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Editorial

Renewable Energy Systems: Optimal Planning and Design

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Renewable energy systems have emerged as a key solution to mitigate the impacts of climate change and meet the growing demand for energy in a sustainable way. The application of renewable energy technologies has the potential to reduce greenhouse gas emissions, promote energy security and access, and foster economic growth and job creation. As such, the development and deployment of renewable energy systems have become a top priority for many countries worldwide.

The Special Issue of *Applied Sciences* on renewable energy systems brings together a collection of original research and review articles that address various aspects of renewable energy systems. The contributions cover a broad range of topics, including solar, wind, and wave energy systems, and energy storage, grid integration, policy and regulatory frameworks, and socio-economic impacts.

One of the key themes that emerge from the articles is the importance of technological innovation, research, and development to drive the advancement of renewable energy systems. Several articles highlight the potential of new and emerging technologies, such as community battery energy storage systems, offshore wind and wave energy integrated stations, and renewable energy-based charging stations for electric vehicles, to enhance the efficiency and cost-effectiveness of renewable energy systems. Alrashidi [1] proposes a bi-level optimization method based on a neural network optimization algorithm for the efficient planning of multiple community battery energy storage systems (BESS) in low-voltage distribution systems with high residential rooftop photovoltaic (PV) units. The method optimally places and operates BESS collectively at a distributed system level, using linear programming to minimize the daily voltage signal. The simulations show the efficacy of the proposed method in enabling utilities to determine the optimal location, capacity, and number of BESS to regulate the voltage within acceptable bounds under the influence of network topology, load profiles, and the amount of PV power.

Le and Nhieu [2] propose a novel dual-side behavioral spherical fuzzy multi-criteria decision-making approach to determine high-efficient and sustainable locations for offshore wind and wave energy integrated stations (WWS). The proposed method combines quantitative indicators and qualitative criteria to provide recommendations for appropriate WWS locations. The research provides efficiency and sustainability positioning maps and compares findings with current development projects, plans, and policies in Vietnam for validation. Alkawsi et al. [3] review studies related to renewable energy-based charging stations for electric vehicles, covering aspects such as resources, potentiality, planning, control, and pricing. The study clarifies challenges and proposes suitable solutions for this type of charging station. The paper aims to provide an overview of charging electric vehicles through renewable energy and establish the ground for further research in this vital field. Pintér et al. [4] explores the potential of utilizing the battery energy storage systems of small electric boats in Lake Balaton, Hungary, as a means of energy storage to mitigate fluctuations in power generation. The paper presents the potential utilization of Europe's significant network of sea and inland recreational ports for the purpose of energy storage and explores the volume of energy storage potential in small electric boats, which may facilitate the creation of new types of flexibility services related to energy storage.

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The innovative novelty of this study is that it regards small, fully electric boats not just as vehicles, but also explores their energy storage potentials.

Others explore the challenges and opportunities of integrating renewable energy sources into the grid, and the role of smart grid technologies and energy management systems in optimizing energy consumption and reducing waste. Thiesen [5] highlights the insufficiency of existing energy system modelling and the literature covering the reduction in power system inertia resulting from the increasing share of grid frequency converter-connected renewables. The work proposes an open-source energy system model that incorporates minimum system inertia constraints, wind turbines, and battery storage systems as carbon dioxide-free sources for synthetic inertial response. The results indicate that integrating system inertia constraints has a high impact on system costs, and investments in additional storage units providing inertial response may be necessary. Sierra-Aguilar et al. [6] proposes a new model for solving the security constrained unit commitment problem in power systems, which addresses the challenges of reducing computational load and modeling uncertainty of intermittent generation and demand. The proposed affinely adjustable robust model uses linear decision rules and a novel method for evaluating N-1 security constraints, which increases computational efficiency when transmission line contingencies are considered. Monte Carlo simulations demonstrate the effectiveness, feasibility, and robustness of the proposed model.

Another significant theme that connects the articles is the need for supportive policy and regulatory frameworks to facilitate the deployment of renewable energy systems. Munkhbat and Choi [7] used a GIS-based approach to identify suitable sites for large-scale solar PV power plant installations in Mongolia. Seven criteria were used to collect data for each cell, and an analytical hierarchy process was used to determine the weightings of these criteria. Results showed that the central region of Mongolia should be prioritized for installing PV power plants due to the presence of good sites and high demand for electric power in the region. Seo and Suh [8] investigated 100 smartphone applications (apps) developed for the solar PV energy sector and categorized them based on their functions. The apps were grouped into seven categories, including computation of sun position, PV system optimal settings, PV site investigation, potential assessment of PV systems, environmental and economic assessment of PV systems, monitoring and control of PV systems, and education and learning for PV systems. The study discusses the limitations of app implementation in solar PV and implications for future improvement.

In sum, the Special Issue of *Applied Sciences* on renewable energy systems provides valuable insights into the current state and future prospects of renewable energy systems. It underscores the importance of interdisciplinary and cross-sectoral collaboration, and the need for continuous innovation, policy support, and stakeholder engagement to enable the transition towards a sustainable energy future.

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