Managing Flexibility and Uncertainty in Markets and Operations

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Summary

Purpose

- Discuss MISO on-going efforts to manage flexibility and uncertainty

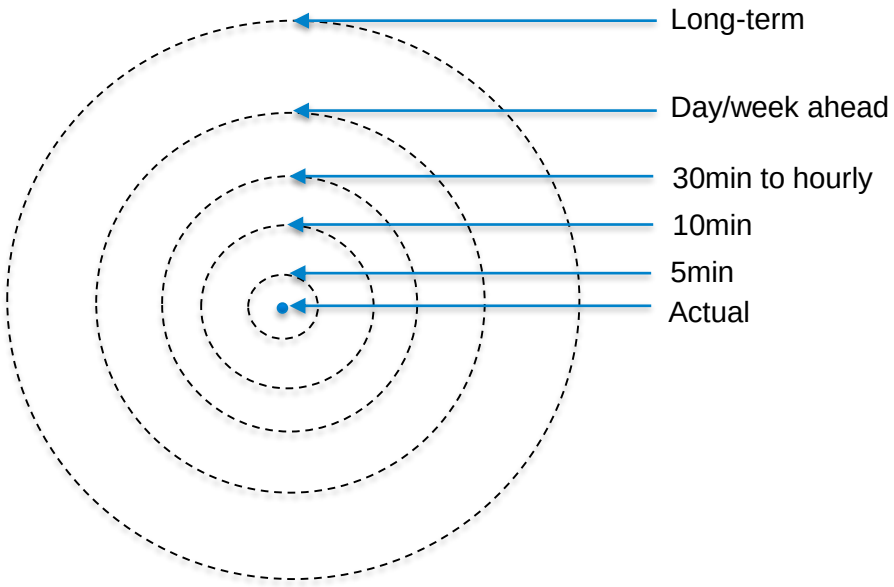
Key Takeaways

- Operation challenges arise from uncertainty and extreme events
- Opportunities exist to improve ramp management and ancillary services in the near term
- Key elements are to quantify system flexibility needs and define available supply

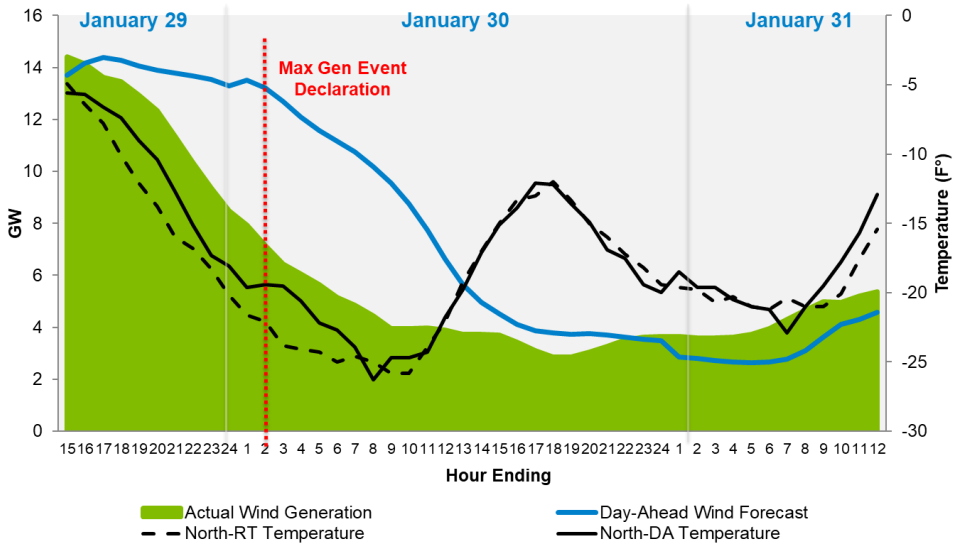
As the system trends toward de-marginalization, MISO faces uncertainty across multi-timescales

- How much confidence do we have in the forecast (load, renewables, etc.) => “Define a cone of uncertainty”
- For those days that fall out of the confidence interval, how do we manage the gap => “Embrace the things that don’t fit”

Uncertainties across multiple timescales

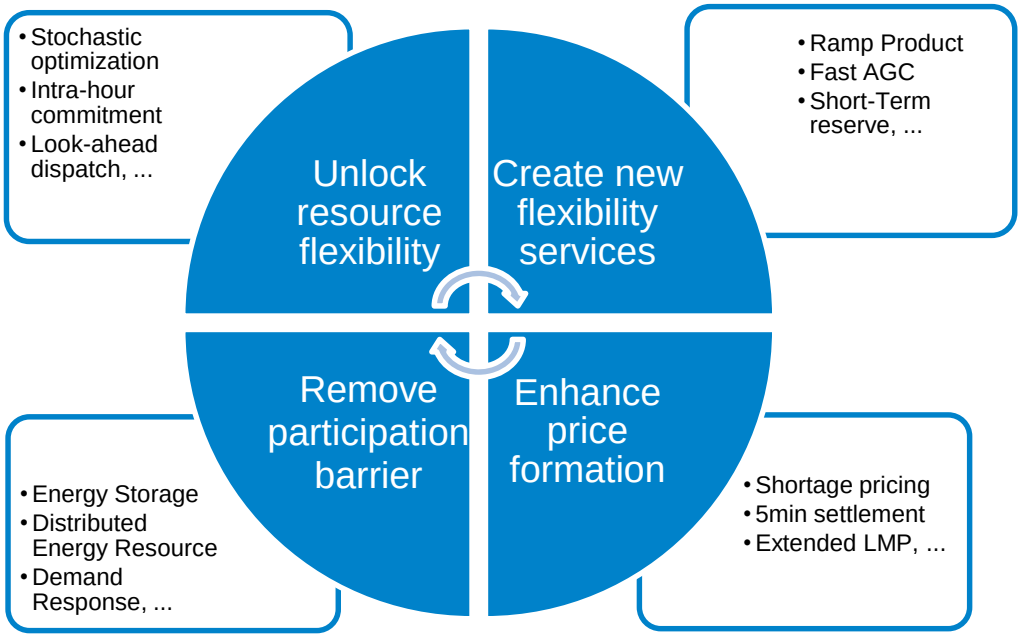


An Extreme Event on January 30, 2019



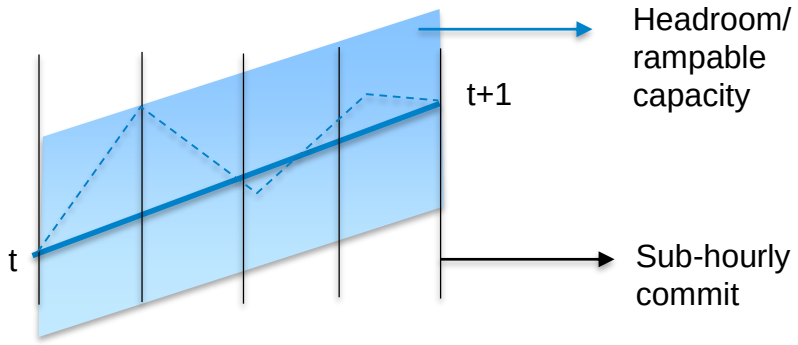
Through a holistic review of markets and operations, MISO identifies flexibility actions

- Are current operation processes fully utilizing resource flexibility attributes?
- Are market incentives in place for resources to provide their flexibility at the right times and locations?

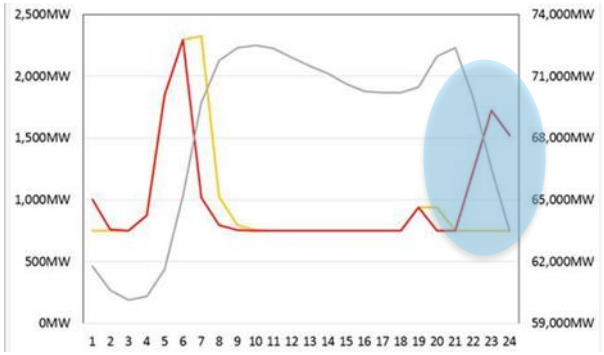


Near-term Enhancements: Day-Ahead Intra-hour Flexibility

- Traditional Day-Ahead Unit Commitment assumes linear load changes between hourly intervals
- The actual load may vary more rapidly, requiring intra-hour flexibility to manage ramping
  - Sub-hourly unit commitment
  - Headroom (rampable capacity) constraint: implemented 2010
- Ramping needs could also arise from supply side when units coming on/offline at the same time
  - Recently improved implementation to account for ramping needs at evening periods when units shutdown

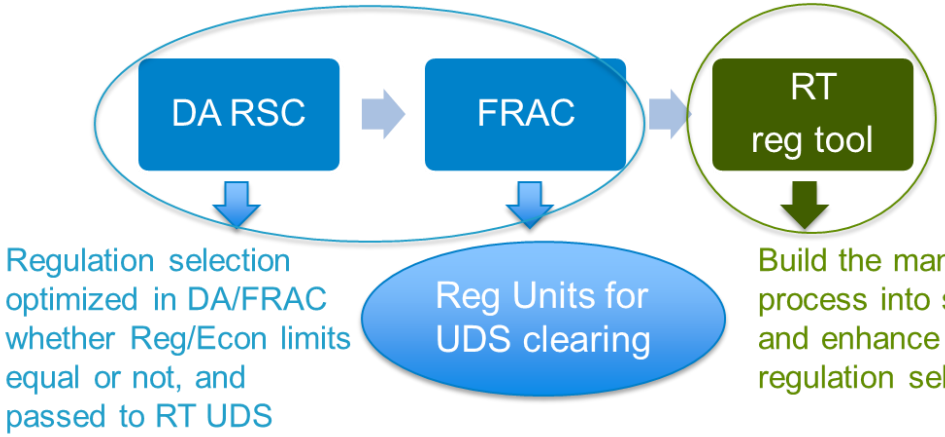


Headroom requirement change
before (yellow) and after (red)



Real-Time Regulation Enhancement

- Unit's regulation clearing in SCED is limited to "REG-committed" resources by SCUC due to different operational limits*
- As system conditions change in Real-Time, the limited pool may be short to provide regulation and units need to be added on REG
- Recently built the manual process in software and improved the resource selection in order not to strand ***capacity or flexibility***



Add units on Reg
• Committed; • Regulation qualified; • Reg limits = Econ limits • Bi-directional ramp = up/down ramp

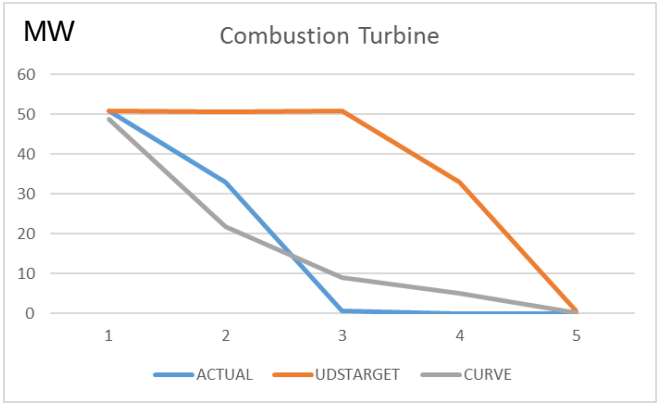
*Note: reg capacity ≤ econ capacity; bi-directional ramp ≤ up/dn ramp
SCED: Security Constrained Economic Dispatch; SCUC: Security Constrained Unit Commitment

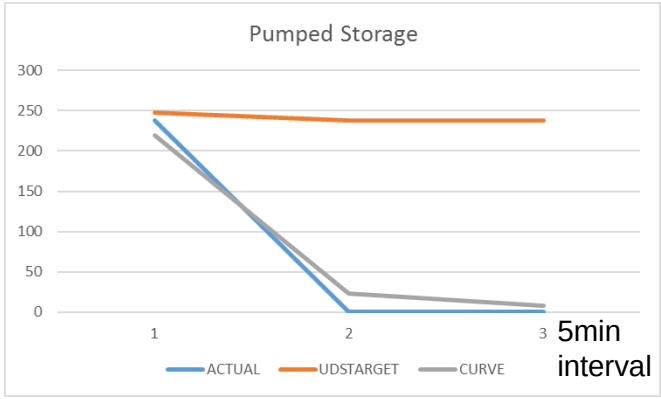
Enhancement of Ramp Management

- Ramp challenges exist when fast-ramping units are shutdown at evening periods
- Ramp Capability Product can help to procure the flexibility, but may not be fully utilized if SCED accounts for inaccurate MW from units fast ramping offline
- A shut down curve is being developed by using historical data analysis and real-time calibration

$$Gen_t = a_t SE_{t-10min}, t = 1, \cdots, T_{stop}$$

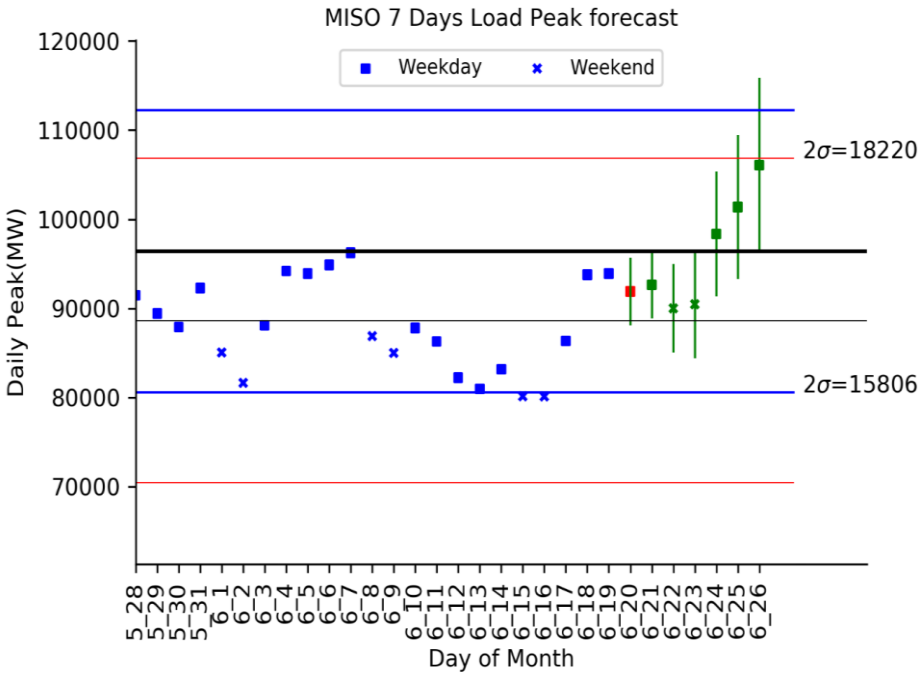
Where a_t is a scaling factor based on historical data; and SE is the State Estimator unit output



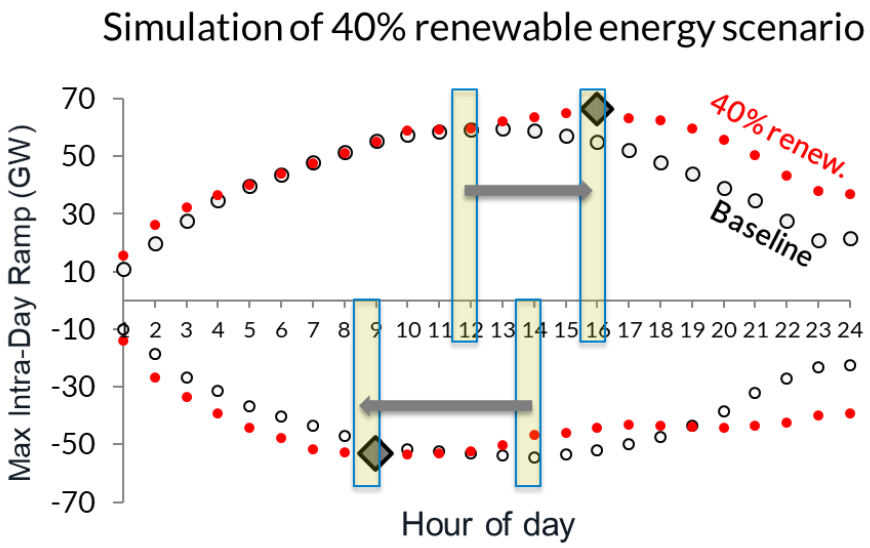


On-going research to quantify uncertainty

- Instead of a point forecast, confidence intervals are being evaluated



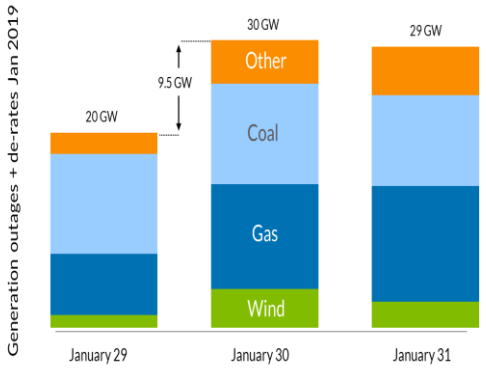
- System flexibility needs are also being projected for future scenarios with high renewable penetration



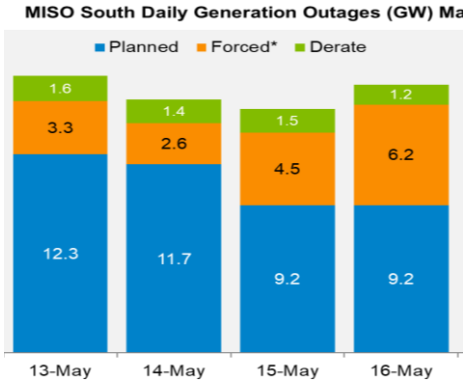
Measure supply of capacity/flexibility

- Generation outages and de-rates can be sizable. What can we learn from historical data?

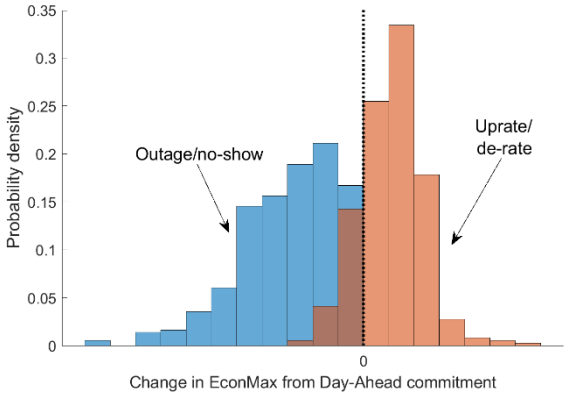
Gas supply and low temperature causing sizable outages/de-rates



Outages/de-rates can show regionally



Can we project resource availability day-to-day?



- Desired features of a flexibility measure:
  - Be technology neutral
  - Assess collective flexibility

Questions?