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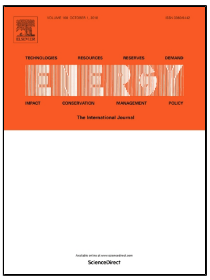

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Keywords: Generation expansion, Health damages, Iterative methods, Power systems planning, Simulation optimization

Highlights

- A generation expansion planning model that minimizes societal costs is presented.
- Simulation-based optimization is used to find a capacity expansion plan.
- A case study for the Northeastern United States is presented.
- The results are compared with various deterministic cases.

Abstract

Electricity generation expansion planning models determine the optimal technology-capacity-investment strategy that minimizes market costs including investment costs, and fixed and variable operating & maintenance costs over a long-term planning horizon. From a market cost perspective, fossil fuels are among the most economical sources of electricity, and thus are the primary sources of energy for electricity. However, these energy sources create by-products that have harmful health effects upon exposure. In this paper, a simulation-based, metamodeling approach is leveraged to quantify health damages associated with power grid expansion decisions by linking the outputs of generation expansion planning simulations with a screening tool that quantifies the human health damages from the electricity sector. Using this as a surrogate function for health damages, these costs are included in the objective function of a generation expansion planning model, in addition to market costs and the social damages of carbon emissions and methane leakage to minimize societal damages. Applying an improvement algorithm, candidate data points are selected to enhance metamodel prediction capability. Finally, using an updated metamodel, a new