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# Editorial: Advances in modeling and simulation of wind and solar energy systems for the built environment

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Editorial on the Research Topic
Advances in modeling and simulation of wind and solar energy systems for the built environment

The Research Topic on "*Advances in Modeling and Simulation of Wind and Solar Energy Systems for the Built Environment*" features seven research articles addressing renewable energy technologies aimed at reducing fossil fuel dependence. Amid the urgent need for sustainable energy under the Paris Climate Agreement, renewables are rapidly expanding globally, employing clean technologies that integrate well into sustainable systems. A key challenge in this transition is enhancing energy performance, such as optimizing wind and solar systems through advanced design and control methods.

This Research Topic explores factors impacting renewable energy systems (RES) to improve their efficiency across scales, with computer-based modeling, simulation, and experimental validation playing central roles. The included studies cover advancements in wind load forecasting, counter-rotating wind turbine structures, grid connection optimization, and control of hybrid renewable systems. Topics also span photovoltaic (PV) and wind energy integration for hybrid systems.

In "Multi-resolution based PID controller for frequency regulation of a hybrid power system," Zhang et al. introduce a novel control scheme using a wavelet-based multi-resolution PID (MRPID) for frequency regulation in hybrid systems, including gas, thermal, hydro, solar, and wind units. The MRPID controller addresses system non-linearities, uncertainties, and load changes by decomposing system errors through discrete wavelet transforms and optimizing controller gains using the Fox Optimizer Algorithm. Tested on a three-area hybrid system, the MRPID outperforms FOA-tuned PID and PI controllers, proving robust under ±30% parameter variation.

In "Wind tunnel test study on wind load variation in a point focus solar furnace," He et al. analyze wind pressure, spectral density, and load coefficients in a solar furnace via wind tunnel tests across 305 scenarios. Findings show interaction effects between heliostats and concentrators that increase peak wind load slightly, suggesting a safety factor of 1.1–1.2 in solar furnace design.

Li et al., in "Optimization of offshore wind power grid-connected structures using an improved genetic algorithm," propose a full life cycle model for optimizing offshore wind system topology. Their improved greedy algorithm analysis reveals that HVAC and HVDC systems have optimal economic distances of 50 km and 170 km, respectively, with a 5.6%–10.2% cost reduction in a three-farm cluster using a point-to-point scheme over star and circular topologies.

Li et al. examine the "Coupled dynamic characteristics of a 10 MW semi-submersible offshore wind turbine," detailing the dynamic response of a Technical University of Denmark turbine on a semi-submersible platform. Their redesigned GSPI servo control manages responses to wind, wave, and fault conditions, with findings that turbulent wind affects surge and pitch, while waves drive heave motion. Faults mainly impact tower bending, with heave remaining stable.

In "Scrutiny of power grids by penetrating PV energy in wind farms: a case study of Jhampir, Pakistan," Soomar et al. model a photovoltaic (PV) system integrated into a wind farm to stabilize wind energy variability. They present three cases: baseline wind farm, enhanced capacity with an autotransformer, and increased PV penetration, which boosts capacity 1.23 times from case 2.

Majid's "Accuracy of wind speed forecasting based on Weibull distribution" develops an algorithm for wind forecasting at Fujairah. By using four simulation methods and moving averages on Weibull parameters, the study finds a 20% variation in scale factor significantly impacts wind speed predictions.

Finally, Saulescu et al., in "Comparative analysis of torque-adding wind energy conversion systems with counter-rotating generators," explore two counter-rotating rotor systems in urban environments. They compare scenarios with varied rotor size, speed, and torque, showing that counter-rotating systems offer mechanical and energetic advantages over conventional designs.

## Author contributions

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