Multiple Objective Stochastic Models for Electricity Generation Expansion Planning Considering Environmental Impacts

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Abstract
A new approach to the electricity generation expansion problem is proposed to minimize simultaneously multiple objectives, such as cost and air emissions, including CO2 and NOx, over a long term planning horizon. In this problem, power-grid system expansion decisions are made to select the type of power generation, such as coal, nuclear, wind, etc., where the new generation asset should be located, and at which time period expansion should take place. A set of Pareto optimal solutions is determined for a multi-objective generation expansion planning problem that explicitly considers availability of the system components over the planning horizon and operational dispatching decisions. Monte Carlo simulation is used to generate numerous scenarios based on the component availabilities and anticipated demand for energy. The problem is then formulated as a mixed integer linear program, and optimal solutions are found based on the simulated scenarios with a combined objective function considering the multiple problem objectives. The different objectives are combined using dimensionless weights and a Pareto front can be determined by varying these weights. The mathematical model is demonstrated on an example problem with interesting results indicating how expansion decisions vary depending on whether minimizing cost or minimizing greenhouse gas emissions or pollutants is given higher priority.

Biography
David W. Coit is a Professor in the Department of Industrial & Systems Engineering at Rutgers University. His current teaching and research involves system reliability modeling and optimization, risk analysis, and multi-criteria optimization considering uncertainty. His research has been funded by National Science Foundation (NSF), U.S. Navy, industry, and power utilities. He received a BS degree in mechanical engineering from Cornell University, an MBA from Rensselaer Polytechnic Institute, and MS and PhD in industrial engineering from the University of Pittsburgh. He also has over ten years of experience working for IIT Research Institute (IITRI), Rome NY, (now called Alion Science & Technology) where he was a reliability analyst, project manager, and engineering group manager. He is a member of IIE and INFORMS.