# Quantum Computing for Stochastic Economic Dispatch in Renewables-Rich Power Systems

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Scenario-based stochastic optimization is a prevalent method for the economic dispatch of renewables-rich power systems. To reduce the time and space complexities for generating massive scenarios and solving pertinent mixed-integer stochastic optimization efficiently, quantum computing can provide critical assistance. To this end, we first propose the unified quantum amplitude estimation (UQAE) to generate massive scenarios with quadratic acceleration by a few qubits, after which the dimension of state variables embedded in the two-stage stochastic optimization also decreases exponentially. Then, by utilizing quantum-classical Benders decomposition, we accelerate the mixed integer master problem in the first stage on quantum processing units, while convex subproblems are solved on central processing units. Especially considering limited qubits in the noisy intermediate-scale quantum era, we propose to reduce the scale of master problem by scenario clustering and cut selection using the customized quantum approximation optimization algorithm (QAOA). Mathematically, we not only prove the decreases of complexities by UQAE-QAOA but also give the feasible ranges of penalty factors for transforming constrained problems into Ising models. Finally, we perform numerical experiments on modified IEEE systems to test the efficiency and accuracy of UQAE-QAOA, as well as the scalability of the designed quantum scheme.

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