

Renewable Energy Optimization for Smart Cities Using Quantum-Inspired Algorithms and Metaheuristics

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Abstract:

The integration of quantum-inspired algorithms and metaheuristic optimization techniques is revolutionizing renewable energy management in smart cities. By emulating quantum computing principles, these algorithms—such as Quantum Particle Swarm Optimization (QPSO) and Quantum Approximate Optimization Algorithm (QAOA)—enhance the efficiency of energy distribution systems. They address complex, multi-objective challenges like minimizing operational costs and reducing environmental emissions in grid-connected microgrids. The application of these advanced computational methods facilitates real-time decision-making and adaptive control in dynamic urban energy environments, contributing to the development of sustainable and resilient smart city infrastructures.

Keywords: Quantum-Inspired Algorithms, Metaheuristic Optimization, Renewable Energy, Smart Cities, Energy Management, Sustainable Infrastructure

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