An Analysis of the Impact of Balancing Area Cooperation on the Operation of the Western Interconnection with Wind and Solar Generation

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Outline

• Overview/objective
• Operating Reserves
• Ramping
• Production Simulation
• Conclusions
Objective

- Analysis of alternative BA configurations in the Western Interconnection
- Proposed Energy Imbalance Market
- Flexibility reserve analysis utilizing method from Eastern Wind Integration and Transmission Study (EWITS)
- Production simulations using GE-MAPS
  - Alternative levels of transactional “friction” for
    - Unit commitment
    - Economic dispatch
Imbalance Market Overview

EIM Footprint

Intra-hour variability is captured and allocated in real-time within the entire region, limited by the physical capability of the wires.

Diversity benefit reduces operating costs for balancing.

EIM Tool: SCED
# Imbalance Market Overview

**Schedule Day-Ahead & Up-to 30 minutes prior to Operating Hour**

- **Market Participant:**
  - Forecast and unit Commit
  - Generators self-schedule
  - Generators voluntary submit offers
  - DSM resources voluntary submit offers
  - Prepare and finalize pre-dispatch schedules

- **WECC EIM Market Operator:**
  - Perform security-constrained economic dispatch to keep balance
  - Provide redispatch if any congestion occurs
  - Send dispatch set points to generators
  - Coordinate any contingency reserve deployments with EIS dispatch

**Real-time Dispatch**

- **Market Participant:**
  - Forecast and unit Commit
  - Generators self-schedule
  - Generators voluntary submit offers
  - DSM resources voluntary submit offers
  - Prepare and finalize pre-dispatch schedules

- **WECC EIM Market Operator:**
  - Perform security-constrained economic dispatch to keep balance
  - Provide redispatch if any congestion occurs
  - Send dispatch set points to generators
  - Coordinate any contingency reserve deployments with EIS dispatch

**Post-Operating**

- **Market Participant:**
  - Gather meter data to support settlements
  - Provide settlement statement and invoices

- **WECC EIM Market Operator:**
  - Gather meter data to support settlements

- **Transmission Provider:**
  - Provide meter data to support settlements
Imbalance Market is not full coordination

- Does not include framework for unit commitment coordination
- Voluntary participation at the BA level
- Not all generators may choose to participate
- Will some level of coordination of unit commitment evolve over time?
Data

- Data from the Western Wind and Solar Integration Study (WWSIS)
Flexibility Reserve/Operating Reserve

- Wide-area pooling of variability analyzed using extension of EWITS approach
- Described in prior work
- Contingency reserve not affected
- Wind and solar increase the dispatch range and ramping speed required from conventional generation → focus of part 1 of the analysis
Full footprint EIM

Reserve Savings for Footprint EIM

<table>
<thead>
<tr>
<th>Type</th>
<th>BAU (MW)</th>
<th>EIM (MW)</th>
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</thead>
<tbody>
<tr>
<td>Total Reg</td>
<td>2440</td>
<td>1198</td>
</tr>
<tr>
<td>Spin</td>
<td>2096</td>
<td>969</td>
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<tr>
<td>Supplemental</td>
<td>4192</td>
<td>1938</td>
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</table>

The bar chart shows the reserve savings for Full footprint EIM with the y-axis representing reserve requirement in MW.
Ramping requirements are reduced, with and without wind/solar
Ramp duration for one year
GE-MAPS analysis: Map of WECC areas
### Alternative levels of transactional friction

<table>
<thead>
<tr>
<th>Commitment hurdle rate</th>
<th>Dispatch hurdle rate</th>
<th>Low renewable penetration</th>
<th>Medium renewable penetration</th>
</tr>
</thead>
<tbody>
<tr>
<td>$5/MWh</td>
<td>$5/MWh</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>$25/MWh</td>
<td>$5/MWh</td>
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<tr>
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<td>$25/MWh</td>
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</tr>
</tbody>
</table>
Total operating costs

Total Operating Costs ($M)

Region (low renewables)  Region (medium renewables)

- Full
- Dispatch
- BAU
Operating cost reductions with increased coordination

- Company (low renewables)
  - Full: $600M
  - Dispatch: $150M

- Company (medium renewables)
  - Full: $650M
  - Dispatch: $200M
Conclusions

- Significant reserve reductions are possible
- Ramping needs are reduced, even without wind/solar energy
- Existing uncoordinated unit commitment will capture 20-40% of total operating cost savings potential compared to full coordination
Questions?