Analysis and feasibility assessment of a roof top grid-connected photovoltaic power system for a Green building

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Abstract - *Independent solar power generation systems necessity to elevate the design. A verdict sufficient purchase of clean energy for the imminent is one of society's most overwhelming challenges. Renewable energy sources will performance a substantial role in a justifiable development of the energy supply in the imminent, due to the negligible impact they are anticipated to have on the environment and their gigantic industrial potential. But on the supplementary hand, it silently requires a great deal of technological and organizational progress before it can contribute substantially to our energy needs in a ecological way.*

In this project an investigation has being supported out with a 1 kW solar PV system to be mounted and integrated into a Green building. By scrutinizing all factors with simulation software called Homer a comprehensive economic analysis methodology has been suggested. The results obtained are very encourageable to plan for further forthcoming projects.

Key Words: Simulation, Rooftop, Homer, Green buildings,

1. INTRODUCTION

A 1 kw solar PV power generation system has been installed in administration block with the following specifications. A complete load survey also conducted to know the load pattern of 1 kw solar PV system. After collecting the data from various sources we have calculated and analyzed the load pattern and load curves of various rooms and checked with HOMER software for accuracy.

ENERGY AUDITING AND LOAD SURVEY PROCESS

For the installation of solar panel we took energy audit and details have taken by batch No. 10 in order to calculate the number of loads and its power consumption. Here we considered all types of loads such as lights, fans etc. in administration block.

Monthly consumption of load for 24hr in a weekday is represented in this T No: 1. This table is prepared by taking accounts of daily class schedule in the college. EE/EEE department working hour starts at 7am and ends at 1pm.So maximum power consumption is taking place in between this time. From 1pm to 3pm lunch break are taken. So there is nil power consumption at that time. Again the department re-opens at 3pm and continues up to 6pm.So at that time there is moderate power consumption is taking place, because in second half there is less class than first half. From 6pm to 7am only one tube-light is glowing for the purpose of lightening the building.

By taking the account of monthly wise we observe that there is more power consumption in between February to May due to summer season. From august to December there is moderate power consumption due to winter season and puja vacation. From May to June there is summer vacation, so at that time we consume less power. January, June and July are the months in which exams take place, so less power consumption take place than other months. By analyzing and taking the above data we simulate it through HOMER software.

Table 1: Daily load pattern at administration block

Hour	Load (kW)	Hour	Load (kW)
00:00 - 01:00	0.000	12:00 - 13:00	0.560
01:00 - 02:00	0.000	13:00 - 14:00	0.100
02:00 - 03:00	0.000	14:00 - 15:00	0.100
03:00 - 04:00	0.000	15:00 - 16:00	0.100
04:00 - 05:00	0.000	16:00 - 17:00	0.560
05:00 - 06:00	0.000	17:00 - 18:00	0.560
06:00 - 07:00	0.000	18:00 - 19:00	0.560
07:00 - 08:00	0.000	19:00 - 20:00	0.300
08:00 - 09:00	0.100	20:00 - 21:00	0.300
09:00 -	0.560	21:00 -	0.100

10:00		22:00	
10:00 - 11:00	0.560	22:00 - 23:00	0.000
11:00 - 12:00	0.560	23:00 - 00:00	0.000

Modeling the Solar PV system with Homer

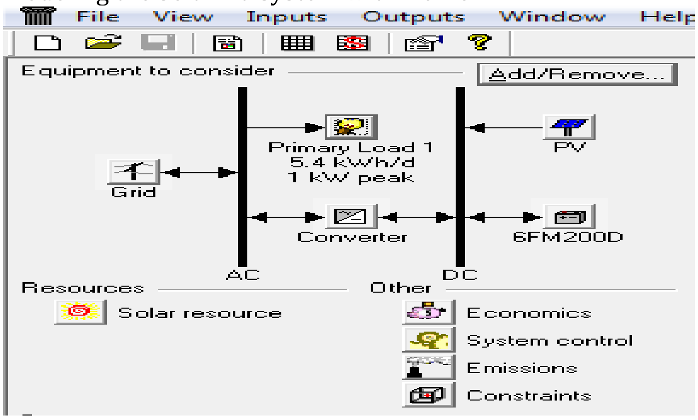


Fig No. 1 Home page of homer

At first we have to click on the add or remove bar for choosing our equipment. A lot of equipment are shown in a window which is appeared like Fig No: 6.1. We have to choose equipment according to our requirements. As per our requirements we take one primary load, one converter, one battery, one PV and a Grid. The below Fig 2will shows how to add or remove equipment for simulating purposes.

Primary load input

Here we have to first choose type of load. The load type is AC. After that 24 hourly values entered in the load table of every month. Each of 24 values in the load table is the average electric demand for a single hour of the day. The above Fig No. 2 show how the primary load gives result.

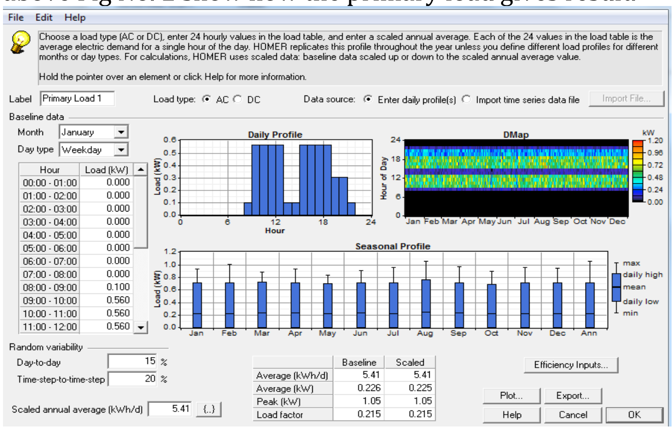


Fig No. 2 Primary load input

PV input

PV is one of the equipments we select. Here we have to put size of the PV according to peak load. We have to also enter the cost and replacement value according to the size of PV. Here we got the curve between cost and size. The above Fig No. 3 shows that, its life time is 25 years.

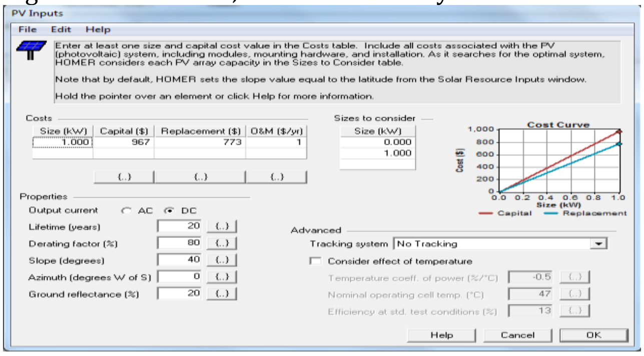


Fig No. 3: PV input

Battery input

Battery is mainly used for backup purpose. Here; we have to choose a battery of appropriate rating which meet our load demand is shown in Fig No. 5.5. After that we have to enter quantity and capital cost to the cost table according to our requirements. Here we get the curve between cost and quantity. We are using battery for back-up supply when there is no grid supply and solar radiation.

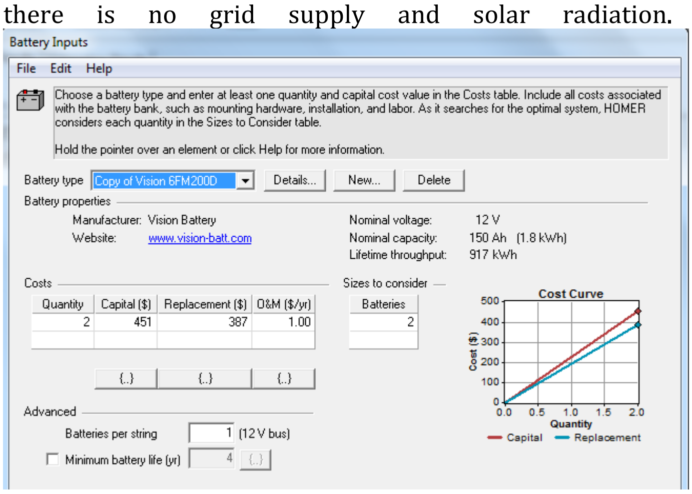


Fig No. 4 Battery input

4. Converter input

A converter may be rectifier or inverter. A converter is required for the system in which DC components serve as AC load and vice versa. Here we have to also enter the cost and size value to the cost table shown in Fig No. 6.6, including labor and hardware installation. Here we get the curve between cost and size. Its lifetime is 15 year.

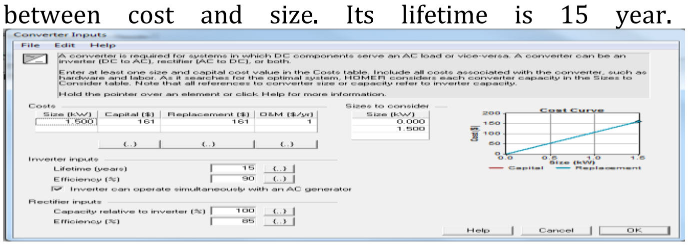


Fig No. 5. Converter input

Grid input

Grid is infinite bus bar, from where power can be taken according to load demand. Here we take grid into accounts to compensate our peak load demand. After selecting the rate we get a graph in between time of day and rate schedule. Grid input is shown in Fig No. 6.

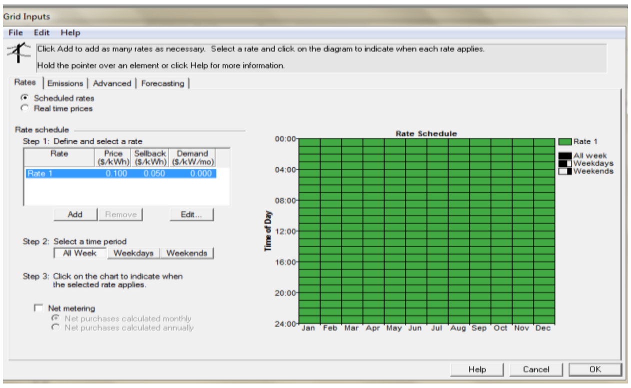


Fig No. 6: Grid input

6. Solar resource input:

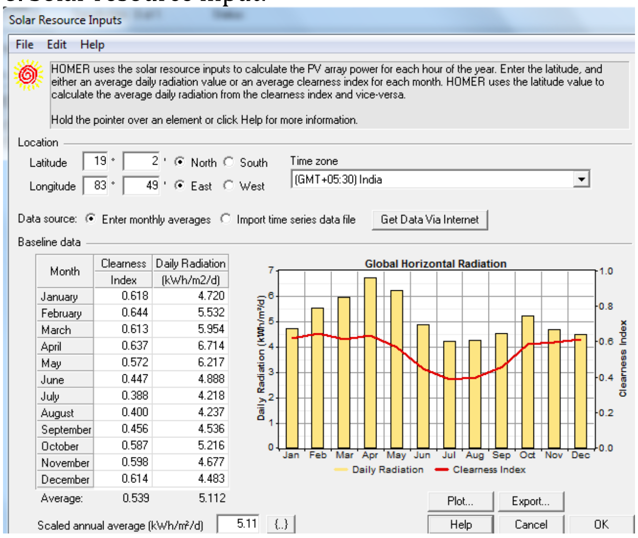


Fig. 7: Solar Resource at Gunupur

Use this window to specify the latitude and the amount of solar radiation available to the photovoltaic (PV) array throughout the year. HOMER uses this data to calculate the output of the PV array each hour of the year.

There are double ways to produce baseline records: you can use homer to produce data, or you can ingress hourly radiation data from a file.

To synthesize data, you must go in twelve average monthly values of both solar radiation or clearness index. You do not have to enter both; homer analyzes one from the other using the latitude. Enter each monthly cost in the fitting row and support of the solar store table. As you cross the threshold values in the table, homer builds a set of 8,760 solar radiation values, or solitary for each hour of the year. Homer creates the synthesized values with the graham process, which outcomes in a data sequence that partakes genuine day-to-day and hour-to-hour changeability and auto correlation.

2. Final simulation result

After putting all the desired data, we go for simulating the project. Finally we got optimization result along with complete report which is shown in Fig No. 6.8.

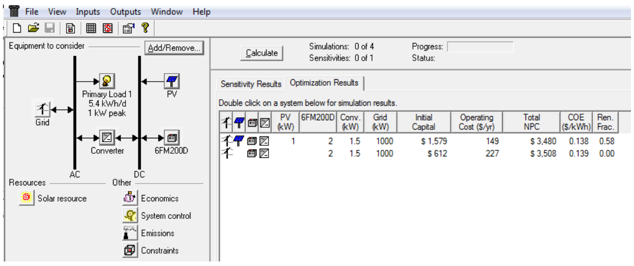


Fig No. 8 Final simulation results

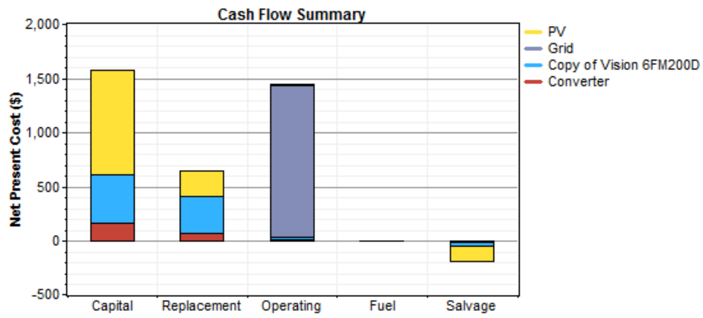
SIMULATION OUTPUT REPORT

Cost summary

Cost summary includes all the expenditure throughout the project. It includes total net present cost; cost of energy and Operating cost details is given. Cost summary also includes cash flow summary which gives detail information about PV, grid, battery and converter net present cost. Here different color shows different net present cost of PV, grid, battery and converter which includes capital, replacement, operating, fuel and salvage cash flow.

Cost summary

Total net present cost	$ 3,480
Levelized cost of energy	$ 0.138/kWh
Operating cost	$ 149/yr



Net Present Costs

Component	Capital ($)	Replacement ($)	O&M ($)	Fuel ($)	Salvage ($)	Total ($)
PV	967	241	13	0	-135	1,086
Grid	0	0	1,410	0	0	1,410
Copy of Vision 6FM200D	451	337	13	0	-45	755
Converter	161	67	13	0	-13	228
System	1,579	645	1,449	0	-193	3,480

Electrical power production and consumption

Every year we got maximum electrical power from PV array and purchased moderate power from grid to fulfill our load profile. Detail information is given.

Below result shows monthly average electric power production in a year. Here PV is represented in yellow color and grid is represented in gray color. Here colors represent PV and grid power consumption in kw every month.

Electrical

Component	Production (kWh/yr)	Fraction
PV array	1,527	58%
Grid purchases	1,103	42%
Total	2,630	100%

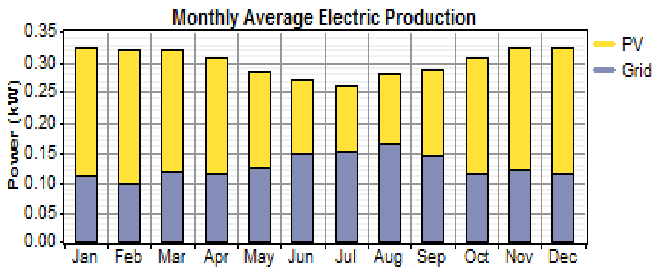


Fig No. 9 Monthly average electric production

PV

Quantity	Value	Units
Rated capacity	1.00	kW
Mean output	0.174	kW
Mean output	4.18	kWh/d
Capacity factor	17.4	%
Total production	1,527	kWh/yr

3. Conclusion

Particulars	Cost
Total system cost	98,000 Rs/-
After subsidy	68,6000 Rs/-
No. of units generated from solar panel	1527 kwh
Each unit rate by considering maximum demand rate and diesel generator option.	9 Rs/-
Total revenue from solar power	1527 × 9 = 13, 743 Rs/-year
Payback period	7 years (without considering net metering option)

Using solar energy at home is becoming increasingly popular. Due to government encouragements and aids on solar systems, the prices of solar panels are becoming more cheap to the everyday purchaser. Home solar power can be used autonomously from a grid system. Surplus electricity made thru the day is stored for night use. More regularly are solar energy systems that are tangled to a grid and trade electricity. In night times and cloudy existences, electricity from the grid is used.

In this paper an analysis has being supported out with a 1 kW solar PV system for GIET campus has been installed at administration block. By analyzing all factors with simulation software called Homer a complete economic analysis methodology has been suggested. The results obtained are very encourageable to plan for further future projects.

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