Stanford University

TomKat Center for Sustainable Energy
Precourt Institute for Energy
Energy and Environment Affiliates Program
Civil and Environmental Engineering
Department of Electrical Engineering

Stanford SmartGrid Seminar

Smarter Markets for a Smarter Grid: The Why and How

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Abstract: As the world moves towards a greater fraction of renewable energy in the total energy mix, a smarter grid and electricity infrastructure has become imperative. New market mechanisms and architectures are going to be needed. One possibility is that there would be entities called `aggregators' who would buy power from the renewable energy generators, and then sell it in the future markets, assuming any risk of a shortfall. Motivated by this, we introduce auction mechanisms for stochastic resources, such as wind power which can only be supplied by the seller with a certain probability. The goal of the `aggregator' is to elicit these probability distributions truthfully. We propose two mechanisms, a Stochastic VCG mechanism, and a Stochastic Shortfall Penalty (SSP) mechanism, both of which we show to be incentive-compatible.

In the second part of the talk, we take another look at the Locational Marginal Pricing (LMP) mechanism that is used daily by most of the Independent System Operators (ISOs) to determine generation and supply schedules. It is part of the folklore in Power System Economics that an equilibrium exists in the LMP mechanism. In this talk, we first show that contrary to conventional wisdom, a Nash equilibrium (NE) may not exist in the LMP mechanism. We give two sufficient conditions under which a NE would exist. We then introduce two power network second-price (PNSP) mechanisms, one single-sided and another double-sided. In either case, we show the existence of an efficient NE.

Bio: Rahul Jain is an Associate Professor and the Kenneth C. Dahlberg Early Career Chair in the EE & ISE Departments at the University of Southern California. He received his B.Tech in EE from the Indian Institute of Technology, Kanpur, an MS in ECE from Rice University, and an MA in Statistics and a PhD in EECS from the University of California, Berkeley. Prior to joining USC in 2008, he spent two years at the IBM T J Watson Research Center, Yorktown Heights, NY. He has received numerous awards including the NSF CAREER award, the ONR Young Investigator award, an IBM Faculty award, and a James H. Zumberge Faculty Research and Innovation Award.