

Title:

Development of non-deterministic multi-scale energy models

Abstract:

Energy plays an important role in achieving sustainable economic development and improving people's living standard. Currently, around 80% of global energy is generated by fossil fuels. Heavy reliance on fossil fuels has led to billions of tons pollutants and greenhouse gases being emitted into the atmosphere, resulting in climate change and air pollution. A number of conflicting issues such as growing economic demand, increasing energy supply, shrinking energy resources, changing climate condition, as well as tightening environmental requirement pose great challenges to decision makers for planning energy system towards cleaner production and sustainable development. In this study, a set of non-deterministic multi-scale energy models (i.e., municipal, regional and national) are developed for investigating the interactions among energy, environment, economy and resources, handling uncertainties expressed as random, fuzzy and interval formats, as well as generating desired schemes for sustainable development of energy systems. In the multi-scale energy models, non-deterministic optimization techniques such as fuzzy programming, multistage stochastic programming, and interval-parameter programming, are incorporated within a general framework; they can tackle uncertainties expressed as type-2 fuzzy sets, probabilistic distributions and interval values and analyze impacts of economic, environmental, policy and technology factors on various energy systems at different scales. Results can help decision makers to well understand the effects of economic development on energy system transition and efficiently cope with issues of energy supply, environmental protection, and climate change mitigation.