iJRASET
International Journal For Research in Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 9 **Issue:** VII **Month of publication:** July 2021

DOI: https://doi.org/10.22214/ijraset.2021.36634

Enhancing Farm Produce in Punjab through Solar Simulation Model - A Step towards Clean Energy and Green Economy

Yameen Muhammad[1], Satish Saini[2], Dharminder Kumar[3]
[1, 2, 3]*Department of Electrical Engineering, RIMT University, India*

Abstract: ***In Indian context, the state government is providing subsidized electricity to the farmers to lessen their financial burden and to mitigate the challenge arising due to uncertain weather pattern. But the electricity supply has a limitation of timing and in near future the cost of electricity will certainly increase . On the other hand Indian government has launched many schemes to electrify the rural areas using renewable sources. PM KUSUM yojana being the one which aims to provide the solar panel to the farmers in subsidized cost. In this backdrop the proposed scheme is introduced to provide continuous power supply during day time to do the pumping activity and can able to serve light load during night time. The power generated from the solar PV is utilized to supply the load in sunny hour and the excess power is stored in the battery bank for use in later stage when the solar PV alone cannot meet the load demand. The application of battery bank will remove the dependency upon the grid and can be operated in standalone mode. Thus the present work aims to introduce the Solar PV system with battery bank and investigates the Standalone PV option for reliable, continuous and cost-competitive power supply.***
Keyword: Solar PV, storage, simulation, power supply, reliability

I. INTRODUCTION

The most important supplier of energy for the earth is the sun. The whole of life depends on the sun's energy. It is the starting point for the chemical and biological processes on our planet. At the same time it is the most environmentally friendly form of all energies, it can be used in many ways, and it is suitable for all social systems [1].

Solar PV systems are usually intermittent, unpredictable and weather dependent. Therefore, a continuous and reliable power supply is hardly possible without energy storage.

By employing an energy storage system (ESS), the surplus energy can be stored when power generation exceeds demand and then be released to cover the periods when net load exists, providing a robust back-up to intermittent renewable energy [2]. The ESS is thus a critical component and powerful partner to ensure sustainable supply of renewable energy [3], and the European Commission finds it will play a key role in enabling the world to develop a low-carbon power supply system [4].

India's economy largely dependent on agriculture, though the share of agriculture to GDP declines in last decade. Recent study suggest around 50% of India's workforce is engaged in agriculture sector alone. But due to changing weather pattern the agriculture production is a challenge.

To irrigate such farm land the national grid provides power with subsidized rate. But there is a time limit for such supply and also the recent trend shows there will be increase in the level of price of electricity in near future. This paper examines solar PV model to provide power to such farm land for irrigation and lighting loads.

A. Modeling of the System

The operating principle of the standalone solar can be briefly described as follows. The solar system produce the energy required by the load during day time. During the time of excess energy production the battery stores the energy and during deficit battery discharges to cater the load. The scheme also complimentary in nature as precipitation, cloud cover and solar PV production are inter related. In this way, a reliable and sustainable energy supply would be guaranteed for 24 h a day if the charging and discharging rates as well as the capacity are sufficient. The primary components of the system is PV array, battery, balance of system as inverter, converter and charge controller.

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.429
Volume 9 Issue VII July 2021- Available at www.ijraset.com

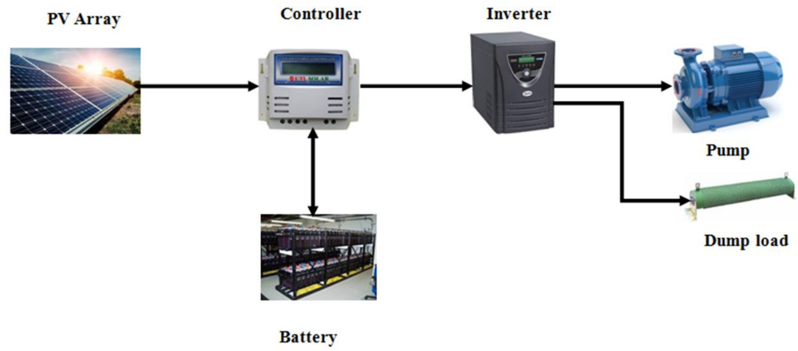


Fig. 1 Solar PV standalone system

B. Load Profile

The proposed system is designed to serve a daily load of 77 kWh/day with a peak load of 13 kW. However, this represents the average load demand. The system is mainly design to cater energy to pump to irrigate the farm land. It can be also seen that the peak demand of the load is occur during sunny hours. The power production schemes are complimentary in nature. synthesized in HOMER software by adding randomness of day, to create a quite reasonable load profile. And for simplicity the seasonal variation of load is not considered. The load of the proposed scheme is taken as constant in all the months for the simulated year.

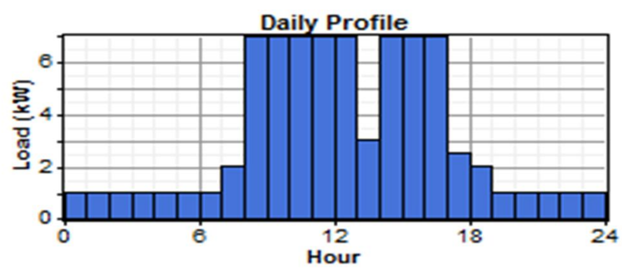


Fig 2 Hourly load demand

C. Solar Energy Resource

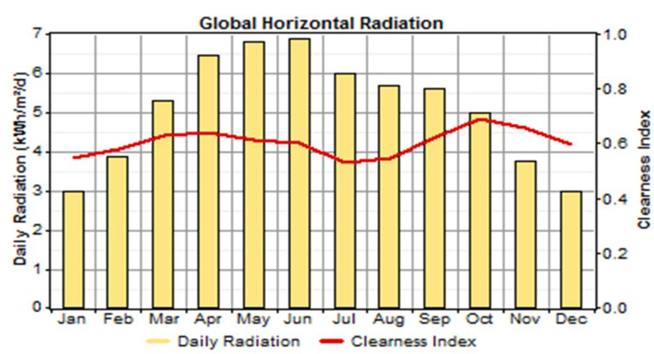


Fig. 3 Monthly variation in solar radiation and clearness index

For the proposed scheme solar energy plays an important role. With the advancement in technology the power production from the PV array is increasing. The power production from the PV array is dependent on the weather condition at which it is being installed. Typical variation of solar radiation in India is found to be 4-6 kWh/m^2/day. The study is conducted at 32.59 degree latitude and 74.59 degree longitude. And for the proposed site monthly average daily solar radiation found to be 5.11 kWh/m^2/day with clearness index of 0.602, the installed capacity of the PV array is 22 kW$_P$.

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.429
Volume 9 Issue VII July 2021- Available at www.ijraset.com

D. Predicted Daily water pumped

The water lifted from a bore well of height approximately 30m. As the pump is the primary load for the scheme. Significant amount of energy is spent for pumping the water. The figure depicted below represents the same. The variation in pumping energy is because of variation in solar insolation. It is observed that during summer month of Aug to June maximum amount of energy is available to lift maximum water which is the requirement of the scheme. This satisfied the aim of the proposed model.

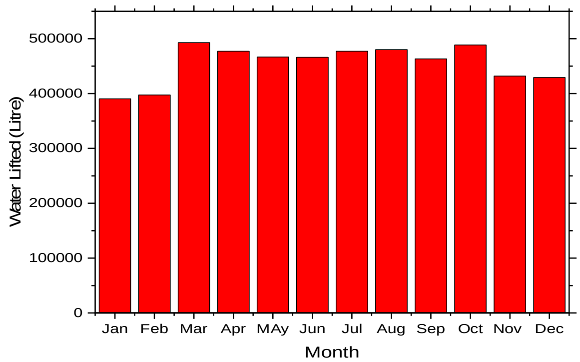


Fig. 4 Water volume pumped

E. Energy Distribution On a Typical Day

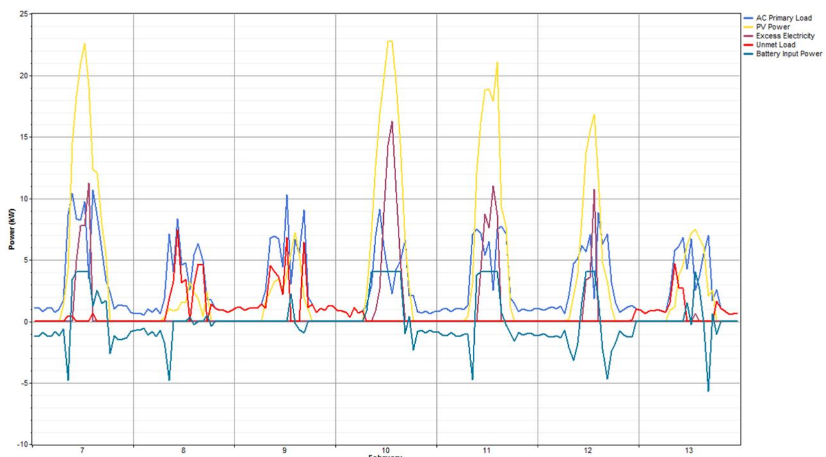


Fig. 6 Energy distribution Pattern

The below figure shows the hourly energy balance of the proposed scheme. It is seen that when the power output from the PV array is not sufficient discharge of battery occurs to meet the load demand and hence the State of Charge of battery unit decreases. And when the power output from the PV array exceeds the load demand the excess power is feed to the battery to increase the SoC of battery which is shown in blue line.

F. Economic Analysis

The fig. shows the overall optimization result of the hybrid system which is generated in the HOMER software. Each row in the table represents a viable system configuration. The first 3 column shows icon , next three column indicate number or size of each component, the next six column shows key simulation results, such as capital cost of the system, operating cost, Net present cost, levelized cost of COE, renewable fraction and capacity shortage. The optimal configuration is the one having lowest NPC which comprises of 22 kW_P PV,20 No of S4KS25P battery, 10 kW converter. The COE is found to be 5.397/kWh and100% renewable fraction and capacity shortage of 10%.

			PV (kW)	S4KS25P	Conv. (kW)	Initial Capital	Operating Cost ($/yr)	Total NPC	COE ($/kWh)	Ren. Frac.	Capacity Shortage
			22	20	10	$ 1,579,540	17,333	$ 1,801,115	5.397	1.00	0.10
			22	20	12	$ 1,589,088	18,542	$ 1,826,113	5.465	1.00	0.09
			22	20	15	$ 1,603,410	20,355	$ 1,863,618	5.577	1.00	0.09
			22	20	16	$ 1,608,184	20,960	$ 1,876,123	5.615	1.00	0.09
			24	15	12	$ 1,701,138	15,719	$ 1,902,080	5.730	1.00	0.10
			24	20	10	$ 1,711,540	17,333	$ 1,933,115	5.684	1.00	0.07

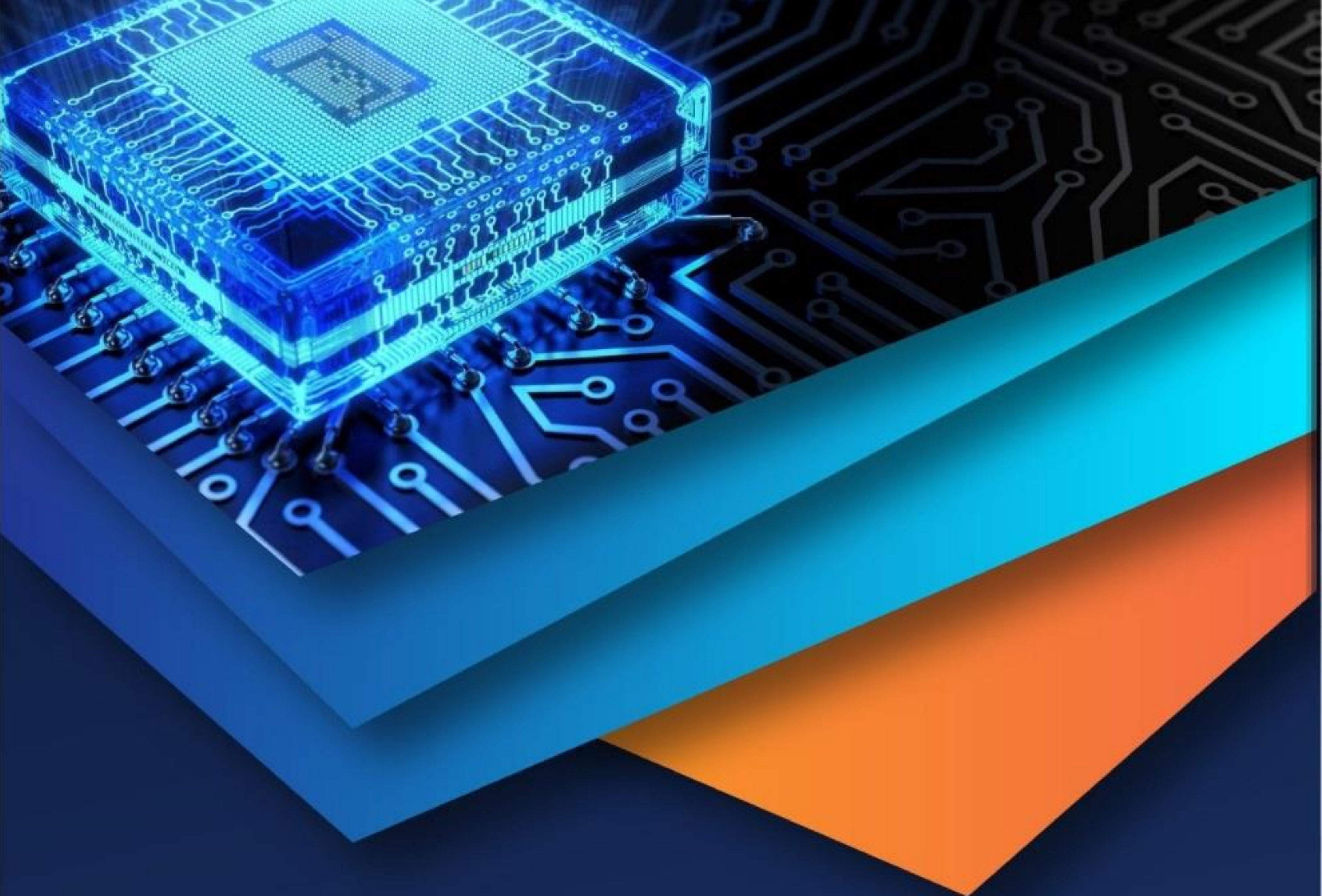
Fig 7 Optimization result of pumped storage

II. CONCLUSION

In this study the standalone PV system is examined to irrigate farm land . The results are showing promising for such scheme. The scheme able to farm land with adequate water supply through out the year. It concludes that with the integration of battery, the power output and quality of the system increases, the schemes employed in the study are also complementary in nature, the capacity shortage is 0.10 % which also increases reliability of the scheme, the levilised cost of energy is estimated as 5.397 INR/kWh, proposed scheme is also having negligible emission and hence eco friendly.

REFERENCES

[1] German Solar Energy Society (Dgs). (2010). Planning and Installing Solar Thermal Systems: A Guide for Installers, Architects and Engineers. Earthscan.
[2] Chen H, Cong TN, Yang W, Tan C, Li Y, Ding Y. Progress in electrical energy storage system: a critical review. Prog Nat Sci 2009;19:29-312.
[3] Daim TU, Li X, Kim J, Simms S. Evaluation of energy storage technologies for integration with renewable electricity: quantifying expert opinions. Environ Innov Soc Trans June 2012;3:29-49.
[4] European Commission. The future role and challenges of energy storage. In: DG ENER Work Pap; 2013.



10.22214/IJRASET

45.98

IMPACT FACTOR: 7.129

IMPACT FACTOR: 7.429

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY