International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 08 Issue: 05 | May 2021 www.irjet.net p-ISSN: 2395-0072

ANALYSIS OF POWER GENERATION FROM BIOGAS AND MINI HYDRO GRID USING HOMER SOFTWARE

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Abstract - *In today's scenario renewable energy is the most efficient green technology for viable growth. HOMER (Hybrid Optimization Model for Electric Renewable) Pro software is used in this work for analysis of power generation from biogas and mini hydro grid to community supply load.*

HOMER Pro simulates and optimizes the appropriate solution for a hybrid system and generates reports covering all the aspects of system development. For the implementations of HOMER software, a typical hybrid system is considered.

The present work involved HOMER Pro software in which data is implemented taken from both plants. The data is collected from practical consideration i.e. from hydro and biogas plant.

After simulations, results are obtained mainly based on operating cost, cost of energy (COE) and net present cost (NPC) are manipulated in HOMER Pro software. The performance of the models for economic viability is evaluated and finally the sensitivity analysis is performed on different conditions of nominal discount rate and inflation rate to optimize the system.

***Key Words*: Agitation, Anaerobic digestion, Biogas plant, Global warming, HOMER pro software, Methane, Mini hydro gird.**

1. INTRODUCTION

A. Background of the study

The past decade, problems with energy supplying are present overall in the world. Without electricity life has become highly unimaginable. The renewable technologies such as (biomass, geothermal, hydel, wind, and solar) neat and clean sources of power energy that can be contribute an electricity to rural areas and connected into grid lines.
Electricity is a conventional shape of energy, personal advancement is greatly enhanced by the active use of electricity. At present, consumers can not be given constant and poor aspect number of electricity, because they want buy good electricity as compared to the national demand. Over population, renewable energy sources are limited use. In the power generation of high dependency on natural gas is improper transmission and distribution policy.

'Hybrid' defines a combination of energy and power storage system. Hybrid arrangement normally lie of more than two renewable energy sources connected to provide enlarged system capability. Electricity generation components that can be apply renewable energy resources.

B. Objectives

i. Make better use of local ordinary resources.
ii. This society should be used to reduce the variation in oil price.
iii. Get immediate access to safe electricity at any time.
iv. Increasing economic productivity and creating employment opportunities.
v. Establish social adherence by giving access to generating power for all consumers.
vi. There are required to improve the healthcare and education.
vii. Fighting climate change and poverty must be tackled head on.

C. Literature Review

The world's population increasing day by day at a high rate, because now day's population is almost double that of 1960, and it is estimated that the increase in population to nine billion by 2050. This situation leads to a situation in which the percentage of global energy use in cities is increasing significantly and biomass is a resource that is contemporary in a variety of materials: sawdust, wood, straw, seed waste, paper waste, compost, Dirty water, household waste, etc. The major countries incorporating the subject of biomass as a renewable asset, according to Scientific Production, are the United States, followed by China, India, Italy and Germany. All three countries are focused on joining different groups: the United States, India and the United Kingdom [1]. Presented a paper on the green technology is creating the environmentally energy resources like as wind power, hydro, solar energy and biogas to increase quickly. Another merit of these renewable energy resources are suitable and cost valuable setting up at remote section with fixed or approximate access to the microgrid power. For the interconnected power system, it shows a modeling based mode arrangement having biogas, hydro, PV generation systems. The distributed management scheme is enforced to stable the frequency and voltage. The dynamic performance

of PV and hydro is also measured by this paper, after the incident of abnormal disturbances over a rapid change in electric load [2]. There are various power plants such as hydro, solar, nuclear, thermal etc. but some demerits like carbon dioxide gas exhaust pollution, the demerits like global warming demand of high fuel price etc. To avoid the factors that we have developed the biomass power plant is the cost of fuel day and night to meet the requirements of electricity and environment involvement which motivate to implementation of renewable energy in India [3]. The rural electrification program is a major challenge in India. In rural areas, distribution of electricity to remote and remote villages by issuing power distribution grids is difficult due to high distribution and communication deficit; Financial impracticality with remote and unknown nature of villages; Spread the population in small villages; Low financial health of state service etc [4]. This paper discussed the usage of biogas and biofuels. This paper studied a brief summing up of conversation with different fuel source with compliments to its effect on the functioning, surroundings, financial dependence of the plant. Initial outcomes from the study founded were most economic benefits with appropriate transport for biofuels alternately energy production, with energy generation was durable and low maintenance demands [5].

2. MATERIALS AND METHODS

A. Study location

Chupki power station is located on village Alamgir, Ludhiana, Punjab, the canal on by pass route. Employing syphon intake technology is used and this plant handling vertical-axis semi-Kaplan Turbines connected with induction generators. Chupki plant is fully automated and appropriate programmable logic control (PLC) established supervisory control and data acquisition (SCADA) system. There are three gates are provided which are electrically operated on the main canal to alter the water into by pass route for power generation and power station is also having two hydraulically operated gates for regulating discharge applicable for power generation. The power station was charge on 12.11.1999. The turbines are associated with vertical alternators over gear boxes. The generated power is linked with LT bus bar over air circuit breakers (ACB) and11 kV step up transformer. 11kV transformer outdoor has been installed with all precondition switch gears and instrument transformer etc. The generated power is transfer to 66/11 kV Substation at Alamgir, Ludhiana, Punjab.

This site proposed for 1MW High Rate Biomethanation Plant is Haibowal Dairy Complex, Ludhiana, Punjab. Domestic biogas plants producing 1-6 cubic meters (CUM) of biogas per day using animal manure have been growing in India for likewise 3 decades. Over time, more 3.4 million units were generated. Some small and medium sized biogas plants with a capacity of up to 100 kW have installed. This project will be the first of its kind in the country where power generation will be done with the help of cow dung. The project at Haibowal was constructing as the 1st project to establish large-scale power generation from animal manure. The project has been instrumental developing such projects for recovery as well as producing large quantities of rich organic fertilizers and GHG has proven the technical feasibility of reducing emissions.

B. Data collection and load profile

Load demand: In this work, an average daily load is considered to be 2145 kWh/day for a community. Generally, daily power consumption in Ludhiana is higher in the evenings for residential usage. The load profile menu in the HOMER software shows the hourly power consumption in a day and the month ahead. A primary load is defined as an electrical demand that must operate according to a specific program, which can produce any sample that uses electricity. In each step, Homer sends the gene's generating devices to the system to provide the total considered primary load.

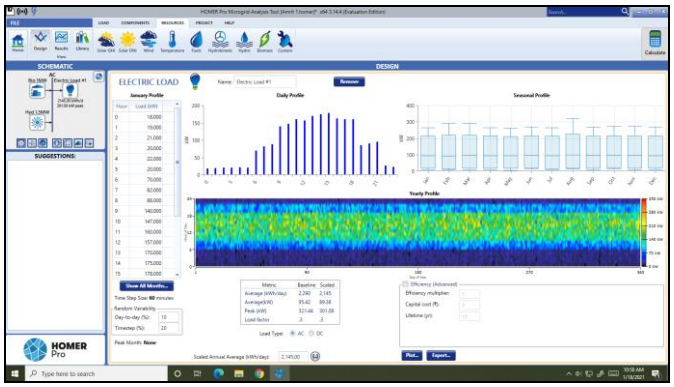

Fig- 1: Community load profile

C. Biomass and Hydro Resource Assessment

A separate source of biomass is available at the selected site, and the major biomass is municipal solid waste generated by nearby cities. The daily solid waste production through Ludhiana city is about 27 tons which is very high. Apart from this, there are many livestock and poultry farms available in the district and fertilizer can also be used from these farms. Therefore, efficient biogas production from these accessible biomass sources may be possible. For this study it is assumed that the daily breast biomass is approximately 27 tons which is available at the selected site. The fuel price, carbon content, gasification ratio and the lower heating value of biogas in the biomass energy consent assessment are shown in Figure 2. India has a huge prospect in hydro energy generation and utilization over the year. Daily average Mini Hydro Resource in the selected location was found 25.90L/s. as shown in Figure 3.

Fig- 2: Monthly available Biomass Resources

Fig- 3: Monthly averages Mini Hydro Resource

D. Plant Data

Table -1: Biogas Plant Details

Sr. No.	Biogas plant parameters	Specifications
1.	Plant capacity (kW)	1000
2.	Dung available (Tonne/day)	07
3.	Biogas produced(m^3/day)	346.5
4.	No. of digesters	2
5.	Capital cost of the plant (Rs.)	14,00,00,000/-
6.	Subsidy@33% (Rs.)	4,66,66,666/-
7.	Net capital cost (Rs.)	9,33,33,334/-
8.	Annual operating cost (Rs.)	23,90,940/-
9.	Annual plant cost (Rs.)	2,01,24,273/-
10.	Labor cost	16,56,000/-
11.	Annual energy generated	1,92,632 kWh
12.	Generation cost (Rs.)	Rs. 6 per kWh
13.	Operating years	20

Table -2: Chupki Small Hydropower Plant (2x750 kW SHP Plant) Details

Sr. No.	Mini hydro plant parameters	Specifications
1.	Plant capacity(kW)	2*750
2.	Capital cost of the plant(Rs.)	8,00,00,000/-
3.	Subsidy@33% (Rs.)	2,66,66,666/-
4.	Net capital cost(Rs.)	5,33,33,334/-
5.	Replacement cost (Rs.)	10,00,000/-
6.	Operating and maintenance cost	17,60,000/-
7.	Labor cost	12,00,000/-
8.	Annual energy generated	2,25,600 kWh
9.	Operating years	30-40

E. Simulation and Optimization with HOMER-Pro

In this study, a Biogas and mini Hydro power plant is used to design the Hybrid Renewable Energy System (HRES). For combustion engine biogas is used to operate the system, which is derived from available biomass resources. The schematic diagram of this system is shown as:

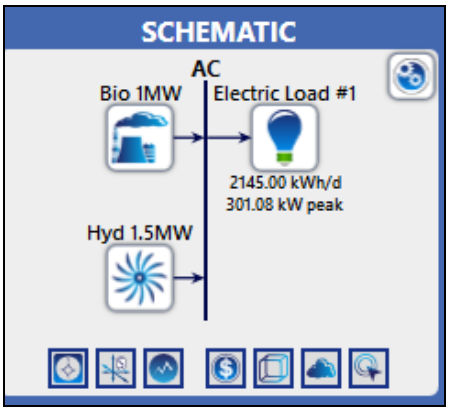

Fig- 4: System components and configuration

3. RESULTS

Annual energy generated by Chupki Small Hydropower Plant (2x750 kW SHP Plant) Ludhiana is 2,25,600 kWh. Annual energy generated by 1 MW biogas plant is 1,92,632 kWh. Optimization Results Optimized biogas and mini hydro power system design based on lowest net current price (NPC) or lowest energy permit (COE) with the ability to

supply power without loss using renewable energy sources available. Optimization results show all possible solutions for the selected sensitivity case that can be categorized or displayed as a whole. It represents a high ranking system configuration referring to the total NPC in the results of the overall optimization. The categorized results table shows the minimum cost system that includes both NPC and COE. The following Fig. shows optimized results optimized for the best biogas and mini hydro power system configurations.

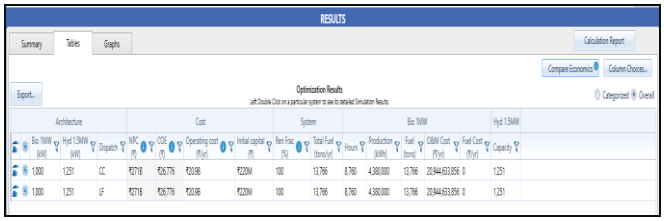

Fig- 5: Categorized optimization results from HOMER

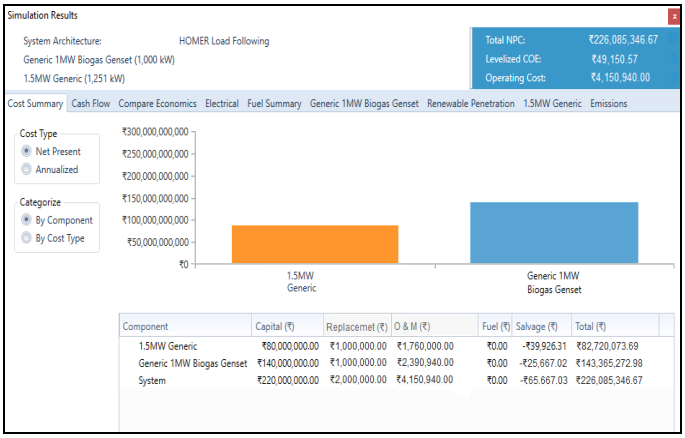

Fig- 6: Cost summary for the selected option

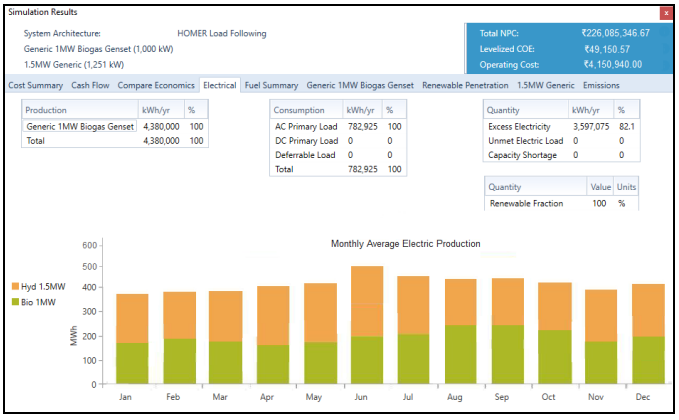

Figure 7. Monthly average electricity generation by the Biogas – Mini Hydro Power system

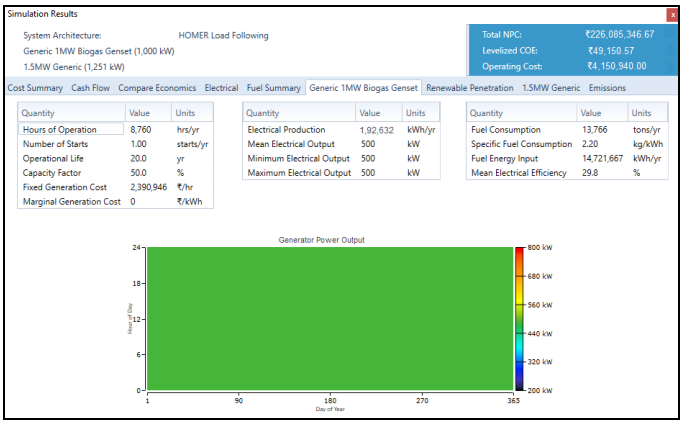

Figure 8. Generic 1MW Biogas Genset Result

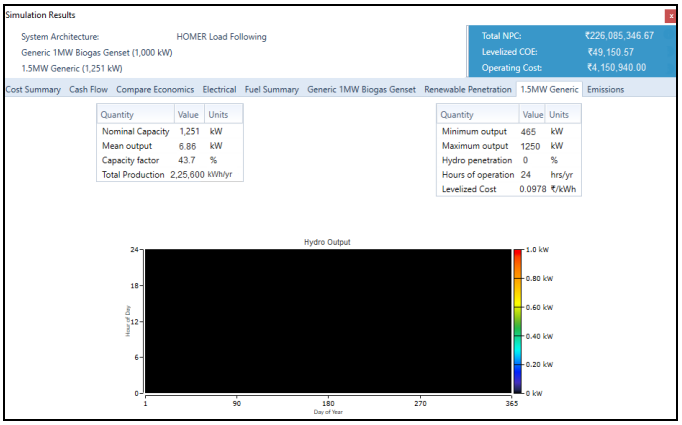

Figure 9. 1.5MW Generic Hydro Power Plant

On the other hand, this type of renewable power generation plant has no negative impact on the environment and has good prospects for the future. Greenhouse gas emissions to the environment by such to-do production plants are minimal and the annual emissions through the proposed HRES system are illustrated in Figure 10.

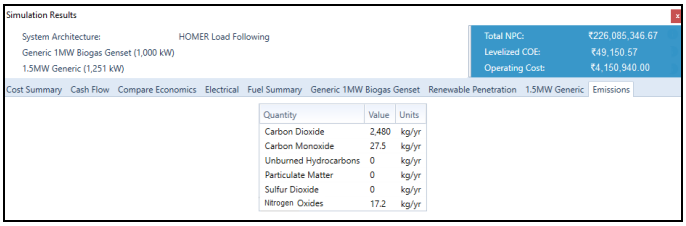

Figure 10. Emissions in HOMER Pro Software

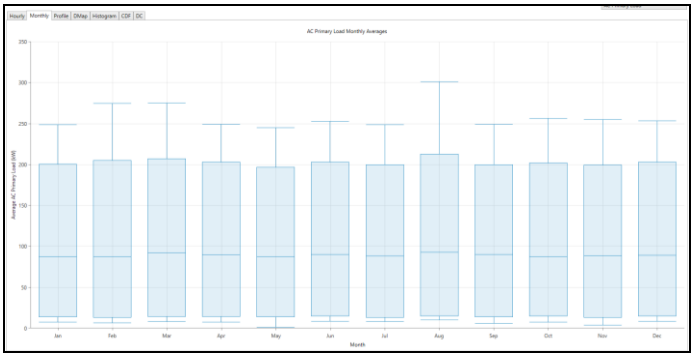

Figure 11. AC Primary Load Monthly Average

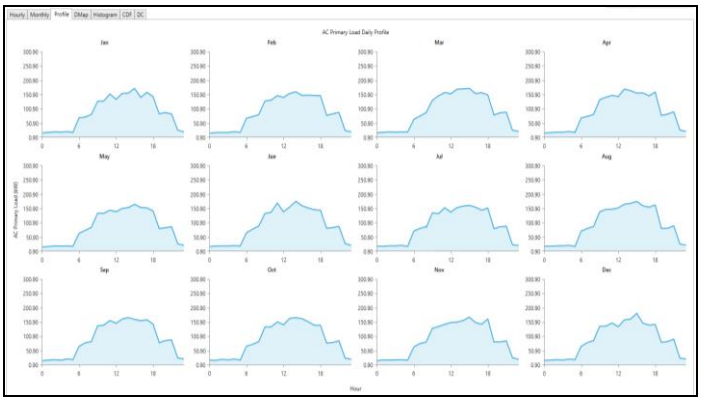

Figure 12. AC Primary Load Daily Profile

4. CONCLUSIONS

This includes a study of a combined biogas and mini hydro power plant for power generation, which will help address the effects of global warming and the impact of statistics on prosperity or dependence. The purpose of hybrid power plant based power generation using biogas and mini hydro power plants is to increase the efficiency of the system. Many alternative sources of energy are being considered, nuclear, solar, groundwater, air, ships based. We need to integrate various non-conventional sources for the different load conditions such as wind energy, photovoltaic, biogas, mini hydroelectricity technology etc.

In this study we need to approach to non-traditional technology and potential in emerging countries like India. The study includes power generation from biogas and mini hydro power plants. Using this study, a 1.5 MW mini hydro power plant including 1 MW biogas power plant can be set up in rural areas of northern India. Mini hydro power plant generation cost is Rs. 6 per kWh. The present work involved HOMER Pro software in which data is implemented taken from both plants. This data is collected from practical consideration i.e. from hydro and biogas plant. The result showed proper performance of every plant and made comparison between both plants. Using the simulation tools we can also optimize these results. However, the various simulation advantages are given as:

i. For each of the 8,760 hours in a year, HOMER can simulate the system by building energy balancing.
ii. Using HOMER software the flow of energy is calculated in every hour and from each component of the system.
iii. The software can also determine a configuration is feasible or not, i.e., whether it can meet up the electricity demand.
iv. It also estimates installing and operating cost of the whole system for lifetime.

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