Panel 3 Discussion
Imperfect Energy and Ancillary-Service Markets

SGG-WI

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Energy and Ancillary Service Markets

- Are real time markets enough?
- Do we need to model forward capacity?
- Do we need to model firm energy markets?
- How can we simulate these effects in our models?
- Do our models reflect reality?

Integrated and Comprehensive View

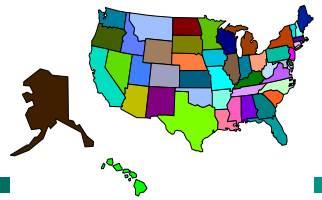
- Supply, demand, physical, financial, and market dynamics across regions with distinctly different rules
- Multiple reference cases for status-quo and changing RTOs
- Causal look at an imperfect world. Want to know risk, not hopes; dynamics, not statics
- Detailed, multi-agent representation of actual market participants
- Tactical and strategic analyses verified by secondary “operations” analysis
- Test-bed for the actual market rules with their specific and interacting impacts on market participants, the physical system, and market economics

Conventional Approach

- Static: fixed input
- Global optimality with perfect information and perfect decisions.
- Assumes ideal operating conditions
- Path or DC transmission
- Idealized representation of RTO rules
- Assumes outcome rather than tests for outcome

"Safety-Engineering" Approach

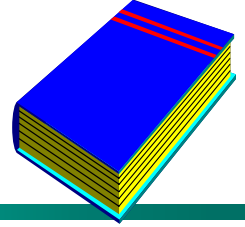
- Worry more about transient failure modes than static, optimal conditions.
- Model rules and system's dynamics; not outcomes.
- Use enough nodes for a valid analysis, but not so many as to know nothing about everything.
- Limit information flows and responses to what is realistic.
- Let loads change differentially at nodes, over time.
- Build capacity based available information.
- Include both MVar and MWh dynamics.



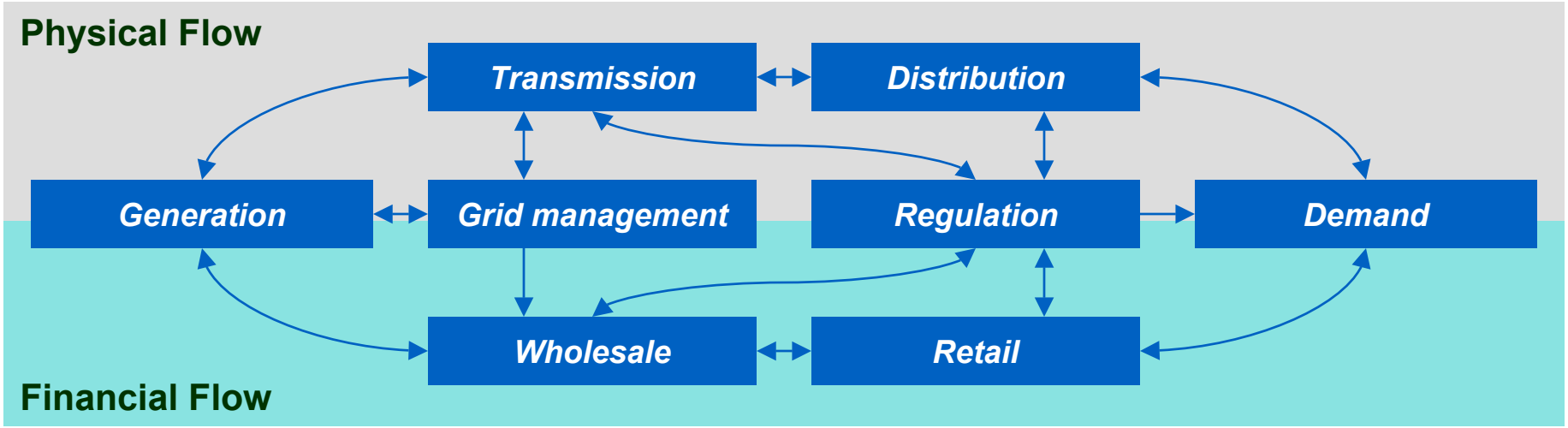
ENERGY 2020 Background

- Simulates Integrated Energy Demand, Energy Supply, Emission, Market Dynamics, and Macroeconomic Impacts.
- Widely used in the Europe, South America, US and Canada
  - US DOE FOSSIL2/IDEAS [Early E2020]: Used for all National Energy Plans since between 1978 and 1998
  - State of Illinois (1986): Assess electric deregulation and rate shock
  - Cambridge University (1994/1995): UK electric deregulation
  - New England ISO: Analysis of market-rules
  - DOE and US Congress: Accurate deregulated-market dynamics
- Comprehensive Coverage
  - Geographical: 50 US states, 13 Canadian provinces, Mexico/ROW
  - Demand: multi-sector with cogen/DG, responsive to price
  - Supply: conventional/non-conventional electricity supply and transmission
  - Emissions: GHG and CAC reductions and cost dynamics

ENERGY 2020 + PowerWorld Approach



- Simulation dynamically models ***all agents in the market***, from generation to customer, as well as different market structures and deregulated regimes.
- Simulates realistic ***behavioral, financial and physical dynamics***, as agents function under operational rules that might or might not produce a stable market.
- Simulation uses ***actual physical and financial data*** for all relevant market players and captures both physical and financial impacts of the market dynamics.
- Simulation captures ***all interacting (feedback) behaviors***, responses, and counter responses the market players produce.



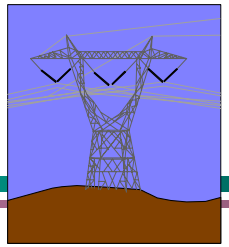
Load Growth Approach

- Energy/demand, by end-use, changes at each node as a function of local economic activity, class prices (for all fuels), and temperature.
- Endogenous dynamic load shapes change from end-use consumer response.
- Load has MVar attributes that affect ability of transmission and generation to provide energy.
- Failure to include feedback on demand is the number one reason for gross misunderstanding of generation forecast. (C.R. Nelson et. al., "The NERC Fan in Retrospect and Lessons for the Future," from The Energy Journal, Volume 10, Number 2, 1989.)

Generation Approach

- Generators “experiment” to find bidding and operational positions, but markets are a moving target
- Capacity expands at node based on “expected” demand, reserve margin, price, or forced programs (e.g. wind).
- Participants do not really know the future (or the present), but only have imperfect and bounded expectations.
- There are uncertain weather, water, financial market, and fuel cost conditions.
- Prices come from contracts, bids, and rules that might not be uniform or conform to perfect competition.

Transmission Approach



- MVar are as important as MWh, and may dominate operational issues.
- Adding new lines might make the system more sensitive to load changes and loop flows.
- New transmission is part of uncertainty analysis, not static optimization.
- Need both 54 (tactical) and 16,000 (operational) bus resolution.
- FTR market dynamics do not have unique solution.
  - » They are based on risk perceptions rather then physical/economic realities.
  - » Participants can experiment to find (volatile) prices, or cost can be based on expected market congestion costs.

Transmission Markets: Stretching the Rules for Fun and Profit, Narasimha Roa, Richard Tabors. Tabors, Caramanis and Associates, Cambridge, MA, June 2000

Transmission Rights and Market Power on Electric Power Networks, Paul Joskow and Jean Tirole, April 27, 2000

RTO Energy-Market Approach

- Native Load
  - Sets base operating conditions and limitations
- Bilateral Contracts
  - Limited, imperfect options without RTO “clearinghouse”
  - Adds constraints but more efficient use of transmission/generation with RTO “clearinghouse”
  - Inter-RTO seams issue
  - Modeled as sampled-auction approach, w/ and w/o RTO
- Hour-ahead, Day-ahead, X- ahead
  - Initially informational. In future, allocated to load/risk.
- Real-time
  - Very thin (volatile) market
  - Energy plus system-ancillary services
  - End of inadvertent interchange

RTO Ancillary Service Approach

- Mostly Schedule Coordinator and part RTO.
  - SC has precedence
  - May lead to inefficient excess reserves
- Bilateral contracts may cause large, involuntary MVar flow.
- Real-time use looks like $/MWh to RTO.
- Reserve costs are mostly residual supply-stack offers.
- Voluntary nature of offers means that GridWest may have limited options when called upon.