National Infrastructure Simulation & Analysis Center

Argonne National Laboratory
Electricity Markets Complex Adaptive Systems (EMCAS) Integration

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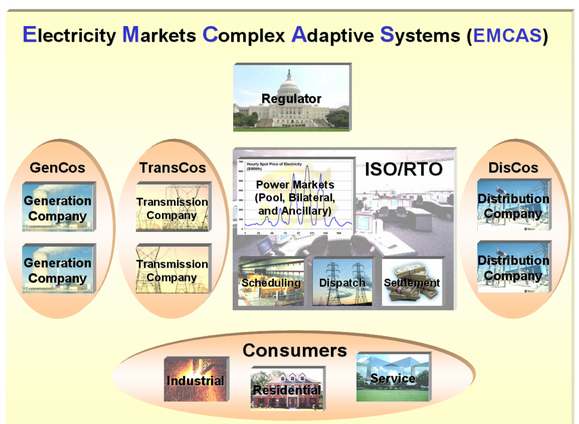
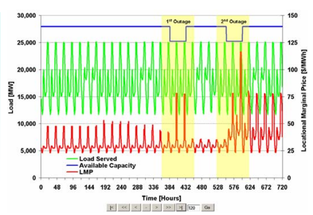
EMCAS Distributed Simulations with N-ABLE

EMCAS is a new agent-based model that simulates electric power generation, distribution, and competitive electricity markets

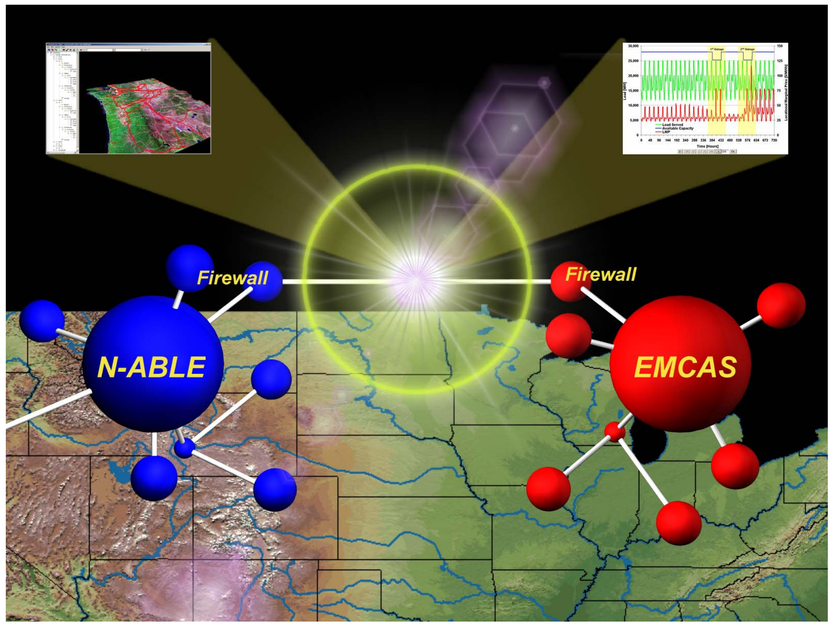
- ***Combines detailed engineering modeling techniques with quantitative market analysis***
- ***Represents multiple market participants and agents with individual company-level, decision-making capabilities***
  - *Incorporates agent learning and adaptation based on past performance and changing conditions*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



- *Typically, zonal prices closely follow the loads*
- *Learning allows agents to raise market prices during recurring events, such as capacity shortages*



- ***The project has integrated the EMCAS model into the NISAC infrastructure simulation framework, using secure, Web Services-based, real-time communications between models in Albuquerque, NM, and Chicago, IL***

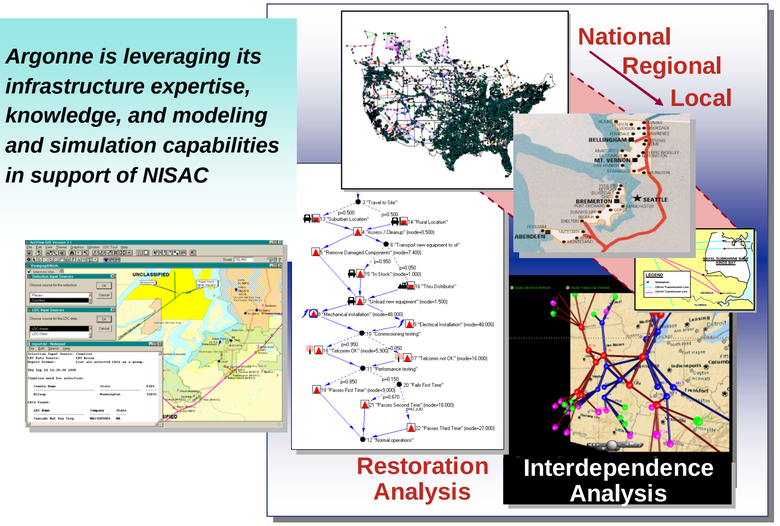


- ***EMCAS power producers supply power to N-ABLE manufacturers***
- ***Disruptions in electric power supply disrupt manufacturing production and sales***
- ***Economics-based changes in manufacturers' demand for electric power change the generation and distribution needs from the power grid***

- ***This integration has added a new level of detail and accuracy to NISAC's infrastructure simulation capability***

Argonne Infrastructure Assurance Center

Argonne is leveraging its infrastructure expertise, knowledge, and modeling and simulation capabilities in support of NISAC



Argonne Infrastructure Assurance Capabilities

- ***Infrastructure analysis***
  - *Identification of critical nodes and links*
  - *System behavior (physical and market)*
  - *Incident tracking and trends analysis*
- ***Infrastructure interdependencies analysis***
  - *Early alerting tools*
  - *Interdependence modeling*
  - *Repair and restoration modeling*
- ***Preparedness planning and consequence management***
- ***Risk management***
- ***Vulnerability assessments***
- ***Exercises***

NISAC's core partners are Sandia National Laboratories and Los Alamos National Laboratory.
Sandia is a multiprogram laboratory operated by Sandia Corporation, a Lockheed Martin Company, for the United States Department of Energy under contract DE-AC04-94AL85000.
Los Alamos National Laboratory is operated by the University of California for the United States Department of Energy under contract W-7405 ENG-36.