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EVALUATION STUDY OF THE FEASIBILITY ANALYSIS OF PHOTOVOLTAGE SYSTEM IN PART URBAN AND RURAL IRAQI

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ABSTRACT

This paper gives the feasibility analysis of a photovoltage system in Samawa rural, Nasiriyah and Ar-Rutbah rural, IRAQ. The simulation and optimization results of the feasibility analyses have been conducted by using HOMER. In this paper, solar panel, the number of batteries, the number of transformers, initial capital, the final cost, battery life, battery production, the productivity of the solar panel, electricity and excess net cost of the system have been conducted. The results show the similarity for all location sites

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Keywords: photovoltaic (PV) system; feasibility, HOMER

1. INTRODUCTION

During the last decade, the European photovoltaic (PV) sector has expanded at an extraordinary pace, significantly contributing to reducing CO2 emissions into the atmosphere, while creating so-called “green jobs” [1–3].

At the end of 2013, Italy accounted for 22.4% of total European PV installed capacity, reaching in the period under analysis an average annual growth rate equal to 149.5%, thus more than doubling every year. In particular, over the years the Italian feed-in scheme has granted overly profitable tariffs and advantageous conditions to investors [2–5], originating from the incapacity of political interventions to correlate incentive size to changes in the PV market [6].

Availability of electricity is a key point of socio-economic development of a country. Being a developing country, the government of Bangladesh is focusing on improving the living standard of the people. Bangladesh has a vast population, and the booming industrial and commercial sectors require enormous amount of electricity supply. Thus, developing the electricity sector has been the main focus of Bangladesh in recent years. Until now, 68% of the total population has been allocated under electrification scheme [7]. However, these people face severe electricity interruptions, and majority is still out of electricity. The rural electrification sector has made a very little progress compared to urban areas. Among the total population having electricity, 80.4% are from urban areas and 18.7% are from rural areas [8]. To avail electricity in rural areas via electricity grid is a matter of huge investment, as well as infrastructure limitation. So far, the main source of electricity in Bangladesh is power plants based on crude oil, coal, natural gas and hydro-electricity. Except hydroelectricity, other sources depend on fossil fuel, which is limited in amount. Moreover, burning of fossil fuel produces greenhouse gases (GHGs) that are responsible for global warming. An easy solution is by introducing distributed generation schemes based on renewable energy resources such as photovoltaic, wind, biomass and hydro [9]. Due to the geographical position, Bangladesh possesses abundant solar energy as well as wind speed. The solar irradiation of the country is 4.67 kWh/m2 and the average wind speed at southern part is above 5 m/s [10, 11]. Thus, distributed generation systems are ideal for Bangladesh. System hybridization with multiple renewable energy sources is efficient and cost effective and can cover larger area. To maximize efficiency, renewable energy sources are combined with conventional diesel generators. Researchers have proposed various configuration of hybrid systems based on renewable energy resources of the concerned locations. The popular configurations are PV/Diesel/Battery [12-15], PV/Wind/Diesel/Battery [16-18], PV/Wind/Diesel [19], PV/Wind/Battery [8, 20] and so on.

In Australia, the Intelligent Grid Program [21] was launched on 19 August 2008, being established under the CSIRO's Energy Transformed Flagship, and focuses on the national need to reduce greenhouse gas emissions [22]. The Townsville Solar City Project administered by the Australian Government and Ergon Energy (a local Queensland based distribution utility organisation) has conducted 742 residential and commercial assessments, and installed 1445 smart meters, 160kW of solar panels and eight advanced energy storage systems [21]. Ergon Energy is also working on analyzing the impacts of high photovoltaic (PV) penetration on the grid. Western

Power (a local Western Australia based transmission and distribution utility organization) has also implemented a Solar City program which includes a PV saturation trial to test the impact of distributed generation on the network. The Australian Government's Solar Cities program has helped many distributors to understand the impact of inverter connected renewable distributed generation (DG) [22- 25].

Kaiser and Aditya [25] developed a model using the HOMER simulation tool to find out the best technically viable renewable based energy system for the consumers located in Saint Martin Island, Bangladesh. Experimental results showed that it will be better to create a PV-wind mini-grid combination system for 50 homes instead of installing single home systems. Setiawan et al. [26] presented a design scenario for supplying electricity and fulfilling the clean water demand in remote areas by utilizing renewable energy sources and a diesel generator with a reverse osmosis desalination plant as a deferrable load. It was shown that this hybrid power system is more efficient compared to a standalone system both economically and environmentally. A techno-economic feasibility analysis has been done for a 500 kW grid connected solar photovoltaic system using HOMER and RETScreen software by Islam et al. [27]. From the experiments, it was found that the per unit electricity production cost is competitive compared to a grid-connected system.

In this paper HOMER, software was used to determine the battery bank power capacity, the optimum combination of PV array power capacity, the productivity of the solar panel and the converter size and PV electrical production for a wide range of constant daily load profiles (10-100)kWh in some part of Iraqi sites

2. METHODOLOGY

2.1. Photovoltaic (PV) system and its components:

Is a set of solar cells connected to each other in a solar panel or group of panels to a group of cells called the solar board matrix [28]. the properties of installation in the roofs of buildings or the highlands does not need the extra space of the building and not need any additional structural foundations, so, this leads converting the building to electric generator, the electric power generation is almost the same place will reduce the loss significantly from the transmission and distribution networks, This has led to the spread of solar cell systems significantly.

There are a lot of features for systems of solar cells, which have contributed to the acceptance of users is the most important:

1. the PV systems have fixed and do not produce any work noise and no pollution to the environment.
2. Practical life time more than twenty-five years, and with a light weight.
3. Not need to maintain complex, and can operate in poor weather conditions.[28]

The components of PV systems are a solar panel, Batteries, and Electric converter. The solar panel is the visible part of the solar cell system which is installed on the highlands, away from trees and high buildings, where it consists of a set of linked solar cells with each other in a row or in parallel to produce electric power.

The electric converter is a device that converts the DC power output from the solar panels into AC, which usually adapts energy specifications that you need loads.

2.3. Feasibility

The study of Feasibility has depended on the calculation of the following parameters:

2.3.1. Daily Load: study the daily load of the electricity which are required such as lighting, water pumping, information and communication devices and electronic devices.

2.3.2. capacity shortage is a shortage that occurs between the operational capability required for the actual amount of the operational capability of the system throughout the year.

2.3.3 autonomy battery: It is the ratio of the battery consumption of the electrical loads.

2.3.4. Excess electricity: It is the excess electrical energy that must be disposed of because it cannot be used to serve the load or charge the batteries. Excess electricity occurs when there is a surplus of energy that is produced (either by a renewable source or generator when it exceeds the minimum output load), and batteries are not able to absorb it all

2.3.5. Battery Throughput: Is the number of stored energy in the battery discharging cycles in one year. And productivity change whenever the energy level change as a result of battery discharge.

2.3.6. Battery Life: Through the productivity of the battery, battery life has measured after the energy stored in the battery and power before unloading them.

2.3.7. Solar panels(PV) Production: amount of electrical energy from photovoltaic energy during the year.

2.4. Cash costs

2.4. 1. Total net cost of the system: Is the value of all costs are paid over a limited period minus the value of all benefits, including revenue, capital costs, replacement costs of fuel and other costs.

2.4.2. Total Capital Cost: cash value of the system cost.

2.4.3. Total Annual Cost is the total annual costs for each element of the system and to other annual costs, for example, the operator.

2.4.4. Energy costs : It is defined as the average cost per kilowatt hour of electricity .

3. RESULTS AND DISCUSSION

After the implementation of the Homer simulation program in selected areas for the best design of PV system in Samawa rural, Nasiriyah and Ar-Rutbah rural,The comparison between the results and choose the best value has conducted The following results for the parameters: solar panel, the number of batteries, the number of transformers, initial capital, the final cost, battery life, battery production, the productivity of the solar panel, electricity and excess net cost of the system.

3.1 Simulation Results of PV system design using Homer for Samawa rural

3.1.1 Daily load versus boarded power generation capacity, the number of batteries , the ability to energy conversion and COE for the Samawa rural..

As shown in Figure 1 below using Homer program, the optimal system for PV system power to the Samawa rural to the ability of power generation boarded PV panel Place between (1 – 26) kW, the number of batteries ranges (1- 15) and the ability to energy converter be between(1 until 14.5) kW and the Energy costs (COE)(0.121 - 0.153) kWh/$ compared with the daily load variable between (4 - 100 kW / day).

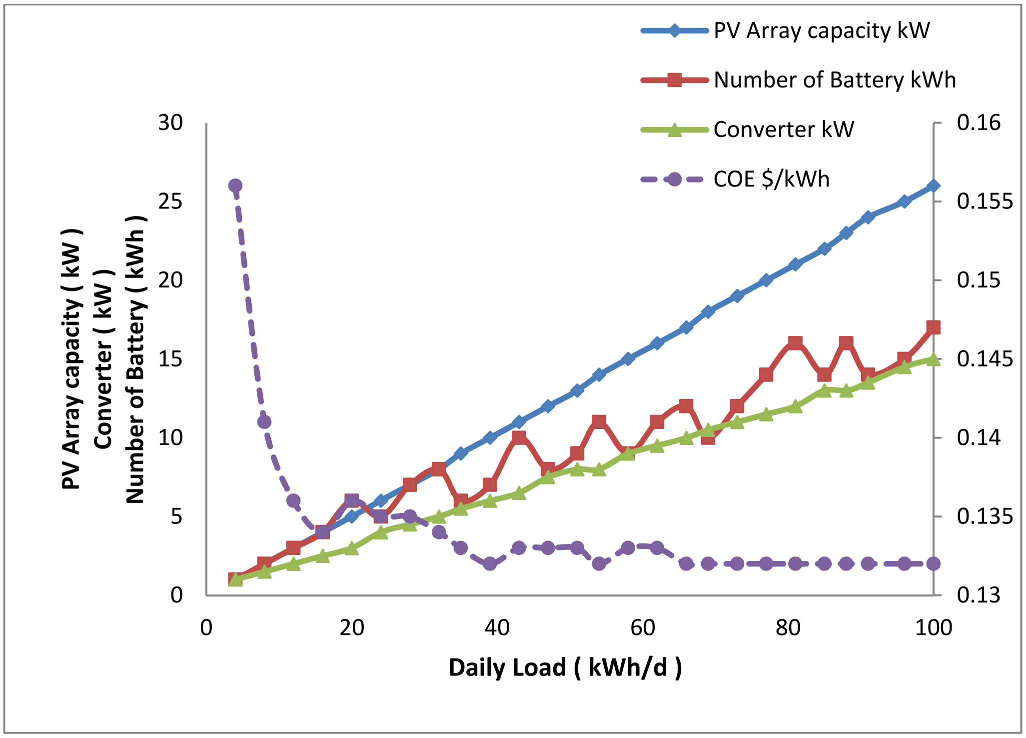

Fig.1.illustrates the change in PV Array capacity, boarded the number of batteries , the ability to convert the energy and COE compared to the daily load for the Samawa rural.

5.1.2 Daily load compared to the extent of PV to produce electricity, the lack of capacity and excess electricity compared to the daily load the Samawa rural.

In the Figure 2 we have get over the PV to produce electricity between (1797 to 47480) kWh / year, and the lack of capacity ranges (from 25 to 1105) kWh / year, as well as, excess electricity will be between (139 to 5333) kWh / year versus variable between Daily Load (4-100) kW / day

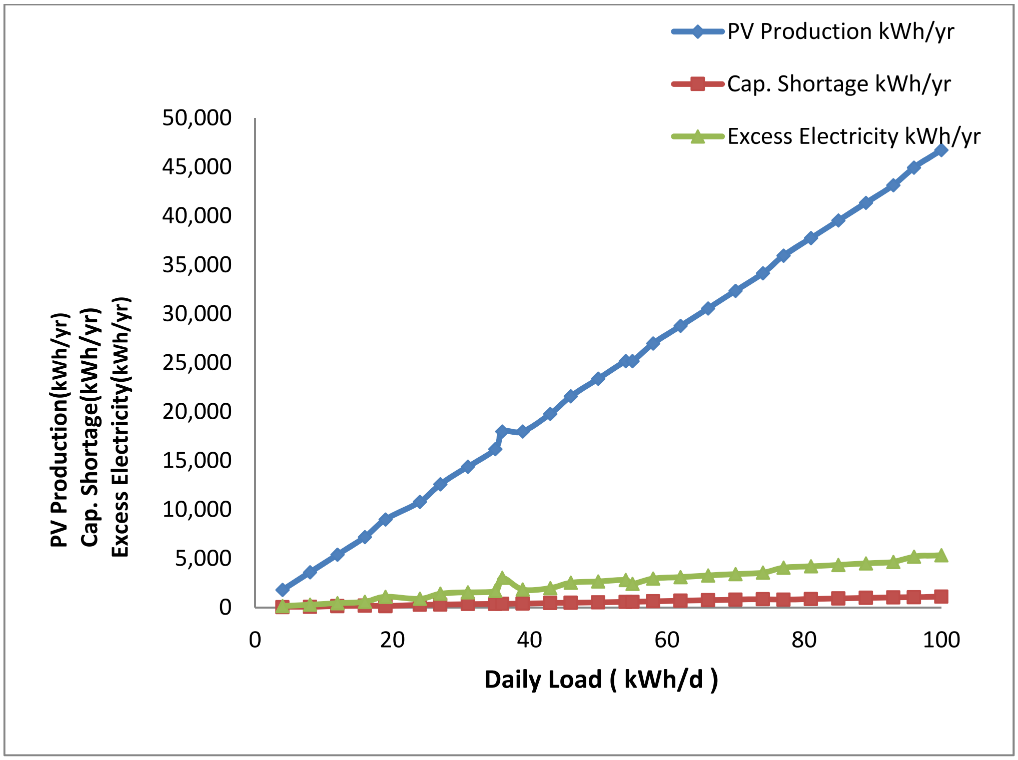

Fig.2 over the PV to produce electricity, the lack of capacity and excess electricity, compared to the daily load for the Samawa rural.

5.1.3 Daily load versus over the productivity of the battery, the number of batteries, chargers self-battery, and battery life time for the Samawa rural.

The following Figure 3 shows over of the productivity of the battery throughput which is change from (343 to 7977) kWh / year, also the number of batteries between (1 - 15) , as well as, self-charging battery autonomy ranges (8.9856– 14.976) hour and the battery life time between(9.4 - 10) a year, compared with the daily load variable between daily load (4 - 100) kW / day.

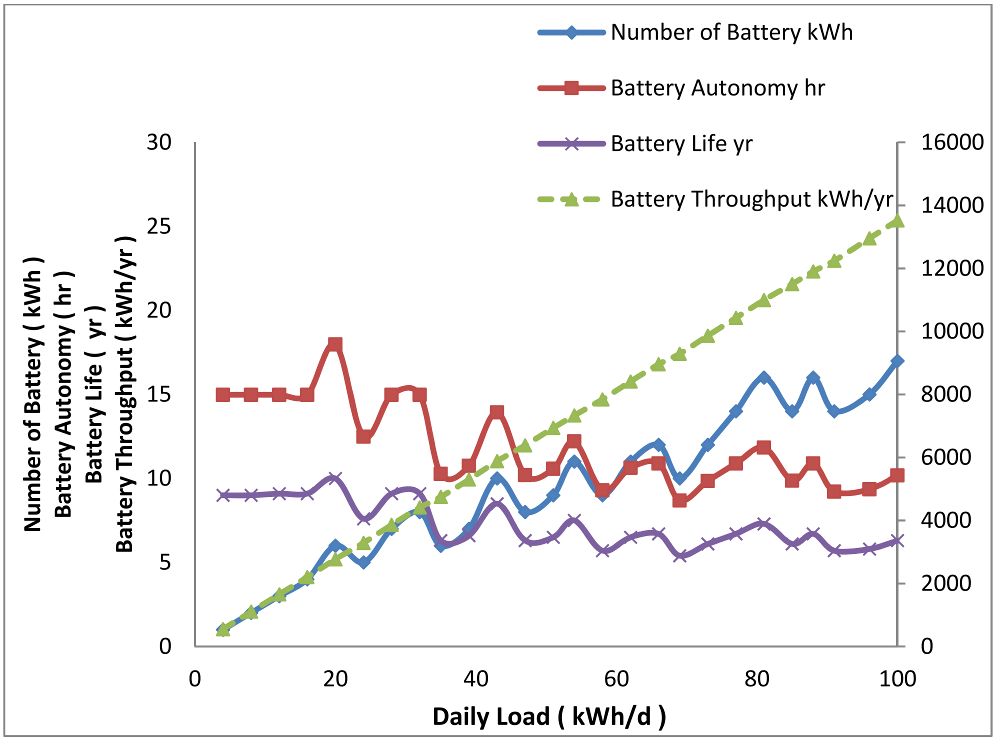

Fig.3. over the productivity of the battery, and the number of batteries, chargers self-battery, and the battery life time, compared with the daily load for the Samawa rural.

5.1.4 Daily load for a set cost of capital and the total net cost of the system and the total annual cost the Samawa rural.

As shown in Figure 4 which are illustrates group of total capital cost (2320 to 47590) USD, the total net cost of the system (total NPC) (2825 to 55377) USD and the total annual cost (Total Ann. Cost) (221 to 4332) USD versus the daily load (4 - 100) kW / day.

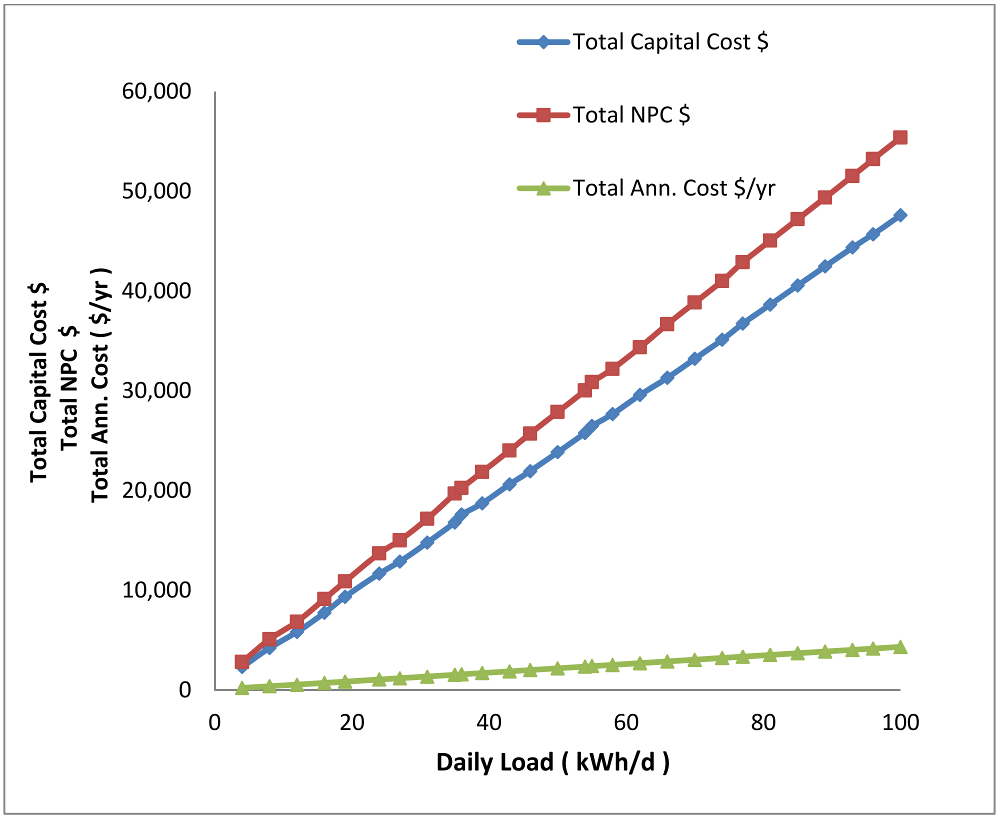

Fig.4 set the cost of capital and the total net cost of the system and the total annual cost versus load on the city of Baghdad.

3.2 Simulation Results of PV system design using Homer for Nasiriyah

3.2.1 Daily load versus boarded power generation capacity, the number of batteries , the ability to energy conversion and COE for the city of Nasiriyah.

As shown in Figure 5 below using Homer program, the optimal system for PV system power to the city of Nasiriyah to the ability of power generation boarded PV panel Place between (1 – 26) kW, and the number of batteries ranges (1- 17) and the ability to energy converter be between(1 until 15) kW and the Energy costs (COE) (0.132 - 0.156) kWh compared with the daily load variable between (4 - 100 kW / day).

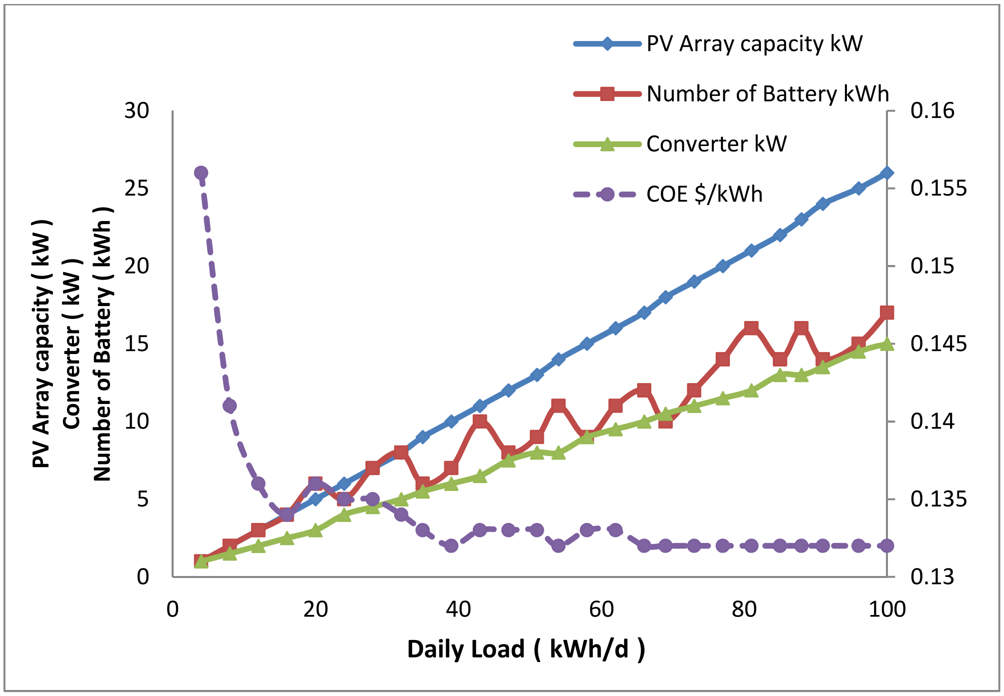

Fig.5. illustrates the change in PV Array capacity, boarded the number of batteries , the ability to convert the energy and COE compared to the daily load for the city of Nasiriyah.

3.2.2 Daily load compared to the extent of PV to produce electricity, the lack of capacity and excess electricity compared to the daily load the city of Nasiriyah.

In Figure 6 we have to get over the PV to produce electricity between (182 to 46480) kWh / year, and the lack of capacity shortage ranges (from 45 to 1074) kWh / year, as well as, excess electricity will be between (130 to 4961) kWh / year versus variable between Daily Load (4-100) kW / day.

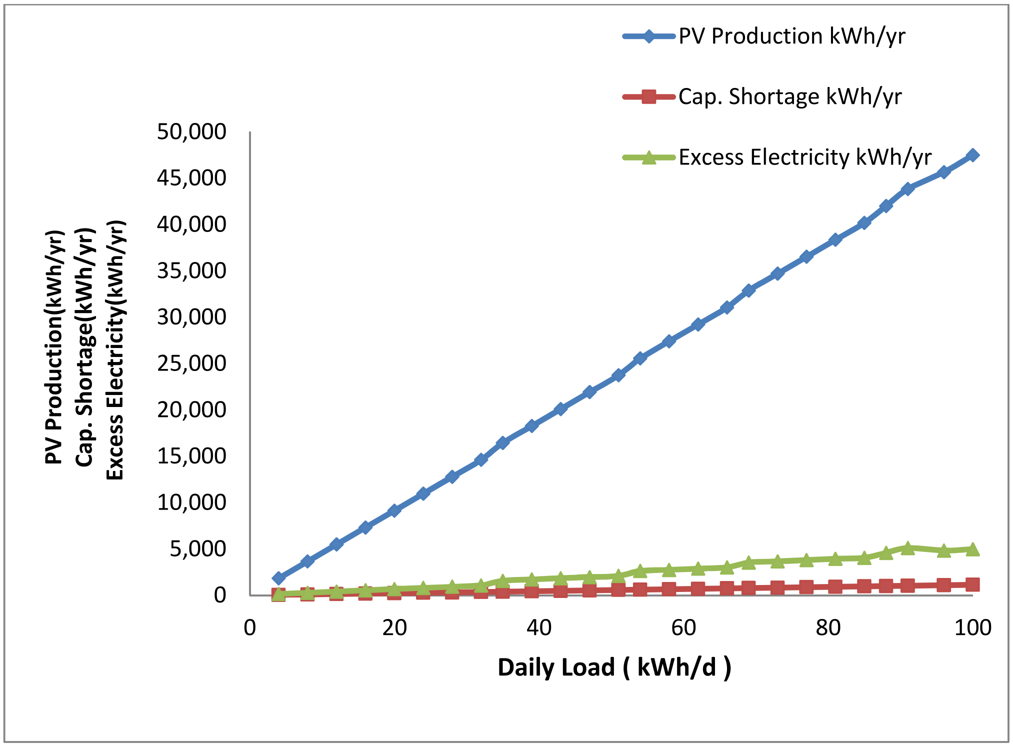

Fig.6. over the PV to produce electricity, the lack of capacity and excess electricity, compared to the daily load for the city of Nasiriyah.

3.2.3 Daily load versus over the productivity of the battery, the number of batteries, chargers self-battery, and battery life time for the city of Nasiriyah.

The following Figure 7 shows over of the productivity of the battery throughput which is change from (553 to 13523) kWh / year, also the number of batteries between (1 - 17) , as well as, self-charging battery autonomy ranges (10.1837–14.976) hour and the battery life time between(9.4 - 10) a year, compared with the daily load variable between daily load (4 - 100) kW / day.

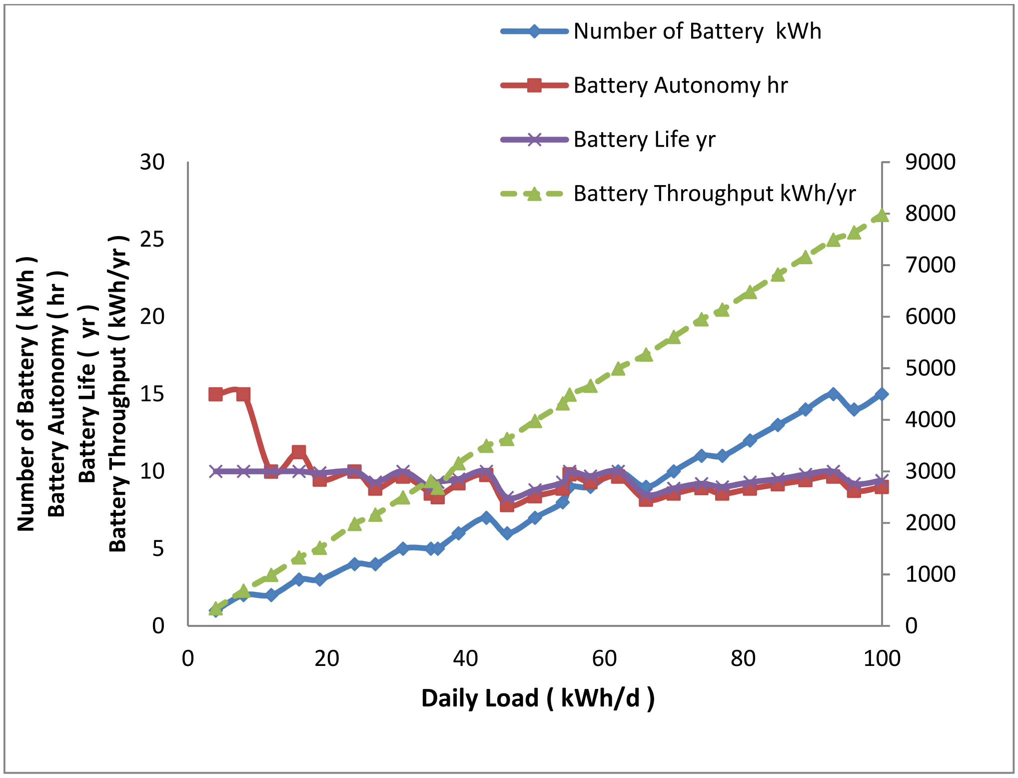

Fig.7. over the productivity of the battery, and the number of batteries, chargers self-battery, and the battery life, compared with the daily load for the city of Nasiriyah.

3.2.4 Daily load for a set cost of capital and the total net cost of the system and the total annual cost the city of Nasiriyah.

As shown in Figure 8 which are illustrates group of total capital cost (2320 to 48600) USD, the total net cost of the system (total NPC) (2863 to 60498) USD and the total annual cost (Total Ann. Cost) (224 to 4728) USD versus the daily load (4 - 100) kW / day.

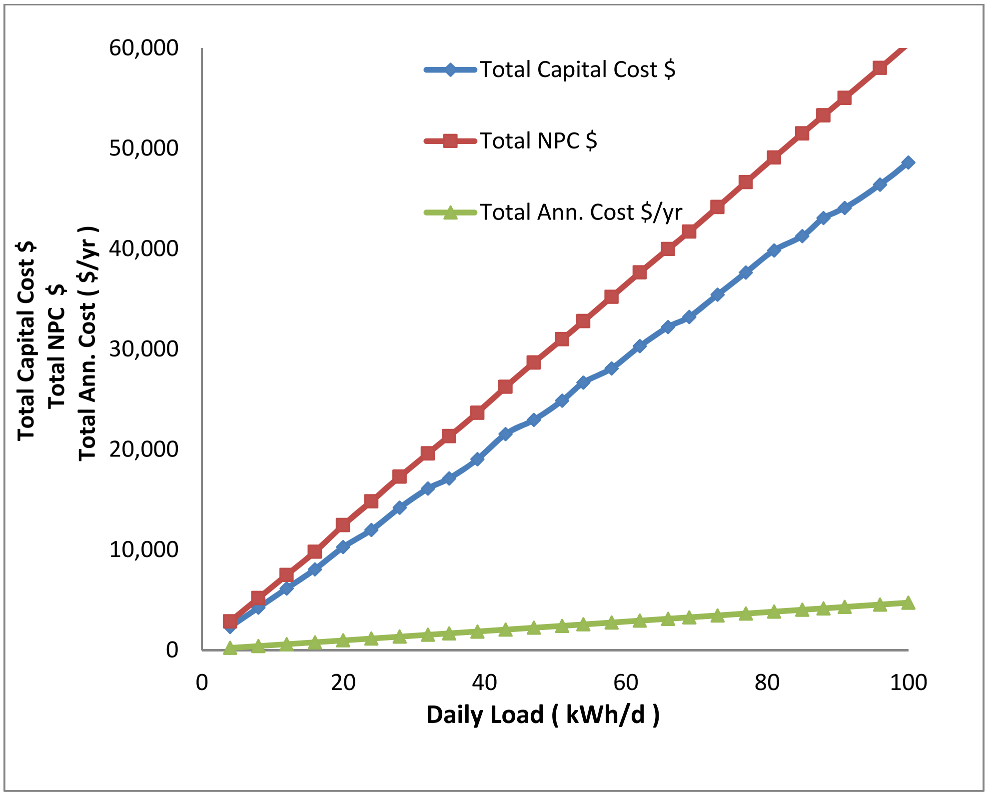

Fig.8. set the cost of capital and the total net cost of the system and the total annual cost versus load on the city of Nasiriyah.

3.3 Simulation Results of PV system design using Homer for Ar-Rutbah

3.3.1 Daily load versus boarded power generation capacity, the number of batteries the ability to energy conversion for the city of Ar-Rutbah.

As shown in Figure 9 below using Homer program, the optimal system for PV system power to the city of Ar-Rutbah to the ability of power generation boarded PV panel Place between (1 – 26) kW, and the number of batteries ranges (2- 15) and the ability to energy converter be between(1 until 14) kW and the energy costs (COE) (0.118 - 0.153) kWh compared with the daily load variable between (4 - 100 kW / day).

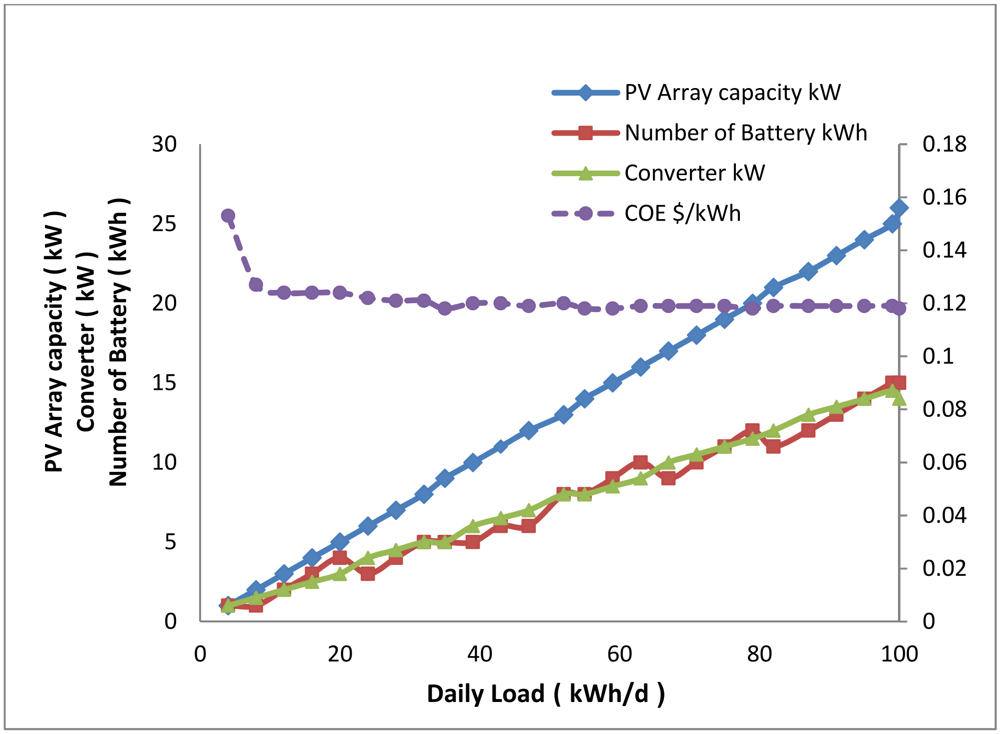

Fig.9 illustrates the change in PV Array capacity, boarded the number of batteries , the ability to convert the energy and COE compared to the daily load for the city of Ar-Rutbah.

3.3.2 Daily load compared to the extent of PV to produce electricity, the lack of capacity and excess electricity compared to the daily load the city of Ar-Rutbah.

In Figure 10 we have to get over the PV to produce electricity between (1867 to 48537) kWh / year, and the lack of capacity shortage ranges (from 19 to 1087) kWh / year, as well as, excess electricity will be between (209 to 7192) kWh / year versus variable between Daily Load (4-100) kW / day.

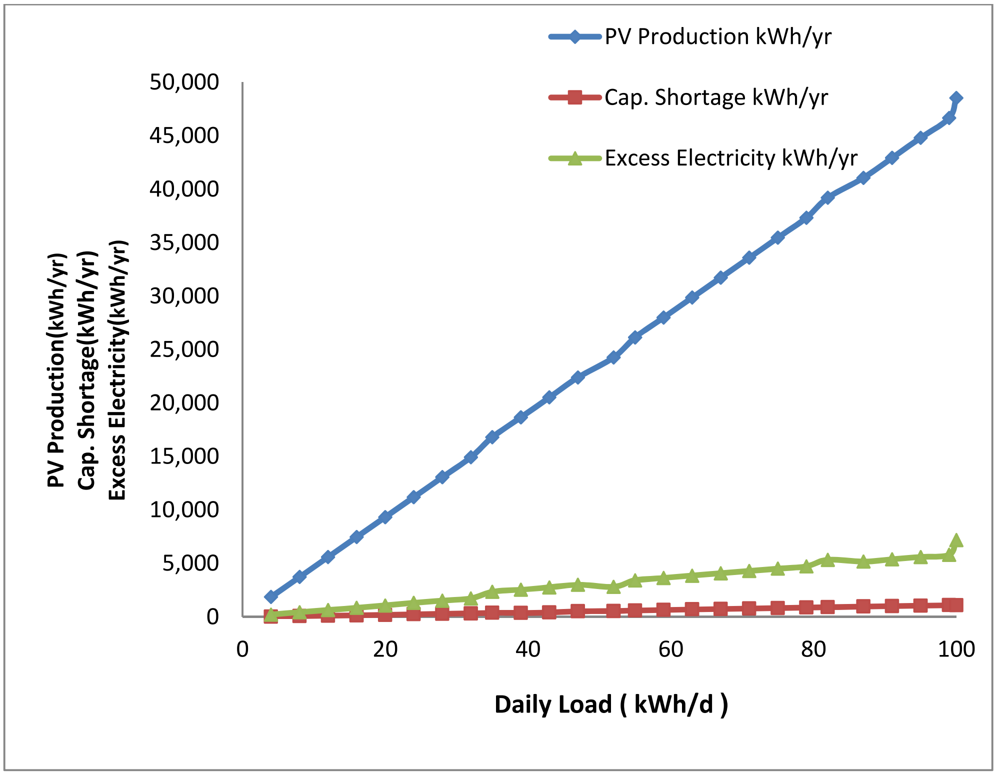

Fig.10 over PV to produce electricity, and the lack of capacity and excess electricity, compared to the daily load for the city of Ar-Rutbah.

3.3.3 Daily load versus over the productivity of the battery, the number of batteries, chargers self-battery, and battery life time for the city of Ar-Rutbah.

The following Figure 11 shows over of the productivity of the battery throughput which is change from (322 to 7443) kWh / year, also the number of batteries between (1 - 15) , as well as, self-charging battery autonomy ranges (8.9853 - 14.976) hour and the battery life time between(8 - 10) a year, compared with the daily load variable between daily load (4 - 100) kW / day.

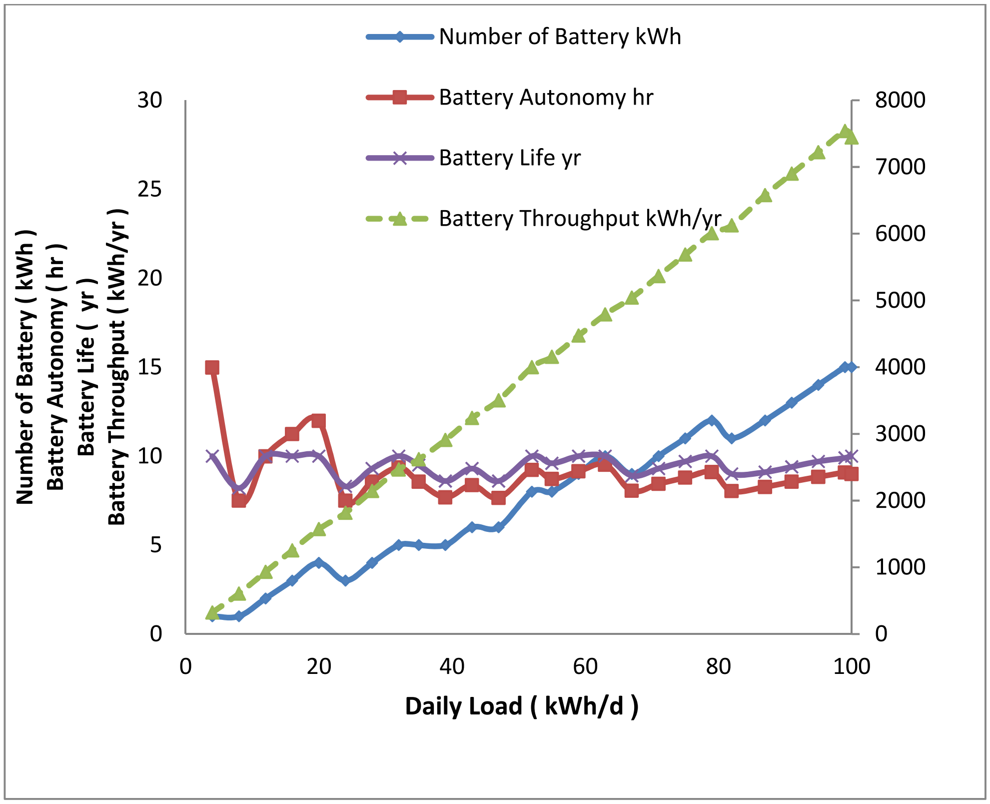

Fig.11 over the productivity of the battery, the number of batteries, chargers self-battery, and the battery life time compared with the daily load for the city of Ar-Rutbah.

3.3.4 Daily load for a set cost of capital, the total net cost of the system and the total annual cost the city of Ar-Rutbah.

As shown in Figure 12 which are illustrates group of total capital cost (2320 to 47180) USD, the total net cost of the system (total NPC) (2825 to 54470) USD and the total annual cost (Total Ann. Cost) (221 to 4261) USD versus the daily load (4 - 100) kW / day.

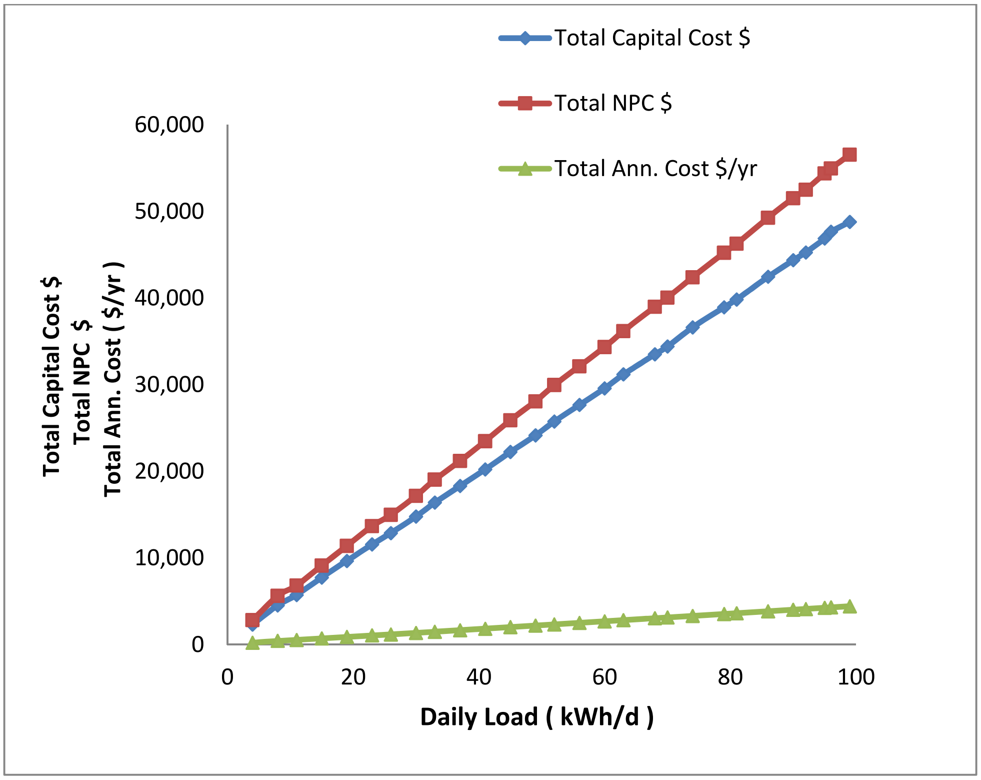

Fig.12 set the cost of capital and the total net cost of the system and the total annual cost versus load on the city of Ar-Rutbah.

4. Conclusion

The most important conclusions results are:

1. The effect of solar radiation data for the three locations by latitude within Iraq influenced a little bit by the technical standards.
2. the values of each of the regions that have undergone a similar study of almost daily compared to load and this can put disclose similar system includes all parts of Iraq.
3. This result encourages the researcher to predict a lot of information and technical standards for the design system and a wide range of areas to carry on the (10-100) kW / day is located in the same circle's show.
4. empirical equations suing in HOMER predicting PV energy values, the ability of the battery exchange of energy, size that were obtained in this study can be used as an easy reference for of the converter and the production of electricity

panels are located at the same latitude within the Arab world in return for me over the download daily (10-100kWh) during the day.

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