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Innovations in Intelligent Microgrid Operation and Control

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Amid the global imperative to balance energy security, environmental sustainability, and economic feasibility, integrating renewable energy sources (RESs) has become central to modern energy systems. Microgrids—capable of standalone or grid-connected operation—are pivotal for efficient RES utilization, while intelligent microgrids, empowered by advanced control, artificial intelligence (AI), machine learning, and sophisticated energy management, drive the transition to decentralized, low-carbon energy networks.

The Special Issue “Innovations in Intelligent Microgrid Operation and Control” presents state-of-the-art research advancing microgrid technology, focusing on novel solutions to boost efficiency, reliability, flexibility, and resilience. Its studies cover critical topics: advanced control systems for RES and load integration, optimized energy storage deployment and operation, distributed/hierarchical control for system-wide coordination, and strategies to enhance microgrid resilience against natural disasters, cyberattacks, and other disruptions. Additional research explores economic/policy frameworks for widespread adoption and design principles balancing resilience with environmental sustainability. Key contributions include: innovative virtual synchronous generator (VSG)-based control to mitigate voltage fluctuations in high-penetration RES networks; intelligent monitoring for critical microgrid components; trust evaluation frameworks for adaptive load optimization in safety-critical systems; and shared energy storage solutions for bipolar DC microgrids.



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