Simulation of Power Systems with Time-Dependent Resources

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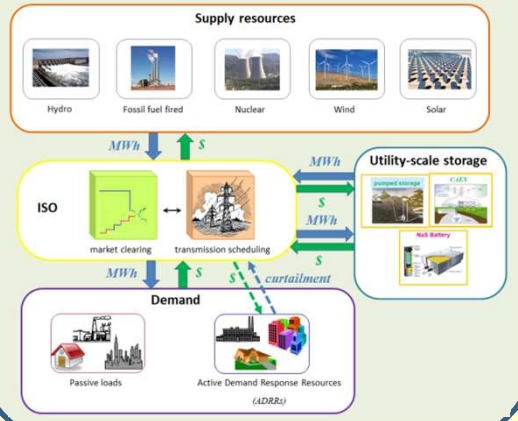
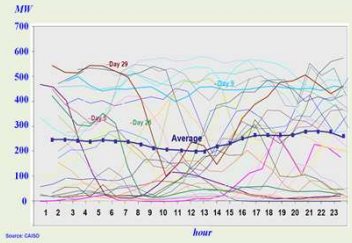
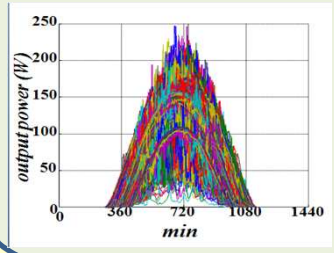
Changing resource mix: deeper renewable and storage resource penetration



Integration challenges are daunting

wind power: intermittent and variable

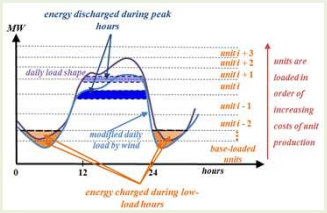




solar power: strong daily pattern but still intermittent and variable

Integration challenges are daunting

utility-scale storage: critical tool in the effective harnessing of the renewable resources



Active Demand Response Resources: demand side participation that provides additional flexibility in managing the supply-demand balance

Research Objective

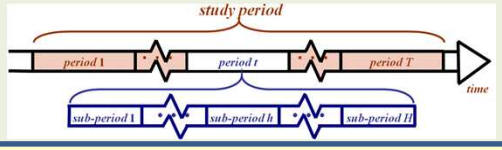
Development of a computationally tractable approach that can quantify, over longer-term periods, the variable effects of :

- economics
- reliability
- environmental impacts

of power systems with integrated time-dependent resources

Proposed Simulation Approach

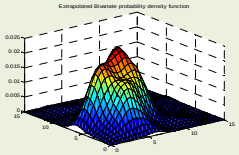
The simulation captures the time-dependent resource utilization in the day-ahead transmission-constrained markets with the explicit representation of uncertainty and evaluates all the variable effect metrics of interest

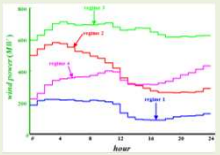


Proposed Simulation Approach

Captures various sources of uncertainty by using Monte Carlo simulation that effectively exploits the power system structure and characteristics

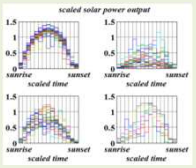
probabilistic models : represent the intermittency and variability of renewable resources





identification of wind regimes: clustering algorithm allows the identification of daily patterns

identification of solar pattern clusters: patterns differentiate between daily climatic conditions



Critical metrics evaluated by the simulation:

- LMPs
- LOLP, EUE
- Greenhouse gas emissions

Potential uses of this research

- Resource planning
- Investment analysis to assess the feasibility of investment opportunities and to develop appropriate strategies and schedules
- Transmission planning studies to determine the timing/benefits of changes in the grid
- Policy analysis to determine the impacts of different policy formulations
- Responses to various *what if* questions