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TECHNO – ECONOMIC ANALYSIS OF HYBRID GRID CONNECTED POWER GENERATION SYSTEM USING HOMER SOFTWARE

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Abstract

The amount of the conservative energy sources is decreasing day by day. To avoid energy shortage, the use of renewable energy sources is highly required. A hybrid energy system usually consists of two or more renewable energy sources and together to provide increased system efficiency, but design of hybrid power involves uneconomic and excessive capacities result in excess electric generation. The main aim is to provide the possible combination of hybrid power generation system for resident with the lowest capital cost investment compare to other system.

Key Words

Renewable energy source, homer, generator

i. Introduction

The contemporary renewable sources of energy like tidal, solar etc. the renewable sources are available free of cost and pollution free. Human being has used these sources for many years. Because of the poor technologies then existing, the cost of harnessing energy from these sources was quite high.[1] Also because of uncertainty of period of availability and difficulty of transporting this form of energy, to the place of its use are some of the factors which came in the way of its adoption or development. The use of fossil fuels and energy replaced totally the renewable methods because of advantages of transportation and certainty of availability; however these have polluted the atmosphere to a great extent. The proposed system can supply the daily demand of 11.26kWh/day. This system incorporates a combination of solar PV and natural as generator for backup power source which is tied with grid.[2] A hybrid system can be defined as a combination of different but complementary energy generation system based on renewable energy or mixed renewable energy source with backup liquefied petroleum gas(LPG)/ Diesel / Gasoline gen set. The analysis has been done by using HOMER Software.

ii. Hybrid System

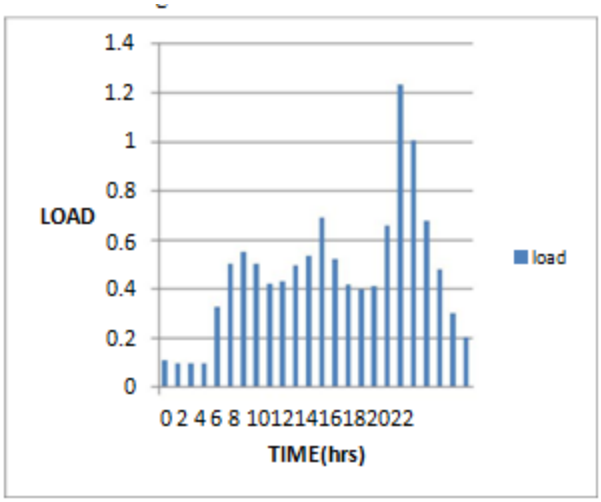
A "hybrid" is something that is formed by combining two kinds of components that produced the same or similar result. A photovoltaic diesel hybrid system ordinarily consists of a PV system, genset and intelligent management to ensure that the amount of solar energy fed into the system exactly matches the demand at that time.[3]

iii. Grid connected solar system

A grid-connected photovoltaic power system or grid-connected PV power system is electricity generating solar PV power system that is connected to the utility grid. A grid-connected PV system consists of solar panels, one or several inverters, a power conditioning unit and grid connection equipment.[4]

Component used in hybrid system

- Charge controller
- Solar array fuse
- DC combine box
- DC distribution box
- AC distribution box
- Cables
- Earthing



- The Graph Shows the residential profile for a load

Net metering, investment and payback period

iv. Net metering

Net metering is a billing mechanism that credits solar energy system owners for the electricity they add to the grid. For example, if a residential customer has PV system on the home's rooftop, it may generate more electricity than the home uses during daylight hours. If the home is net-metered, the electricity meter will run backwards to provide a credit against what electricity is consumed at night or other periods where the home's electricity use exceeds the system's output. Customers are only billed for their "net" energy use. On average, only 20-40% of a solar energy system's output ever goes into the grid. Exported solar electricity serves nearby customer's load.[5]

- **Investment**

Cost of system :-

Cost of 1kw panel
=70,000rs

Cost of 5kw panel = 3,50,000rs

- Surge Protection
- Junction box
- Inverter and grid Tie inverter

Residential load profile
Cost of PNG generato = 55,000rs

Cost of mounting structure
=20,000rs
Cost of inverter
=10,000rs
Miscellaneous parts – cables , combiner box =10,000rs

Installation cost &interested margin

Total cost of 5kw solar rid connected hybrid system =5,00,000 approximate

(Cost of panels &other mounting structure cost is as per KENBROOK solar, which is providing the good quality panel and efficient panel under economical cost)

- **Payback period**

Total generation of the system is 5440 unit/year.

As per the approximate calculation the generation of the system is 5440 unit/year.

By analyzing the approximate Consumption of electricity by 5kW residential load is 3100 unit / year

Electricity bill paid normally:
0-100 unit =Rs 2.60/kWh
101-200 unit =Rs 3.60/kWh
201-300unit= Rs 5.75/kwh

Since the production is 5440 uints , and consumption of the residential load is 3100unit / year hence the entire bill is waived off and generation gets Rs 5.25/kWh.

So, yearly benefit :

Waived of bill	=16,275 rs.
Add payment for units generated	=12,285 rs.
Total benefit / year	=28,560 rs.

If we consider 30% subsidy approved by the government than the final cost of the system is 3, 36,000.

SO, THE PAYBACK PERIOD IS 11 YEARS & 8 MONTH.

v. HOMER Software

HOMER is computer software that has been developed by United States (US) National Renewable Energy Laboratory (NREL) since 1993. It simplifies the task of evaluating design option of varied off-grid and grid connected systems for autonomous, remote, and distributed generation (DG) applications. It also facilitates the comparison of power generation technologies across a wide range of applications.[6]

HOMER allows the modeller to compare a number of different design options, taking into account the technical and economic features of system components and providing a method to find the lowest cost system design the basis of energy source data, system components, and a given load size. It also helps researchers understand and quantify the effect of uncertainty or changes in the inputs. [5]

HOMER's optimization and sensitivity analysis algorithms make it easier to evaluate the many possible system configurations. In designing any power system, the decisions about the configuration of this system needs to be analysed, like components and its specification for the system design, size of that all components, the availability of energy resources and technological options, and the cost of each available technology, all these information are difficult to achieve.

To use it, we provide the model with inputs which describe technology options, component costs, resource availability and etc. It also displays simulation results in a wide variety of tables and graphs that help us to compare configurations and evaluate them on their economic and technical merits. When we want to explore the effect that changes in factors such as resource availability and economic conditions might have on the cost-effectiveness of different system configurations, we can use the model to perform sensitivity analyses.

To perform a sensitivity analysis, we provide HOMER with sensitivity values that describe a range of resource availability and component costs. HOMER simulates each system configuration over the range of values. We can use the results of a sensitivity analysis to identify the factors that have the greatest impact on the design and operation of a power system.

Component :

Methodology:

The considered simulated hybrid renewable energy system consists of Grid, photovoltaic (PV) array with power converter and Natural gas generator. Considered system is designed for an on grid case for a resident to supply 24/7 bases. The data required for solar was taken from online data of NASA methodological department. The HOMER software is used to perform the determination of optimal sizing and operational strategy for a hybrid renewable energy system that based on three main tasks which are simulations, optimization and sensitivity analysis. The following discusses on three principle tasks of the HOMER software.

Solar PV array:

In a PV Array, semiconductor material absorbs photons from solar radiation, which are converted into a voltage through the movement of electrons. Module is produced by combining PV cells together. Modules put together to form array. Solar resource means the amount of global solar radiation that strikes earth's surface. Solar radiation for this study was obtained from the NASA Surface Methodology. Solar radiation ranges from 4.220 kWh/m2/day to
6.790 kWh/m2/day, and the annual average of the solar radiation is estimate to be 5.30 kWh/m2/day. In this case the 4.4kW PV array is used. The operating temperature and efficiency is 45 degree Celsius and 17.30% respectively.

Generators:

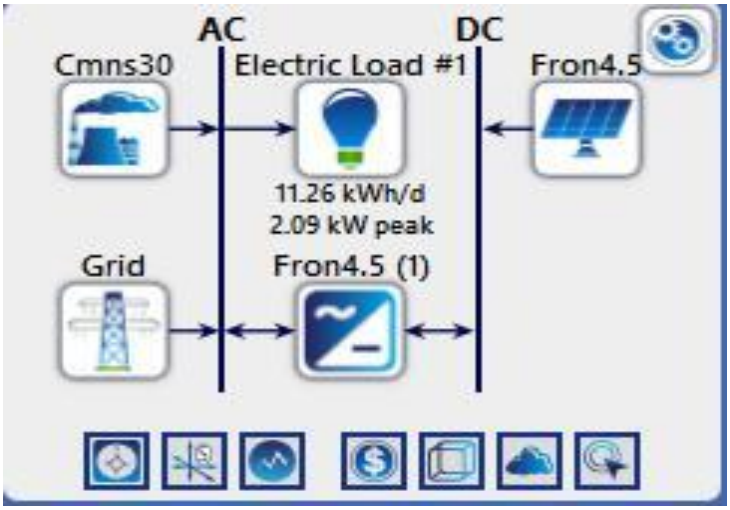
LPG generator sets are easy to operate, use and maintain. They produce no visible exhaust and lower emissions than petrol powered generators. LPG fuelled generator sets are also more durable and reliable than comparable petrol powered units and have a longer life span. In this model 30kW capacity natural gas generator is used. Here 30kW natural gas generator is used because it is the smallest rating capacity natural generator available in homer software for simulation purpose.5kW natural gas generator is preferred for practical design of system.

Converter:

Here converter is used in both mode rectifier and inverter. No storage device is needed is this system, so that the converter will work only as an inverter. Here 4.5kW converter of 97% efficiency is used.

Solar resource:

Main electrical generator of the proposed system is photovoltaic panel which converts solar irradiation directly into Electricity. Since the solar radiation varies daily, hourly and seasonally the electricity produced by the PV array vary accordingly. It can be seen that the solar radiation ranges from 4.220 kWh/m2/day to 6.790 kWh/m2/day, and the annual average of the solar radiation is estimate to be 5.30 kWh/m2/day.



Simulation Result

	CAPACITY				Initial capital cost ($)	NPC ($)	COE ($)
	Front4.5 (kW)	Cmns30 (kW)	Grid (kW)	Front4.5 (1) (kW)			
Grid	-	-	9,99,999	-	-	-	-
PV+ Grid+ Converter	4.40	-	9,99,999	4.50	-	-	-
Generator + Grid	-	30	9,99,999	-	-	-	-
Grid+ PV+ Converter+ Generator	4.40	30	9,99,999	4.50	8,020	6,835	0.0371

Conclusion

In this work proposed hybrid power Generation System is for Resident. Optimization of Grid-PV-Generator hybrid power system connected to Resident Load. The results obtained from the HOMER in the case study gives the optimized Initial Capital Cost is 8020$, Net Present Cost is 6835 $, Cost Of Energy is 0.03071 $.

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