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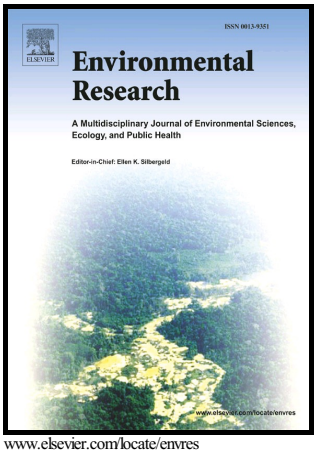

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An air quality index-based multistage type-2-fuzzy interval-stochastic programming model for energy and environmental systems management under multiple uncertainties

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Abstract

In this study, a multistage type-2-fuzzy interval-stochastic programming (MTIP) method is developed, which extends upon the existing multistage stochastic programming (MSP) by allowing uncertainties expressed as probabilistic distributions, interval values and type-2 fuzzy sets to be effectively incorporated within the optimization framework. Through coupling air quality index (AQI) with MTIP, an AQI-MTIP model is formulated for energy and environmental systems (EES) management of Tianjin. A number of scenarios based on changed AQIs are examined to analyze the impacts of environmental requirements on the city's energy system. Results indicate that (i) with the improvement of environmental requirement, utilization of clean energies (especially natural gas) is provoked markedly; (ii) $PM_{2.5}$ is the primary pollutant, 64.50% of which should be reduced each period to maintain the city's air quality at a health-safe level. These findings can help decision makers adjust energy structure, make effective mitigation strategy, and gain deep insight into the relationship between energy consumption and environmental requirement.