

Integrating electric vehicles into urban car-sharing systems: addressing grid constraints and operational challenges for sustainable mobility

Urbanization is accelerating, creating challenges in transportation, energy use, and emissions. Car-sharing can lower private car ownership and greenhouse gas emissions, while electric vehicles (EVs) produce zero emissions and can use renewable energy. Combining EVs with car-sharing offers a sustainable transport solution. However, the rising electricity demand from widespread EV adoption may threaten grid stability and capacity, complicating their integration into car-sharing services. This study tackles the challenge of optimizing fleet operations while maintaining grid reliability. It presents a framework that addresses car-sharing operational issues and includes strategies to minimize charging impacts on distribution grids. Key strategies involve active management of EVs through coordination between distribution system operators and car-sharing companies to match charging with network demands and incorporating distributed generation, such as renewable energy and vehicle-to-grid technology. These strategies allow EVs to support the grid by considering the grid conditions while satisfying the needs of car-sharing systems. By modeling grid-aware EV car-sharing systems, this research provides actionable insights for improving system resilience and sustainability. The findings aim to support mobility operators and policymakers in developing efficient, scalable, and grid-compatible urban mobility solutions.

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