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Multi-Objective Electric Vehicle Charge Coordination for Economic Network Management under Uncertainty

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Abstract : Electric vehicles are a popular transportation medium renowned for potential environmental benefits. However, large and uncontrolled charging volumes can impact distribution networks negatively. Smart charging is widely recognized as an efficient solution to achieve both improved renewable energy integration and grid relief. Nevertheless, different decision-makers may pursue diverse and conflicting objectives. In this context, this paper proposes a multi-objective optimization framework to control electric vehicle charging to achieve both energy cost reduction and peak shaving. A weighted-sum method is developed due to its intuitiveness and efficiency. Monte Carlo simulations are implemented to investigate the impact of uncertain electric vehicle driving patterns and provide decision-makers with a robust outcome in terms of prospective cost and network loading. The results demonstrate that there is a conflict between energy cost efficiency and peak shaving, with the decision-makers needing to make a collaborative decision.

Keywords : electric vehicles, multi-objective optimization, uncertainty, mixed integer linear programming
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