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 include: 1) developing a comprehensive generation technology based portfolio optimization methodology, 2) developing carbon revenue redistribution strategies to achieve goals of emissions control policies (cap-and-trade), and 3) 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 control 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: $71,906
Universities: USF
External Collaborators: Argonne National Lab

Progress Summary

During the initial phase of the project, our efforts were focused on developing a generation capacity expansion model that incorporates the implications of the implementation of a CO_2 cap-and-trade program in the U.S. A CO_2 cap-and-trade program will change the way generators make capacity expansion decisions, especially if the allowances (or pollution permits) created with the program are distributed via auction (as opposed to be given away for free based on historical emissions). In fact, the profitability of a particular expansion plan is measured by adding the profits obtained by the generator in the allowance and electricity markets. Furthermore, the generators' bids and profits in the electricity market are directly impacted by the additional cost generators incur in purchasing allowances.

We have been working on expanding our problem scope by including the issue of optimal redistribution of the revenue collected from the CO_2 allowances. It is anticipated that the implementation of a CO_2 emissions control scheme, either a cap-and-trade program with auctioned permits or a carbon tax, will provide the government with an important new source of revenue. Several economists advocate for the redistribution of this carbon revenue i.e., for the emissions control schemes to be revenue neutral. We have developed an optimization model to obtain redistribution strategies of the carbon revenue collected by an electricity-sector emissions control scheme. We consider two types of subsidies through which the redistribution is accomplished: i) bid subsidies for low-emission generators, which are directed at lowering locational marginal prices throughout the power network, and ii) R & D subsidies, whose purpose is to improve the competitiveness of low-emission generators against fossil-fuel generators. We use empirical curves found in the literature to model the potential effect of R & D subsidies on the cost reduction of low-emission technologies. The optimization model that we have developed attempts to strike a balance between the allocations of these two types of subsidies for a given planning horizon. In addition, by considering the OPF as the basis for our formulation, we intend to address some of the regional (locational) equity issues that may arise if an equal per capita revenue redistribution rule (as proposed in the literature) is implemented.

We are currently conducting numerical analysis of the mathematical model via a 4-node sample problem. With the objective of examining the effect of network location in the results, we are examinning two subsidy-scenarios: discriminatory and non-discriminatory allocation. Our goal is to better understand the leverage that redistribution has on achieving the goals of CO_2 emissions control strategies.