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# Smart City $CO_2$ Emission Reduction Optimization Through Machine Learning and Metaheuristics-Based Models

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**Abstract:**

The growing urbanization and energy demands of modern cities necessitate innovative approaches to mitigate $CO_2$ emissions and promote environmental sustainability. This study proposes an integrated framework that leverages machine learning and metaheuristic algorithms to optimize $CO_2$ emission reduction strategies in smart cities. Machine learning models are employed to analyze large-scale urban data, including traffic patterns, energy consumption, and industrial emissions, to identify high-impact intervention points. Metaheuristic algorithms such as genetic algorithms and particle swarm optimization are then used to design and fine-tune policy and infrastructure interventions for maximum emission reduction. The proposed hybrid approach enhances decision-making, supports real-time adaptation, and contributes to the development of greener, more efficient urban environments.

**Keywords:**

$CO_2$ emission, smart city, machine learning, metaheuristics, optimization, urban sustainability.

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