Energy Market Management

An Integrated Framework
- Decentralized bilateral markets
- Spot day-ahead market
- Real-time markets
- Energy, and ancillary services
- Bid/Offer based

Central Commitment & Dispatch
- Locational Marginal Pricing (LMP)
- Congestion Revenue Rights

Co-optimization of Energy and Ancillary Services
Integrated Forward Market Business Process

• Forward Bilateral Markets
• Day Ahead Market
• Intra-Day Markets
• Real Time Markets
• Coupled by Dynamic Dispatch
EMM Uses Precise Physical Models

- EMM uses precise physical models so that dispatch signals can be followed by plant

- Combined Cycle Plant modeled with individual components: Gas Turbines, Heat Recovery Steam Generators, Steam Turbines

- Full Transmission Network Model for secure operations

- Units (Hydro, Thermal), Demand Response, Energy Storage

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## Unified, Configurable Market Clearing Engine

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<th>Feature</th>
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<th>SCED</th>
<th>DD</th>
<th>SCDD</th>
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- **ED** - Economic Dispatch
- **SCED** - Security Constrained Economic Dispatch
- **DD** - Dynamic Dispatch
- **SCDD** - Security Constrained Dynamic Dispatch
- **UC** - Unit Commitment
- **SCUC** - Security Constrained Unit Commitment
Mixed Integer Programming

- Market Clearing formulated as a mixed integer program
- Enables precise models of physical plant
- More economic solutions possible
EMM

• Single configurable engine allows:
  • Use for ISO Market Clearing
  • Use as security constrained unit commitment for vertically integrated utilities
  • Dynamic Dispatch of all on line resources

• EMM Improvements
• Economics (up to ½ percent of fuel costs)
• Dispatch Instructions that plants can follow
• Allows integration of renewables with variable generation characteristics
• System Security (reliability)
Thank you for your attention!