

Optimal Operation Method of Hydrogen-Storage Integrated Energy System Considering Source-Charge Uncertainty

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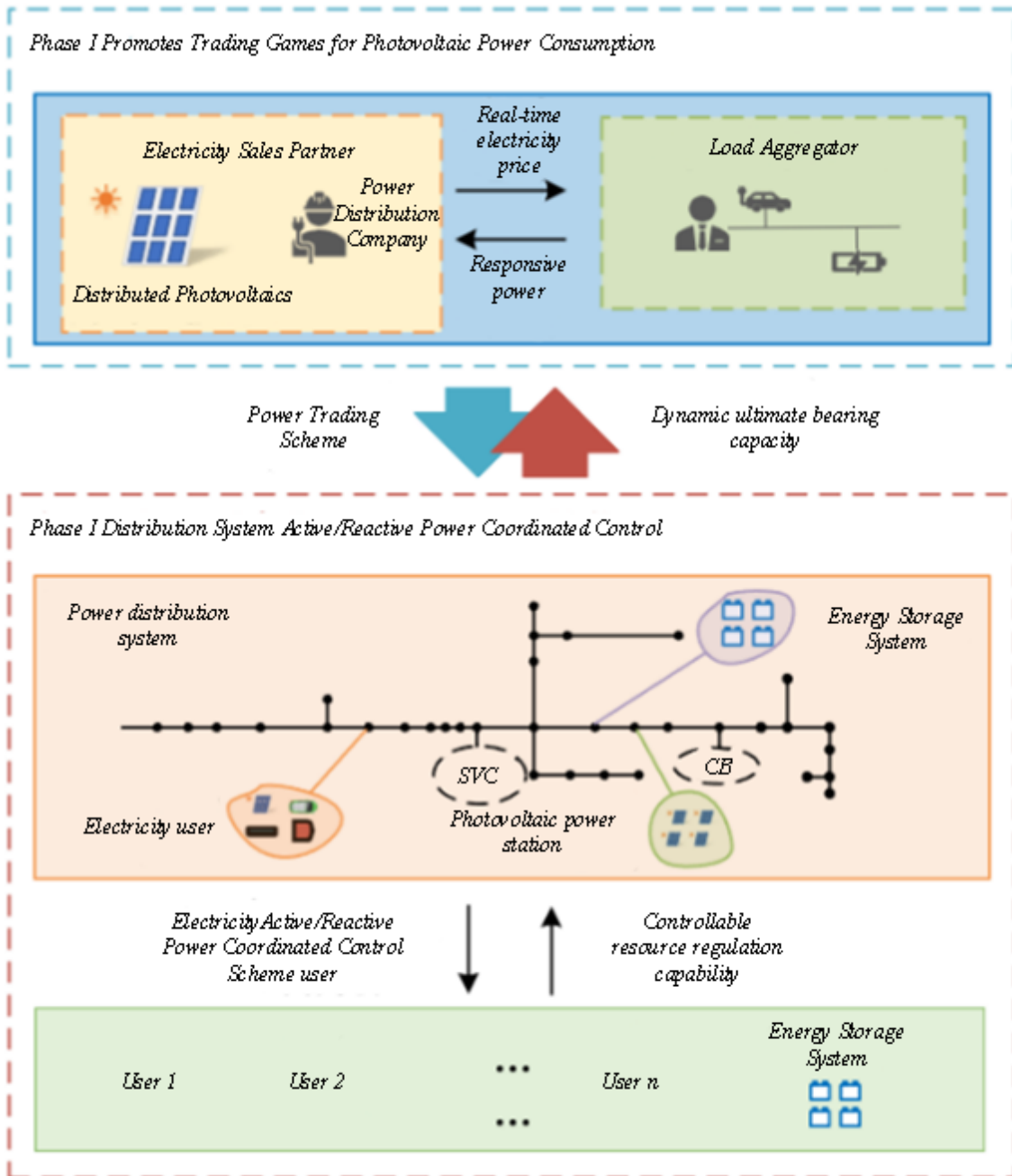
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Abstract

With the rising share of renewable energy, source-load uncertainty presents significant challenges to integrated energy system operations. This paper introduces a two-stage robust optimization method for integrated energy systems with hydrogen energy storage, accounting for source-charge uncertainty. It achieves multi-energy coupling and cross-cycle adjustment through hydrogen energy storage, thereby improving system economy and reliability. Specifically, first, an electricity-hydrogen-heat multi-energy flow coordinated operation model was constructed, and the electrolysis/fuel cell bidirectional conversion mechanism of hydrogen energy storage was introduced; Secondly, a data-driven distributed robust optimization method is employed to address the uncertainty in wind and solar output as well as load demand. Lastly, an accelerated Benders decomposition algorithm with adaptive step size is developed to enhance solution efficiency. Experimental results indicate that, compared to the traditional deterministic model, the proposed method reduces operating costs by 15.2%, wind curtailment rate by 9.8%, and calculation time by 42%, thereby demonstrating its effectiveness and superiority in handling uncertainty.

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Innovative Description: This proposed method has effectiveness and superiority in handling uncertainty.