Public Abstract

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Graduation Term:FS 2017
Department:Industrial Engineering
Degree:PhD

Title:APPLYING OPTIMIZATION TECHNIQUES TO IDENTIFY MULTISTATE COLLABORATIONS FOR IMPROVING BIOPOWER ENERGY POLICY

The US Environmental Protection Agency (EPA) proposed a rule that aims to reduce carbon emissions from US coal-fired power plants. The proposed "Clean Power Plan" specifies state-specific rate-based goals to achieve a total US carbon emission reduction of 32% below 2005 levels by 2030. An increase in the co-firing of woody biomass with coal to generate biopower is one of the potential approaches that electricity providers could take to comply with EPA's proposed rules. We develop a mixed integer linear programming (MILP) model to identify minimum-cost approaches for reducing CO2 emissions via co-firing biomass subject to spatially-explicit biomass availability constraints. An important feature of the EPA recommendations is an allowance for states to participate in multi-state compliance strategies. We extend the MILP model to optimize within a larger geographical framework that allows states to identify minimum-cost partnerships that meet aggregated emission reduction goals. We apply the MILP model to data for five Midwestern US states to determine the role that co-firing biomass could play in achieving their EPA-proposed emission reduction targets, and find that some states can meet their renewable energy generation targets through co-firing, although co-firing alone is not sufficient to achieve any state's emission reduction targets. This MILP is extended to MILP model, addressing the uncertainties in power plant boiler installation cost, coal electricity generation cost, as well as the emission rate. We apply this robust model to a set of 18 states in the northern US to identify optimal sets of multi-state collaborations.
Finally, we investigate the impact of energy policy-related regulations on biomass demand and procurement cost using econometric models. We develop a demand response model and then incorporated this into a robust mixed-integer nonlinear programming (MINLP) model. We utilize a two-stage approach to solve the resultant robust mixed integer nonlinear programming model. This model is then applied the same set of 18 states in the northern US to identify optimal sets of multi-state collaborations for different feasibility rates and emission levels.