Stochastic optimization-based sustainable retrofit of petrochemical energy systems under multiple uncertainty

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Abstract

We report a multi-objective stochastic mixed-integer non-linear programming (MINLP) framework for sustainable retrofit and capability expansion of traditional energy systems in petrochemical complexes. Multiple uncertainties including energy demands, solar radiations and wind speeds are considered in the optimization framework, which are characterized by normal distributions of historical data or normal distributions pre-defined with assumed mean values and standard variations. A stochastic reduced order model sampling technique is introduced to describe the uncertainties by a small number of scenarios and their individual probabilities. The optimization framework further accounts for system configuration selection and sizing of the candidate energy conversion equipment, such as thermal storage units, gas turbines, boilers, steam turbines, as well as their operating capacities in each time period. A case study is investigated to demonstrate the performance of the proposed strategy and the optimization results under three modes (deterministic, stochastic and semi-stochastic programs) are compared.

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