Northwest **Power** and **Conservation** Council

May 9, 2017

MEMORANDUM

TO: **Power Committee**

FROM: **Charlie Grist and John Fazio**

SUBJECT: **Understanding System Adequacy Shortfalls**

BACKGROUND:

Presenters: Charlie Grist and John Fazio

Summary: Staff will brief the Council on findings from investigating capacity and energy shortfall events from the 2021 resource adequacy analysis.

The Seventh Power Plan identified near-term regional capacity constraints that drive the value of energy efficiency and demand response resources. The Council's 2021 adequacy analysis showed a system loss of load probability of about 10 percent, which is above the maximum allowed value of 5 percent in the Council's current adequacy standard. These capacity shortfalls are one of the factors that makes energy efficiency and demand response high-valued resources. Results from the resource adequacy analysis for 2021 were inspected to better understand the frequency, magnitude, duration and timing of shortfall events –times when loads exceed resources.

The analysis identified significant shortfall events in both winter and summer. The variance of both load and of resource production are important factors that cause shortfall events. Hydro storage and shaping are important dynamics that have the effect of turning short high-

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magnitude peak shortfall events into longer-duration energy events in order to more easily correct them.

Relevance: Understanding system adequacy is key to understanding the characteristics of new resources that are valuable to the region's going forward. Capacity impacts of energy efficiency and demand response are key sources of value for these resources.

Workplan: A.1.5. Conservation - Enhance the understanding, use, and reporting of capacity impacts from conservation. C.1 and C.2 Data Development for Energy Efficiency and Demand Response.

Background: The Council's 2021 adequacy analysis was conducted in 2016 and adopted by the Council in August of 2016. A new analysis for 2022 is being undertake at this time.

More Info: Link to 2021 Adequacy Analysis

Understanding System Adequacy Shortfalls

Capacity Interactions with EE, DR, and Other Resources

Power Committee May 16, 2017

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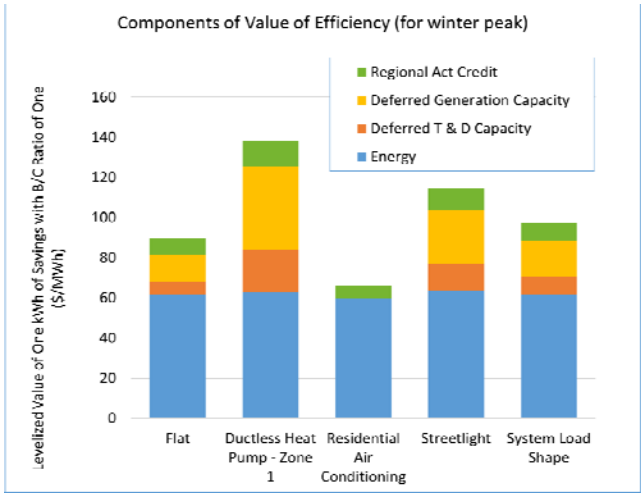

Deferred Capacity Value is a Big Deal

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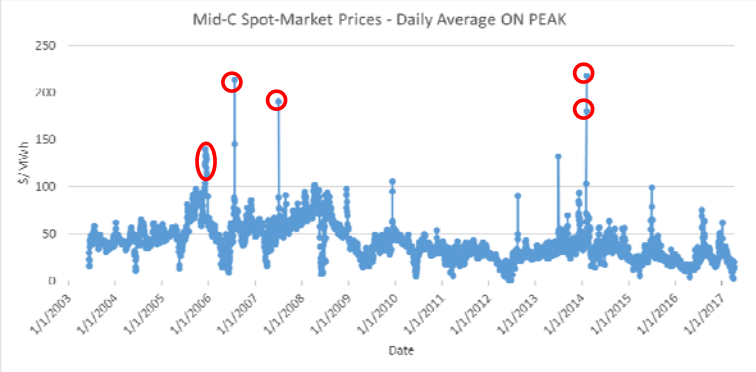
Low Spot Market Power Prices – Mostly



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1. PNW is short on capacity – sometimes
2. Spot market prices are not <u>firm</u> power

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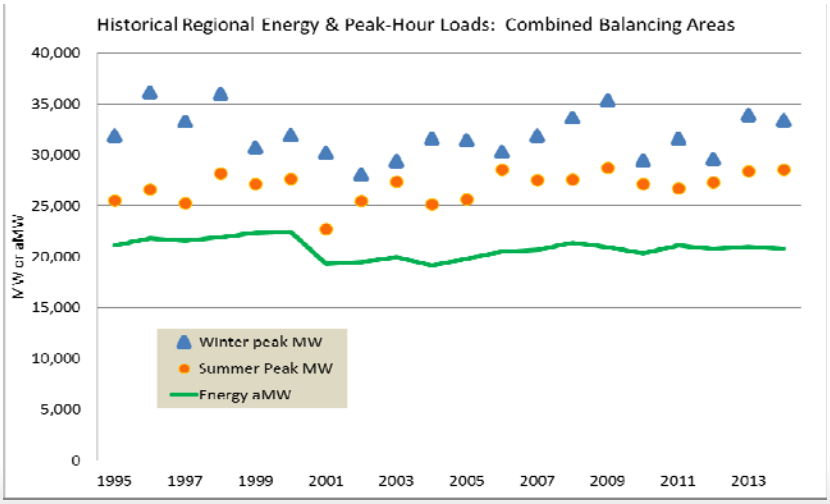
Use Adequacy Assessment to Explore Capacity Shortfalls

- Identify frequency, magnitude, timing
- Based on 2021 Adequacy Analysis

How can the PNW be short on capacity?

LOADS

Peaks Variable



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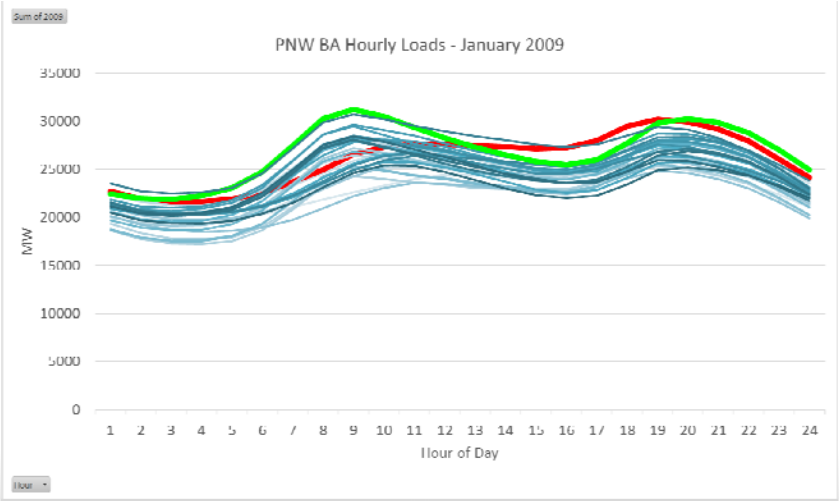
Daily Winter Profiles



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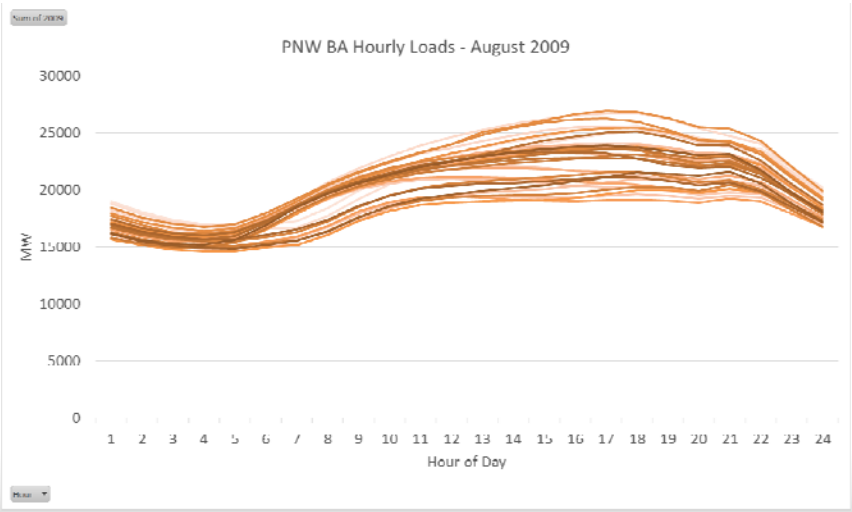
Daily Summer Profiles



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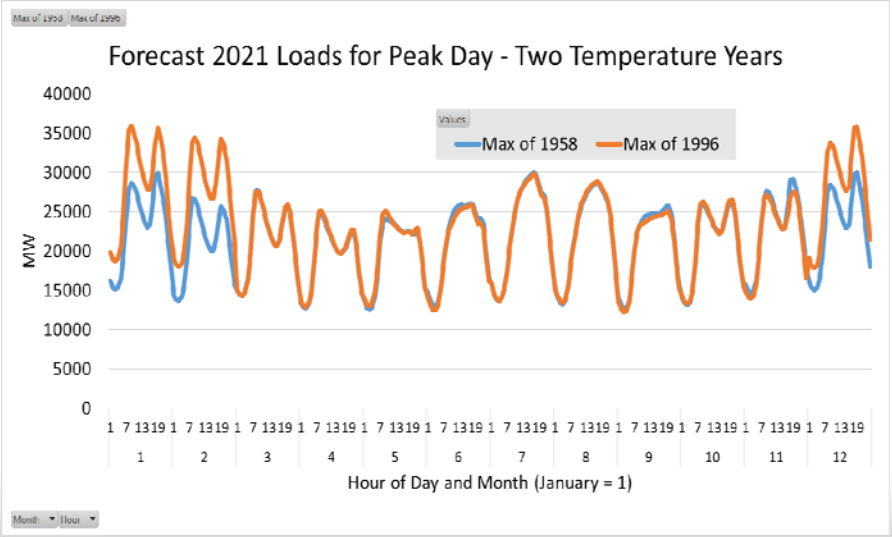
Forecast Daily Load Profiles Vary



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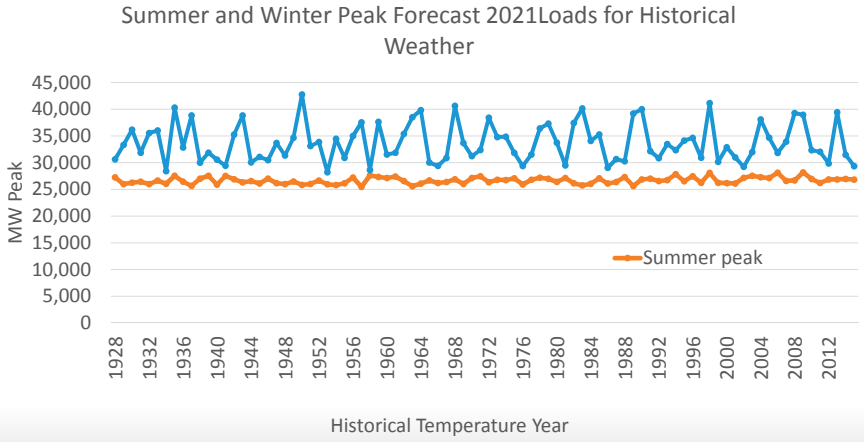
Forecast Winter & Summer Peak Loads Variable



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It takes Two to Tango

RESOURCES

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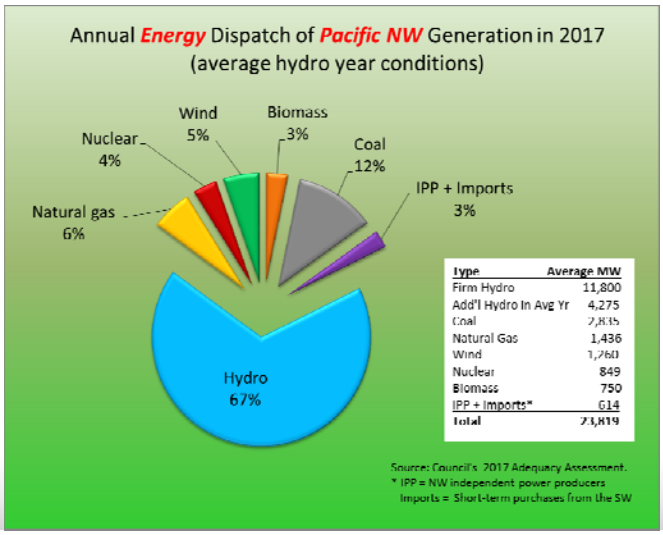
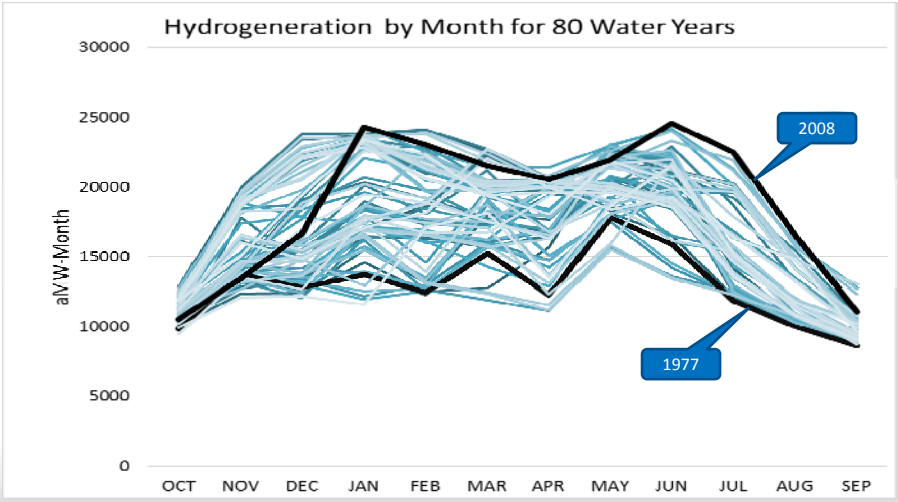
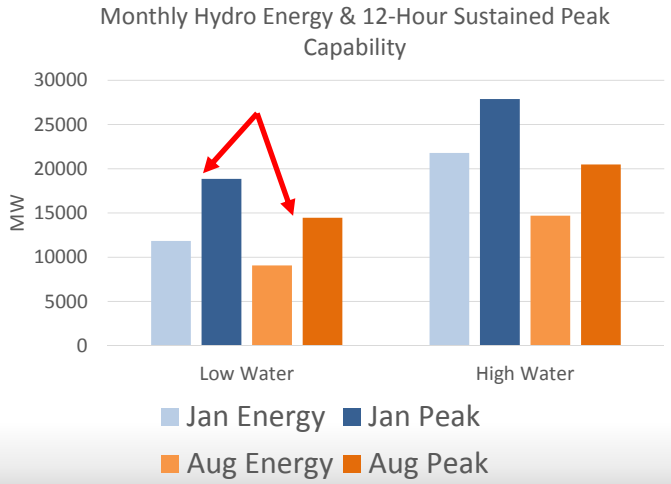
PNW Energy Production
Average Hydro & Wind



PNW Largest Generating Resource is Highly Variable Year to Year



Dependable Peak Capacity from Hydro Varies



Hydro can be shifted to peak

Peak capacity depends on runoff

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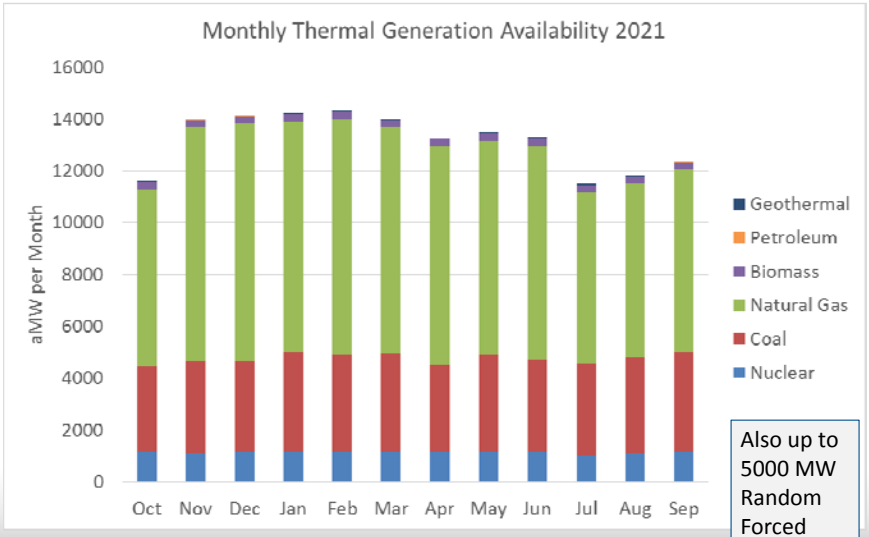
PNW Thermal Resource Availability



Also up to 5000 MW Random Forced Outage

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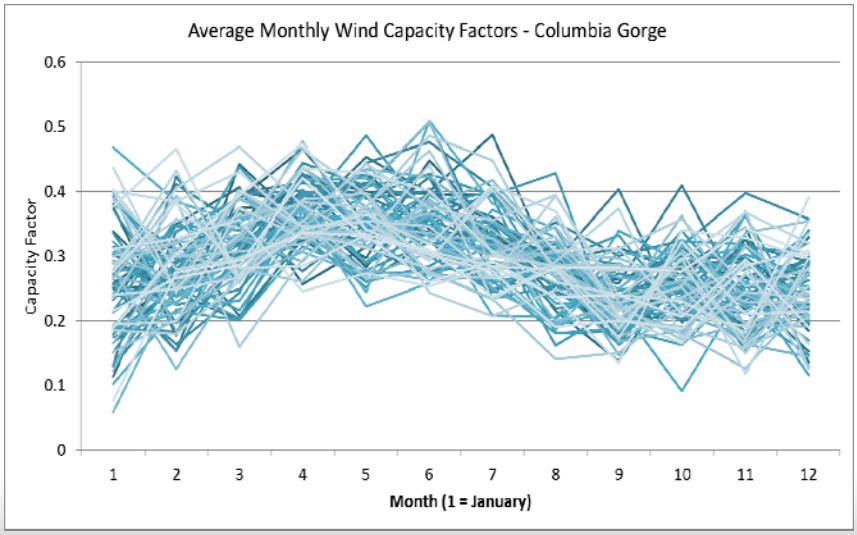
PNW Wind Resource is Seasonal



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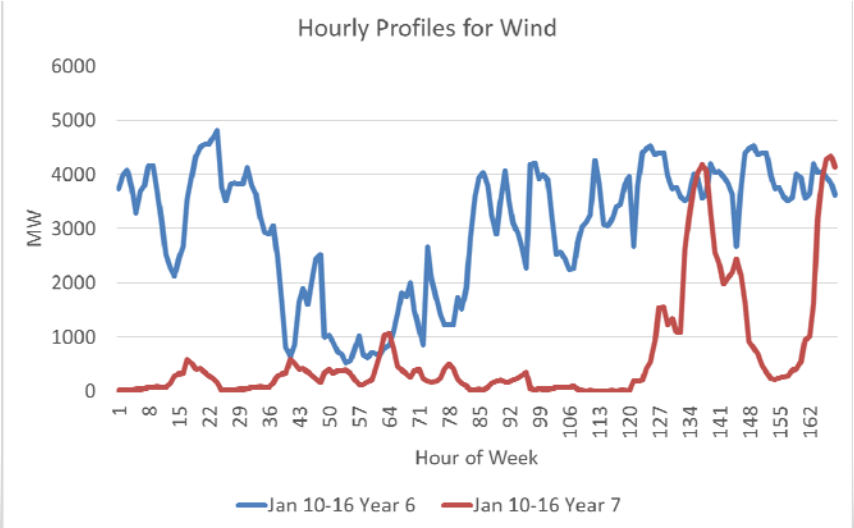
PNW Wind Resource is Highly Variable



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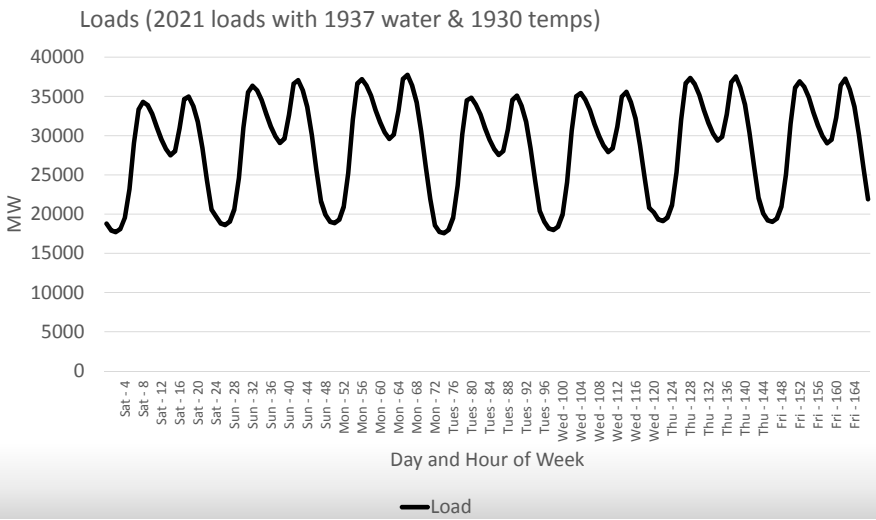
Toss the Dice with Loads and Resources

- Estimated Year 2021 Hourly Loads
- 77 Daily Historical Temperature Years
- 80 Monthly Historical Hydro Years
- Hydrogenation Shaping Limits
- Import Limits
- Random Forced Outages Thermal
- Every Hour Simulated

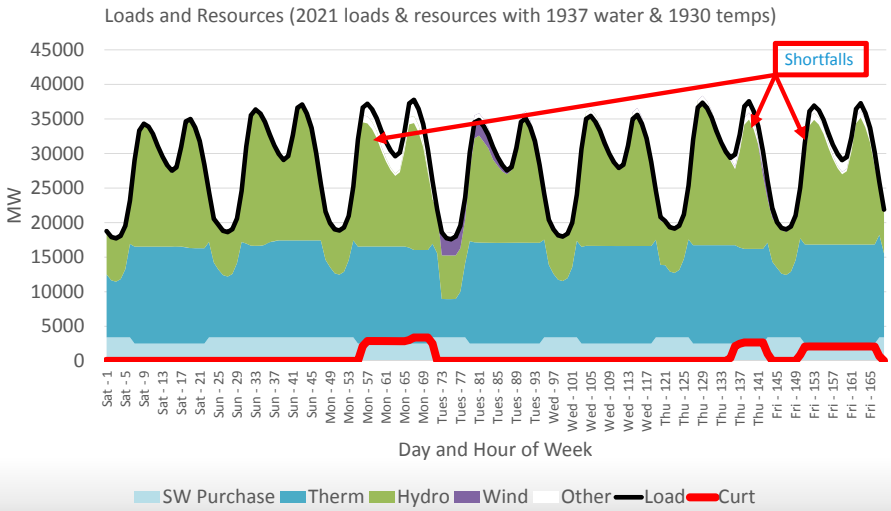
Inspect the Shortfall Events

Where Loads Exceed Resources 2021

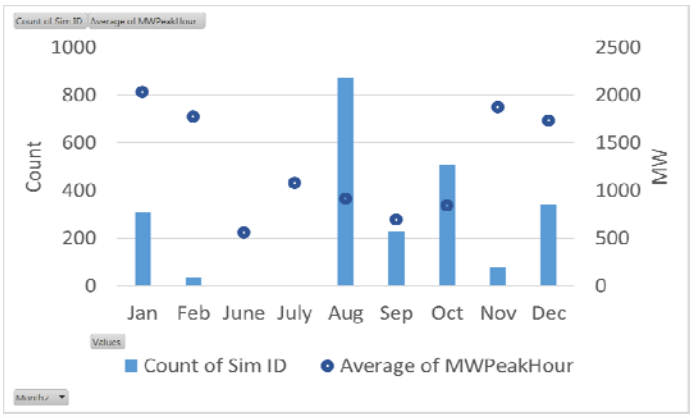
Hourly Loads One Week in January



One Week Three Shortfall Events



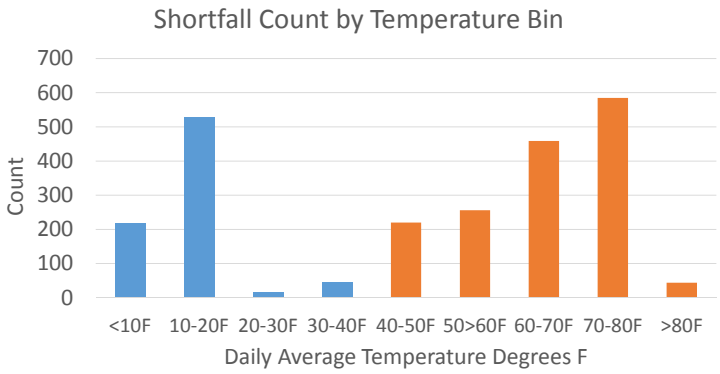
Frequency & Magnitude of Shortfall Events



Winter Highest Magnitude

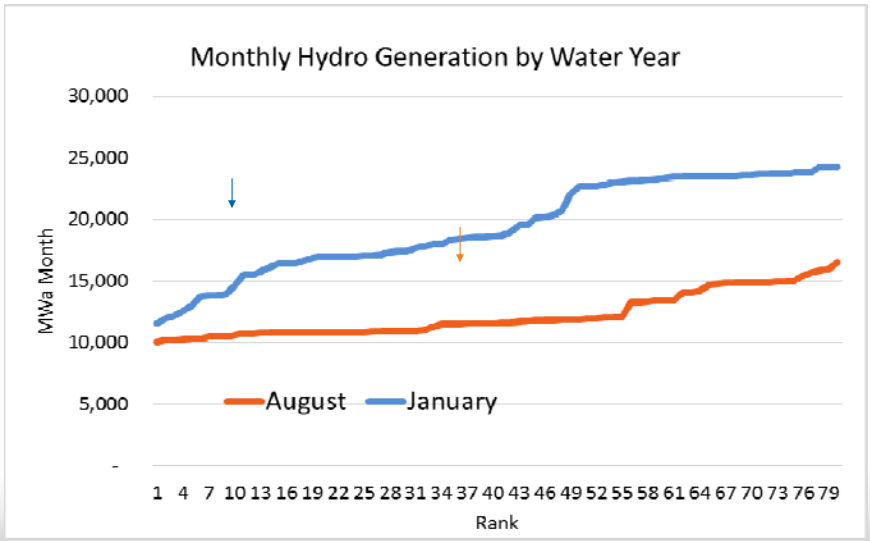
Summer & Fall Events Most Frequent

Winter Shortfall Events on Cold Days



Summer Events Less Temp Driven

Low Hydro Drives Summer Events



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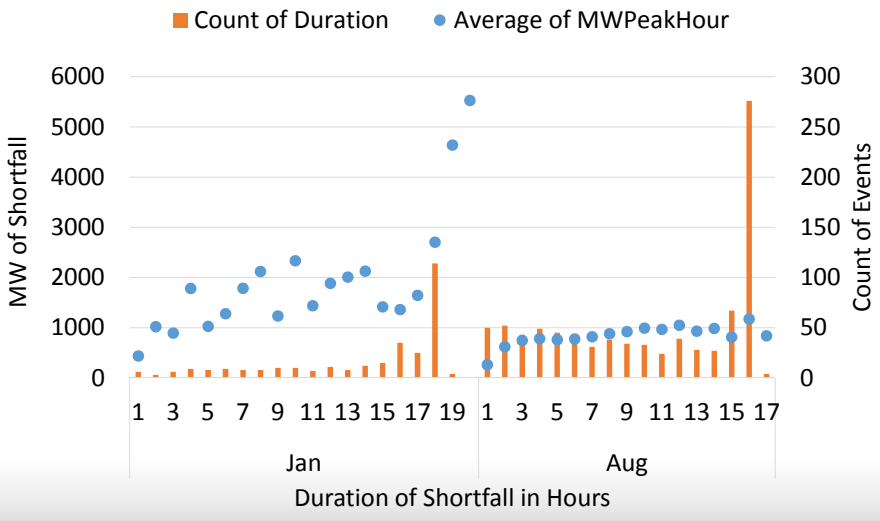
Magnitude & Duration of Shortfall Events



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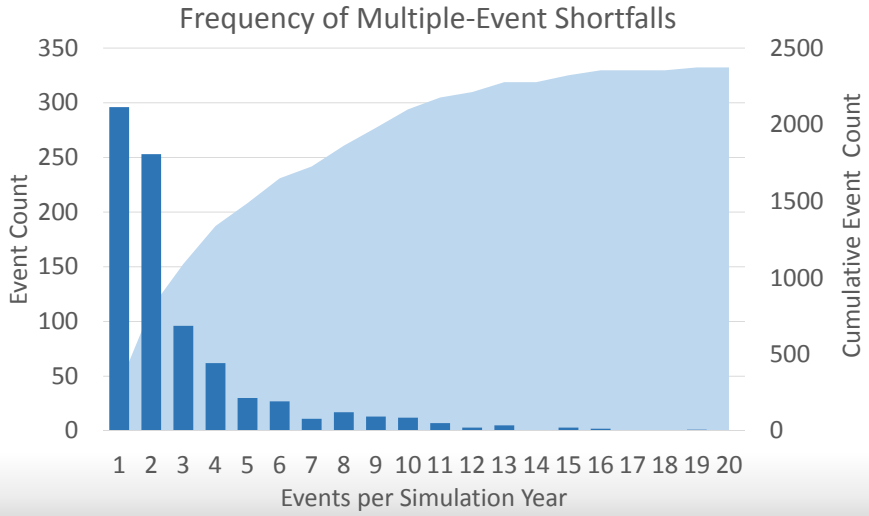
Multiple Events in Shortfall Years



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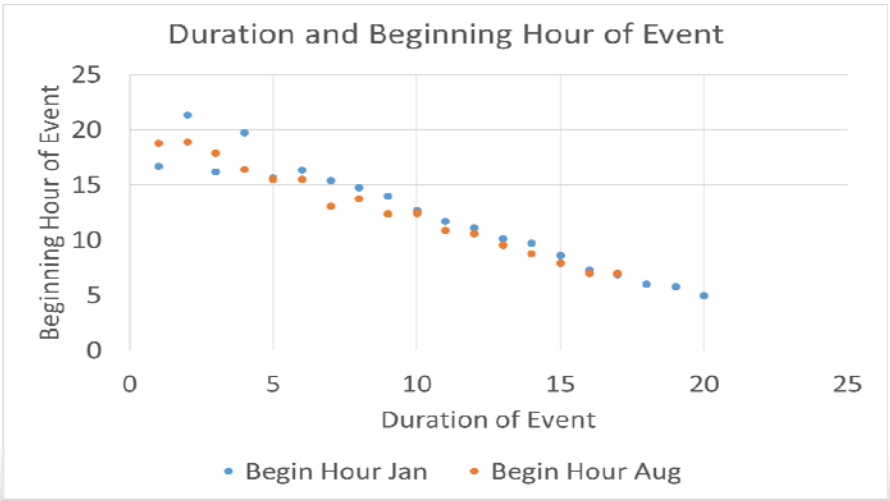
Short Duration Events Begin Late in Day



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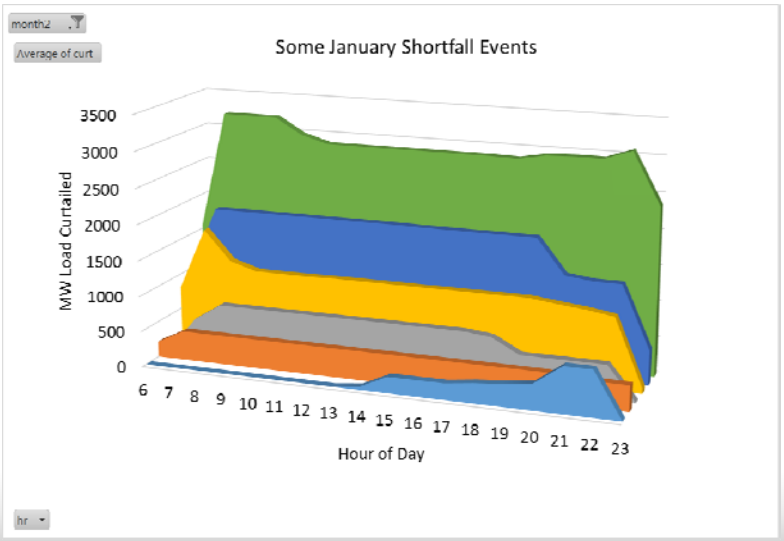
Winter Events Typically Long Duration



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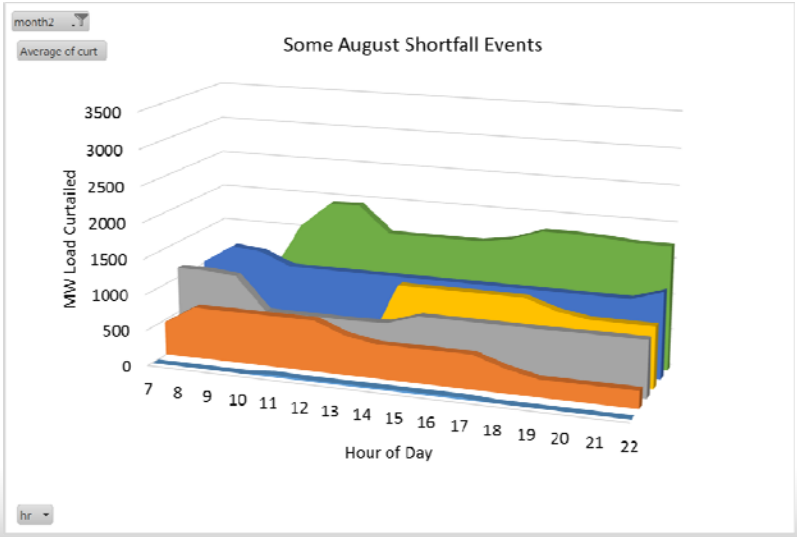
Summer Events Typically Long Duration Too



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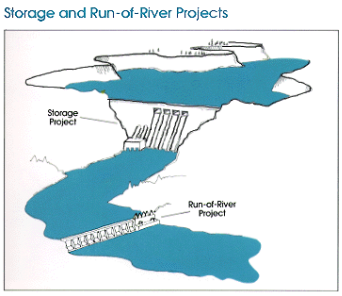
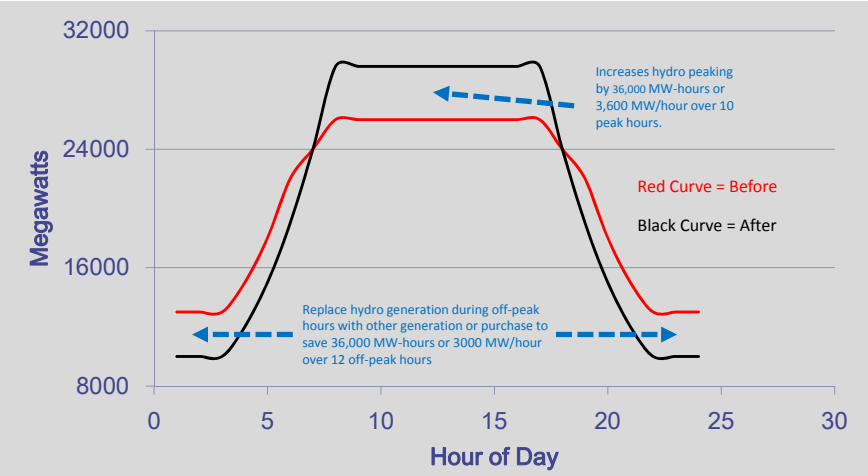
Hydro Shaping

- Turns many peak capacity problems into short-duration energy problems
- Enhances capacity contribution of a resources, solar, wind, thermal & EE
- But a limited resource
- Associated System Capacity Contribution (ASCC)



How Saving Water by Night Produces Power by Day



Integrated Capacity Values

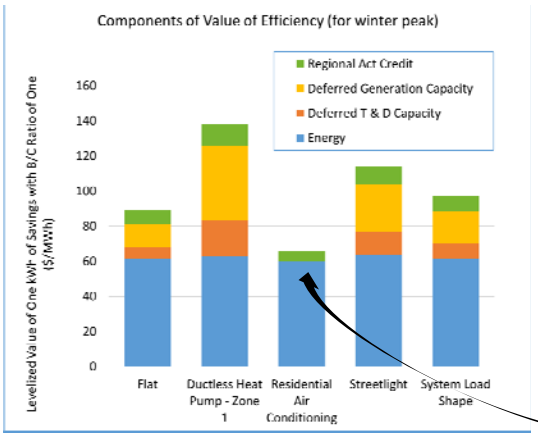
(Associated System Capacity Contribution)

Resource	Q1	Q2	Q3	Q4
Solar PV	0.26	0.81	0.81	0.42
Energy Efficiency	1.24	1.01	1.14	1.16
Wind	0.03	0.11	0.11	0.08
Gas-Fired Turbine	1.28	1.00	1.02	1.20
Geothermal	1.28	1.00	1.02	1.20

Not Very Frequent – But Expensive to Fix

- Probability Shortfall ~ 10% Annual
- Summer ~ one day per 10 years
- Winter ~ one day per 20 years

- Peaking Power Costs
- $190/ kW–year (gas peaker)
- Pay it even if not used
- Expensive if only 1/10 years



Wrapping Up:

Capacity Component of EE Value Large

Summer Value Higher Than Previously Thought

Add $300/MWh Summer Peak

What Does This Mean for EE & DR?

- For PNW System as a Whole:
  - Both Loads AND Resources Matter
  - Capacity savings value can be greater than energy savings value
  - Both winter & summer savings can be important
  - EE savings both day & evening are valuable – due to hydro shaping
  - Reduce short-duration events to improve reliability cost-effectively
  - Measures that save more at cold temps valuable in winter
- Caveats - Every system is different
  - Seasonal and daily load patterns – and hourly profiles changing
  - Amount of hydro shaping & storage -
  - Resource availability changes – new, retirements & hydro regulation
  - Revised hydro regulation may reduce frequency of summer events