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Comparasion of Different Configuration of Hybrid Electrical Power System – A Case Study of a Site in Peshawar

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***Abstract*--** Instructions are this paper is the cost analysis of different sources of electricity for an educational institute in Peshawar. The technical and cost analysis of different system is done for the case study so that a system could be recommended for the site which can fulfill the demand requirement by least net present cost. By using HOMER software load profile is created and cost analysis is done for a project life time of 15 years. Five different configurations is studied in this paper for techno economic analysis of the system. These configurations are made by selected different combination of solar, generator, battery storage and diesel generator. HOMER software simulate these configuration find out a system which have least net present cost.

By analysis of result obtain from different configuration a hybrid system consists of solar photo voltaic cells of 77 Kw, diesel generator of 50kva, a battery storage of 8 strings of 4 batteries can fulfill our need a least net present which is the recommended system to be install for our system. The system will have a net present cost of 24.6 million, level zed cost of energy is 29.04Rs.

***Keywords*—** electricity, educational institute, loads shedding, HOMER software, net present cost, level zed cost of energy.

I. Introduction

This template Economic devolvement of a country is mainly concern with production and use of electricity. In this modern society living without electricity is very difficult. In flied of life we see electricity is used I-e in daily life we use electricity for lighting for running fans, ironing our cloths, washing cloths using refrigerator or running a television or a computer. On commercial side it is used in decoration and lighting of building and running different electrical machine. While on industrial side it is used in manufacture of various materials used in our daily life. So electricity is backbone of industrial area.

In developing countries like Pakistan there is a lot of energy crisis which have created many problems for the people of Pakistan [1]. Load shielding become the common phenomena in Pakistan. People uses their own solution for load shielding some people uses generator other use solar system [2]. But they don't know what the best solution is for them.

In this research we study hybrid of solar, grid, battery storage and diesel generator. We will find the optimum way to utilize these resources in order to satisfy the diversified load of a commercial building on both optimization of generation sources and also strategy of changing load according to the cost of the source in order to gain maximum economic benefits[3][4].

Literature review shows a lot of been done in this area including current load shielding situation in Pakistan. Potential of renewable energy in Pakistan. A lot similar work in which the feasibility of hybrid system is studded. The techno economic evaluation is also studded by different author by using the HOMER as tool different configuration is consider and their comparison is carried out by their net present cost and cost of energy[5].

Another good research has been carried out by Saleh at all, for Malaysia for PV diesel and unreliable grid. The methodology[7] he used in work nearly similarly to my work. During his work four scenario were investigated and simulation has been carried out through HOMER software and found that there is 13% reduction in net present cost, 10% cost of energy and 50% reduction in carbon dioxide.

In Dhaka city a design implementation and experimental analysis is similar work related to my study[8]. A PV diesel based hybrid is taken as the configuration and the result show that by optimization techniques in HOMER software PV diesel system can reduce the because of dependence of fuel is reduced. The cost of energy of this system is .36 USD/KWH and net present cost is 164106 USD. The installation of PV will save 18440 USD annually. The 30 year revenue will be 553200 USD[8]

Another research is carried out by Deepak Kumar Lal for optimization of PV/wind micro hydro/diesel generator system by using HOMER for a rural area in Sundergah district Orissa state of India various alternative is used to see the see the result. He carried out different simulation in HOMER by changing different load condition on hourly bases and found that a hybrid renewable energy can replace the conventional grid and thus the

transmission and distribution losses can be reduce by using this method[9][10].

J. B. Fulzeli has done his research on optimization of PV wind hybrid system with some battery back. In his research he has done the best way to select to component and used it the site. HOMER has done various optimization process and finally select the best way to optimize these resources so the least net present cost could be obtain. During his research he conclude the contribution of each components in portion of PV is 16.5% battery has 3.8% and generator has largest portion which 76.8% of the total cost [11].

II. ROSPOSED LOCATION

The case study is a college (NIMS) which is under construction. There are three floors in the college and we are going to design a hybrid economical system which can fulfil the demand. According to the owner in 2019 and 2020 we need only ground floor and library on first floor and rest will be needed in future so we have to design a hybrid system which has a demand of ground floor and library.

III. METHODOLOGY

This section describes the procedure implemented throughout this study. An investigation was done to assess the load of selected site. Different possible sources of electricity were observed and HOMER Pro software is used to do the techno-economic comparison of different models for the system. The different steps taken for this research is given bellow.

A. Sessional condition of load

In this section we will start a pre design preparation by making load profile. For this perfuse we visit the site and gain the information of connected load also interview the owner of the site and make a table of the connected load which is given. The case study is a college which is under construction. The load of the site seasonally according to the table shown.

TABLE 1 SEASONAL LOAD CONDITION OF SITE

Months	Dec, Jan, Feb	March, April, May	Jun, July, Aug	Sep, Oct, Nov
Air conditions	Off	Off	On	Off
Fans	Off	On	On	On
Water cooler	Off	On	On	On
Other loads	On	On	On	On
Total connected Load	14.65 KW	20.55KW	30.35 KW	19.55KW

B. Modelling of system

For modelling the system, we use simulation software called hybrid optimization model for multiple energy resource HOMER. Homer software do simulation, optimization and sensitivity analysis of different configuration. It will determine the technical feasible and more economical system among the given configuration the daily load data is obtain through as shown in fig.

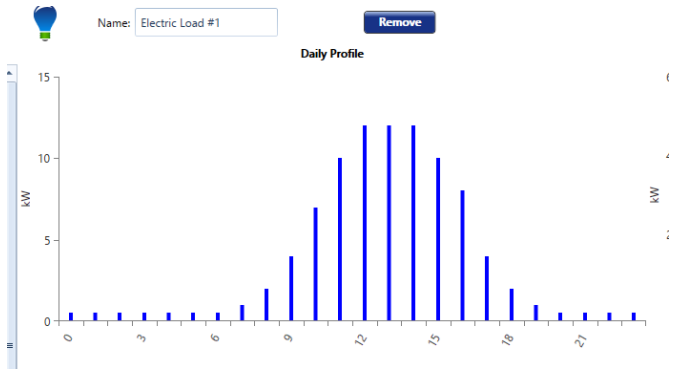

Figure 1 daily load profile

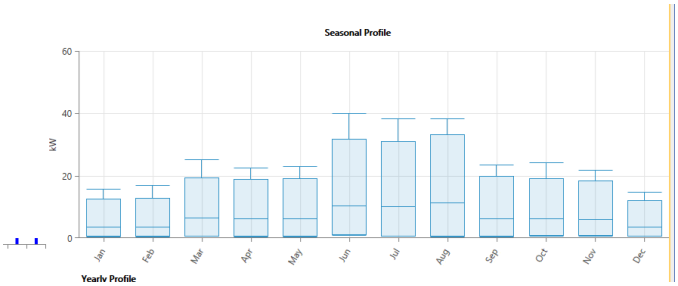

Figure 2 monthly load profile

IV. SIMULATION AND RESULTS

For simulation we take different possible configuration and compare them on technical economical basses and find the best possible configuration for them.

- Reliable grid connected system
- Grid and photo voltaic system
- reliable Grid, PV, storage system
- un reliable Grid, PV, storage system
- unreliable grid, PV, storage and generator system

A. Relaible grid connected system

In this system we will study that how much bill is to paid when the load we created is connected to the system and taking the ideal situation that no load shielding is consider.

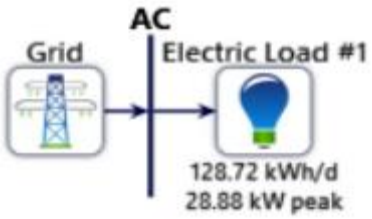

Figure 3 reliable grid connected system

The net present cost of this system is 14.6M which is taken as reference for comparison of other configuration

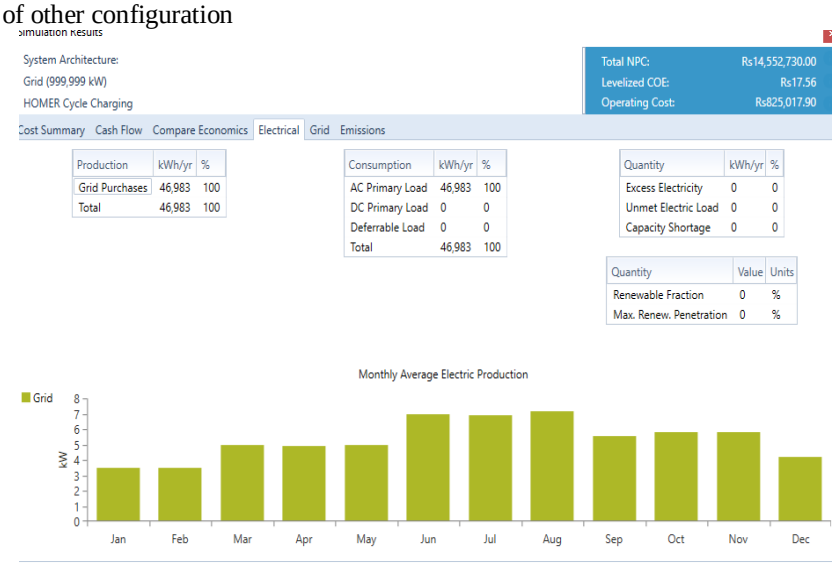

Figure 4 result of reliable grid connected system

B. Reliable grid connected pv system

This system is also an ideal model so that no load shielding is consider. But the study of this system is to investigate the system that how a how a solar system can reduce the level cost of energy and net present cost.

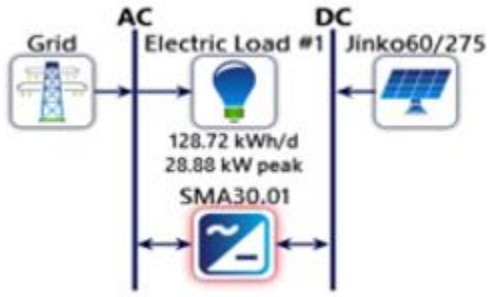

Figure 5 reliable grid with PV system

The net present cost of this system is reduce 9.1M, decrease the cost of the system up to 37 percent.

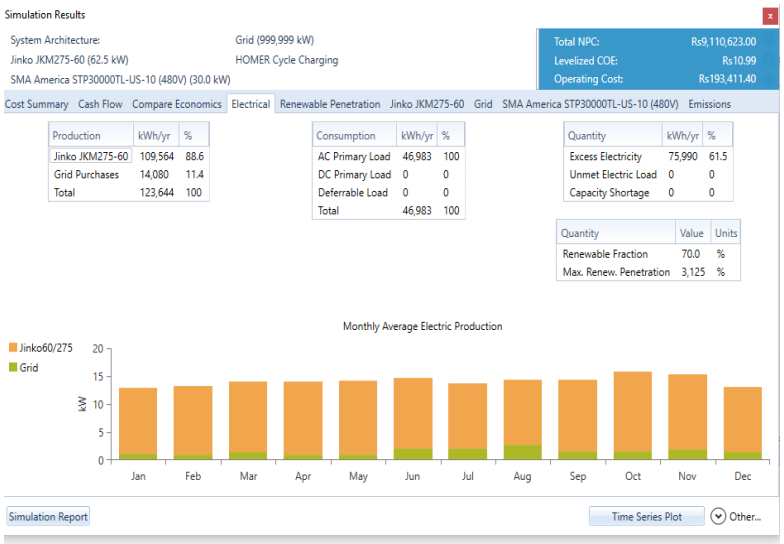

Figure 6 reliable grid with PV

C. Reliable grid, PV, and storage system

in this system the effect of adding a storage battery is study that how it effect the net present cost and cost of energy provided that there is no load shielding is consider the battery will store energy from solar during peak sun hours and use it during off sun hours

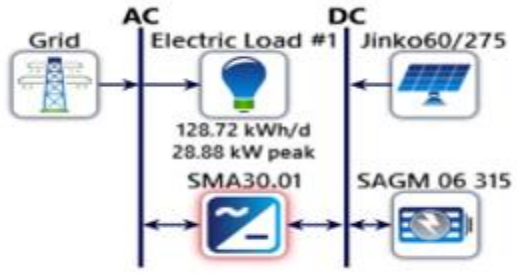

Figure 7 reliable grid, PV and storage

In this system we have a storage system to see its effects on technical and economic evaluation. As there was a lot of excess energy which we lose but by connecting a storage source we can decrease the excess energy to 64,386 kwh/year. The net energy production by solar panels is 98,961 Kwh per year.

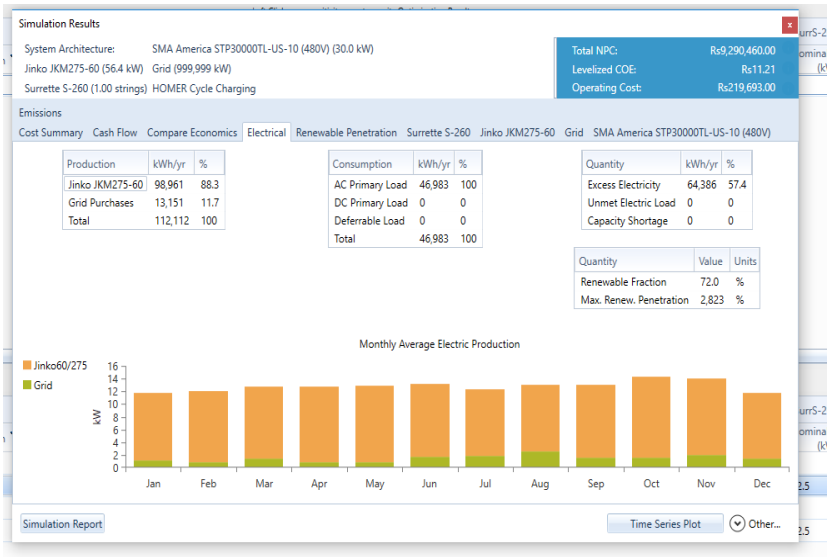

Figure 8 result of reliable grid, PV and storage

The economic analysis of the system obtain from the result of simulation is the LCOE is 11.2Rs while NPC of the system is 9.29 million as shown in fig 23 and table 8. For economic evaluation the net present cost of the system is increased to 9.29 million from 9.15million.

D. UN reliable grid, PV, storage system

Gradually we are coming to our real time situation in which the grid is unreliable. There is none schedule load shielding in our study site. So we simulate the system according to our observation and prediction of hours in which grid is present and hours in which grid is absent we will compare the study to precious system that cost is effected when the grid become un reliable.

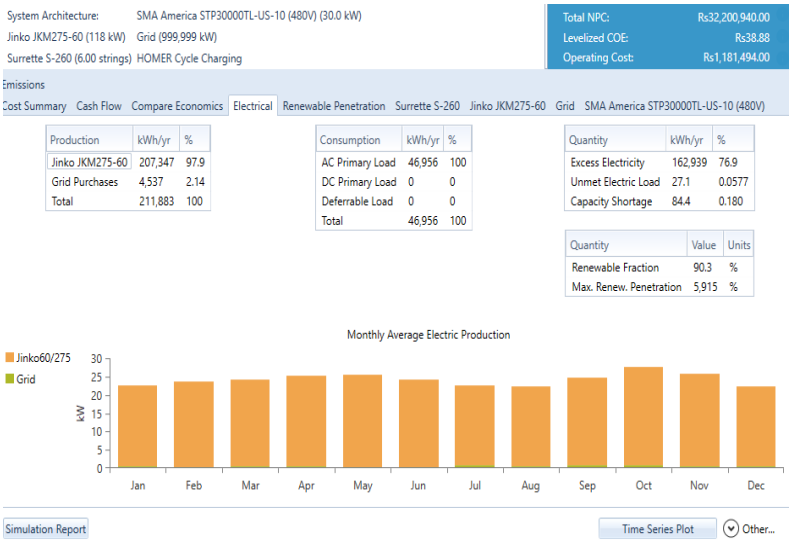

Figure 9 result of unreliable grid PV and storage

The net present cost of the system is 32.2M which 112percent of net present of reliable grid connected system, which is because we make our unreliable system reliable by compromising on economy.

E. Unreliable grid, PV, storage and generator system

The 5th system that is unreliable grid, photo voltaic cells, battery storage and a generator. This system is the most used situation in Pakistan which is our real scenario. The simulation result of the system.

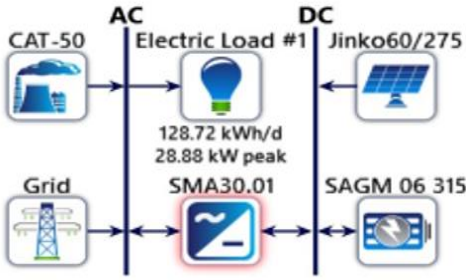

Figure 10 unreliable grid, PV, storage and generator

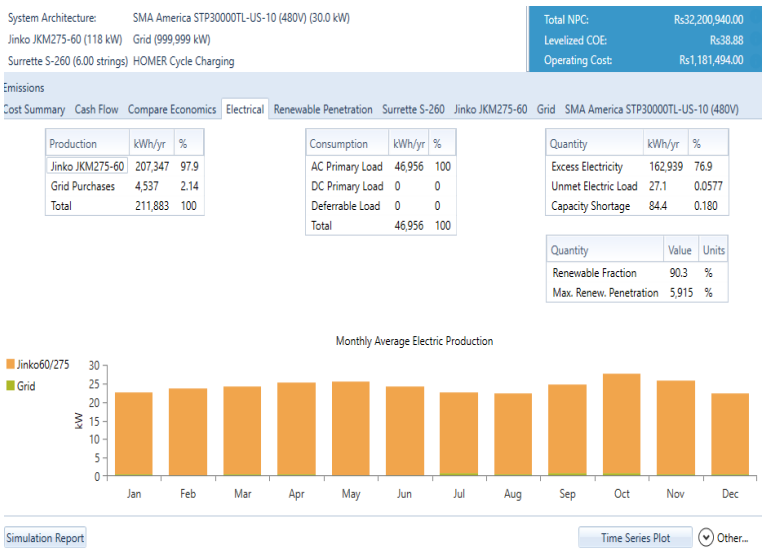

Figure 11 result of unreliable grid, PV, storage and generator

The net present cost of this system is 24.1M. Which is 65 percent of the net present cost of reliable grid connected system.

CONCUSLION

The final conclusion of work is that we simulate different configuration for the system so that an optimize configuration could be obtain. The result of different system by HOMER software. By comparison of different system on the basis of net present cost, level zed cost of energy, excess amount of energy, unmet capacity of energy is calculated and a decision is taken and found out that a grid connected PV, battery storage with diesel generator is the more suitable option for the case study. The optimize values of these component are PV of 77kW, battery storage of 24 and a diesel generator 50 kVA which give us net present cost of 24.6M at LCOE of 29.04Rs per kWh which is recommended system to be install on case study.

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