Michael C. Ferris

University of Wisconsin-Madison

Modelling 100 percent renewable electricity

In the past few decades, power grids across the world have become dependent on markets that aim to efficiently match supply with demand at all times via a variety of pricing and auction mechanisms. These markets are based on models that capture interactions between producers, transmission and consumers. Energy producers typically maximize profits by optimally allocating and scheduling resources over time. A dynamic equilibrium aims to determine prices and dispatches that can be transmitted over the electricity grid to satisfy evolving consumer requirements for energy at different locations and times. Computation allows large-scale practical implementations of socially optimal models to be solved as part of the market operation, and regulations can be imposed that aim to ensure competitive behaviour of market participants.

The recent explosion in the use of renewable supply such as wind, solar and hydro has led to increased volatility in this system. We develop models that aim to ensure enough generation capacity for the long term under various constraints related to environmental concerns, and consider the recovery of costs for this enhanced infrastructure. We demonstrate how risk can impose significant costs on the system that are not modeled in the context of socially optimal power system markets and highlight the use of contracts to reduce or recover these costs. We also outline how battery storage can be used as an effective hedging instrument.

This is joint work with Andy Philpott, University of Auckland.

Bio:

Michael C. Ferris is the Stephen C. Kleene Professor in Computer Science and the director of the Data Sciences Hub within the Wisconsin Institute for Discovery at the University of Wisconsin, Madison, USA. He received his PhD from the University of Cambridge, England in 1989.

Dr. Ferris' research is concerned with algorithmic and interface development for large-scale problems in mathematical programming, including links to the GAMS and AMPL modeling languages, and general-purpose software such as PATH, NLPEC and EMP. He has worked on many applications of both optimization and complementarity, including cancer treatment planning, energy modeling, economic policy, traffic and environmental engineering, video-on-demand data delivery, structural and mechanical engineering.

Ferris is a SIAM fellow, an INFORMS fellow, received the Beale-Orchard-Hays prize from the Mathematical Programming Society and is a past recipient of a NSF Presidential Young Investigator Award, and a Guggenheim Fellowship. He serves on the editorial boards of Mathematical Programming, Transactions of Mathematical Software, and Optimization Methods and Software.