Sustainable renewable energy generation: A case study based teeny review

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Abstract. The global temperature rise is a great alarming factor. The most remarkable contributors are industries and automobiles. Many researchers around the world struggling to find the solution sooner. Many emphasized that solution is required at the earliest possible time, already glaciers in arctic started melting. The majority of them, such as fossil fuels, coal well as others, have been contaminating the immediate area. There is also the option of using renewable energy resources (RERs) that also would be a natural treasure to humanity because of their proximity. Based on a variety of factors, the amount of energy that can be harvested by using RERs is limited, such as seasonal, inadequate equipment, as well as huge collection space. In this article, the emphasis is now on the extent to which other constraints can be utilized. Sectors that produce goods demand enormous amounts of energy, but that energy might indeed not be used in those sectors. As a result, the RERs can sometimes be extensively employed by households and small businesses whose power needs are minimal. As a result, this review has been consolidated in the way of several different test cases.

Keywords: Renewables test case; Hybrid RERs; power systems; energy management

1. Case studies

1.1. Decentralized generation

If the residential electricity supply continues to fail to do is focus on providing rural regions with something like a dependable supply of electric power, an alternate solution, as well as a dependable form of electricity, is decentralized generation capacity. Increasingly, researchers are relying on coal as well as petroleum fuels for our power needs, which is both a limited resource as well as a source of GHG emissions but also pollutants throughout our water as well as air. Natural resources like wind biomass, photovoltaic, hydro as well as biogas are plentiful. It also protects our planet by reducing the amount of carbon dioxide we emit. Integration of renewable structure is a combination of different types of sustainable energy source materials that can be used separately or together (HRES)\textsuperscript{[1]}. Researchers
could indeed also use a combination of something like a diesel generator as well as HRES, depending on the load as well as the available technology. Distributed electricity production, integration of renewable systems, off-grid electrical production as well as job opportunities for native youth seem to be among the various studies evaluated in this article, which have been optimized well with aid of specialized software such as HOMER, LINDO as well as HYPOA among others. The net present cost (NPC), Life cycle cost (LCC), Per unit electricity cost (PUEC), Levelized cost of energy (LCOE), Levelized unit electricity cost (LUEC), as well as the cost of energy (COE) can be especially in comparison for that kind of blended methods about grid-connected devices as well as grid expansion. The goal of this research is to identify the most cost-effective, long-term, technically feasible, as well as ecologically responsible combination technology blending for producing energy from either a mix of alternative energy source materials throughout an off-grid town [2-6].

1.2. Prosumer – depends on management

In the stage of activity dilemma, the MOHEM is introduced with 2 separate objective functions, including minimizing the everyday energy cost of the user and maximizing the cumulative comfort level index. Technologies are used to optimize the suggested 2nd-stage optimization model. This study considers a standard smart home consisting of numerous manageable home appliances to test the efficacy of the suggested 2-stage optimization model. The experiment considers three separate contextual analyses to determine the feasibility of the proposed framework. As well includes a financial review to analyze the resource advantages of the smart home customer [7-10].

1.3. Home Energy Management Systems (HEMS)

Specifying the community's optimum energy consumption plan, the CEMS unit will disentangle the aggregate energy usage pattern into the allocation for sole private buildings by information sharing with HEMS. The HEMS system will work with CEMS commands to monitor household appliances, including water heaters, washers, refrigerators, lighting, and dishwasher, and so on. Among all household appliances, HEMS can modify a few of their energy usage mode. For example, the washer may operate overnight to avoid excessive electricity bills. Additional home appliances such as computers, ovens as well as television have been not appropriate for HEMS regulation, as they must be used by inhabitants as they wish [11-16].

![Figure 1 (a) Power managing system in the house (b) HEMS framework [11]](image-url)
They suggested an innovative HEMS construction with RES as well as ESS wherein they make usage of the energy of the chief grid and energy sale into consideration. Results demonstrate that, through the HEMS method, RES, as well as ESS, will support to drop residential energy prices dramatically to 19.71 percent, by the results of earlier works. By augmenting the charge/discharge range of ESS, energy price can be lowered by 4.32 percent for 0.6 kiloWatt along with 8.51 percent for 0.91 kiloWatt. Besides that, by utilizing multi-objective optimization, the device could deliver greater PAR with a reasonable energy price [17-24].

1.4. Smart building

Stakeholders’ participation throughout energy management systems (EMS) is made possible across demand response (DR) techniques in distributed generation. A microgrid can benefit from integrating renewable energy sources (RES), electric vehicles (EVs), as well as energy storage systems (ESS). The rewards of just a micro grid’s procedure are influenced by variables such as RES generation, market prices, as well as the driving schedules of electric vehicles. Mixed-integer linear programming (MILP) is used in one such article to examine: (i) bi-directional electricity market operational capability of either an EV fleet having arrived at such an office complex under variation based drivers schedules, (ii) the influence of PV ambiguity upon that operating condition of either an energy management system derived from real actionable information, as well as (iii) the impact of PV ambiguity on EMS operating condition in comparison to a methodology that relies solely on predetermined Solar PV systems. Throughout all case reports, the expected total everyday expense for such method was much lower than in their correlating deterministic instances, which confirmed the importance of something like the probabilistic model Based mostly on a deterministic as well as stochastic technique, the output current here between micro grid’s elements as well as the grid was demonstrated inside the referenced case study [25-31].

1.5. Demand Side Management System (DSM)

Visualization using the MATLAB - BPSO algorithm. Arithmetically modelled the power system, influences of DSM incorporated microgrid have been evaluated for various households to reduce energy costs. Simulation models indicated that DSM deployment substantially lowered peak loads and generated trade-off RERs.
Analysis indicates possible DSM deployment benefits of sinking peak load and energy costs. As a consequence of a mandate response program and the deployment of renewable energy, customers would use minimum money for grid electricity and might trade the grid's excess energy. This practice significantly influences the price of average electricity for households. Even so, several constraints link the analysis on the integrative approach of optimal house energy management, which could be an opportunity for future study. In this scenario, for example, capital expenses involved with electricity production were not addressed. Sustainable environmental evaluation of such an integrative approach could be a future trend. Besides these, model responsiveness was conducted recognizing only swarm number and size iteration; furthermore, the implications of acceleration coefficients, inertia weight, and velocity clamping-limit can be further explored [32-36].

1.6. Vehicle connected to the home system

The self-healing construction is however accomplished through the collaboration of the power capital. The prominent features of the model are as follows; the house is capable of working through sole interruption including its machinery and also isolated from its grid. The wind, as well as load variability, are included in the periodic trend is regarded for wind energy, loads, and costs. The durability architecture is researched and modelled under disruptions and incidents like grid electricity or wind system interruption [37-42].
1.7. Combined Microgrids

This article presents a new decentralized organized regulation for hybrid smart grid, which could refer to both grid-connected and insulated design with hybrid energy resources and dynamic loading. The framework allows organized deployment of distributed generation units to grant sufficient active power and added value while necessary. In addition, the high-power point monitoring methodology is utilized to both solar photovoltaic along with wind generators to ensure greater power generation from both the combined energy system as atmospheric circumstances change. After that, a simulation is performed with a photovoltaic, wind turbine, integrated smart grid also as a framework that can be subjected to multiple situations, including tiny homes and offices. The simulation outcomes confirmed the efficacy and effectiveness of the implemented hybrid smart grid strategy operating in various modes [43-47]. A recently integrated control technique with solar cells and wind turbine resources is presented. The key contributions can indeed be defined as follows. Locally, communicated converter topologies are synchronized to regulate output V and I. Explicitly, the AC / DC intertwined converter develops proactive energy and V control framework to maintain stable AC / DC voltages and promote grid synchronization as well as connexion. Additionally, an advanced droop control technique focused on embedded system current sharing is created to avoid the disadvantages of traditional droop control. Proposed control MPPT technique to control the solar cell along with the wind power. Numerous grid-connected, insulated and generator-synchronization case studies have verified the adequate output of the smart grid infrastructure and the suggested control mechanism [48-53].

1.8. Smart house energy management (SHEM)

Scenario-based stochastic bill production was also designed to develop robust FDIA scheduling. Study optimization results showed that perhaps the corresponding component is stable toward FDIA. Methodology of an optimization method was suggested to reduce energy costs either with or without analysis of battery discharge costs for an SH by utilizing variable DR. Inclusion of battery discharge costs in the methodology influences intensity of battery charging and discharge. Furthermore, throughout the case of SH’s demand planning regarding FDIA, the customer's energy bill, as well as load usage, is dramatically affected. The scheduling algorithm must use the recommended FDIA robust planning to mitigate FDIA possible effects. The suggested robust FDIA equation negates the impact of the assault on the price of electricity data [54-60].

Figure 5 SHEM Architecture [54]
1.9. Stochastic renewables

Dispersed generation and load inconsistencies are approached and use a probabilistic model with Kantorovich metrics, resurrect in a 2-stage stochastic program. An alternate clustering approach validates the final variety of scenarios. For site charging points, a flow-based site–allocation principle with available for the entire traffic conditions is utilized. Numerical results show the proposed method’s potential. Allocation planning authorities may gain from the plan to make intertemporal investment choices whilst retaining system output efficiency. Novel multi-objective structure for preparing distribution extension with RERs and EV charging points in a combined distribution and transport network. The paradigm uses scenario-based stochastic programming to manage complexities by functions of likelihood. A multi-criteria, the nonlinear mixed-integer program is developed to steadfastness the computational tricky is based through an evolutionary model algorithm with both the Tchebycheff decomposition approach. Applying the structure to either an illustrative test case of preparation has explicitly shown how the nature of expansion planning and its target principles change, like renewable energy. The proposed methods created for such a particular scenario demonstrated some relevant relationships with the total cost and traffic flow obtained. The framework's key strength is modeling ambiguity. It needs broad historical load and weather datasets at the low temporal resolution, along with delivery system as well as traffic flow information. The conceptual methodology can therefore be used as strategic proposals and lead to sustainable generation, supply protection, and cost-effective energy for environmental and economic benefits. Even so, several drawbacks rendered the proposed structure feasible. In general, the geological characteristics of the region are being overlooked and development preparation is restricted to removing the exchange of energy only with the transmission system. Yet more research could explore how transporting behavior interacts with geographical regions along with the energy economic situations in the wider network [61-65].

1.10. AI in renewables for home system

Electricity costs, like RERs, were measured and applied to the various price multiplier seeing the project’s profit. The overall structure included both sensor and PV panel costs. The forecast model was a sub-discipline of this work where the potential output value was estimated, and can also be a value engineering criterion for renewable energy. Project extension is feasible with a moderate or greater system [66-69].

1.11. Integrated Grey Wolf with Shark Smell algorithms

The impact of incorporating RERs and storage systems into the method is analyzed for comparative analysis. Findings confirm that perhaps the introduction of power generation may reduce the price of production and enhance system reliability by around 20% and 18%, correspondingly; notice that growing sensitive load can contribute to a narrower peak load as well as provide maximum harvesting for both the device such that the V deviation of MG can be increased by around 21%. This study examined the impact of receptive load incorporation on MG in the incidence of DRP. A traditional MG was tested at three stages of receptive load penetration. Analysis indicates that increased sensitive load penetration levels can minimize power consumption, boost voltage deviation, and provide more cost-reduction benefits. A comparable study found that renewable energy and energy storage could minimize generation costs and increase network reliability by about 20% and 18% respectively. Introducing energy storage will reduce these variations as well as provide maximum device shaving to increase the voltage deviation of MG by about 21 percent. A future case study may also discuss the reorganization of pooled MGs by recognizing the customer management issue [70-74].
1.12. Renewables integration

To this extent, such technologies influenced the research profession to even further explore and develop RERs-based hybrid thermal and power arrangements in household and business sectors. This approach views electricity production from RERs like solar, wind, and geothermal while operating as a cogeneration plant or integrated with either a hybrid heat or power method. The main objectives of such a study are all to assess the performance of its recent state-of-the-art design features as well as provide a comprehensive review addressing recent research developments in thermal, wind, and geothermal energy. This study intends to enhance integration through multiple simultaneous renewable energies into integrated thermal and power systems. In this context, initial research studies are classified by utilizing RERs insole and several incorporations. Even more, categories are being conducted based on some of the most referred research trends throughout this particular renewable energy industry to recognize the current research goals and challenges which every renewable field currently facing. Global climate change and growing energy consumption prompted every energy sector to consider alternative ways of generating power and heat [75-77].

Clean energy production along with Combined Heat and Power (CHP) systems are being implemented to mitigate energy production carbon fuels frequency, reduce CO2 and GHG pollution, and improve efficiency as well as sustainable integration. CHP or cogeneration mechanism is indeed a type of construction supportive of extracting as well as using excess heat while energy production of alternative forms of energy including such boiling water including space thermal heating in domestic DH grids or process industries heat. These power methods can be described mostly on basis of size, guiding force, and power sequence, whereby high capacity can range from 75 to 95 percent while contemplating thermal generation. RES are renewable and sustainable resources for energy production owing to global warming and environmental consequences, focus has been focused in recent times on formulating and delivering sustainable processes in different contexts. In the study, wind, solar, and geothermal is renewables. This work analyzed state-of-the-art experimental activities and recognized those integrations' current status. Besides that, each potential perspective of sustainable power was explored [78-82].

1.13. Modelling of RERs

This methodology involves charging storage systems and producing hydrogen through WT-DFIG and PV generators for surplus power. Consequently, if WT-DFIGs and PV energy are insufficient, the FC and storage system will be utilized as backup systems to supply adequate electricity. This ability to contribute with effectiveness is checked in MATLAB / Simulink that are acceptable results can be achieved. A versatile source renewable smart grid including integrated storing energy is examined. WT-DFIG combined with PV and FC. So, although integrated power storage comprises of such a battery bank energy storage system - BBESS coupled with only a hydrogen producer electrolyzer device. Utilizing MATLAB / Simulink, its total integrated MG simulator archetypal has been produced. The methodology and functionality of the key elements of the project are provided, outlining the total control as well as the power storage plan is proposed for hybrid energy devices. WT-DFIG and PV storage units are the most important power storing devices, and electrolyser-battery bank (BB) acts as either a dump load by using any surplus electricity required for BB storing and H2. The FC and BB system seems to be the substitute and supply energy whenever energy deficiencies arise [83, 84]. The conclusions are drawn often affirm the reliability and efficacy of the suggested control that allows everyone to appreciate the luxury of integrating a stator-flow-oriented control (SFOC) with a variable structure control (VSC) operation, using the nonlinear sliding mode control (SMC) based technique for governing the effective power processing mostly on Ac system as well as the localized reactive power adjustment. Even this confirms the DFIG’s effectiveness in directing and maintaining effective-reactive power, especially as just a localized grid voltage control scheme, in which it can work as just a synchronous machine in
asynchronous operation. Besides that, the results revealed the suggested smart grid's satisfactory efficiency and productivity. Even so, the main objectives of such an initiative are effective delivery regulation among different RERs, efficient functioning including its projected smart grid (DC and AC grid) offering enhanced energy quality as well as continuous service. Improved power conservation would then be witnessed, allowing the effective function of the system with high smart grid performance amid undesirable as well as crucial conditions including such variations in power consumption and unpredictable [85-90].

2. Conclusion

Case studies assessment made in this article based on the decentralized power generation, Prosumer depends electricity management, Home Energy Management Systems (HEMS), Smart building, Demand Side Management system, Vehicle connected to the home system, Combined Microgrids, Smart house energy management (SHEM), Stochastic renewables, AI in renewables for a home system, Integrated Grey Wolf with Shark Smell algorithms, Renewables integration, Geopolitical Viewpoint and Modelling of RERs reveals the efficiency in the renewables can be achieved either by integration of technology to RERs and or combining many RERs.

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