Northwest **Power** and
Conservation Council

August 2, 2016

MEMORANDUM

TO: **Council Members**

FROM: **John Fazio, Senior Systems Analyst**

SUBJECT: **System Capacity Contribution of Montana Wind Resources**

BACKGROUND:

Presenter: John Fazio

Summary: During the development of the Seventh Power Plan, the Council established a method to assess the associated system capacity contribution (ASCC) for all resources, including energy efficiency. The ASCC is used in conjunction with the Council's adequacy reserve margin in the Regional Portfolio Model to ensure that all resources are evaluated on an equal basis. The ASCC is a measure of how a resource interacts with the existing power supply, in particular, the hydroelectric system and its inherent storage.

A resource can provide an effective system capacity that is greater than its nameplate capacity by generating during light load hours to replace hydroelectric generation. This increases the amount of water available during peak load hours, which can increase the hydroelectric system's peaking capability. The combined nameplate capacity of the added resource plus the increased hydroelectric peaking capacity are added to make up the associated system capacity contribution.

The Council has recently obtained historical generating data for several Montana wind generating sites. Two promising sites (near Judith Gap and near Great Falls) were examined in more detail. Simulated wind

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generation data for these two sites was created based on National Renewable Energy Laboratory (NREL) Weather Research and Forecasting Model and site appropriate turbine power curves. This data was analyzed using the Council's GENESYS program to assess the ASCC value for these two wind sites.

Preliminary results indicate very promising ASCC values for these two sites – greater available wind generation during regional peak load hours. Staff will present on these initial findings.

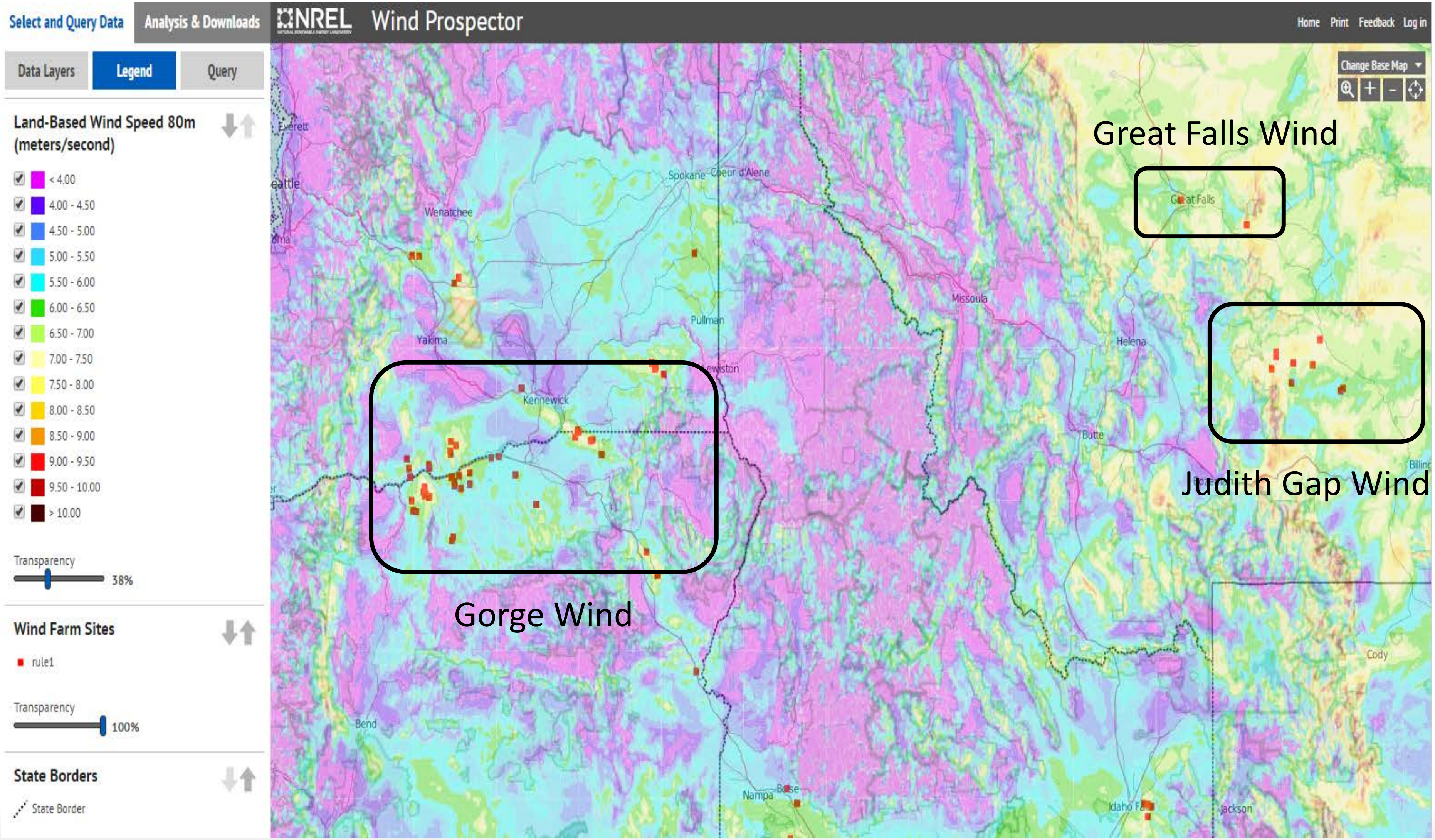
Relevance: Although wind generation is variable and sometimes unpredictable, it has proven to be an important non-carbon emitting resource for the Northwest. Adding generation from many diverse wind sites has the effect of "averaging" out the generation from these variable resources and makes them more valuable to the power supply.

Workplan: C.4.1 Update generating resource datasets and tools

Background: Wind resource development has increased dramatically over the past 15 years. Since 2003, over 8,300 megawatts of wind nameplate capacity has been added to the regional power supply. Today, wind makes up 14 percent of the region's installed capacity but, unfortunately, only provides 8 percent of the region's energy generation. Wind is a good non-carbon emitting resource when added to a system that has significant storage, i.e. the hydroelectric system. Wind can be more effective in meeting our demands if more diverse wind sites can be developed.

More Info: N/A

Montana Wind Capacity Contribution



Council Meeting, August 9, 2016

Polson, Montana

Associated System Capacity Contribution (ASCC)

- **ASCC = the effective change in the aggregate system capacity when a resource is added to the existing power supply**
- Because of the interaction between the added resource and the hydroelectric system, the added resource can sometimes provide more capacity than its nameplate.
- If a resource can run during light load hours and replace hydroelectric generation, some water may be held in reservoirs to be used during peak load hours over the next day(s).
- This interaction can increase the hydroelectric system's sustained peaking capability.
- 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

Note: *ELCC = Incremental load/Resource nameplate capacity needed to serve that incremental load (without affecting adequacy)*

Examples of ASCC

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

- **Energy Efficiency**
  - EE capacity for 5% LOLP 4,900 MW
  - ASCC = 5,850/4,900 = 1.2

Associated System Capacity Contribution from the Seventh Power Plan

	Q1	Q2[1]	Q3	Q4
Solar PV[2]	0.26	N/A	0.80	0.42
Geothermal	1.28	N/A	1.02	1.20
Energy Efficiency	1.24	N/A	1.14	1.16
Natural Gas	1.28	N/A	1.02	1.20
Columbia Gorge Wind[2]	0.03	N/A	0.11	0.08

[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

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)

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Columbia Gorge Wind[2]	0.03	N/A	0.11	0.08
Judith Gap[2]	0.52	N/A	0.25	0.74
Great Falls[2]	0.63	N/A	0.18	0.40

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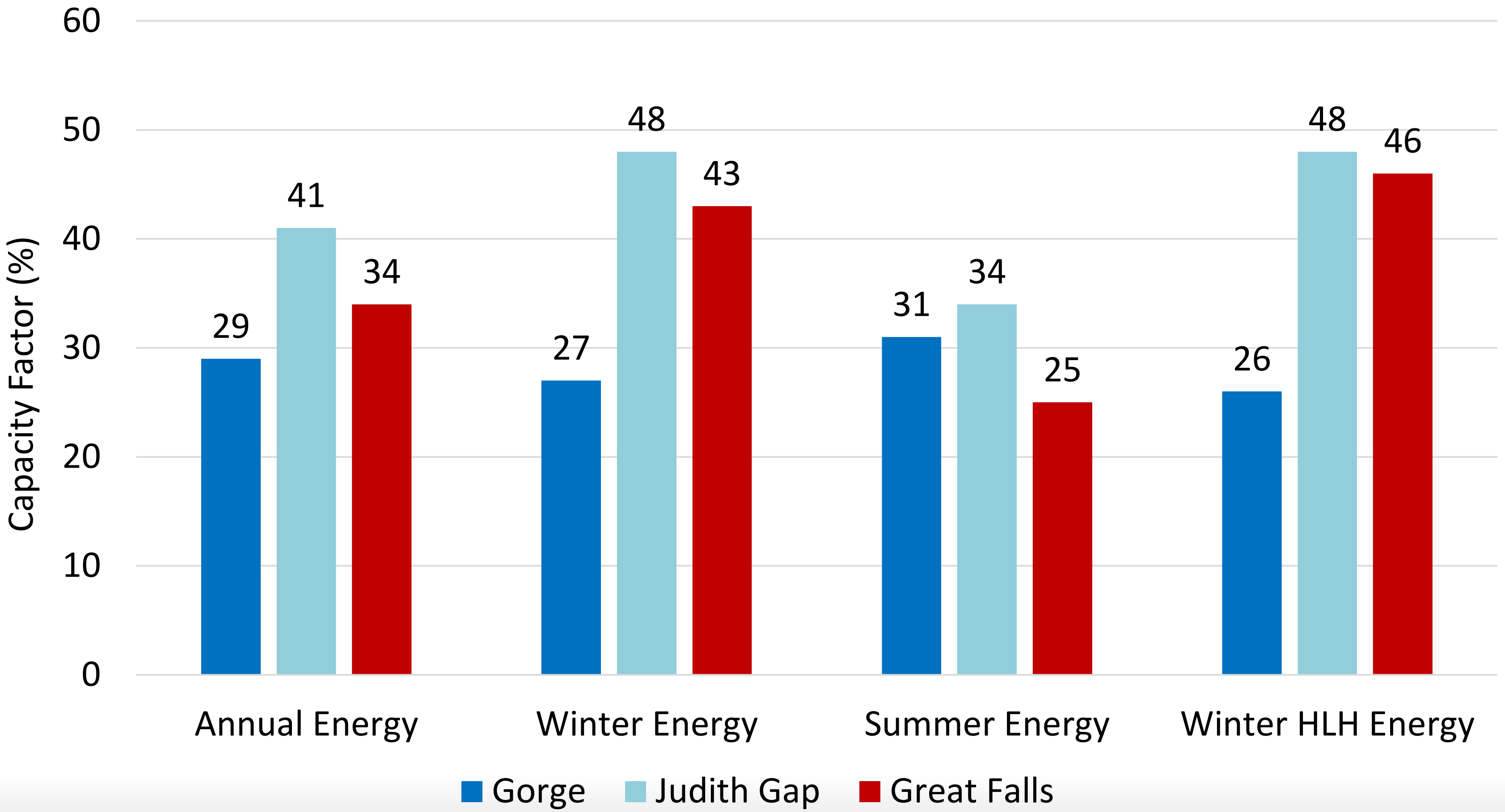
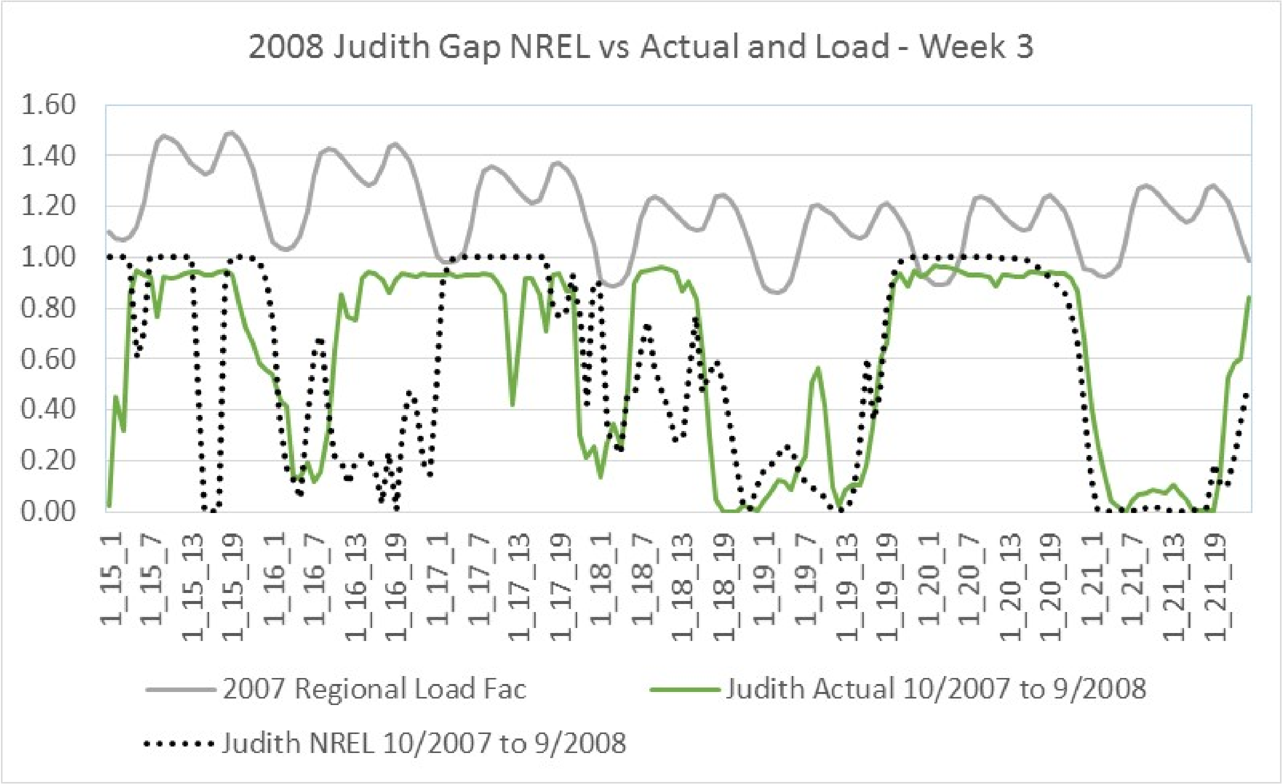
Wind Site Characteristics

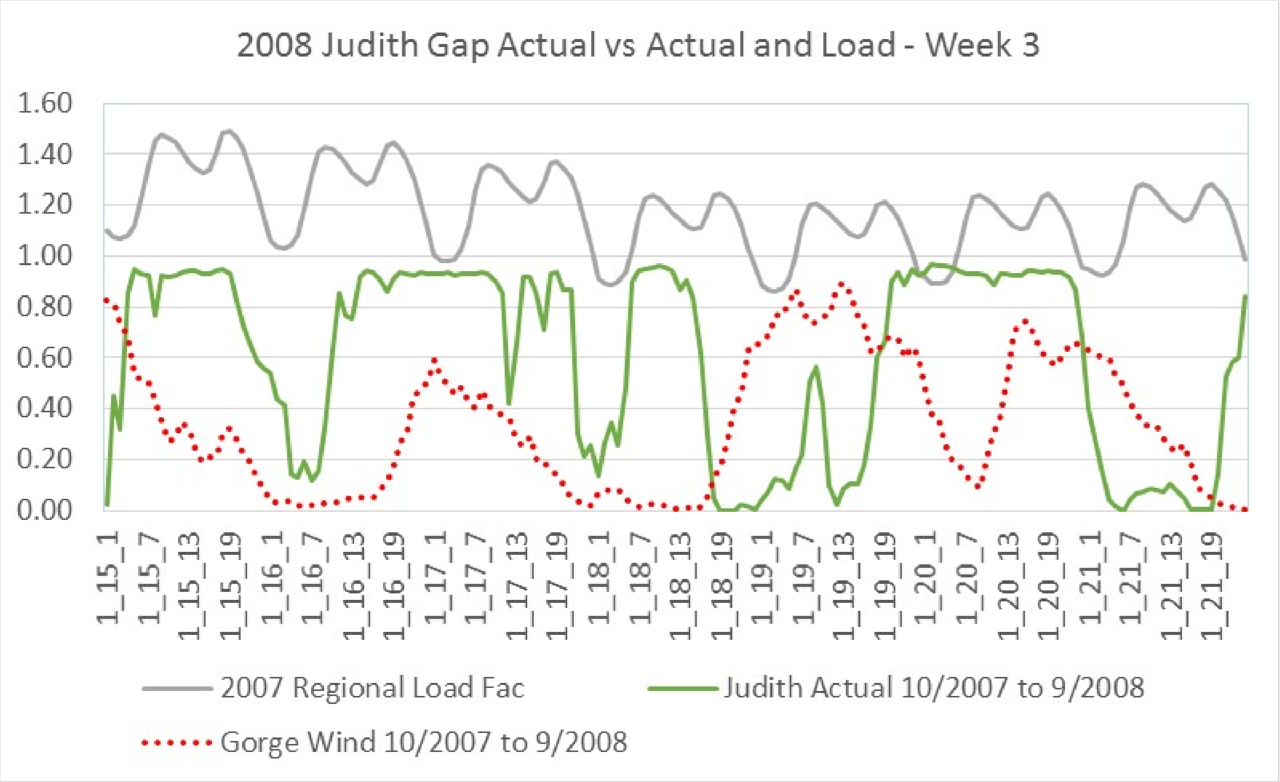


Actual vs Simulated Wind CF
Judith Gap – January 2008 Week 3



Judith Gap vs Gorge Wind CF

January 2008 Week 3



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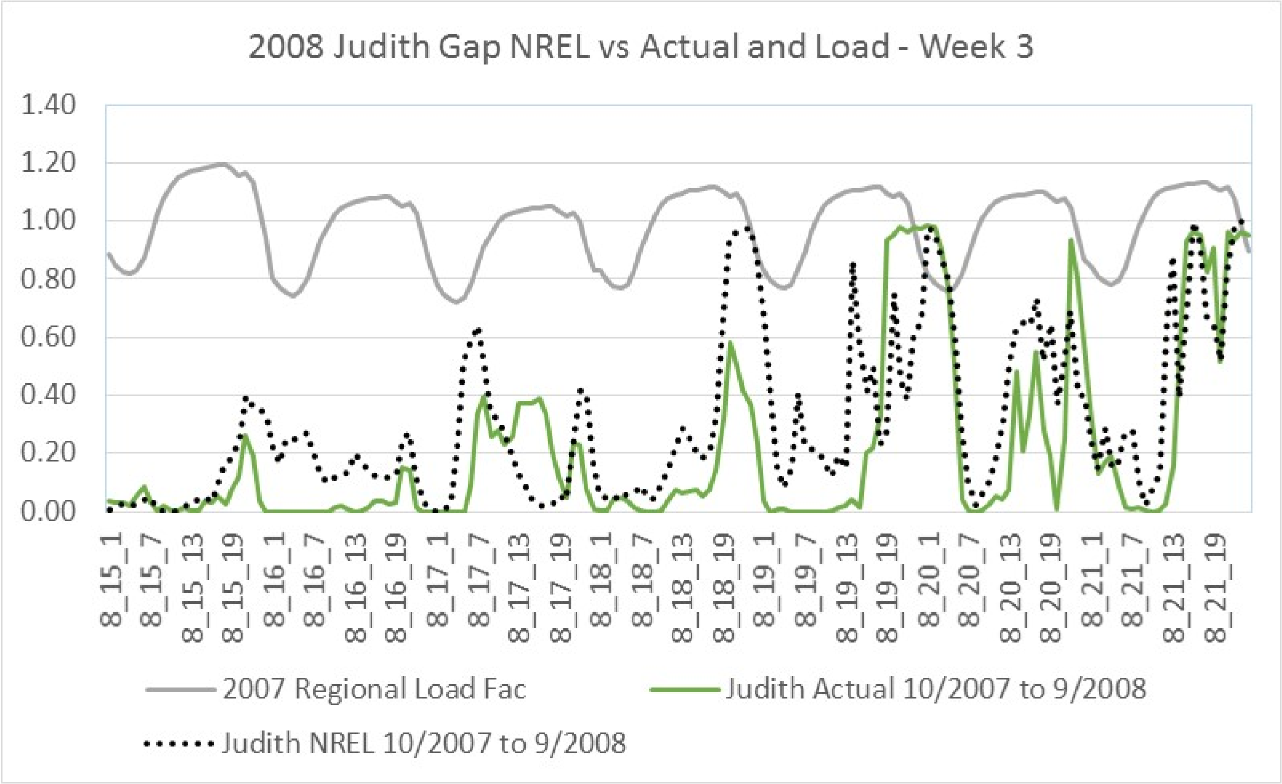

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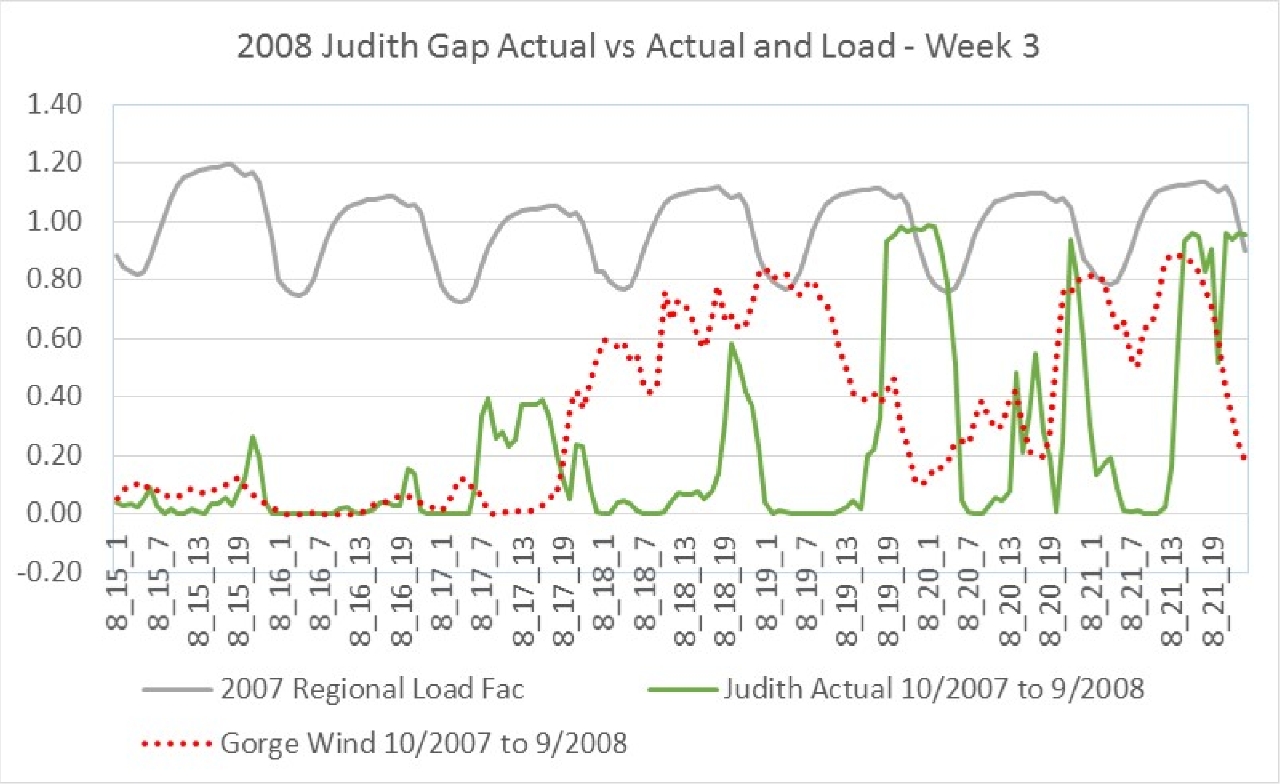
August 2008 Week 3



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Conclusions

- Higher annual energy generation, especially in winter – helps increase ASCC
- Montana wind correlates better with timing of regional winter peak load

Next Steps

- Obtain more historical data to improve simulated generation

- Investigate other potentially promising sites in Montana

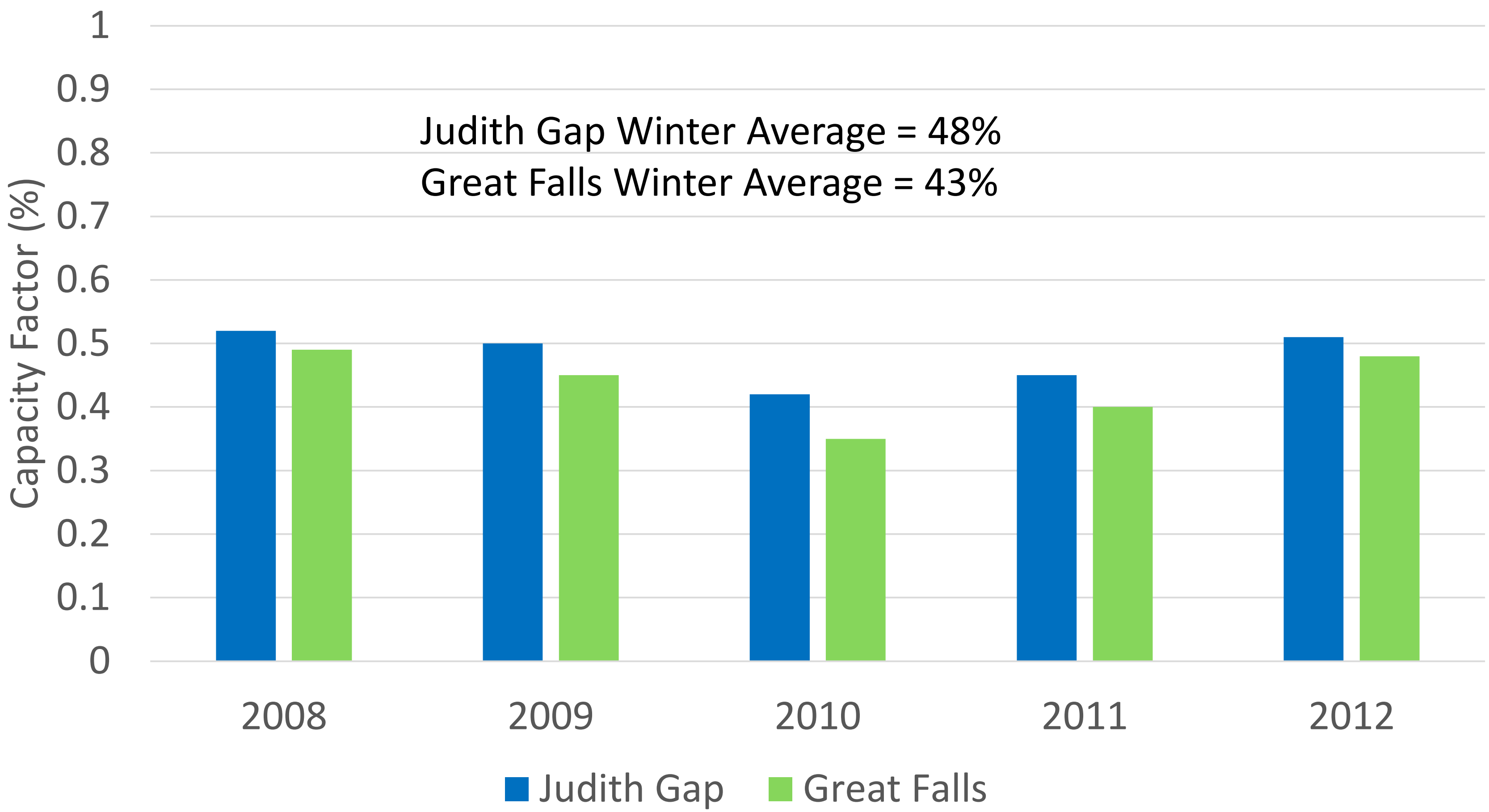
Additional Slides

Wind Site Characteristics

	Average Values			
Wind Site	Annual Energy (% of NP)	Winter Energy (% of NP)	Summer Energy (% of NP)	Winter HLH[1] Energy (% of NP)
Gorge	29%	27%	31%	26%
Judith Gap	41%	48%	34%	48%
Great Falls	34%	43%	25%	46%

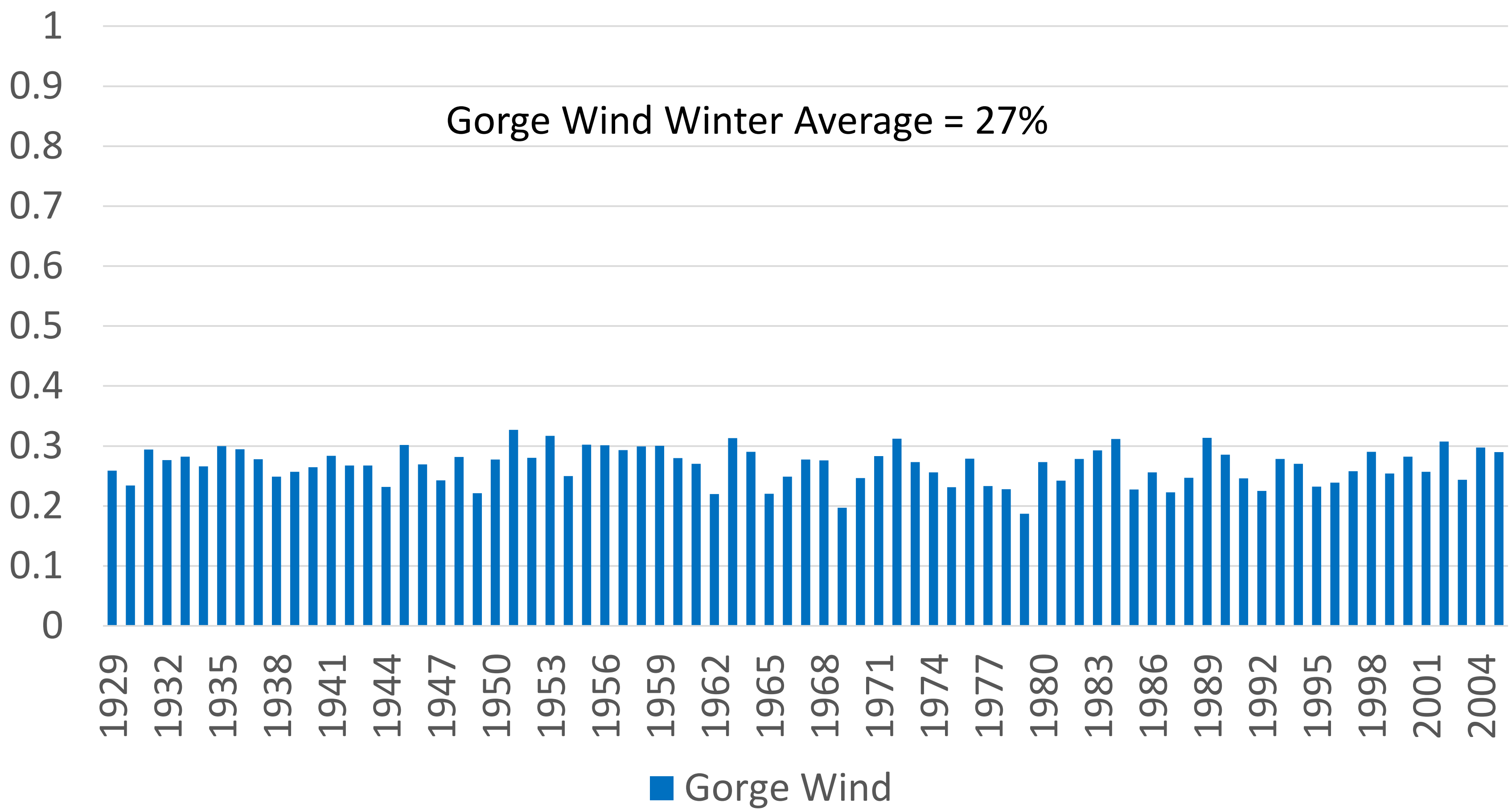
[1]HLH = High Load Hours, in this case from 7am to 6pm all days.

Variation in Winter[1] Wind Energy Judith Gap and Great Falls



[1]Winter months from October through March

Variation in Winter[1] Wind Energy Gorge Wind



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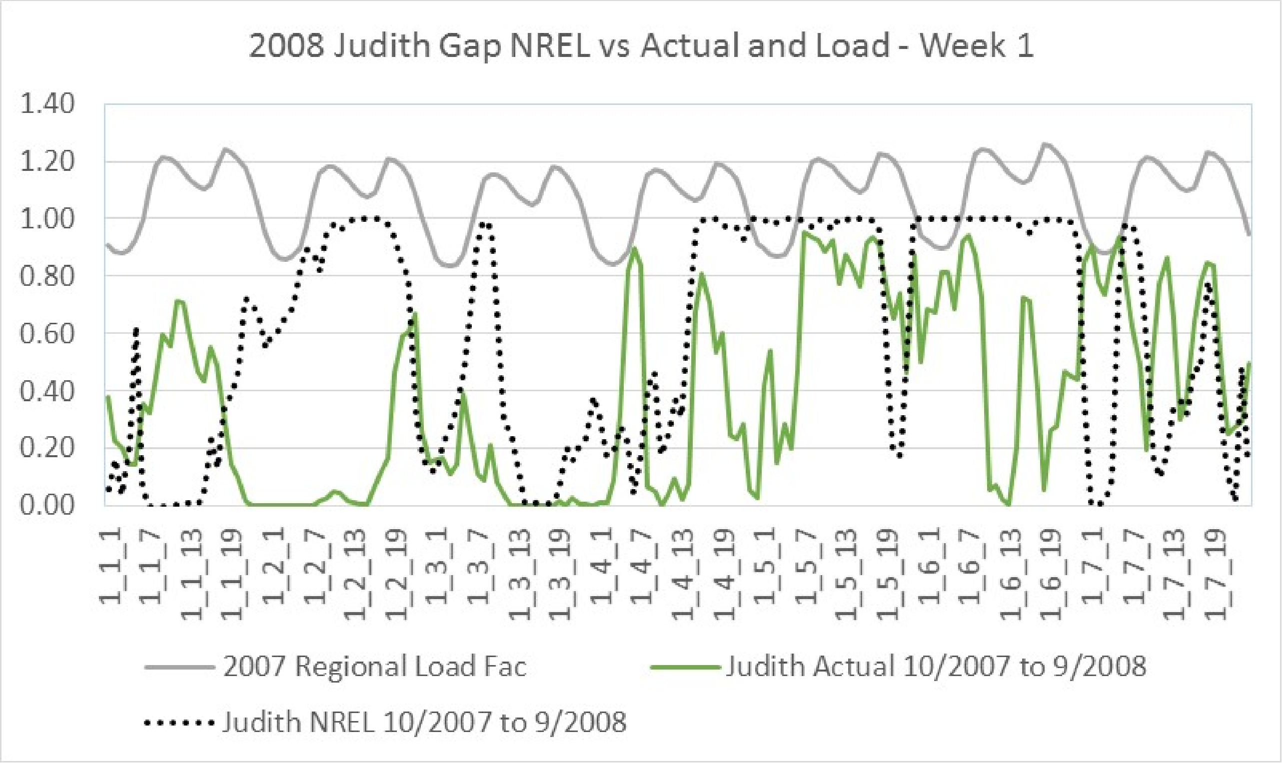
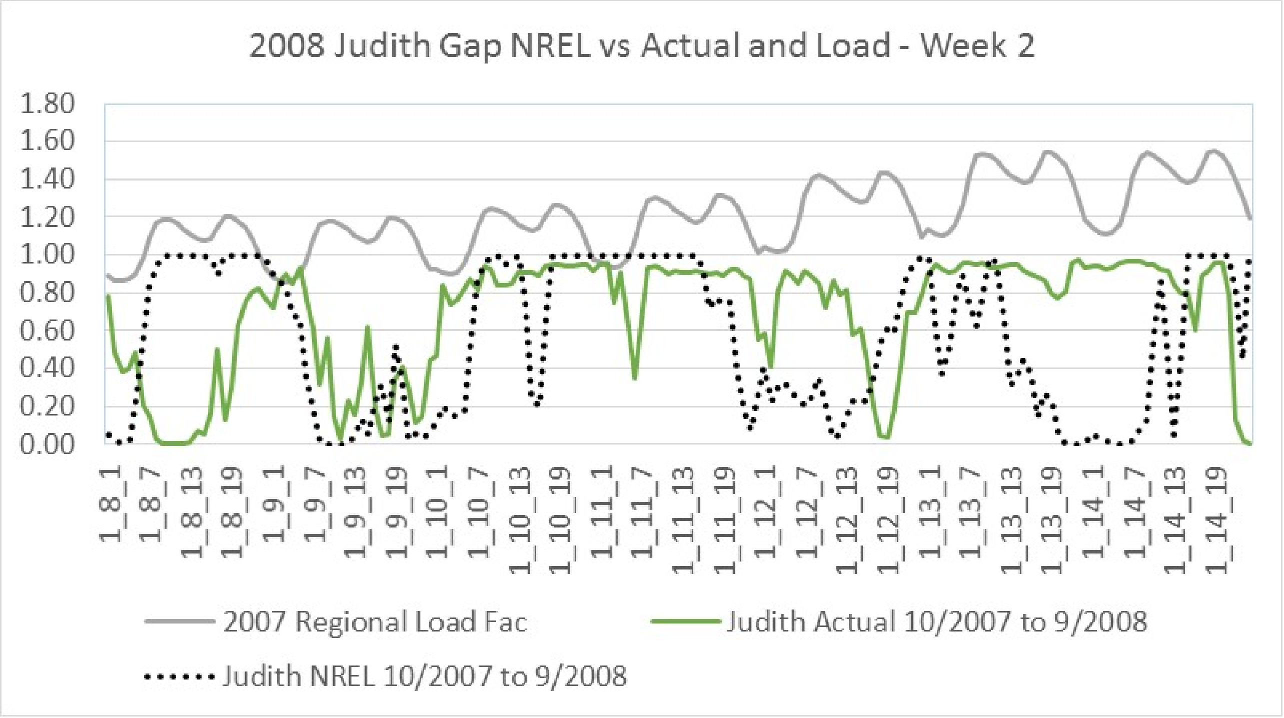
Actual vs Simulated Wind CF

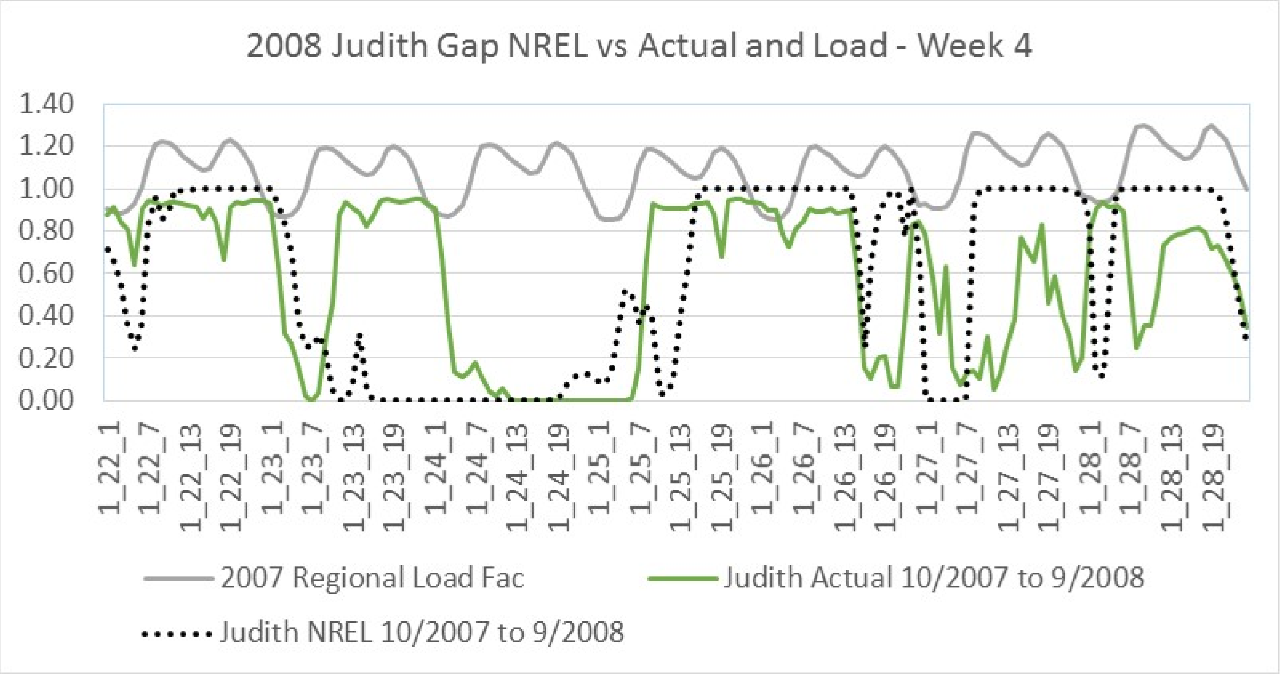
Judith Gap – January 2008 Week 1



Actual vs Simulated Wind CF
Judith Gap – January 2008 Week 2



Actual vs Simulated Wind CF
Judith Gap – January 2008 Week 4



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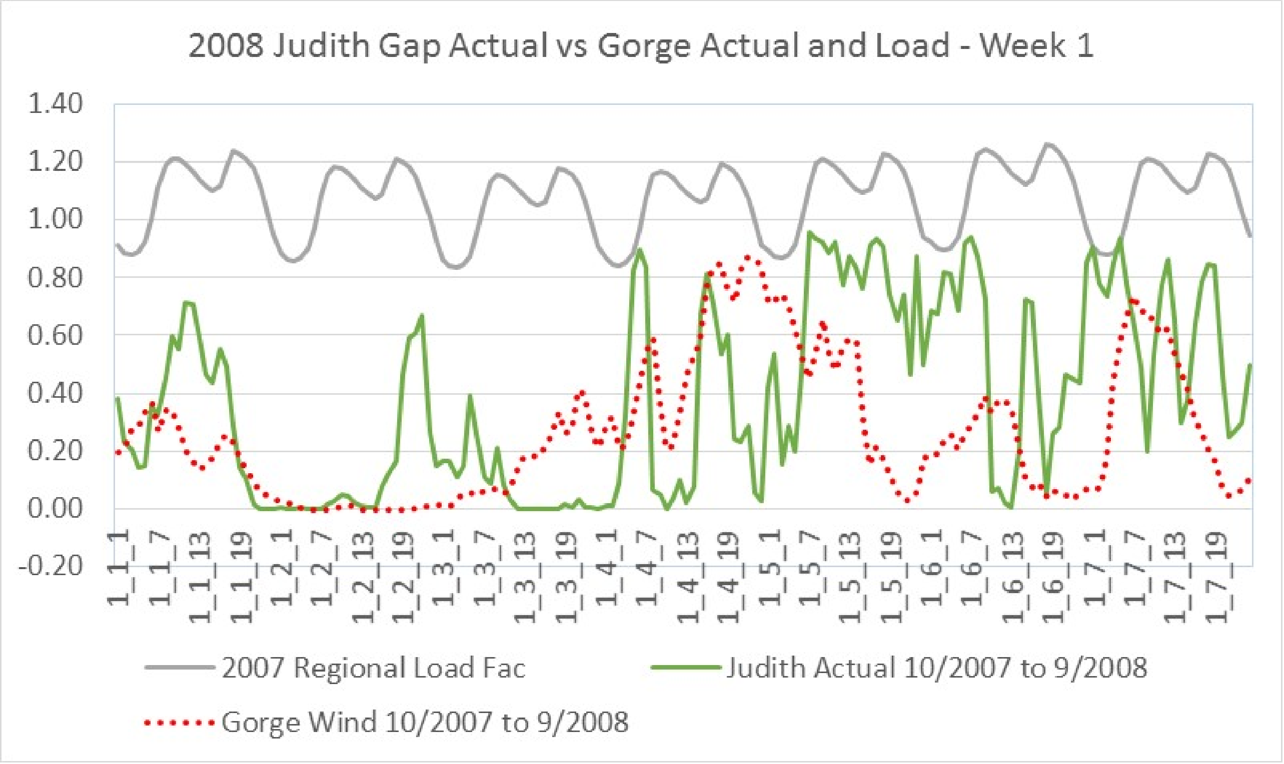
Judith Gap vs Gorge Wind CF
January 2008 Week 1



Judith Gap vs Gorge Wind CF
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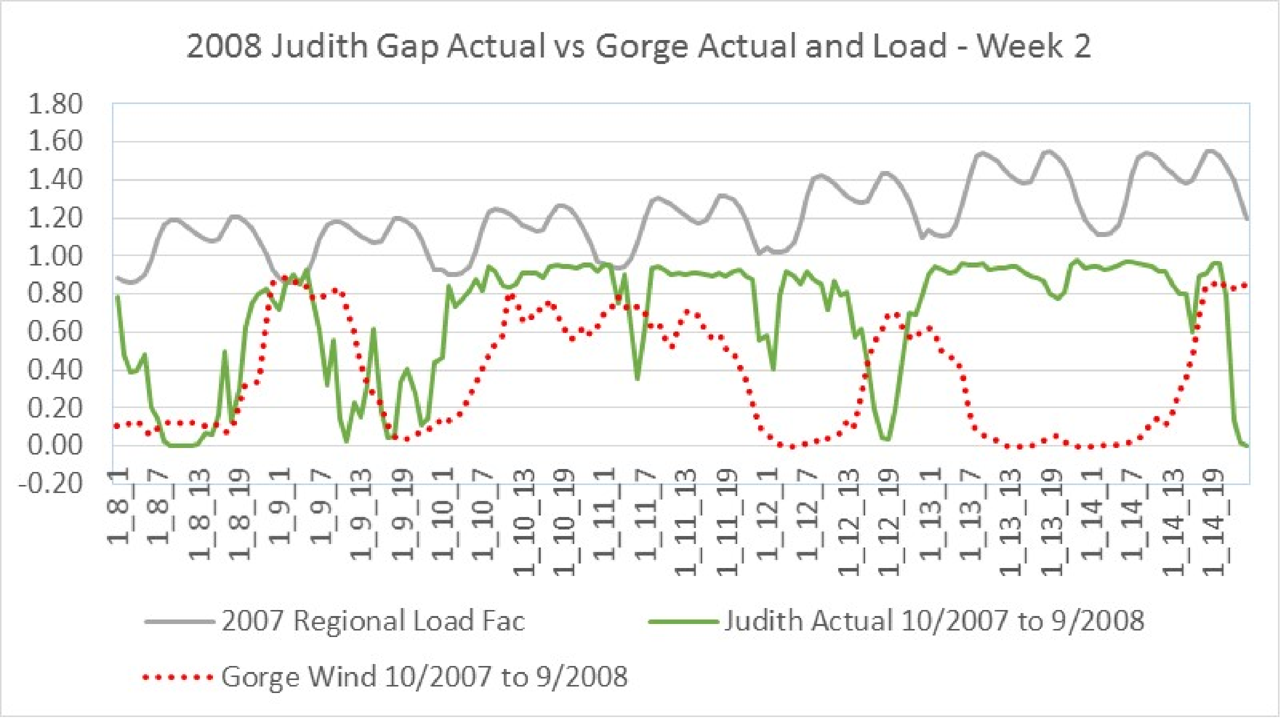

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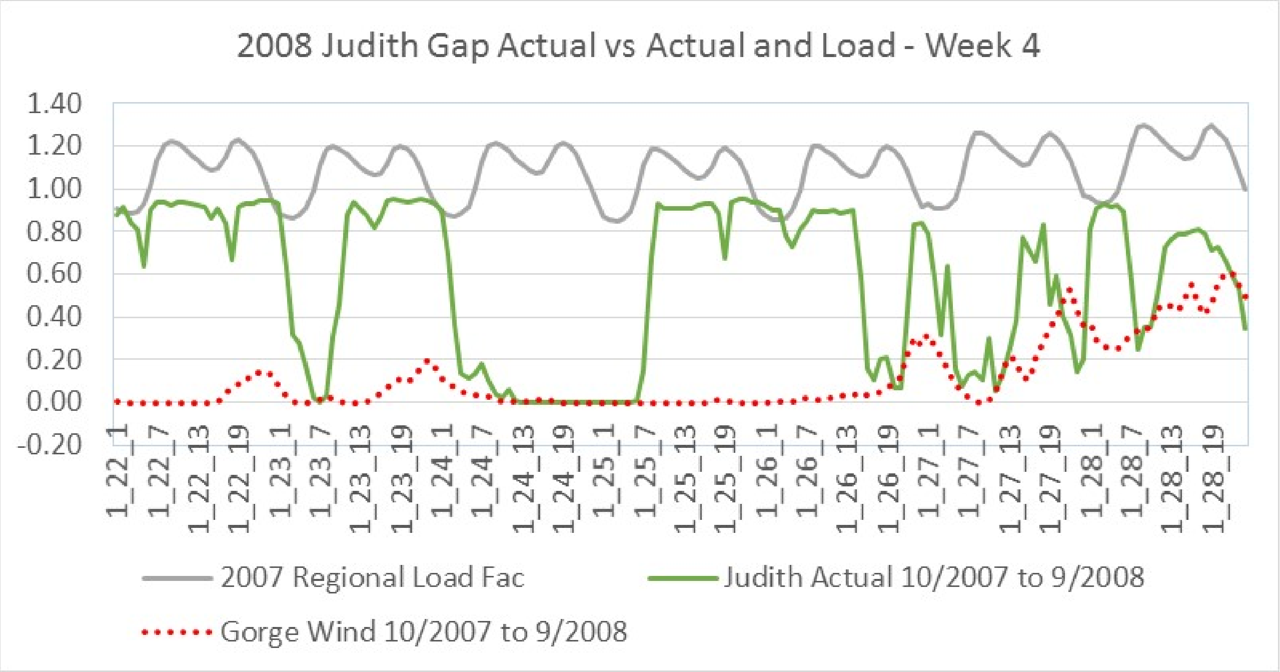
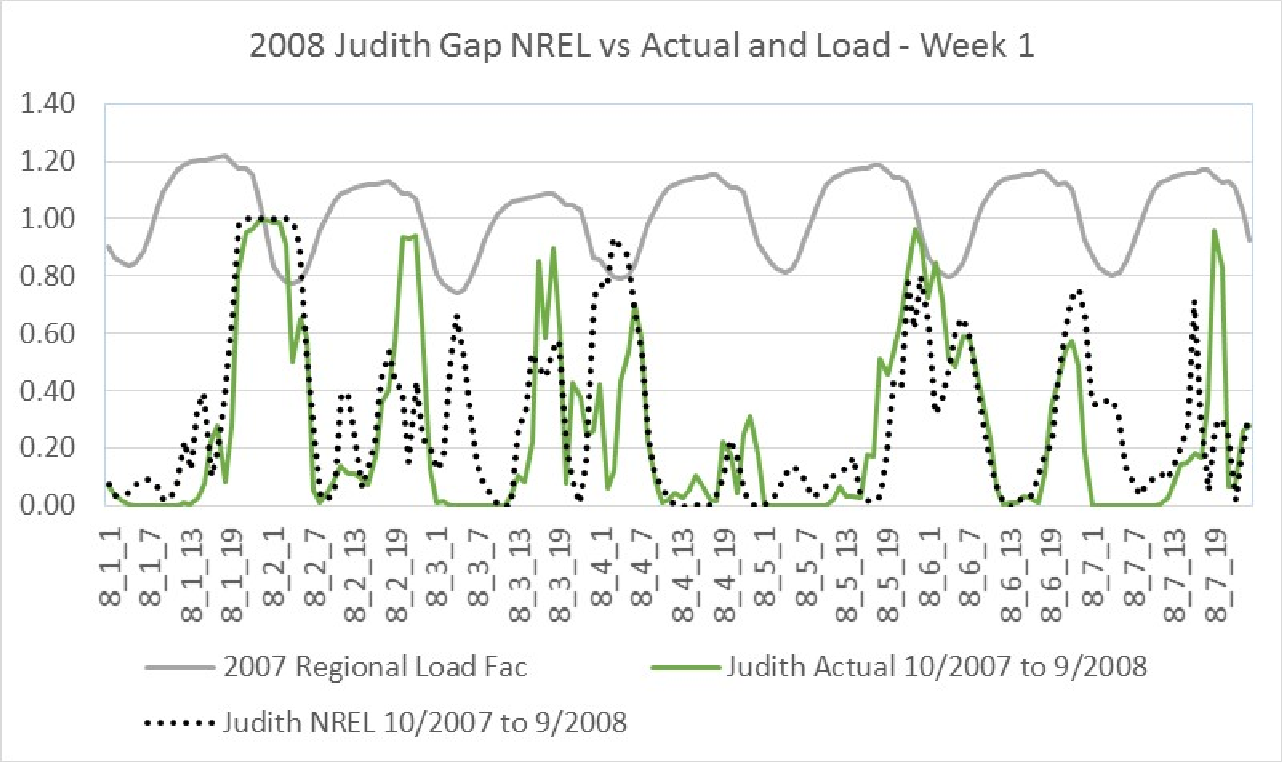


Actual vs Simulated Wind CF

Judith Gap – August 2008 Week 1



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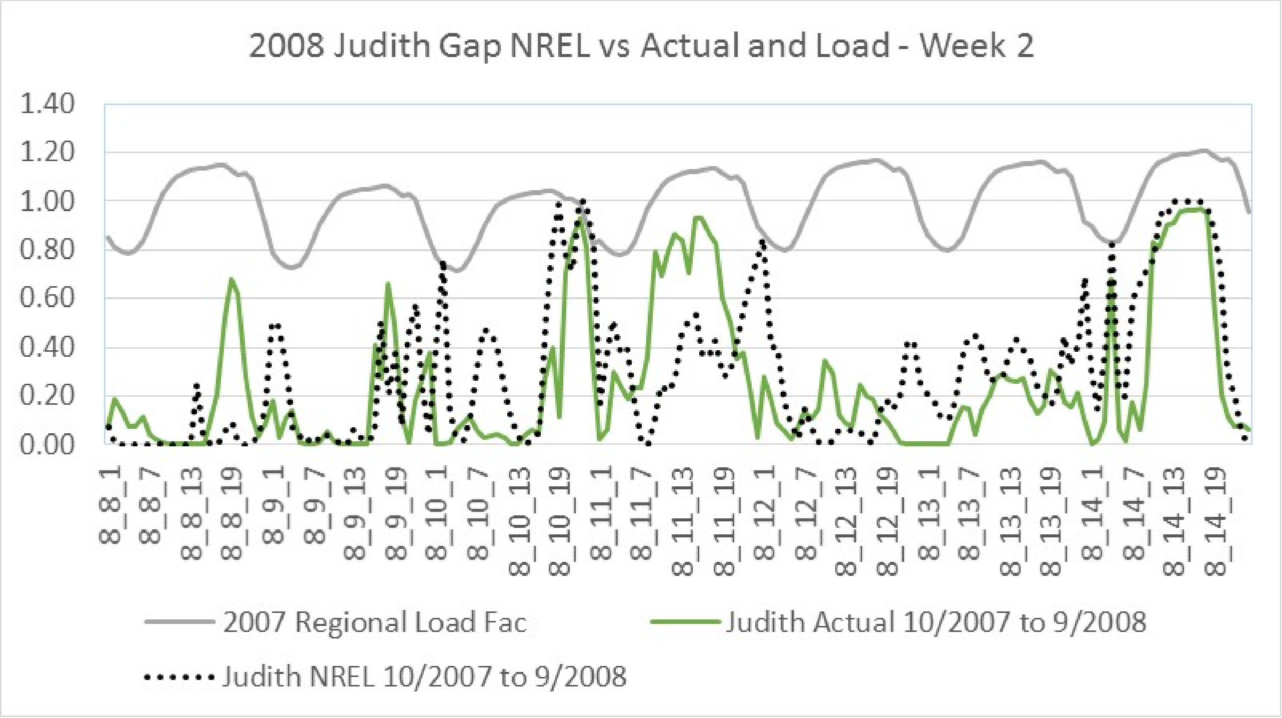
Judith Gap – August 2008 Week 2



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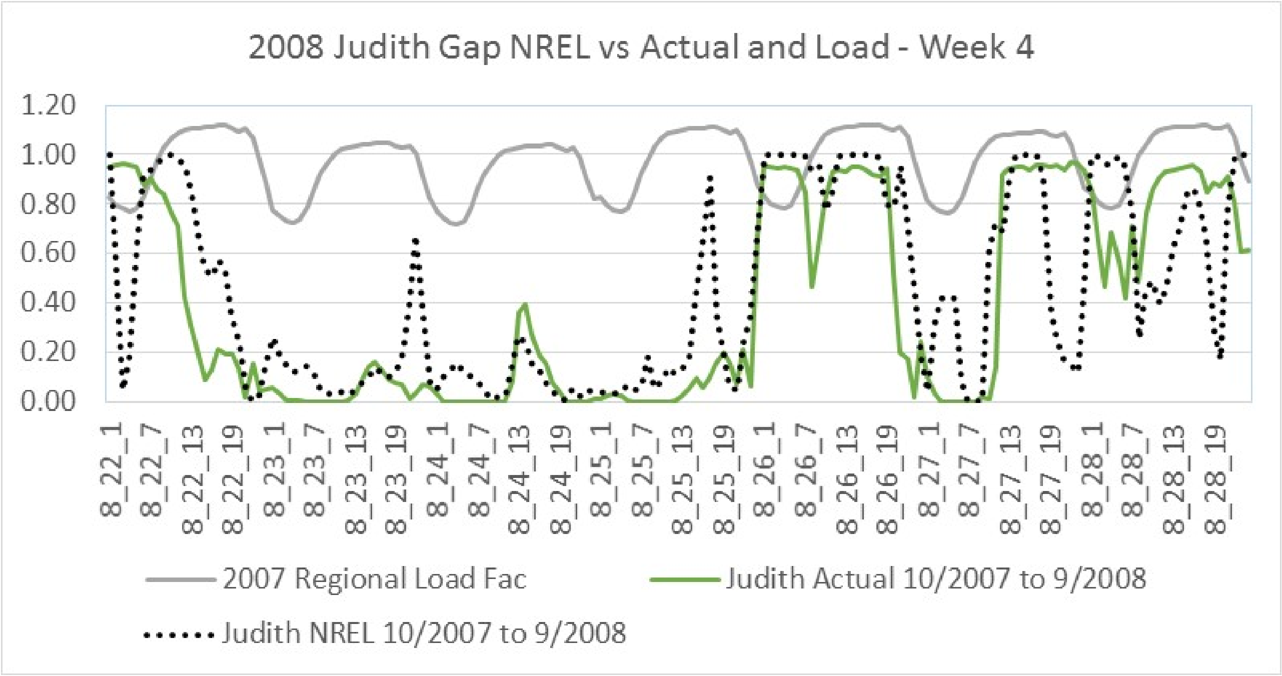

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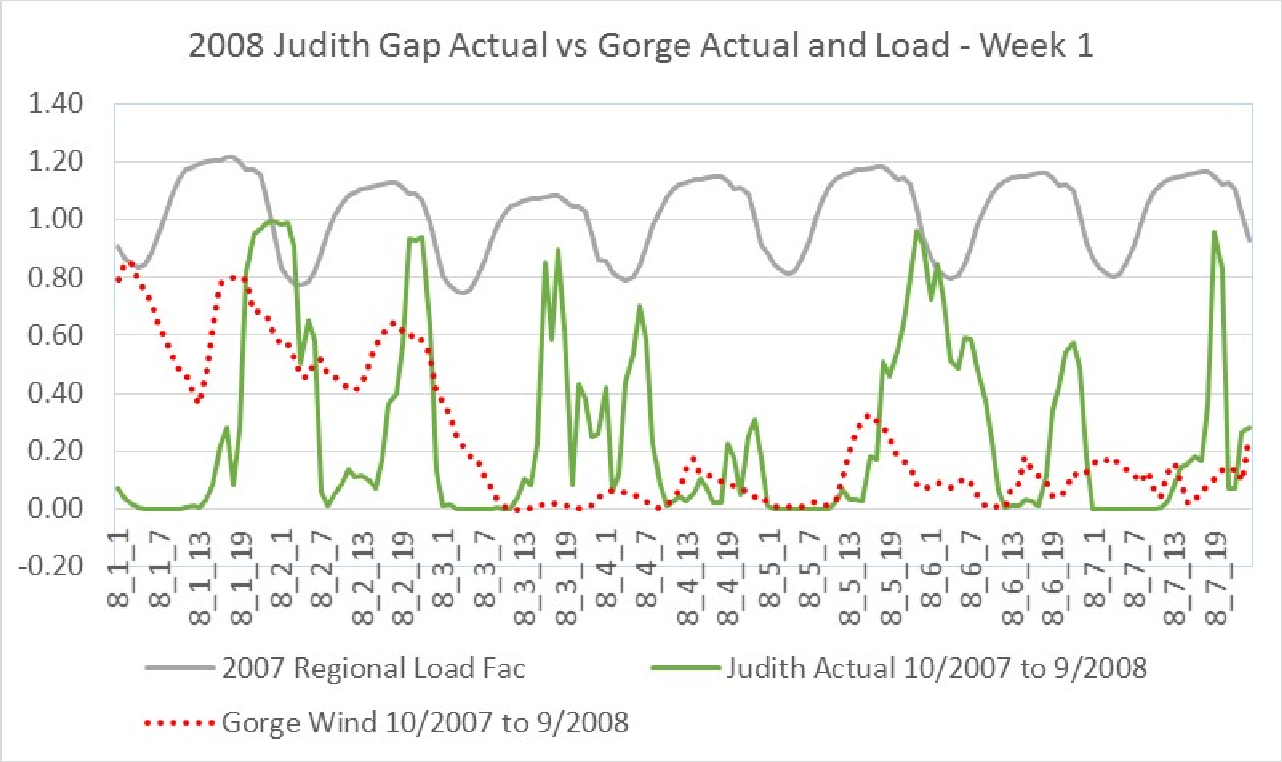
August 2008 Week 1



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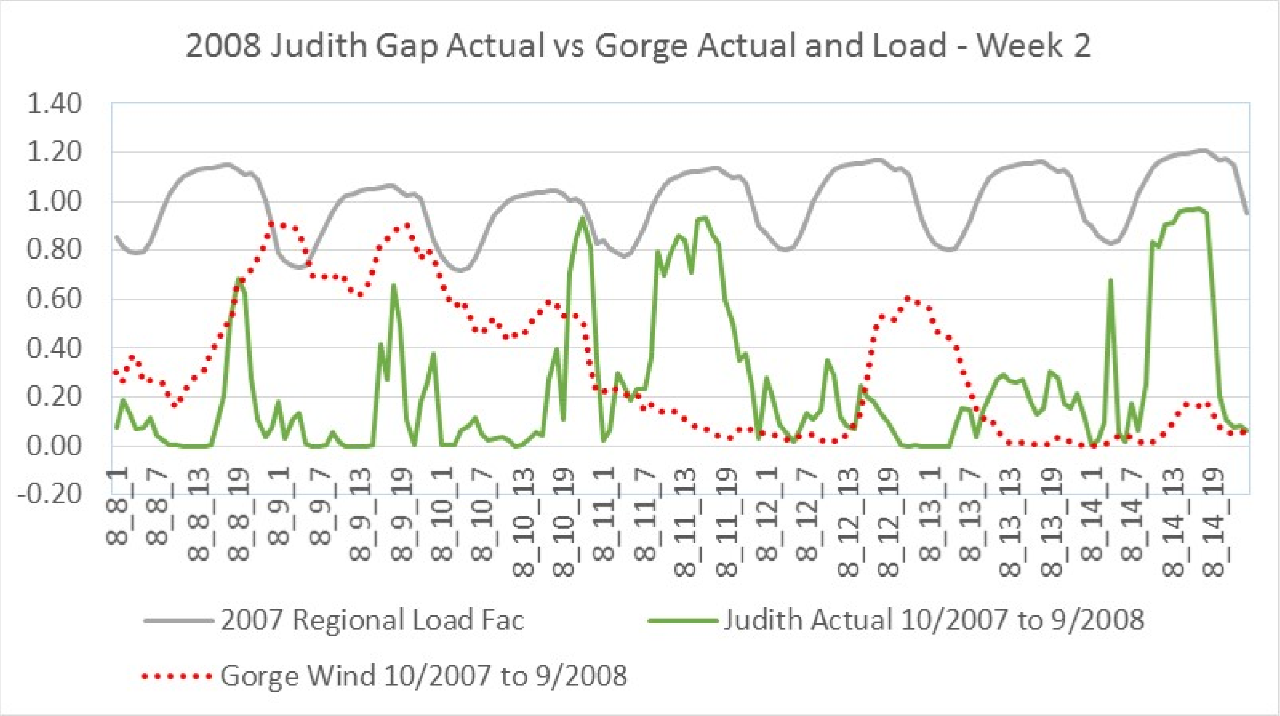

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