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Optimal sizing method for stand-alone Kitchen waste based biomass system: An approach towards sustainable buildings

G.R.K.D. Satya Prasad[1], Dr. Jagadish Panda[2], Deepak kumar bishi[3], Dhiraj kumar agarwal [4], Bapun kumar samal[5] Subhankar tripathy[6]

[1]Asscoaite Professor, Department of Electrical Engineering, GIET, Gunupur, *Orissa, INDIA*
[2]Professor, Department of Computer Science Engineering, GIET, Gunupur, *Orissa, INDIA*
[3,4,56]*Final Year UG student, Dept. of Electrical Engineering,* GIET, Gunupur, *Orissa, INDIA*

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Abstract –

The uses of renewable energy sources are becoming very necessary due to the limited reserves of fossil fuels and worldwide environmental concerns for the production of electrical power generation and utilization. In remote areas, villages, it is easy to get more amount of biomass. Hence by the use of these systems consisting of Biomass to generate methane gas and electrical energy in these remote areas can be more economical.

Kitchen (food waste) was collected from different hostels can be utilized for biogas production or generation of power. of to the reactor which works as anaerobic digester system to produce biogas energy. The anaerobic ingestion of kitchen leftover produces biogas, a treasured energy resource. Anaerobic digestion is a microbial progression for production of biogas, which involves of primarily methane (CH4) & carbon dioxide (CO2). Biogas be able to be used as energy source and also for abundant purposes. But, any possible application requires knowledge and evidence about the composition and quantity of constituents in the biogas formed.

In College campuses by utilizing the hostels food waste and other biomass residues can be utilized for better purposes. Biogas production requires anaerobic digestion. A hybrid expertise of Solar with Biomass generator is a verdict to improve the consistency of the system. This project has highlighted the economic reflections of Solar - Biomass hybrid systems by using Homer software simulation.

Key Words: Kitchen food waste, Biogas, Simulation, Homer, Green buildings

1. Introduction

After careful study of the possibility of generation of biomass power from canteen kitchen waste there some potential of generating biogas and power.

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. To check the validity of kitchen waste based power in GIET campus a 10kw biomass plant has to be simulated for experimental validation purpose. After observing financial viability of the system a decision has to be taken for the installation of 100 kw biomass plant in GIET campus and 1kw biomass plant for Green building.

2 ENERGY AUDITING AND LOAD SURVEY PROCESS

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.

Modeling hybrid system with Homer software

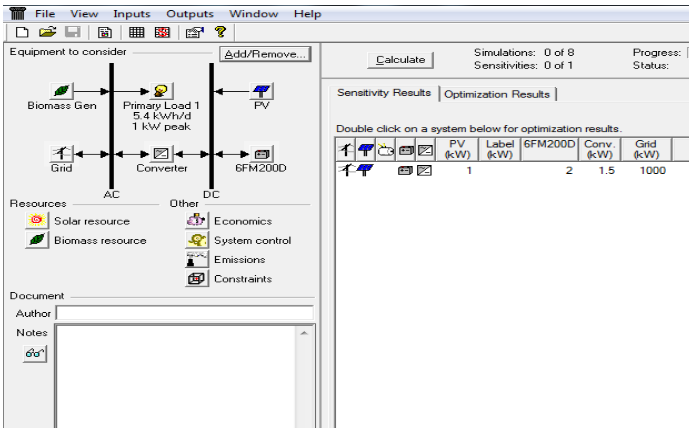


Fig No. 1 Home page of homer

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: 5.1. We have to choose equipment according to our requirements. As per our requirements we take one primary load, one converter, one battery, one PV, wind and a Grid. The below Fig No. 5.2will shows how to add or remove equipment for simulating purposes.

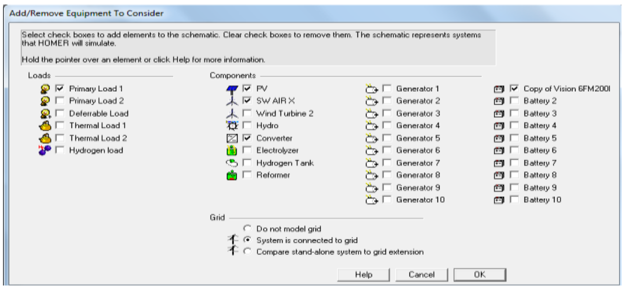


Fig No. 2 Add or remove equipments for simulating purposes

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. 6.3 show how the primary load gives result.

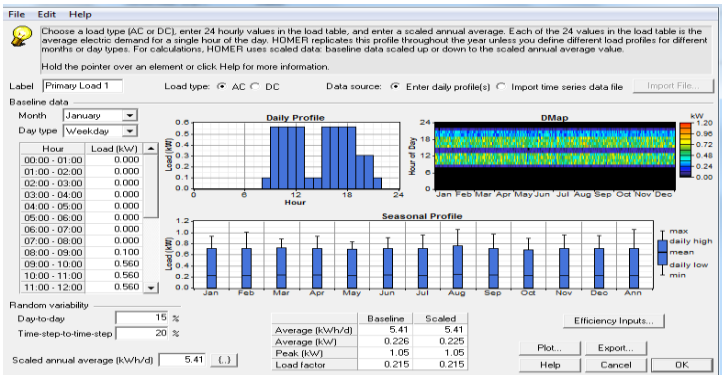


Fig No. 3 Primary load input

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. 5.4 shows that, its life time is 20 years.

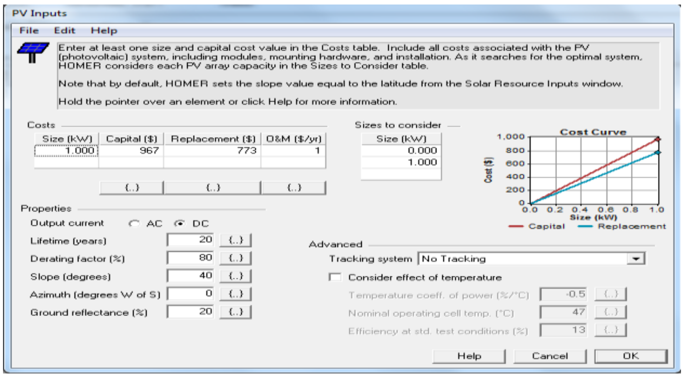


Fig No. 4 PV input

Using this window will specify the latitude and the amount of solar radiation available to the photovoltaic (PV) array throughout the year. HOMER uses this data to estimate the productivity of the PV array each hour of the year.

Biomass resource inputs

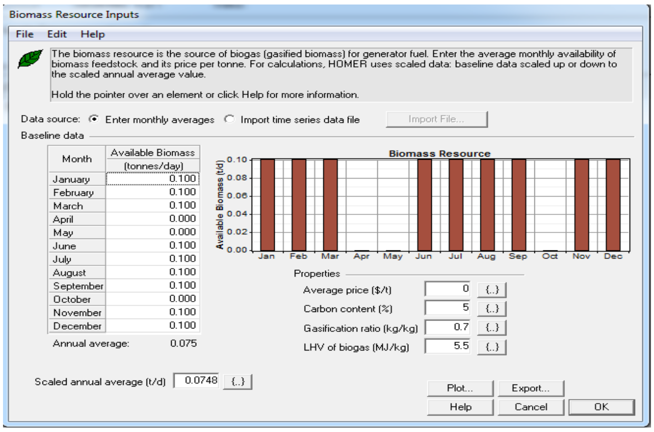


Fig. 5.: Biomass Resource inputs available in Central mess

Biomass resource participations are engaged based on the kitchen waste offered in central mess on yearly basis.

Battery input

Battery is primarily used for backup persistence. Here; we have to indicate a battery of appropriate rating which meet our load petition is shown in Fig No. 5.7 After that we have to enter quantity also capital cost to the cost table according to our requirements. At this point we get the curve amongst cost and quantity. We are with battery for back-up supply when nearby is no grid resource and solar radiation.

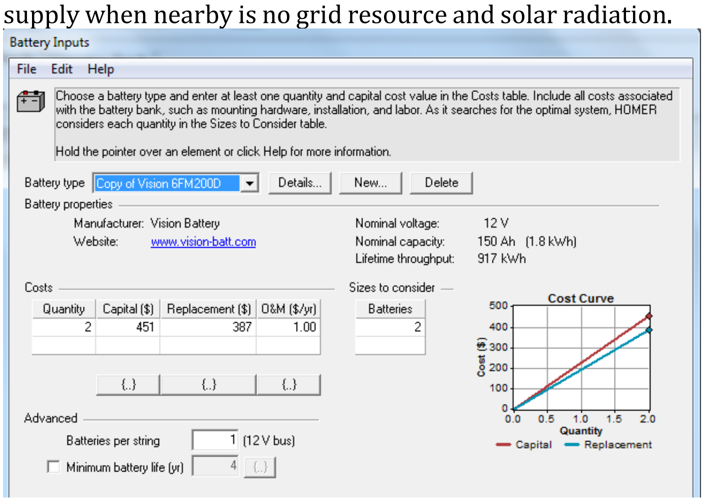


Fig No. 6 Battery input

Converter input

A converter could 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.

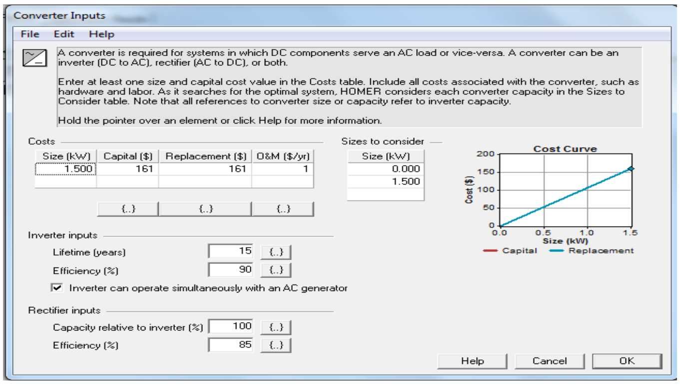


Fig No. 7 Converter input

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. 5.9.

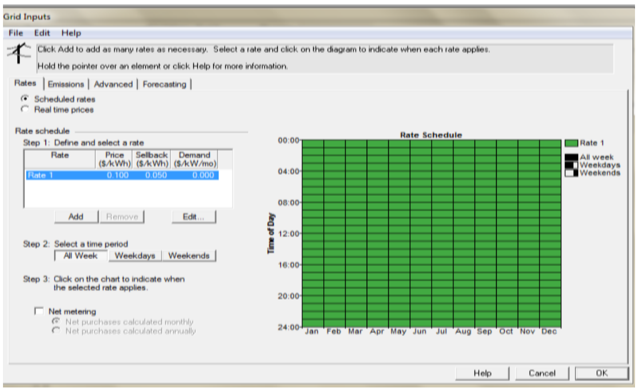


Fig No. 8. Grid input

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. 8.

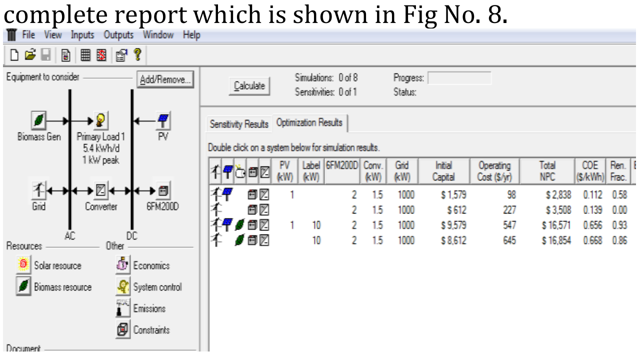


Fig No. 9: Final simulation results

3. SIMULATION OUTPUT REPORT

System architecture

System Report - Final biomass

System architecture

PV Array	1 kW
Biomass Gen	10 kW
Grid	1,000 kW
Battery	2 Copy of Vision 6FM200D
Inverter	1.5 kW
Rectifier	1.5 kW
Dispatch strategy	Cycle Charging

Cost summary

Total net present cost	$ 16,571
Levelized cost of energy	$ 0.656/kWh
Operating cost	$ 547/yr

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, Biomass generator, battery and converter net present cost. Here different color shows different net present cost of PV, grid, battery and converter which includes capital, replacement, and operating, fuel and salvage cash flow.

Net Present Costs

Component	Capital ($)	Replacement ($)	O&M ($)	Fuel ($)
PV	967	241	13	0
Biomass Gen	8,000	2,515	12,847	0
Grid	0	0	-8,406	0
Copy of Vision 6FM200D	451	337	13	0
Converter	161	67	13	0
System	9,579	3,159	4,480	0

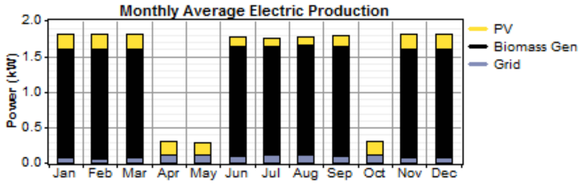
Electrical power production and consumption

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	Fraction
	(kWh/yr)	
PV array	1,527	12%
Biomass Gen	10,050	81%
Grid purchases	828	7%
Total	12,405	100%



Load	Consumption	Fraction
	(kWh/yr)	
AC primary load	1,975	16%
Grid sales	10,278	84%
Total	12,252	100%

4. Conclusion

Particulars	Cost
Total system cost of PV 1KW	1,00, 000 Rs/-
Biomass Generator 10KW	5,00,000 Rs/-
No. of units generated from solar panel	1527 kwh
No. of units generated from biomass	10050 kwh
Each unit rate by considering maximum demand rate and diesel generator option.	9 Rs/-
Total revenue from solar power & Biomass power	12405 × 9 = 1,11,645 Rs/- year
Payback period	5.73 years

Here, the wind turbine power generation is very low comparing to its cost. If the wind turbine capacity is more the number of units generated will be more. As a rule of thumb; If a 5kw wind turbine preferred; then the number of specific units generated will be much more than the 400 w unit. Hence they pay back period will be a smaller amount.

The habits of renewable energy sources are flattering very necessary due to the inadequate reserves of fossil fuels and global environmental apprehensions for the production of electrical power generation and exploitation. In remote areas, villages, it is laid-back to get more volume of biomass. Henceforward by the use of these systems comprising of Biomass to generate methane gas and electrical energy in these remote zones can be more cost-effective.

Kitchen (food waste) was composed from unlike hostels of to the reactor which mechanism as anaerobic digester system to products biogas energy. The anaerobic digestion of kitchen waste produces biogas, a appreciated energy resource. Anaerobic digestion is a microbial process for production of biogas, which entails of primarily methane In College university grounds by employing the hostels food waste and other biomass deposits can be exploited for better purposes. Biogas production involves anaerobic digestion. A hybrid technology of Solar with Biomass generator is an opportunity to improve the steadfastness of the system. This paper has emphasized the economic respects of Solar - Biomass hybrid systems by via Homer software simulation.

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