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Robust virtual power plant investment planning

A. Baringo Morales; L. Baringo Morales; J.M. Arroyo Sánchez

Abstract-

This paper proposes a novel approach based on adjustable robust optimization for the investment planning of a virtual power plant that participates in the energy electricity market. The virtual power plant behaves in this market as a price-taking agent that faces exogenous prices. The virtual power plant comprises conventional, renewable, and storage units, as well as flexible demands. Investment decisions on conventional, renewable, and storage units are made under the uncertainty related to future production costs of the conventional generating units, future consumption levels of the flexible demands, and future energy market prices. As a major modeling contribution, the nonconvex operation of both conventional generating units and storage devices is precisely accounted for, thus yielding a trilevel program with lower-level binary variables. The resulting model is solved using an exact nested column-and-constraint generation algorithm, which constitutes the methodological contribution. Results from several case studies are provided to show the effective performance of the proposed approach.

Index Terms- Adjustable robust optimization; Energy electricity market; Investment planning; Nested column- and-constraint generation algorithm; Nonconvex operation; Uncertainty; Virtual power plant

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