

Novel Solar PV Off-Grid Hybrid System with algorithm for Most Cost-Effective Configuration Analysis¹Mukut Biharee Gautam, M.Tech. Power System Scholar²Avinash Sharma, Assistant Professor, Dept. of EE, JIT, Jaipur³Ankit Kumar Sharma, Assistant Professor, Dept. of EE, JIT, Jaipur**Abstract**

In the today's world, every work is dependent on the electricity, the daily office works, preparation of food in kitchen, transportation, and many more. In such a situation the working without electricity is not possible. Taking into consideration of that we have proposed the novel concept of the Off-grid based generator when the solar PV are utilised and diesel generator is also used to form the uninterrupted supply of electricity. By considering bigger than normal PV structure gauges, the calculation chooses the energy stockpiling limit need for logically inquisitively enormous PV system sizes. The result is an outline demonstrating how much energy stockpiling limit versus the sum PV are required for an off-grid structure, which shows a contrary connection among age and capacity. Since PVs and energy stockpiling have different costs, the calculation calculates the expense of each off -grid course of action and chooses the savviest structure.

Keywords: Hybrid Power Systems, Off-Grid, Solar PV**Introduction**

Energy is key to the economic and the social new development and furthermore improves personal satisfaction. It is noteworthy for the making social orders [1]. In the Nigeria, most private homes are then connected to the electric based grids. In any case, there then despite everything exists the couple of "off - grid" or the remote locations, which, for money related just as environmental reasons related to their great ways from a current power lines, are then not connected to the utility -based grid. Most by far of these living courses of action get their power from gas or the diesel-powered based generators, one which can likewise be rambunctious and one that can have the shortcoming of growing the ozone draining substance emissions one which adversely influences the environment. Amidst the environmental issues of using oil and diesel-based generators, and the cost of then running them is additionally extremely high. In light of the critical cost of running oil/diesel generators, various Nigerians are glad to move from using these of the traditional generators for the utilization of the maintainable power sources progresses.

Manageable power sources innovations, (for instance, solar-photovoltaic systems) that can be confined and furthermore decentralized not at all like the national power grid. And furthermore, this licenses end-customers to make their own power wherever they are found. In like manner, the advances don't require the any of the running expenses, in contrast to the traditional oil/diesel-based generators.

The installations of the solar power-based structure to override or the offset the portions of the diesel power generation is the option so as to consider it for the remote private homes. The all out superseding of the diesel generation with the solar power is likewise ordinarily not useful, due to low solar contribution during the blustery season. In any case, the solar/diesel-based combination structure known as the hybrid systems can wind up being really strong and monetarily

smart given the right conditions, (for instance, perfect assessing). Hybrid energy applications are of extending interest, and an inside and out regulated hybrid solar-diesel system can achieve lifetime fuel save reserves, while ensuring strong power deftly. To the degree that diesel fuel is diminished, and such systems reduce CO₂ similarly as the particulate based emissions one that are pernicious to prosperity. They are one of the economical options in regions confined from the grids. [1]

Hybrid Renewable Energy Systems (HRES) that can be found under different terms and furthermore the definitions and furthermore moreover then considered as the component of the general concepts of the Distributed based Energy Resources (DER) or the Distributed Generation (DG). Furthermore, there are various terms and furthermore the concepts that empower to and the exploration forward jumps related to HRES within literature.[2]

Beyond what 12 of the terms that can be found recorded as a hard copy to suggest the innovations in the HRES. A total of the 172 articles that can have been in HRES under various stating. Most by far of them imply the hybridizations of the conventional based energy systems introducing manageable power sources as options in contrast to the grid connections. That can be seen in gure 1.2, the word ing goes additionally from the most expansive terms of the Renewable based Energy Sources (RES) to the most specific. [2]

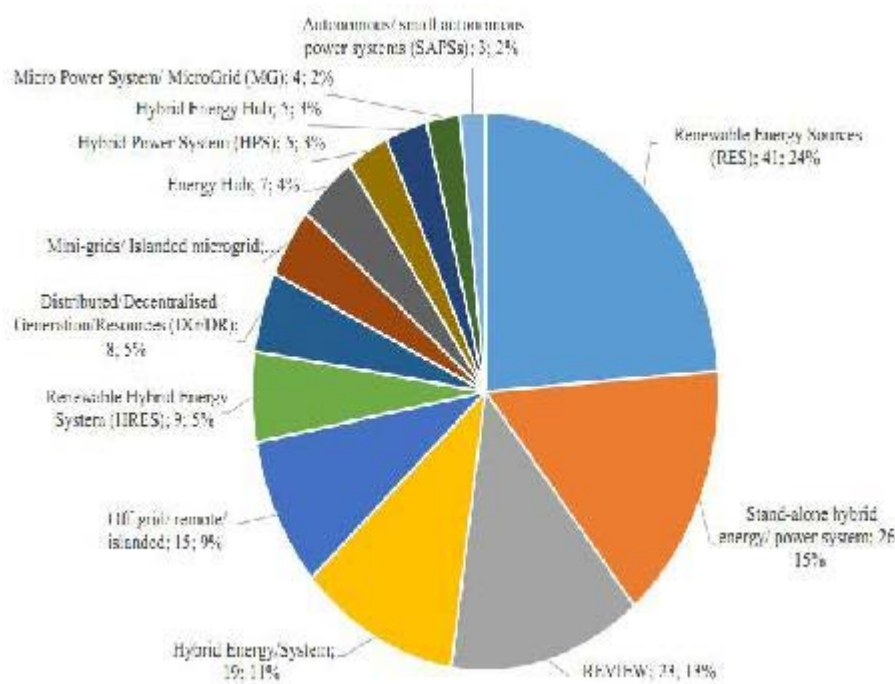


Fig 1: Involvement of Hybrid Systems

"Hybrid Renewable Energy Systems (HRES) additionally consists of in any event two of the ene rgy sources, with in any occasion one of them manageable and facilitated with power control equipment and an optional amassing structure." HRES as guard over that can be found in the composing in like manner under various terms such Terms implying the HRES innovations and furthermore the quantity of the articles.[2]

As free hybrid-based energy (or the power) structure, o - grid, the remote, the islanded, hybrid-based system, hybrid-based energy (or the power) system, microgrids, littler than regular grids or the autonomous based power systems.

Additionally, relevant composition for those of the systems that can be discovered that under the provisions of Distributed Energy Resources (DER) or Decentralized Generation (DG), among others as portrayed immediately.

Literature Survey

C. D. Rodríguez-Gallegos, K. Rahbar, M. Bieri, O. Gandhi, T. Reindl and S. K. Panda,[3] This paper contemplates the estimating issue of PV-battery-diesel Base hybrid systems using convex the optimization - based methodology.

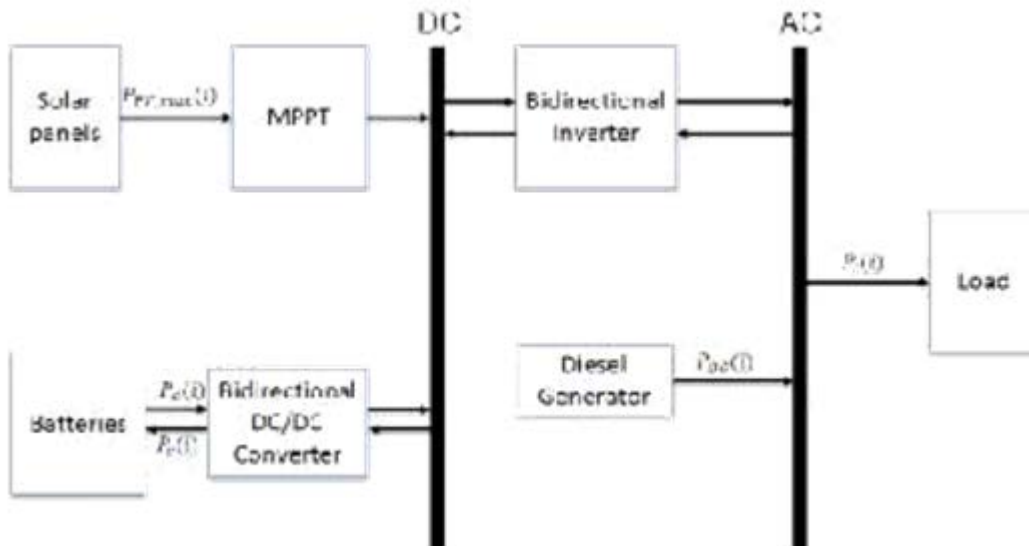


Fig 2: Proposed Hybrid System [3]

The contextual examination occurs in an Indonesian island where the stack demand totally depends upon a singular diesel-based generator (DG). Additionally, the goal is to smooth out the amount of the solar loads up and batteries are likewise to be acquainted with lessen the supreme cost of the structure over the lifetimes of the 25 years.

B. Singh, A. Verma, A. Chandra and K. Al-Haddad [4] Authors proposed the charging station which is primarily planned to use the solar based photovoltaic (PV) show and the limit battery energy so as to charge the electric vehicles (EV) batteries. Regardless, in case of exhaust of limit battery and difficult to reach solar PV based generation, likewise the charging station shrewdly removes the power from the grids and furthermore from the DG set. Regardless, the power which is from the DG set is then pulled in a manner that, it by and large works at the 80-85% stacking to achieve most extraordinary eco -cordiality under all stacking conditions.

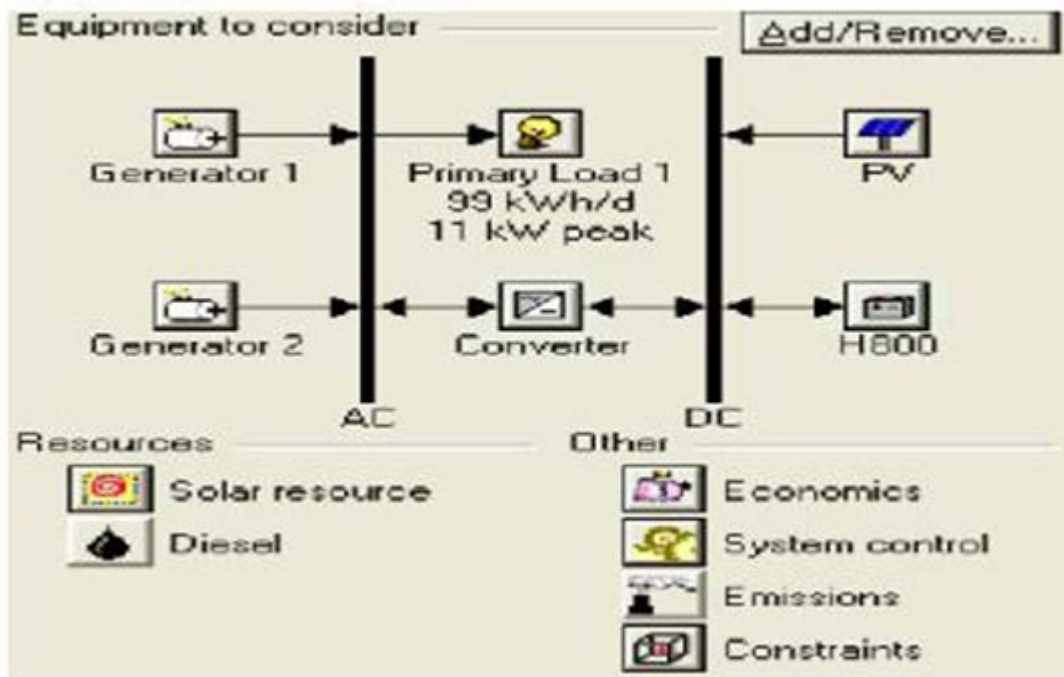


Fig 4: Scheme Diagram [6]

Proposed Work

Rechargeable Battery Model

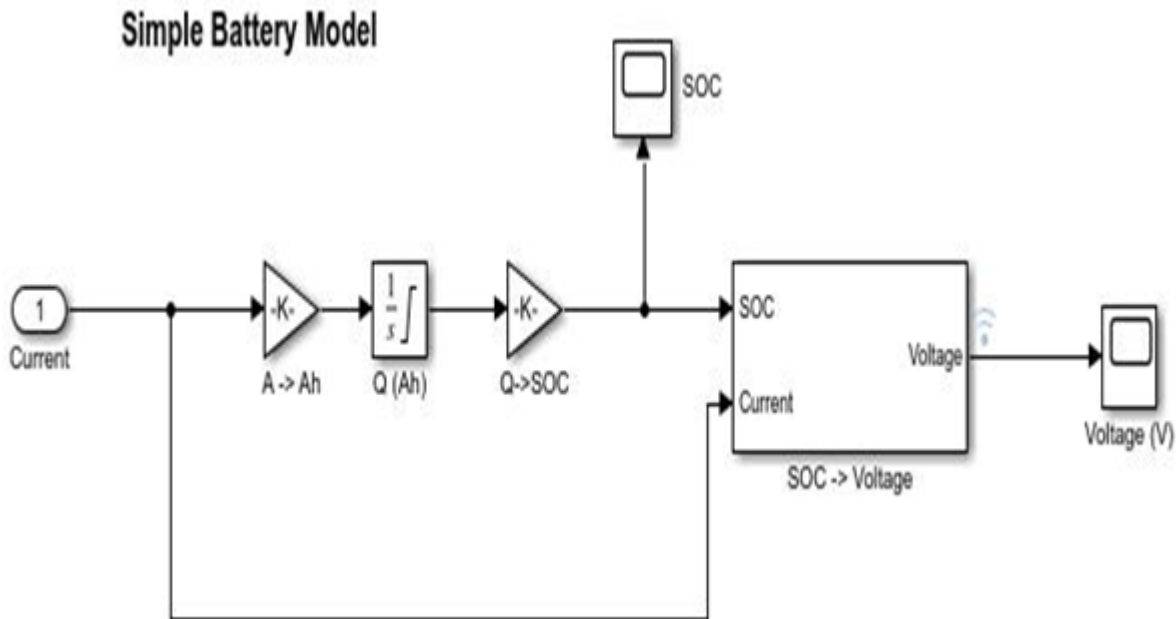


Fig 5: Simple Battery Model

The model depends on the equation

$$E = (1 - Loss) * V - K * Q_{max} * \frac{1 - s}{s}$$

Where:

- E is the battery terminal voltage in Volts.
- V is the battery constant voltage in Volts.
- K is the battery polarization resistance in Ohms.
- Q_{max} is the maximum battery capacity in Ampere-Hour.

Off-Grid Solar Power System

Off-grid based systems work unreservedly of the grids anyway have the batteries one which can store the solar powers which are made by the structure. The system normally consists of the solar sheets, the battery, the charge controller, the grid box, the inverter, the mounting structure and furthermore the equalization of the systems. The sheets stores enough sunlight during the days and use the wealth power delivered in the evenings.

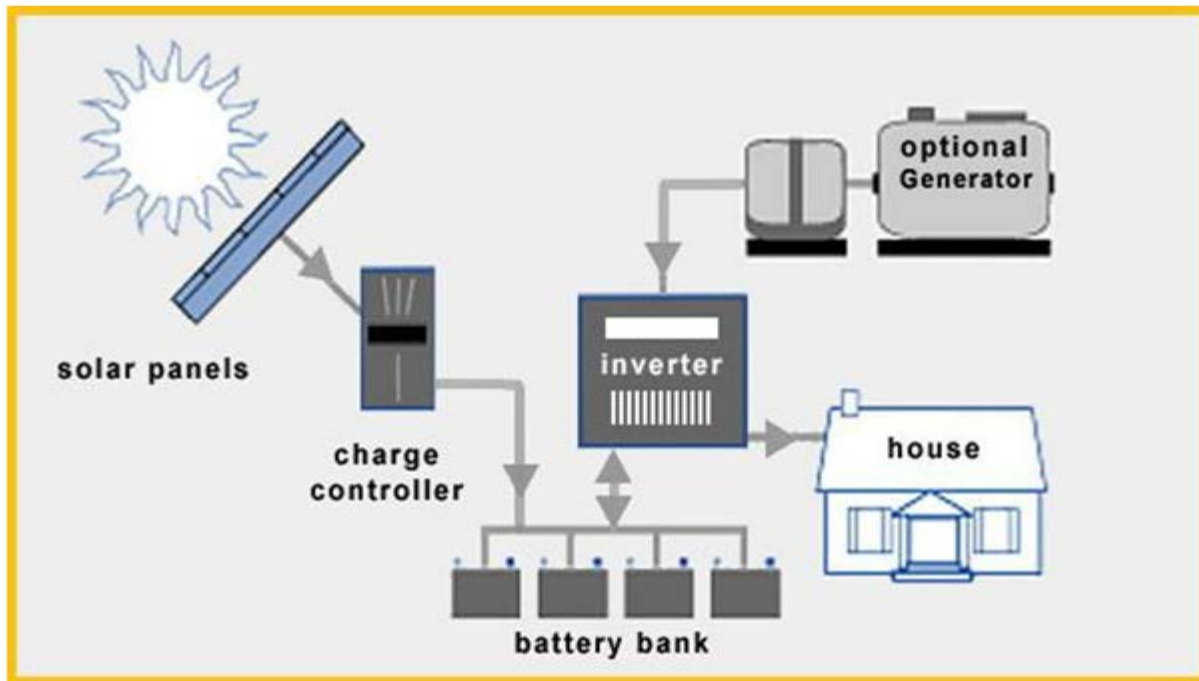
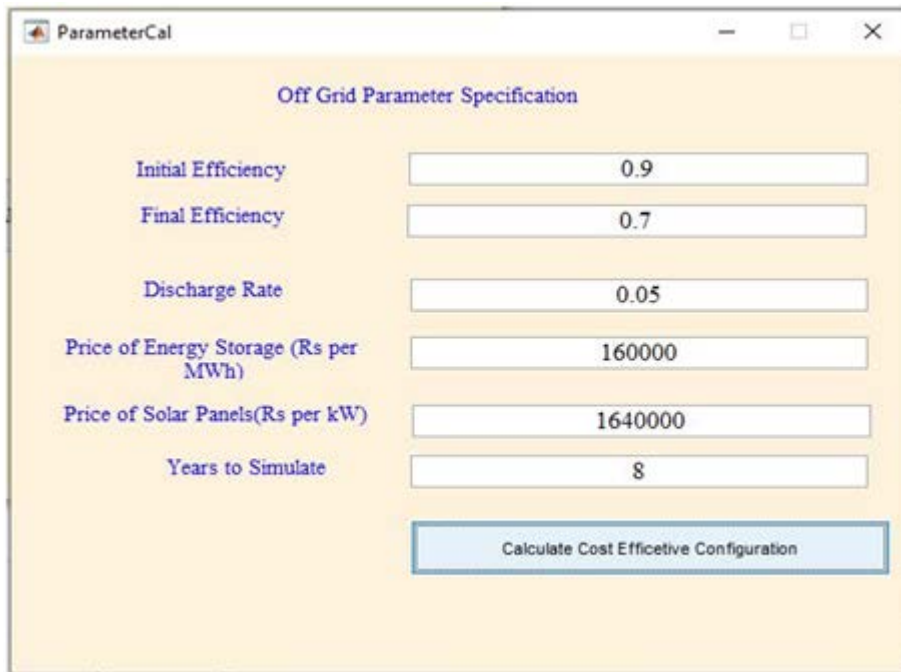


Fig 6: Off-Grid Solar Power

These of the systems are then self -supporting and furthermore can offer power to essential weights in regions where the power grids aren't available. Regardless, these of the systems will require specific equipment to the function and furthermore can be extravagant to present. These are ideal for organizations which can bolster for a short period of time with no power.

Simulation and Result Analysis



The 'ParameterCal' window displays the following parameters for off-grid specification:

Parameter	Value
Initial Efficiency	0.9
Final Efficiency	0.7
Discharge Rate	0.05
Price of Energy Storage (Rs per MWh)	160000
Price of Solar Panels (Rs per kW)	1640000
Years to Simulate	8

A button labeled 'Calculate Cost Effective Configuration' is located at the bottom right of the window.

Fig 7: Grid Parameters Specification

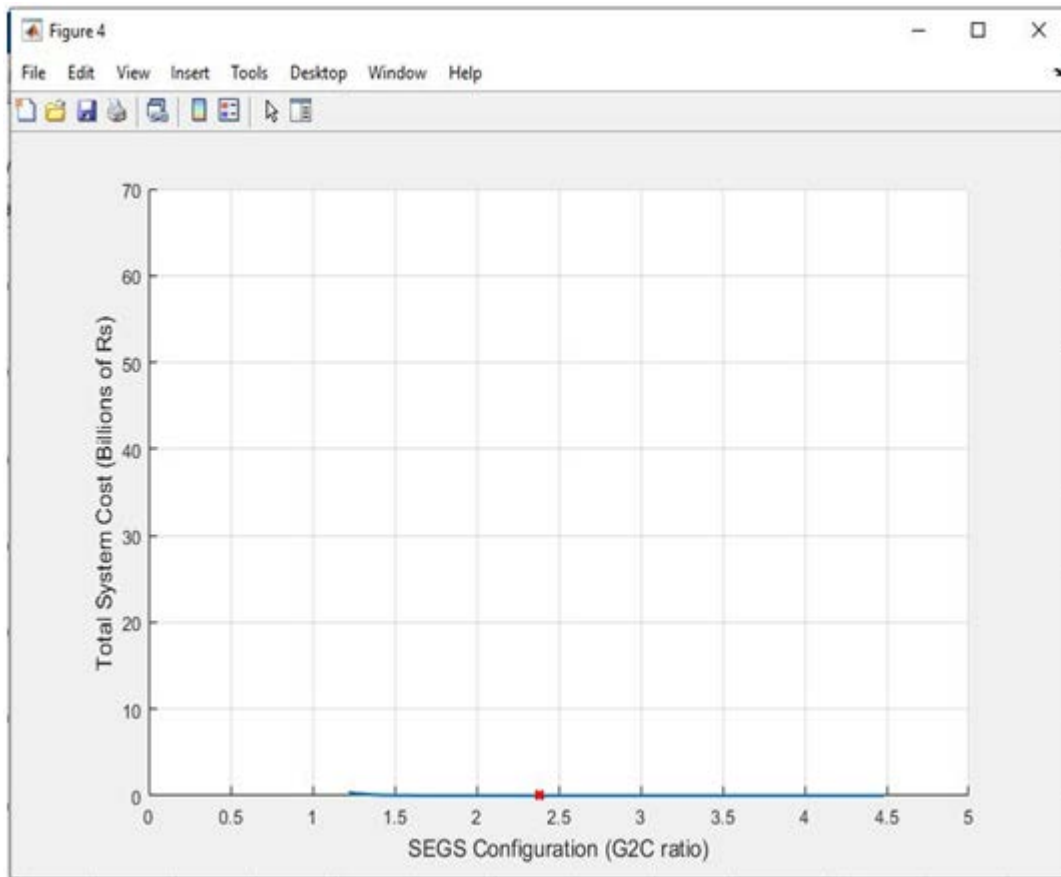


Fig 8: G2C Ration and Total Cost of System

Table 1: Most Cost-Effective Estimation On Year Basis

	G2c_Min	Optimized Total Cost Billions	Cost Optimized PV Size MW	Cost Optimized Storage Size Mwh	Inverter Size
Year Simulation=4	2.3420	0.0143	3.1534	57	14.7917
Year Simulation =8	2.3820	0.0144	3.2073	57	15.0895
Year Simulation =12	2.5420	0.0144	3.4227	55	16.2087

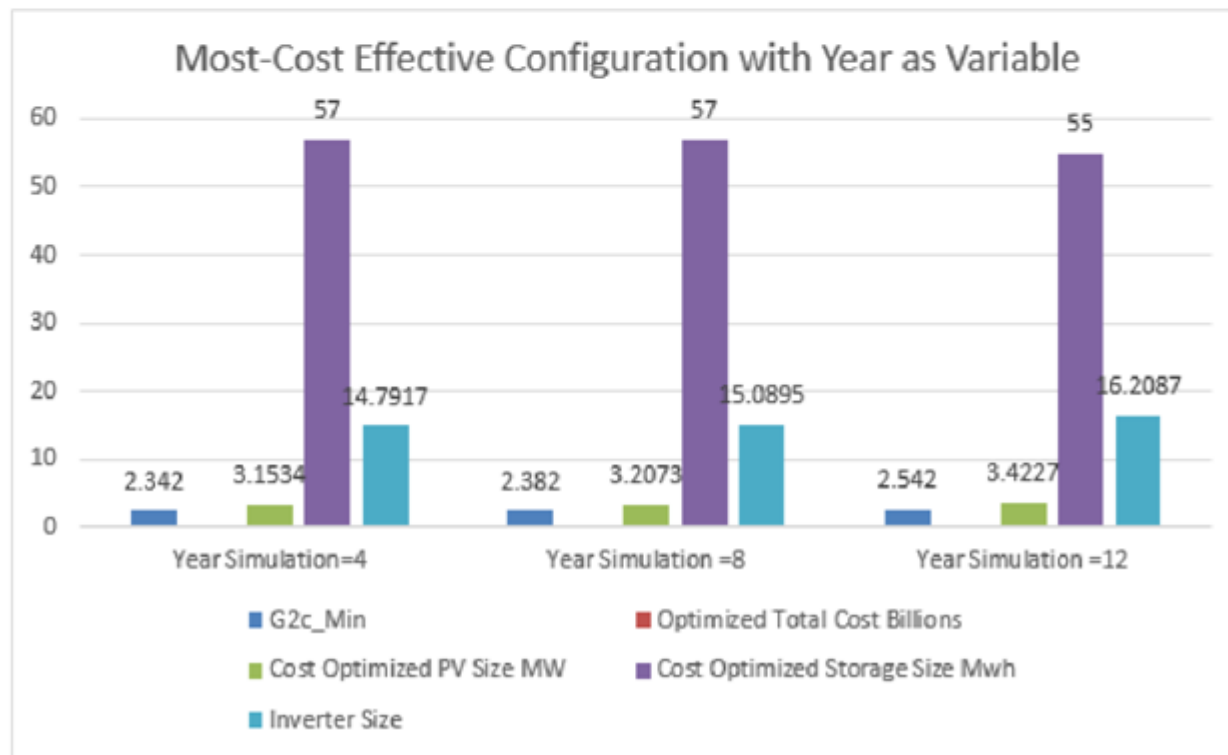


Fig 9: Graph on Year Parameter

Conclusion

The proposed structure has the upside of the power outages. Power outages can occur with no notification. Losing power suggests living without lighting which can be an inconvenience present second and marvellously upsetting in the long-term. The loss of power shifts from storms, freezing precipitation, hail whirlwinds and high breezes which can hurt power lines and apparatus. Cold spells or warmth waves cause offer which prompts over-troubling the electric connections, transformers, and other tech that at long last crash and burn. Off-grid solar energy systems are reliable for power outage situations as these systems store energy and consistently arranged for potential fiascos. A home with an off-grid solar power structure can prolong experiencing power blackouts amidst any potential incidents. The proposed structure helps in reducing power costs. Oil subordinates are up 'til now the world's basic energy source.

References

1. J. Mahdi and B. A. Fadheel, "A Modified Algorithm for Economic Evaluation between Diesel -Generator and PV Solar System," 2018 2nd International Conference for Engineering, Technology and Sciences of Al-Kitab (ICETS), Karkuk, Iraq, 2018, pp. 83-87.
2. M. R. Khan, "Prospect of solar PV based irrigation in rural Bangladesh: A comparative study with diesel based irrigation system," 2nd International Conference on the Developments in Renewable Energy Technology (ICDRET 2012), Dhaka, 2012, pp. 1-3.
3. D. Rodríguez-Gallegos, K. Rahbar, M. Bieri, O. Gandhi, T. Reindl and S. K. Panda, "Optimal PV and storage sizing for PV-battery-diesel hybrid systems," IECON 2016 - 42nd Annual Conference of the IEEE Industrial Electronics Society, Florence, 2016, pp. 3080-3086.
4. Singh, A. Verma, A. Chandra and K. Al-Haddad, "Implementation of Solar PV-Battery and Diesel Generator Based Electric Vehicle Charging Station," 2018 IEEE International Conference on Power Electronics, Drives and Energy Systems (PEDES), Chennai, India, 2018, pp. 1 -6.
5. M. Mahmud and R. E. Blanchard, "Assessing a rural electrification program in Malaysia: System performance analysis on 11 solar PV-diesel hybrid systems," 2016 4th International Conference on the Development in the Renewable Energy Technology (ICDRET), Dhaka, 2016, p p. 1-5.
6. M. T. Riasat, M. A. Ahmed, S. Tasin, M. A. Nabil and S. Andalib, "Design and performance analysis for hybrid PV-Diesel-Battery power system for residential area in Dhaka city," 2013 IEEE 39th Photovoltaic Specialists Conference (PVSC), Tampa, FL, 2013, pp. 1515-1520.
7. J. Abu-Taha and H. shaheen, "PV Diesel Hybrid Energy Supply for Nasser Hospital in Gaza Strip," 2019 IEEE 7th Palestinian International Conference on Electrical and Computer Engineering (PICECE), Gaza, Palestine, 2019, pp. 1-6.
8. P. Phuenmuenwai, P. Inrawong, K. Buayai and K. Kerdchuen, "Conceptual Design of Solar PV Pump for Raw Sand Production in Central Region of Thailand," 2019 International Conference on Power, Energy and Innovations (ICPEI), Pattaya, Chonburi, Thailand, 2019, pp. 8 -11.

9. Ghenai, I. Al-Ani, F. Khalifeh, T. Alamaari and A. K. Hamid, "Design of Solar PV/Fuel Cell/Diesel Generator Energy System for Dubai Ferry," 2019 Advances in Science and Engineering Technology International Conferences (ASET), Dubai, United Arab Emirates, 2019, pp. 1-5.
10. A. Hossain, "Design and economic analysis of PV-diesel hybrid system for particular section of IUT campus," 2nd International Conference on Green Energy and Technology, Dhaka, 2014, pp. 91-94.
11. D. Rodríguez-Gallegos et al., "A Siting and Sizing Optimization Approach for PV–Battery–Diesel Hybrid Systems," in IEEE Transactions on Industry Applications, vol. 54, no. 3, pp. 2637-2645, May-June 2018.
12. D. Rodríguez -Gallegos et al., "Placement and sizing optimization for PV-battery-diesel hybrid systems," 2016 IEEE International Conference on Sustainable Energy Technologies (ICSET), Hanoi, 2016, pp. 83-89.
13. H. W. Salih, S. Wang and B. S. Farhan, "A novel GA-PI optimized controller for MPPT based PV in a hybrid PV-diesel power system," 2015 5th International Conference on Electric Utility Deregulation and Restructuring and Power Technologies (DRPT), Changsha, 2015, pp. 1288-1293.
14. S. A. Jeddi, S. Hamidreza Abbasi and F. Shabaninia, "Load frequency control of two area interconnected power system (Diesel Generator and Solar PV) with PI and FGSPi controller," The 16th CSI International Symposium on Artificial Intelligence and Signal Processing (AISP 2012), Shiraz, Fars, 2012, pp. 526-531.