The Classic ELCC Wind Capacity Study:

1. Take an existing system simulation with an estimated Loss of Load Probability or other reliability metric

2. Add load to the system which will make the system less reliable

3. Add wind generation until the system is back to the same reliability level
Ambiguity gets introduced because of the load. Is the additional load:

- A flat annual block
- Proportional load
- An end-use future forecast load
- Something else
In the Northwest hydro generation can further confuse the study.

- If hydro is re-dispatched, some additional system capacity may be available.

- If integration is done with hydro, some capacity may be held back that should be netted against the capacity contribution.

- Different run-off means capacity contribution is different every combination of wind year and water year.
The Seventh Plan took a unique approach by measuring the system capacity contribution of a new resource:

- ASCC = the effective change in the aggregate system capacity when a resource is added to the existing power supply

- The ASCC can be thought of as a resource’s nameplate capacity plus any capacity gained by the hydroelectric system.
Calculating ASCC

1. Start with an inadequate power supply (i.e. LOLP > 5%)

2. **Needed Capacity for Adequacy** = Analyze the curtailment record produced by the GENESYS model to determine the exact amount of capacity needed to get 5% LOLP

3. **Nameplate Capacity for Adequacy** = Using the GENESYS model, add increments of new resource nameplate capacity until the LOLP gets to 5%

4. **ASCC** = Needed capacity/Nameplate capacity
Examples of ASCC

- **Combustion Turbine**
  - Base case is inadequate
  - Needed capacity
  - Nameplate capacity
  - ASCC = 5,850/4,400 = 1.3
  - LOLP = 50%
  - 5,850 MW
  - 4,400 MW

- **Energy Efficiency**
  - EE capacity for 5% LOLP
  - ASCC = 5,850/4,900 = 1.2
  - 4,900 MW
### Associated System Capacity Contribution from the Seventh Power Plan

<table>
<thead>
<tr>
<th></th>
<th>Q1</th>
<th>Q2(^1)</th>
<th>Q3</th>
<th>Q4</th>
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<tbody>
<tr>
<td>Solar PV(^2)</td>
<td>0.26</td>
<td>N/A</td>
<td>0.80</td>
<td>0.42</td>
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<tr>
<td>Geothermal</td>
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<td>N/A</td>
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<td>1.20</td>
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<td>Energy Efficiency</td>
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<td>1.16</td>
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<tr>
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<td>1.20</td>
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<tr>
<td>Columbia Gorge Wind(^2)</td>
<td>0.03</td>
<td>N/A</td>
<td>0.11</td>
<td>0.08</td>
</tr>
</tbody>
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\(^1\)The lack of adequacy issues in Q2 makes the system capacity contribution meaningless.

\(^2\)Within-hour balancing reserves were not adjusted for the solar or wind ASCC analyses.
## Associated System Capacity Contribution from the Seventh Power Plan

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<td>0.08</td>
</tr>
<tr>
<td>Judith Gap(^2)</td>
<td>0.52</td>
<td>N/A</td>
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<td>0.74</td>
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<tr>
<td>Great Falls(^2)</td>
<td>0.63</td>
<td>N/A</td>
<td>0.18</td>
<td>0.40</td>
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</table>

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\(^2\)Within-hour balancing reserves were not adjusted for the solar or wind ASCC analyses.
Caveats and Notes

• 7th power plan methods and assumptions
• No additional within-hour balancing reserves were added
• Very small sample size for Montana wind
• Staff to revisit ASCC methodology (7th power plan action item)
Wind Site Characteristics

- **Annual Energy**: Gorge = 29, Judith Gap = 41, Great Falls = 34
- **Winter Energy**: Gorge = 27, Judith Gap = 48, Great Falls = 43
- **Summer Energy**: Gorge = 31, Judith Gap = 34, Great Falls = 25
- **Winter HLH Energy**: Gorge = 26, Judith Gap = 48, Great Falls = 46

Legend:
- Blue = Gorge
- Light Blue = Judith Gap
- Red = Great Falls
Actual vs Simulated Wind CF
Judith Gap – January 2008 Week 3

2008 Judith Gap NREL vs Actual and Load - Week 3

2007 Regional Load Fac
Judith Actual 10/2007 to 9/2008
Judith NREL 10/2007 to 9/2008
Judith Gap vs Gorge Wind CF
January 2008 Week 3

2008 Judith Gap Actual vs Actual and Load - Week 3

- 2007 Regional Load Fac
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Actual vs Simulated Wind CF
Judith Gap – August 2008 Week 3

2008 Judith Gap NREL vs Actual and Load - Week 3

- 2007 Regional Load Fac
- Judith Actual 10/2007 to 9/2008
- Judith NREL 10/2007 to 9/2008
Judith Gap vs Gorge Wind CF
August 2008 Week 3
Conclusions

• Higher annual energy generation, especially in winter – helps increase ASCC

• Montana wind correlates better with timing of regional winter peak load
Next Steps

• Update study with additional data and continue to add data as available

• Investigate other potentially promising sites in Montana
Additional Slides
## Wind Site Characteristics

<table>
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<th>Wind Site</th>
<th>Annual Energy (% of NP)</th>
<th>Winter Energy (% of NP)</th>
<th>Summer Energy (% of NP)</th>
<th>Winter HLH&lt;sup&gt;1&lt;/sup&gt; Energy (% of NP)</th>
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<td>Gorge</td>
<td>29%</td>
<td>27%</td>
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<td>26%</td>
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<tr>
<td>Judith Gap</td>
<td>41%</td>
<td>48%</td>
<td>34%</td>
<td>48%</td>
</tr>
<tr>
<td>Great Falls</td>
<td>34%</td>
<td>43%</td>
<td>25%</td>
<td>46%</td>
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<sup>1</sup>HLH = High Load Hours, in this case from 7am to 6pm all days.
Variation in Winter\(^{1}\) Wind Energy
Judith Gap and Great Falls

- Judith Gap Winter Average = 48%
- Great Falls Winter Average = 43%

\(^{1}\)Winter months from October through March
Variation in Winter\textsuperscript{1} Wind Energy

Gorge Wind

Gorge Wind Winter Average = 27%

\textsuperscript{1}Winter months from October through March
Actual vs Simulated Wind CF
Judith Gap – January 2008 Week 1

2008 Judith Gap NREL vs Actual and Load - Week 1

- 2007 Regional Load Fac
- Judith Actual 10/2007 to 9/2008
- Judith NREL 10/2007 to 9/2008
Actual vs Simulated Wind CF
Judith Gap – January 2008 Week 2

2008 Judith Gap NREL vs Actual and Load - Week 2

- 2007 Regional Load Fac
- Judith Actual 10/2007 to 9/2008
- Judith NREL 10/2007 to 9/2008
Actual vs Simulated Wind CF
Judith Gap – January 2008 Week 4

2008 Judith Gap NREL vs Actual and Load - Week 4

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Judith Gap vs Gorge Wind CF
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Judith Gap vs Gorge Wind CF
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Judith Gap vs Gorge Wind CF
January 2008 Week 4

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Judith Gap – August 2008 Week 1
Actual vs Simulated Wind CF
Judith Gap – August 2008 Week 2

2008 Judith Gap NREL vs Actual and Load - Week 2

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