frontiers | Frontiers in Energy Research

TYPE Editorial
PUBLISHED 02 July 2024
DOI 10.3389/fenrg.2024.1451373

OPEN ACCESS

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RECEIVED 19 June 2024
ACCEPTED 20 June 2024
PUBLISHED 02 July 2024

CITATION
Balachandran PK, Thanikanti SB, Ayodele BV, Fahrioglu M and Nwulu N (2024), Editorial: Attainment of SDGs through the advancement in solar PV systems.
Front. Energy Res. 12:1451373.
doi: 10.3389/fenrg.2024.1451373

Editorial: Attainment of SDGs through the advancement in solar PV systems

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KEYWORDS

sustainable development goals, solar photovoltaic, clean electricity, energy efficiency, solar mini-grid

Editorial on the Research Topic
Attainment of SDGs through the advancement in solar PV systems

As we approach 2030, it is imperative to confront the significant disparities that are impacting our wellbeing, standard of living, and global economies. The development of renewable energy systems, particularly solar photovoltaic (PV) systems, can directly and indirectly contribute to the achievement of many of the UN's Sustainable Development Goals (SDGs). Solar PV systems are often regarded as highly efficient means of generating clean electricity, making them crucial for achieving these objectives. A multitude of researchers worldwide are presently concentrating on enhancing efficiency, minimizing expenses, recycling, reconfiguring, and innovating materials for solar PV systems. By employing sustainable energy systems for various purposes such as electricity production, farming, and electric vehicle charging, we may actively contribute to the successful attainment of the SDGs. Nevertheless, it is crucial to evaluate and emphasize the degree of achievement of SDGs in current research on solar PV systems.

The Research Topic "*Attainment of SDGs through the advancement in solar PV systems*" promotes research focused on achieving any of the 17 Sustainable Development Goals (SDGs) through the advancement of solar photovoltaic (PV) systems. Several authors have delved into the Research Topic by considering the progress in the efficient production and application of solar PV power systems; utilizing solar PV systems for everyday requirements such as electric vehicle (EV) charging; analyzes the achievement of SDGs through the use of renewable energy systems; progress in the modeling and optimization of solar systems via the application of innovative techniques and procedures to improve energy output.

Karna et al. provides a performance assessment of two solar mini-grid systems, namely, Thabang Solar Mini-Grid (TSMG) and Sugarkhal Solar Mini-Grid (SSMG), in Nepal. The study uses secondary data from 2021–2023 and PVsyst software 7.4 to measure the peak levels of irradiance in April for both systems. The study explores the process of energy generation by solar PV modules, emphasizing that it is closely correlated with the intensity

of irradiance levels. The authors reported that an increased irradiance leads to greater energy production, however elevated temperatures were reported to decreased production as a result of their negative effect on the efficiency of solar cells. Several variables were also reported to impact energy production, including temperature, shade, dust buildup, and the capability of system components. It was concluded that efficient placement and consistent upkeep of solar panels are essential for optimum energy production.

Srilakshmi et al. examines the integration of a unified power quality conditioner (5L-UPQC) with wind, solar, and battery storage systems as a solution to power quality problems. The study presents a suggested approach that utilizes an Artificial Neural Network-based Controller trained with the Levenberg–Marquardt algorithm. This ANNC generates reference signals for converters, hence removing the requirement for conventional transformations. The study assessed the system's performance in different scenarios, showcasing its efficacy in reducing current harmonics, enhancing power factor, and eliminating fluctuations in grid voltage. It proposes that the same approach can be applied to multilevel UPQC systems with fewer switches to achieve even greater improvements.

Aljafari et al. explores a new PV array layout inspired by the Renzoku puzzle pattern. The proposed layout aims to tackle the problem of power loss in PV systems that are only partially shaded. The PV array was suggested as a solution to address the limitations of prior configurations in terms of power generation and mismatch losses. The suggested arrangement was verified using a simulation of a 9 × 9 PV array in MATLAB/Simulink® and its subsequent construction in hardware. The study presents results and characteristic curves that demonstrated the efficacy of the layout under different amounts of partial shade.

Qin et al. presents a technique for monitoring the rapid frequency response of solar power stations in order to maintain the stability of the power grid. The system incorporates a sensor data gathering module and a data analysis module to accurately evaluate response rates. The study suggested method's anti-disturbance performance was validated using a frequency step disturbance test conducted at a power station in China.

Srilakshmi et al. describes an efficient architecture for a power system that combines solar, wind, battery, and electric vehicle technologies with a Unified Power Quality Conditioner. The study employs an advanced most valuable player algorithm to choose active filter and PID Controller settings for the purpose of regulating power flow and enhancing power quality. The findings demonstrate that the ANFIS-based power flow management, along with the optimal design of UPQC, effectively tackles the difficulties related to power quality (PQ) and achieves efficient power sharing.

In a similar study by Srilakshmi et al., a concept for a reduced switch converter, which aims to decrease costs and enhance reliability by utilizing a reduced number of switches was presented. The study introduces an innovative method of combining Static Harmonic and Reactive Power Filter with renewable energy sources. It showcases enhanced power quality and consistent power supply across different operating situations. The study examined four test scenarios in both grid and standalone situations, assessing the performance of the optimized controller in comparison to current approaches such as sliding mode control and classic fuzzy logic control.

Pushkarna et al. introduces a compensation approach that utilizes Unified electricity Quality Conditioner to establish a connection between wind farms and electricity networks that have low strength. The study discusses the difficulties of incorporating wind farms equipped with Squirrel Cage Induction Generators into vulnerable power networks, which can have negative impacts on Power Quality and stability. The study emphasizes the utilization of CUPS, specifically UPQC, to enhance voltage regulation and minimize variations at the Point of Common Coupling. The results indicate that the suggested compensatory approach improves power quality and stability in wind farms.

Luo et al. conducted a comparison of the environmental effects of solar photovoltaic power generation and coal power in Ningxia, China, employing life cycle assessment and ecological footprint analysis. The GHG emission rate of solar photovoltaic power generation was substantially lower in comparison to coal power. The solar photovoltaic power generation has an excess of ecological resources, whereas coal power displays an increasing shortage of ecological resources. The report proposes a transition towards sustainable energy sources, such as solar photovoltaic power generation, in order to match with China's objectives of achieving carbon neutrality.

Fekik et al. presented a battery management system that incorporates three separate modes: charging, direct, and discharging. These modes provide intelligent control over crucial circumstances. The simulation findings highlight the resilience of the suggested system across various conditions, showcasing its efficacy in regulating power distribution according to battery charge levels, even in situations with inadequate solar power. The study makes a significant contribution to the advancement of knowledge in PV/battery systems and provides a realistic and sustainable solution for improving energy generation, distribution, and storage.

Smida et al. proposed a novel metaheuristic maximum power point tracking called the Crow Search Algorithm (CSA) to ameliorate the tracking performance of a grid connected shaded PV system. The CSA is a nature inspired method based on the intelligent behaviors of crows in its search process for hidden food sources. This novel method succeeds to mitigate the adverse impacts of partial shading on the performance of PV systems by accurately tracking the GMPP. Based on the small-signal dynamic model, the stability of the proposed system is analyzed. Simulation results for three different levels of partial shading, including zero, weak, and severe shading, demonstrate the better performance of the suggested CSA compared to fuzzy logic controller (FLC) and Inc-Cond techniques.

Kumar et al. demonstrated the enhancement of power quality in a grid-connected PV system using a hybrid energy storage system. The proposed technique enhances the consistency of photovoltaic power generation, stabilizes the direct current voltage, and eliminates the harmonic distortions caused by non-linear loads on the power source. The two primary roles of the Shunt Active Power Filter functioning as a reactive power buffer mitigate variations and minimize distortions caused by current harmonics. This enables the direct transfer of active electricity into the electrical grid by harnessing sustainable solar PV energy. The effectiveness of

the projected compensation system may be observed by the sinusoidal current and reactive power compensation. The system's minimal overall harmonic distortion demonstrates the effectiveness of the configuration.

Baskaran et al. suggested the use of four high-step-up DC-DC converters to convert low-voltage sources, such as solar photovoltaic, fuel cells, and battery banks. Their performances were assessed based on their capacity to achieve optimal capability and maintain high dependability. Out of the four suggested designs, the bootstrap converter was chosen due to its capacity to minimize losses and eliminate unnecessary parameters. The suggested converter operates the inverter-driven switching reluctance motor (SRM) assembly using a directly coupled approach, therefore eliminating the requirement for battery banks and contributing to cost reduction.

The interest in the Research Topic "Attainment of SDGs through the Advancement in Solar PV systems" is evidenced by the subject set's cumulative view count, which at the time of writing this editorial had reached 7,815. There had also been 1,010 downloads of the different articles.

Author contributions

PB: Conceptualization, Visualization, Writing–review and editing. ST: Conceptualization, Visualization, Writing–review and editing. BA: Conceptualization, Writing–original draft. MF: Conceptualization, Visualization, Writing–review and editing. NN: Conceptualization, Visualization, Writing–review and editing.

Funding

The author(s) declare that no financial support was received for the research, authorship, and/or publication of this article.

Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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