EMCAS: New Agent-Based Model Simulates Competitive Electricity Markets

**EMCAS Capabilities**
- Combines detailed engineering modeling techniques with quantitative market analysis.
- Represents multiple market participants and agents with individual company-level, decision-making capabilities.
- Incorporates agent learning and adaptation based on past performance and changing conditions.
- Makes available a wide range of market strategies to different agents (from risk-averse to risk-prone).
- Models various markets, including energy spot markets, bilateral markets, and ancillary services markets.
- Performs long-term system expansion under uncertainty and competition.

**Electricity Markets Complex Adaptive Systems (EMCAS)**

**EMCAS Capabilities**
- Each company agent has a set of corporate objectives, such as profit, risk exposure, market share, etc.
- Multiple objectives are combined into a "corporate utility function."
- Each agent seeks to maximize its own utility.
- User-specified market rules affect the behavior of both individual agents and the system.
- Market behavior emerges from agent interactions.
- DC load flow model simulates the actual operation of the physical system configuration.
- Generators and transmission nodes are represented at the individual bus-level; transmission lines are represented as individual branches.

- Agents go through a complex evaluation process to prepare bids or solicitations.
- In the decision-making process, agents rely on historical and projected information as well as information on competitors.
- Agents have individual forecasting capabilities.

- The EMCAS interface is designed to easily construct and manipulate power market configurations and access model inputs and simulation results.

- EMCAS is used to study the future Illinois electricity market.
- In a restructured electricity market in Illinois, some companies will have the ability to exert market power due to limitations in the transmission system.
- Prices will vary by hour and by month with prices expected to be highest in the summer months.

- Agents operate in a multi-dimensional environment that consists of multiple interconnected simulation layers.
- The physical layer represents the physical generation, transmission, distribution, and consumption of electricity, three business layers represent the business side of the electricity market, the regulatory layer allows to set the market rules and monitor market performance.

A U.S. Department of Energy laboratory managed by The University of Chicago