EMCAS: New Agent-Based Model Simulates Competitive Electricity Markets

Argonne NATIONAL LABORATORY

EMCAS Capabilities

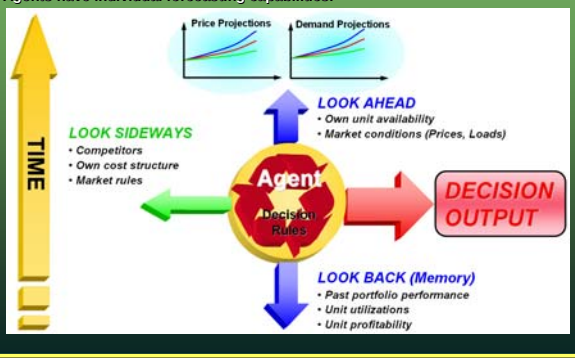
- Combines detailed engineering modeling techniques with quantitative market analysis.
- Represents multiple market participants and agents with individual company-level, decision-making capabilities.
- Incorporates agent learning and adaptation based on past performance and changing conditions.
- Makes 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)*

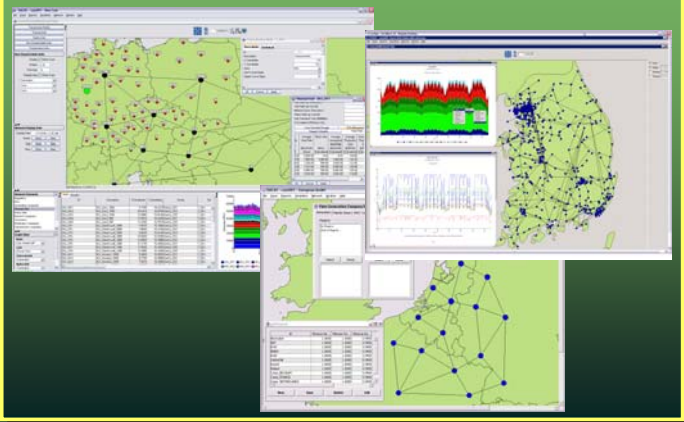
EMCAS Capabilities

- 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.

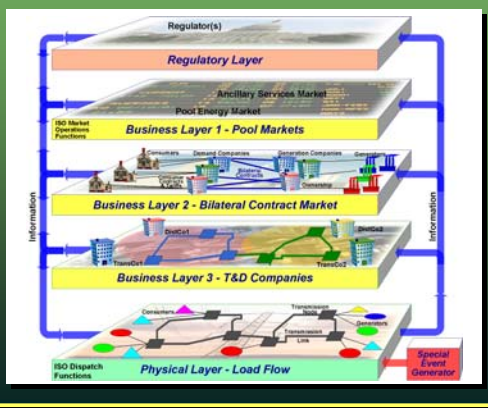
- Agents go through a complex evaluation process to prepare bids or solicitations.
- In the decision-making process, agents rely on historical and projected information as well as information on competitors.
- Agents have individual forecasting capabilities.



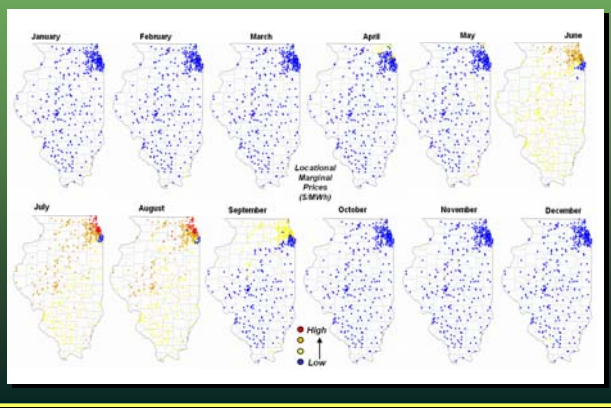
- The EMCAS interface is designed to easily construct and manipulate power market configurations and access model inputs and simulation results.



- 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.



- 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.



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