Coupling Renewable Energy Supply with Deferrable Demand
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How Should We Structure the Future Grid?

Centralized Control
- Wind
- Conventional generators
- Flexible load

Coupling Renewables with DR
- Wind
- Conventional generators
- Flexible load

Price-Based Control
- Wind
- Conventional generators
- Flexible load

Research Approach

Statistical Models
- Wind speed
- Wind power
- Multi-Area wind power
- Firm load
- Real-time prices

Stochastic Unit Commitment
- Decomposition Algorithm
- Scenario selection algorithm

Case Study
- California ISO
- 225 Buses
- 371 lines
- 124 generators
- 42 scenarios
- 5 wind sites
- Transmission / generator failures

Research Objectives
Quantify the impact of large-scale renewable supply and demand response on
- Reserve requirements
- Operating costs
- Renewable supply utilization

Results

Single-area study

Multi-area study

Demand response study

A Jensen-inequality effect

Publications

Potential Uses of this Research
- Stochastic unit commitment software
  - Operation
  - Asset valuation
  - Market analysis / forecasting
  - Policy analysis
  - Renewable integration / demand response research
- Smart charging algorithms for deferrable loads
  - Operation
  - Fleet valuation
  - Contract design