University of South Florida

Power Generation Expansion under a CO_2 Cap-and-Trade Program

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Description: The objectives of the proposed research are to 1) develop a comprehensive generation technology based portfolio optimization (GTPO) model and its solution algorithm, and 2) develop educational resources to enhance training of scientific workforce for the state of Florida. The research will directly address three major challenges: fulfillment of the growing power demand, meeting the emissions targets, and supply of technology workforce. The potential economic impact of the proposed research on the State of Florida is expected to be very high, since an energy-secure environment is a basic necessity to support the current trend of explosive growth both in industry and human resources.

Budget: $92,442
Universities: USF
External Collaborators: Argonne National Lab

Progress Summary

Summary of Progress: Our team, in collaboration with Argonne National Lab and Iowa State University, submitted a NSF proposal for $400,000 this past February. The title of the proposal is "Impact Analysis of Alternative CO_2 Emissions Control Schemes on Future Power Generation" and its main objectives are: 1) Build a modeling framework to assess the impact of CO_2 cap-and-trade and carbon tax programs on future generation expansion. 2) Develop a computational solution methodology for the model. 3) Analyze and compare the impact of alternative CO_2 cap-and-trade and carbon tax programs on emissions reductions and social welfare. 4) Build a test bed using Illinois electricity market data and assess the impact of cap-and-trade and carbon tax programs. 5) Train a cadre of graduate and undergraduate students, especially from underrepresented minority groups, and develops support programs for science education of K-12 teachers.

Progress Made Toward Objectives During Reporting Period: Additionally, we are about to submit a paper to the European Journal of Operations Research titled Generation Capacity Expansion in Restructured Power Markets under a CO_2 Cap-and-Trade Program. In the paper, we present a game-theoretic capacity expansion model and its solution algorithm to obtain equilibrium capacity expansion plans for a number of generators under different CO_2 cap-and-trade designs. The game theoretic model is applied to a sample network constructed based on the power market conditions of the state of Illinois. This work was presented at the past INFORMS Conference in San Diego on October 2009.

The team is also working on developing an optimization model to obtain redistribution (recycling) strategies for the revenue collected from emissions control schemes. We currently have a preliminary formulation, a quadratic non-convex optimization model, and its corresponding solution. This work was one of the recipients of the 2009 College of Engineering Research Week Poster Award. We are planning to present this work at the upcoming INFORMS Conference 2010.

Last but not least, we have started to work on developing a model to obtain an optimal cap-and-trade program design for a given power network and given emissions reductions targets. This work is in the literature review phase.