



## Modeling and Computing Oligopolistic Strategic Forward Market Equilibrium in a Congested Electricity Network

A Public Lecture by

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**3:00-4:00 pm on Friday 14th of November 2008**

391.201, Engineering Science, 70 Symonds Street

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**Abstract:** A model of two-settlement electricity markets with strategic forward and spot transactions is introduced, which accounts for flow congestion, demand uncertainty, system contingencies and market power. We formulate the subgame perfect Nash-Cournot equilibrium for this model as an equilibrium problem with equilibrium constraints (EPEC), in which each firm solves a mathematical program with equilibrium constraints (MPEC). The model assumes linear demand functions, quadratic generation cost functions and a lossless DC-approximated network, which lead the equilibrium constraints in the form of a parametric linear complementarity problem (LCP). The presentation will highlight modeling choices involved in representing the interaction between power generation firms and the Independent system operator and the implications of such choices. The computational model was solved by a special purpose algorithm based on solving quadratic programming sub-problems and on parametric LCP pivoting. Numerical examples and a test case based on the California electricity system demonstrate the computational feasibility of the model and illustrate some interesting economic implications.

**Dr. Shmuel S. Oren** is the Earl J. Isaac Chair Professor in the Science and Analysis of Decision Making in the Industrial Engineering and Operations Research department at the University of California, Berkeley. He is the Berkeley site director of PSERC – a multi-university Power System Engineering Research Center sponsored by the National Science Foundation and industry members. He has published numerous articles on aspects of electricity market design, planning and regulation and has been a consultant to various private and government organizations including the Brazilian Electricity Regulatory Agency (ANEEL), the Alberta Energy Utility Board (EUB), the Polish system operator (PSE), the Peruvian regulatory agency (OSINERG) and the electric power research institute (EPRI). He currently serves as Senior Adviser to the Market Oversight Division of the Public Utility Commission of Texas (PUCT), and a consultant to the Energy Division of the California Public Utility Commission (CPUC). He holds B.Sc. and M.Sc. degrees in Mechanical Engineering from the Technion in Israel and also an M.S. and Ph.D. degrees in Engineering Economic Systems from Stanford University. He is a fellow of the Institute of Electrical and Electronic Engineers (IEEE) and of the Institute of Operations Research and Management Science (INFORMS).

