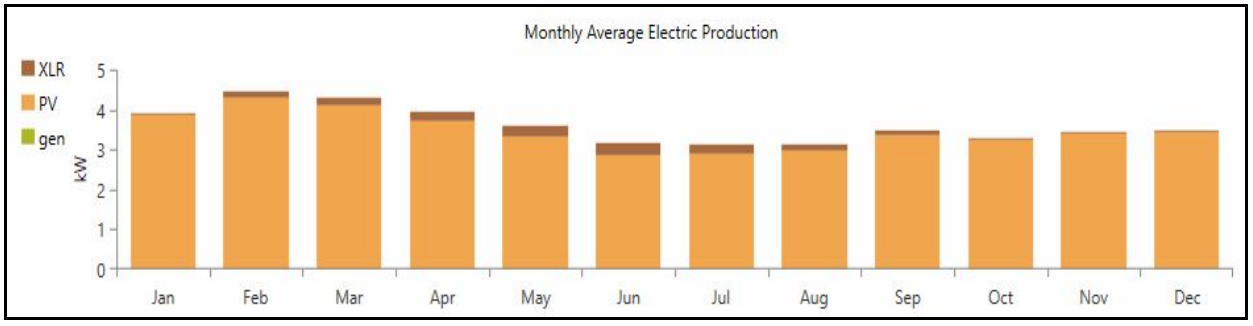


Fig 10 : Amount of power produced by each resource

7. Conclusion

In this paper feasibility study of Wind/ PV/ diesel hybrid energy system under loading conditions is presented. A detailed modeling of both the PV and wind subsystem components are discussed and simulated in HOMER . The proposed hybrid system in kumbakonam is PV and Diesel plant. By which emission of GHG will be decreased greatly and we can preserve the fossil fuel for future.

8. References

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