

# California's CO<sub>2</sub> Cap-and-Trade System in Power Sector – Effects of Point-of-Regulation and Allowances Allocation on Emissions Leakage and Contract Shuffling



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## **Abstract**

In response to Assembly Bill 32, the State of California is considering three types of carbon emissions trading programs for the electric power sector: load-based, source-based, and first-seller. They differ in terms of their point-of-regulation. In this talk, we formulate a market equilibrium model for each of the three approaches, considering power markets, transmission networks, and emissions trading. We analyze the properties of their solutions and show the equivalence of load-based, first-seller and source-based approaches, contrary to claims elsewhere.

The second part of the talk will examine the effects of emissions allowances allocation schemes on two phenomena -- GHG (greenhouse gas) leakage and contract shuffling. Two allocation methods are considered – grandfathering and output-update. Our results suggest that the magnitude of GHG leakage is inversely associated with per MWh of the future allowances awarded for today's output. The power prices under output-update approach could be either higher or lower compared to the grandfathering. Yet, the equivalence among source-, load-based and first-deliverer approaches remains valid only under certain conditions.

## **Bio**

Dr. Andrew (Lu) Liu joined the School of Industrial Engineering at Purdue University as an Assistant Professor in August, 2009. He received his Ph.D. in Applied Mathematics and Statistics from The Johns Hopkins University in 2009. He also holds an M.S. in Mathematical Sciences from Johns Hopkins, and a B.S. in Applied Mathematics from Beijing Institute of Technology. Dr. Liu's primary research interests lie in the interactions of optimization, game theory and industrial organization, with applications to model and analyze energy markets and environmental policy. His secondary interests involve risk management

in energy markets. In addition to his university experience, Dr. Liu has worked at ICF International as a Senior Associate, responsible for developing optimization and stochastic models on investment and environmental policy analysis related to electricity markets.