International Journal of Electrical and Computer Engineering (IJECE)
Vol. 9, No. 1, February 2019, pp. 141~147
ISSN: 2088-8708, DOI: 10.11591/ijece.v9i1.pp141-147

A comparative approach between different optimize result in hybrid energy system using HOMER

Shweta Goyal[1], Sachin Mishra[2], Anamika Bhatia[3]
[1]Department of Electrical Engineering Graphic Era demmed to be University, India
[2]School of Electronics & Electrical, Lovely Professional University, India
[3]Department of Electronics Engineering Graphic Era demmed to be University, India

Article Info

Article history:

Received Aug 29, 2017
Revised Jan 6, 2018
Accepted Jan 20, 2018

Keywords:

Comparative analysis
Configuration
Resources
Study area

ABSTRACT

To compare the different result of optimization of a hybrid energy system. A hybrid renewable energy system (HRES) is the combination of renewable and non-renewable sources which is playing a very important role for rural area electrification when grid extension is not possible or excessively expensive. Non renewable sources like diesel power generator (optional) are used in a HRES for backup when renewable energy supply is not sufficient. While the HRES is very important due to the smallest natural and physical contact compared to non renewable sources, this work proposed a comparison outcome with the help of different component by using HOMER software and get best optimize result for the model. This paper presents a wide-ranging review of various aspects of HRES. This paper discusses study, best sizing, and model, organize aspect and reliability issue.

Corresponding Author:

Shweta Goyal,
Department of Electrical Engineering Graphic Era demmed to be University,
Dehradun - 248002, Uttarakhand, India.
Email: shwetugoyal@gmail.com

1. INTRODUCTION

Electricity generation through renewable sources in a very important topic for research now days. the reduction of fossil fuels and the knowledge of ecological humiliation is the main reason for increasing use of renewable energy in today's scenario, to reduce the effect of green house gases it is very important to develop of a HRES system in rural area [1]. Use of non renewable sources alone can be a very expensive process so to reduce the cost of electricity generation we can also use the renewable sources. They are cheap and easily available for generation.

The main apparatus of the HES mainly is renewable power generator as a primary (AC/DC sources), non-renewable generator as a backup system(AC/DC sources), power conditioning unit, battery system, load (AC/DC) and sometimes it is grid connected while some time stand alone [2]. A general HRES configuration has been shown in Figure 1.

HOMER (Hybrid Optimization of Multiple Energy Resources) is the international set in small grid software, based on decades of listen to the desires of user in the order of the world with knowledge in designing and arrange small grids and transmitted power system that can contain a grouping of non-conventional energy sources, storage, and conventional generation either it is through a local generator or a power grid. Homer system used to reduce the dependency upon other conventional sources [3]. It used to simplify the designing task of the hybrid model, and optimization and evaluation of the economical and scientific option of a highest amount of options like machinery expenses, electric load, and power supply accessibility whether stand alone and grid connected. HOMER basically designed for rural community electrification and now it is licensed to HOMER Energy. Objective Oriented Project Planning) of a hybrid renewable energy system can be used to develop a novel approach of optimization [4].

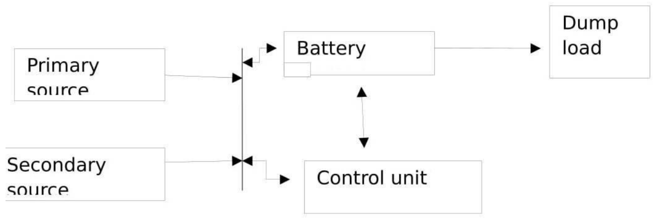

Figure 1. Hybrid energy system component

2. STUDY AREA

Either the government companies are not able to set positive infrastructure for electricity in hilly areas of Uttarakhand because of transportation difficulties. RTI query by Dehradun-based activist Ajay Kumar reveals this information through investigation; that More than 76 villages of Uttarakhand are not electrified yet [6]. Amazingly, two district of Uttrakhand, Uttarkashi and Pithoragarh divide global border with Nepal and China, have a mass of village unelectrified. The current reading projected stand alone hybrid energy system consisting of biomass, solar photovoltaic, diesel generator, and battery. Table 1 shows the particulars of cluster of Dehradun block [7].

Table 1. Number of Villages Targeted for Electrification/Intensive Electrification under DDUGJY (Deen Dyal Upadhyay Gram Jyoti Yojna)

Block	No. of Unelectrified & Deelectrified Village	No. of Electrified Villages Perviously	Total
Chakrata	32	122	154
Doiwala	0	77	77
Kalsi	30	174	204
Raipur	7	111	118
Sahaspur	0	115	115
Vikas Nagar	0	49	49
TOTAL OF ALL BLOCKS	69	648	717

3. LOAD ASSESSMENT

Dehradun block has adequate sunshine as a natural resource; it has moderate wind speeds while biomass available in great quantity as the animal population is much greater in this area and other parts of block. Data collected by the survey and the demand of energy is separated into five main category (i) domestic load (ii) commercial load (iii) agriculture/irrigation load (iv) school load (v) medical centers. Domestic load consists of light, television set, fans, and radio system. Commercial load include power for shops, community centre, street lights while agriculture load includes water pump, irrigation pump, well, fodder machine. Medical centre load consist, CFL, refrigerator, fans, while school load consist of CFL, ceiling fan, desktop, television Table 2 shows types of load for different section. In this section year is divided into two segment of 6-6 month namely summer and winter from May to October and November to April respectively. Different load profiles shown in Figure 2, Figure 3 and Figure 4. shows combined yearly load assessment for given area.

Table 2. Different Categories of Load for Each Time Segment

Load	Power(watts)	Summer Time (May-oct) Watt-hrs/Day	Winter Time (November-April) Watt-hrs/Day
Domestic Purpose Includes :Low Energy Lights(CFL)/Television/Fan/Immersion Rod			
Total		109250	270750
Business Load Includes :Shops/Community Centre/Street Light			
Total		42800	33360
Agriculture/Irrigation Purpose Includes :Water Pump/Irrigation Pump/Well/Fodder Machine			
Total		73814.4	59648
Medical Centre Include :Low Energy Lights(cfl)/Ceiling Fan/ Refrigrator			
Total		15630	15270
School Load Includes: CFL/Ceiling Fan/Desktop(computer)/Television			
Total		5620	2140

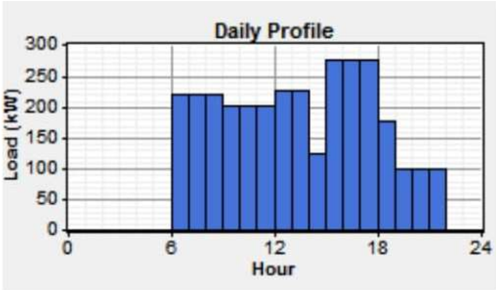

Figure 2. Winter period load profile

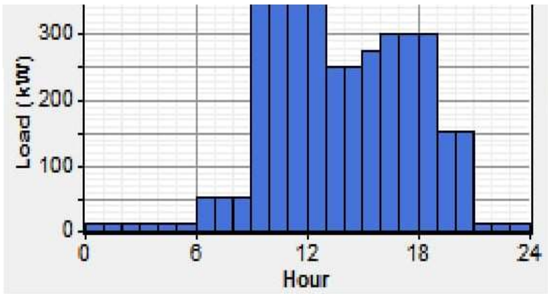

Figure 3. Summer period load profile

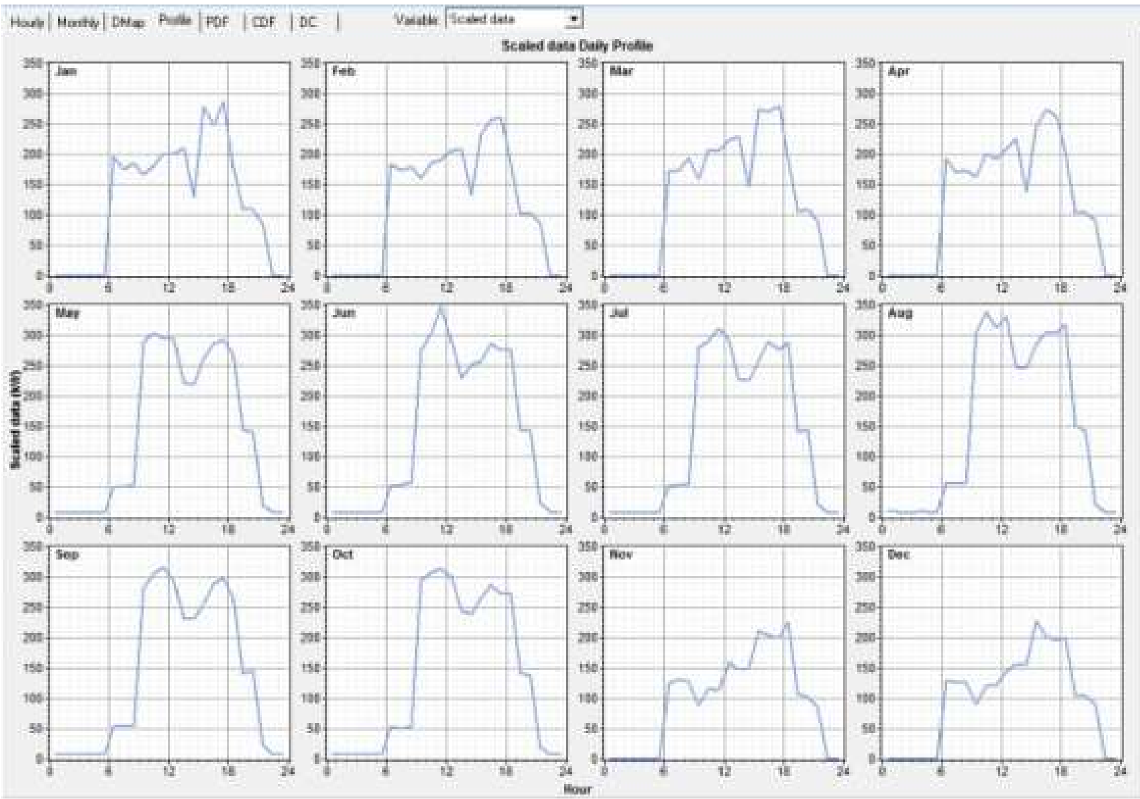

Figure 4. Combined load profile

4. RESOURCES ASSESMENT

In this area, solar and biomass are the major resources. The estimation of potential of available energy resources as well as the energy demand of the study area is carried out as follows:

4.1. Photo voltaic system

The wealth is used for 50 KW system is $37,500 and replacement cost is taken $11,693. 50, 100, 200 kW used as the different capacities for Solar PV panels. And system life is considered 20 years [8]. Table 3 shows the PV input data used in HOMER and Figure 5 shows the graphical representation of that Table 3.

Table3. Solar Resource Input in HOMER

Month	Clear index	Daily radiation (kWh/m2/d)
January	0.620	3.571
February	0.627	4.391
March	0.627	5.429
April	0.637	6.479
May	0.653	7.258
June	0.618	7.075
July	0.519	5.837
August	0.537	5.625
September	0.623	5.698
October	0.707	5.289
November	0.699	4.211
December	0.608	3.256
Average	0.617	5.345

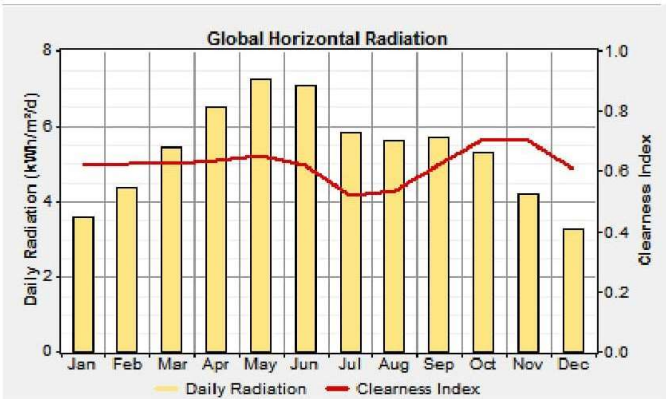

Figure 5. Solar input graph

4.2. Biomass energy

The estimation of Biomass probably depends on the accessibility of animal and agriculture waist. The availability of biomass on the site about 14t/day, Table 4 shows the biomass data in that area. Some biomass used for domestic purpose and balance is obtainable for power generation using biomass gasification [9].

Table 4. Biomass Resource Input

Month	Available biomass(tones/day)
January	10.000
February	15.000
March	17.000
April	10.000
May	15.000
June	17.000
July	10.000
August	15.000
September	17.000
October	10.000
November	15.000
December	17.000
Average	13.984

4.3. Diesel engine-generator set

A generator of 3 kW AC is used at cost $338 initially and replacement cost $576 is considered with $ 0.38 per hour process and preservation charges. Its time is predictable as 15000 working hours. Different capacities of ac generators are considered, for e.g. 15 kW, 20 kW for optimization. Algorithm Figure 6 defines the algorithm work for this research work and Costs of various apparatus are given in Table 5.

Table 5. Cost of Various Components

Component	Cost ($/KW)
PV cell	750
Biomass generator	952
Diesel generator	113
Convertor	750
Battery	1000

This proposed model prepare with the help of one 50 kW photovoltaic cell, one 200 kW bio diesel generator, one 1 kwconverter, 1 S4KS25P battery, one 3 kW diesel generator (for backup system) with 3mwh/day and peak load is 645 kW shown in Figure 7.

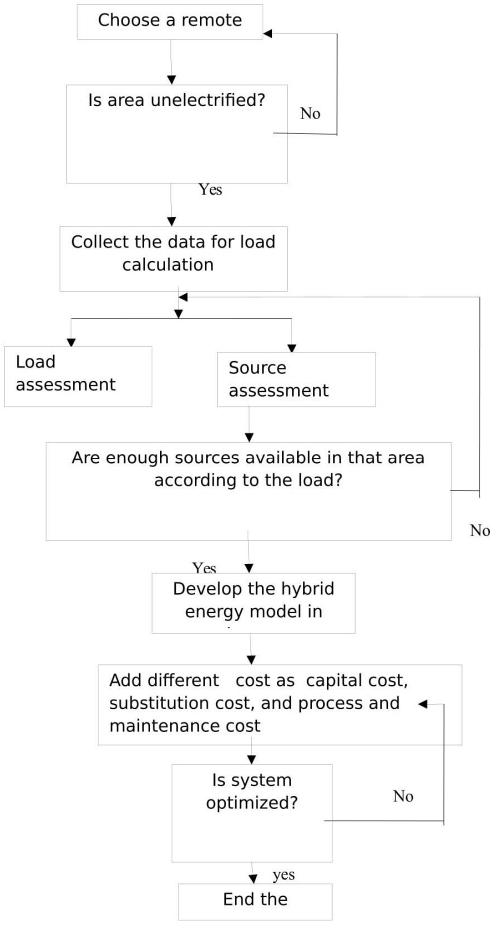

Figure 6. Algorithm frame work

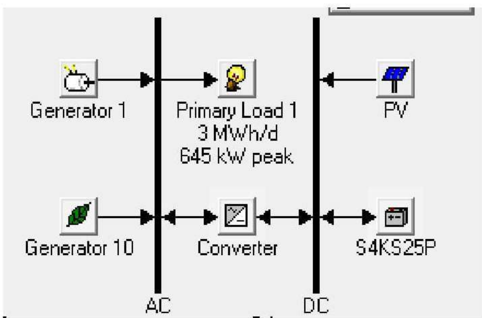

Figure 7. Final model of HRES

5. DIFFERENT CONFIGURATION OF PROPOSED MODEL

We get different configuration with different component result which is shown in Table 6. But the best result configuration get is I model.

Table 6. Four Different Configurations with Different Component

System Component	Availability			
	I Model	II Model	III Model	IV Model
Solar Photovoltaic	Yes	Yes	Yes	Yes
Biodiesel	Yes	Yes	Yes	Yes
Battery	Yes	No	Yes	No
Generator	Yes	No	No	Yes

It is seen that when using all four component then NPC (Net Present Cost) of $270,146 and COE (Cost of Energy) $0.024/kWh which is best configuration with moderate production. Table 7 shows the electricity production by different apparatus from I configuration. Table 8 shows the comparative study between different configurations in homer with step time 50 and optimized completed in 1.34 min.

Table 7. Power Generation by Different Apparatus

Production	KW/yr	%
PV array	114,863	10
Generator 1	7,474	1
Generator 10	973,728	89
Total	1,096,065	100

Table 8. Comparative Study between Different Configurations

S. no.	Configurations	Total energy production KWh/yr	NPC($)	COE($)/KWh	Operating cost($)/yr
1	SPV ,biodiesel with battery and diesel generator	1,096,065	270,146	.024	3,141
2	SPV, biodiesel without battery and diesel generator	1,170,408	241,074	.021	972
3	SPV, biodiesel with battery without diesel generator	1,089,155	242,034	.021	969
4	SPV, biodiesel with diesel generator without battery	1,177,575	269,228	.024	3,148

6. COMPARATIVE ANALYSIS AND DISCUSSION

The job had been done on HRES for Dehradun Block using solar/ biogas/ diesel/ battery/converter apparatus and found the best suited hybrid model for the selected block, by which we can found the lowest NPC, COE, Operating cost. The optimization and simulation shows that on the base of reasonable COE and NPC, i.e. with the entire four components we get best alternative but meet maximum consistency.

1. I model has the maximum renewable incursion
2. II model consists of SPV/ biogas but no diesel/ battery has lowest NPC. But there is no back up in the system. If somehow any renewable source are not present than we will not able to get electricity. With the comparison of model 1 it reduce the initial cost But meet higher COE and NPC.
3. In III model without diesel generator has same problem as II model
4. In IV model without battery does not have any storage system for excessive battery. Which will increase operating cost so NPC and COE also increase

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BIOGRAPHIES OF AUTHORS

Shweta Goyal is a PhD scholar in electrical engineering department at Graphic Era (deemed-to be University), Dehradun she received her M.Tech form same university .Her interest area included Energy system, Renewable Energy. she has presented papers at several national and international conferences in India

Dr. Sachin Mishra, Associate Professor in School of Electronics and Electrical Engineering (SEEE), Lovely Professional University, Punjab. He received his B.E. in Electrical & Electronics Engineering from B.R. Ambedkar University, Agra, M.Tech in Control Systems from Jai Narian University, Jodhpur. He has completed his Ph.D. from IIT Roorkee in Alternate Hydro Energy Centre. He has several papers in International/national conferences indexed with SCI, Scopus, and UGC approved. His area of research includes Renewable Energy, Design & Management of Small Hydropower, Reliability Engineering and Optimization

Dr. Anamika Jain is a Professor in ECE Department at Graphic Era (deemed-to be University), Dehradun. She has received her PhD Degree from IIT-Roorkee with specialization in Soft Computing. Her interest areas include Artificial Intelligence, Fuzzy Control Systems and Process Control. She has a vast academic experience of twenty years. She has to her credit more than twenty nine publications in National and International Journals/Conferences. She is currently supervising three Ph.D. students and more than ten M.Tech and B.Tech students. She has versatile knowledge and a contributor to Journal reviews.