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

September 10, 2019

MEMORANDUM

TO: **Council Members**

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

SUBJECT: **2024 Resource Adequacy Assessment**

Presenter: John Fazio

Summary: By 2021, the regional power supply becomes inadequate due to the planned retirement of 1,619 megawatts of coal generating capacity. The loss-of-load probability (LOLP) is estimated to be 7.5 percent, which exceeds the Council's 5 percent maximum. By 2024, with the retirement of an additional 127 MW of coal resource, the LOLP grows to 8.2 percent.

Between 2024 and 2032, an additional 1,853 MW of coal generating capacity is expected to be retired. In the unlikely event that these resources were to be retired by 2024, the LOLP would grow to 33 percent and the region would find itself with a very large resource gap to fill. However, it is not likely that utilities would retire resources without having replacement plans. The Council's next power plan, which will address this issue, is scheduled to be completed by 2021. Thus, there is time to develop an appropriate replacement strategy.

It should be noted that individual utilities within the Pacific Northwest are facing varying needs for new resources and are appropriately planning for those needs in their integrated resource plans.

The Council's Resource Adequacy Advisory Committee (Committee) has reviewed all the analyses used for this assessment and agrees that the

results are reasonable given the agreed upon assumptions. The Council is in the process of enhancing its adequacy model (GENESYS) to better account for capacity, flexibility and market transactions. Preliminary results using the new model were presented to the Committee, but members agreed that any results using the new model should be further vetted by the Committee before use as the primary source for the adequacy assessment.

Relevance: Besides being an early warning to ensure that the regional power supply remains adequate, the Council's adequacy standard is converted into Adequacy Reserve Margins (for both energy and capacity) that are fed into the Regional Portfolio Model to ensure that resource strategies developed for the 2021 Power Plan will produce adequate supplies.

Workplan: A.5.2 Complete Annual Adequacy Assessments

Background: In 2011, the Council adopted a methodology to assess the adequacy of the Northwest's power supply. The purpose of this assessment is to provide an early warning should resource development fail to keep pace with demand growth. The Council's standard defines an adequate power supply to have no more than a 5 percent chance of a resource shortfall in the year being assessed. This metric is commonly referred to as the loss-of-load probability (LOLP) and any future power supply with an LOLP greater than 5 percent is deemed to be inadequate. The Council makes this assessment every year, investigating the adequacy of the power supply five years into the future.

More Info: None

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2024 Resource Adequacy Assessment

Executive Summary

By 2021, the Northwest power supply is likely to become inadequate, due to the planned retirement of 1,619 megawatts of coal-fired generating capacity. Besides existing resources, this assessment includes planned resources that are sited and licensed and projected future energy efficiency savings. The loss-of-load probability (LOLP) for the 2021 operating year is estimated to be about 7.5 percent, which exceeds the Council's standard of 5 percent.

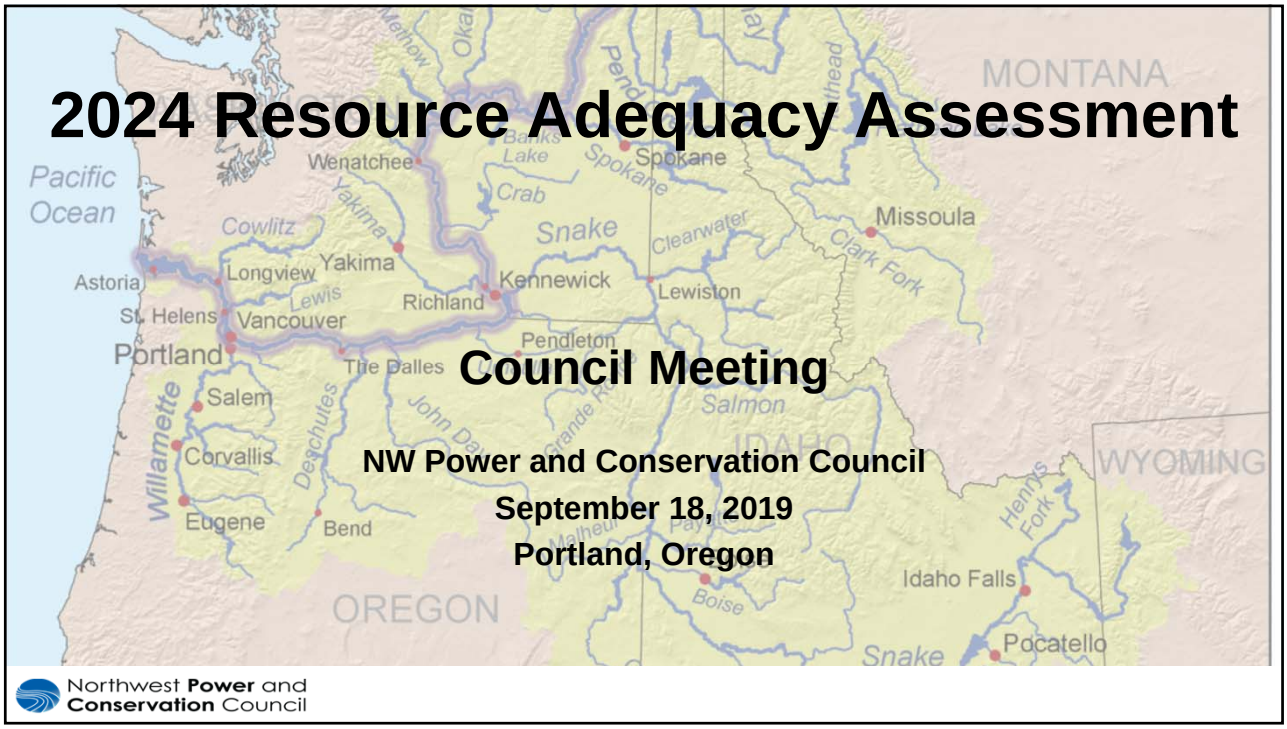
By 2024, with the planned retirement of an additional 127 megawatts of coal resource, the LOLP grows to 8.2 percent. Load growth over the next 5 years is almost entirely met by projected energy efficiency savings. Since the region's current LOLP is estimated to be under 5 percent, the amount of new generating capacity needed to keep the supply adequate through 2024 may be less than the announced retirement capacity. However, the final amount of capacity needed is highly sensitive to resource type.

Analyses show that almost three quarters of potential 2024 shortfall events occur during winter months. And, while shortfall event durations range from a single hour to over 24 hours, winter events have a longer average duration (24 hours) than summer events (6 hours). Winter events also have a higher average peak-hour shortfall (1,700 megawatts) than summer events (500 megawatts).

It should be noted that these results could change significantly if future load growth and/or market conditions were to change. For example, under a high load growth (3 percent above medium) and lower market supply (1,000 megawatts less) scenario, the power supply's 2024 LOLP grows to 21 percent. On the other hand, under a low growth (3 percent below medium) and higher market supply (1,000 megawatts more) scenario, the LOLP drops to 2 percent. But those future conditions are less likely to occur. And, although recent Council analysis indicates that the out-of-region market supply may be higher than the assumed 2,500 megawatts in the reference case, much more rigorous analyses are needed before the Council would deem it prudent to assume a higher value for the resource adequacy assessment.

These results reflect the adequacy of the aggregate regional power supply. Individual utilities within the Pacific Northwest will have varying needs for new resources and are planning for any projected shortfalls in their individual integrated resource plans.

Between 2024 and 2032, an additional 1,853 MW of coal generating capacity is expected to retire. In the unlikely event that these resources retire by 2024, the LOLP would grow to 33 percent and the region would find itself with a very large resource gap to fill. However, it is not likely that utilities will retire resources without having replacement plans. Also, the Council's next power plan, which will address this issue, is scheduled to be completed by 2021. Thus, there is time to develop an appropriate replacement strategy.



2024 Resource Adequacy Assessment

Council Meeting

NW Power and Conservation Council

September 18, 2019

Portland, Oregon

Northwest Power and Conservation Council

Outline

- Primer on Resource Adequacy
- Announced coal retirements through 2032
- 2024 Resource Adequacy Assessment
  - LOLP heat map
  - Curtailment statistics
- Enhanced GENESYS adequacy model
- Actions recommended by the RAAC

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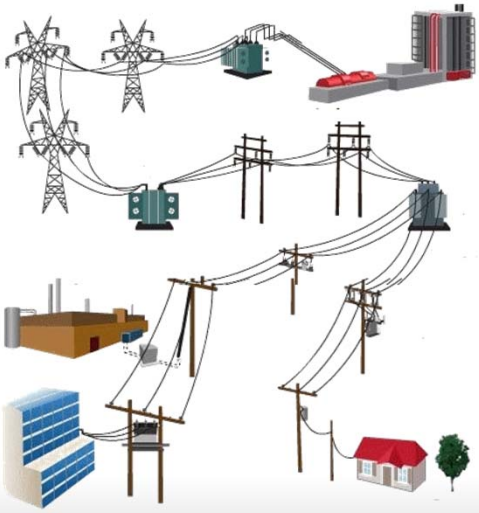
Reliability vs. Adequacy – NERC Definition

- ***Adequate*** and ***Reliable*** have specific meanings in the power industry. Adequacy is a component of reliability. A power system is reliable if it is:

- ***Adequate*** - the electric system can supply the aggregate electrical demand and energy requirements of the customers at all times, taking into account scheduled and reasonably expected unscheduled outages of system elements.
- ***Secure*** - the electric system can withstand sudden disturbances, such as electric short circuits or unanticipated loss of system elements.

Three Major Areas for Assessment



Generation

Transmission

Distribution

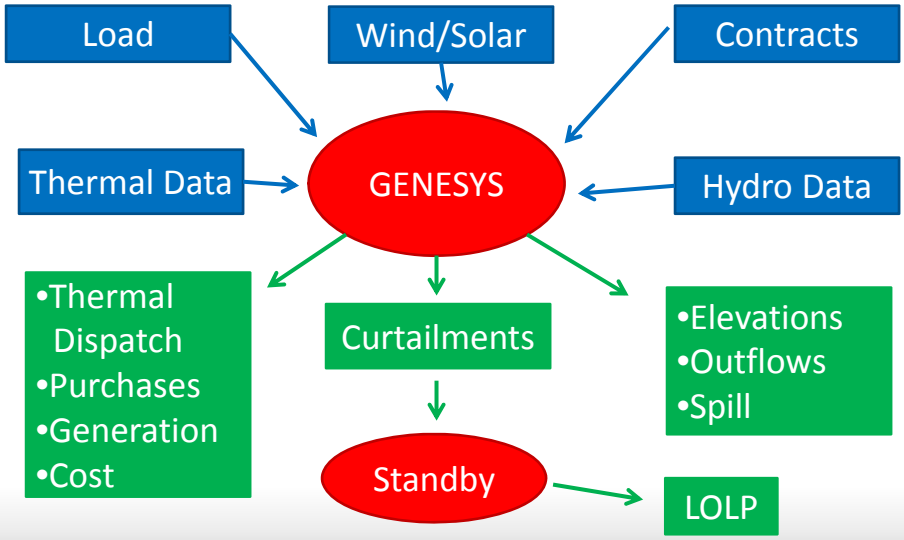
Council's Focus

- **Generation System Only**
  - Generating resources
  - Energy efficiency savings
  - Import Markets
- **Adequacy**
  - Test for sufficient generation
  - In general, measure the *frequency*, *duration* and *magnitude* of potential shortfalls

Council uses a Simulation Method

- Analytical tool (GENESYS):
  - Monte-Carlo chronological hourly simulation of power supply operation
  - Run thousands of simulations for an operating year with different manifestations of future uncertainties
- Future uncertainties:
  - Natural river flows (80 historic years)
  - Temperature-sensitive loads (based on hourly temps from 1949-2017)
  - Generator forced outages
  - Variable wind and solar generation
- Output:
  - Record of simulated hourly shortfalls
  - Multiple adequacy metrics are calculated from the curtailment record

GENESYS Adequacy Model



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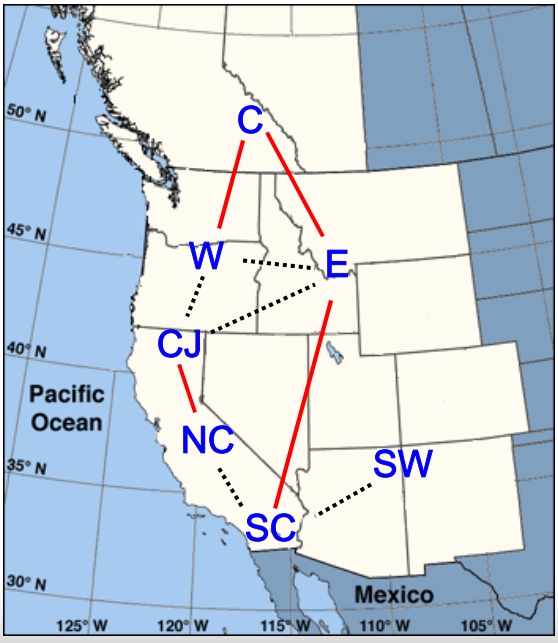

Transmission in GENESYS

- NW region includes:
  East (E)
  West (W)
- Solid lines indicate transmission into and out of the region
- Not a power-flow analysis
- East/west transmission capability varies based on BPA data
- Southern interties have fixed transfer capability
- SW modeled as import market only

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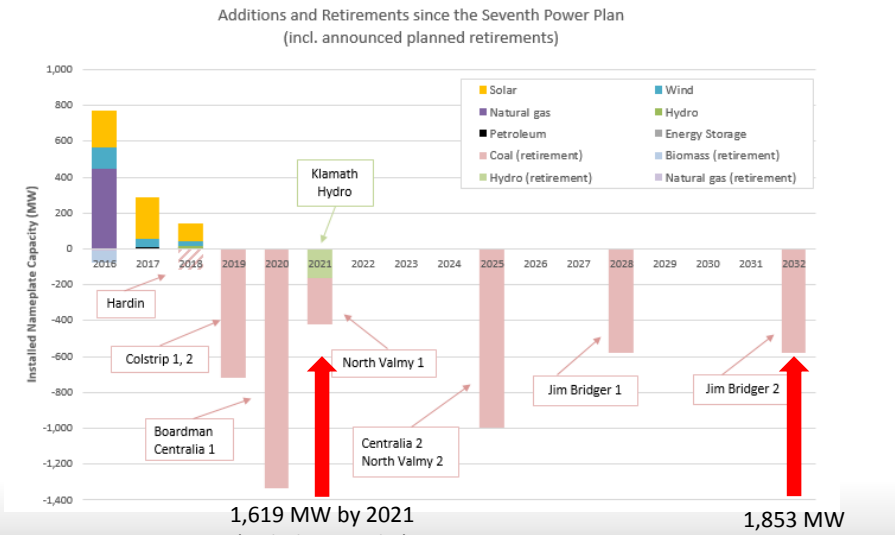
Council's Adequacy Standard[1]

- *The Council deems the regional power supply to be adequate if the likelihood of having one or more shortfalls in a future operating year is less than or equal to 5 percent (i.e. annual LOLP ≤ 5%).*

- Annual LOLP = $\frac{\text{Simulations with shortfalls}}{\text{Total number of simulations}}$

[1]Officially adopted by the Council in 2011.

Projected Coal Retirements (3,357 MW)



1,619 MW by 2021 (including Hardin)

1,853 MW between 2022-2032

2021-24 Resource Adequacy Assessments

- 2021 LOLP = 7.5% (estimate)
  1,619 MW Retired Capacity (Hardin, Colstrip 1 and 2, Boardman, Centralia 1)
- 2022 LOLP = 7.5% to 8%
  127 MW Retired Capacity (N Valmy 1)
- 2023 LOLP = 7.5% to 8%
  No cola retirements
- 2024 LOLP = 8.2%
  No coal retirements

- 2024 LOLP = 33%
  1,853 MW Early retirement case (Centralia 2, Bridger 1 and 2, N Valmy 2)

Future Uncertainties not Modeled Explicitly

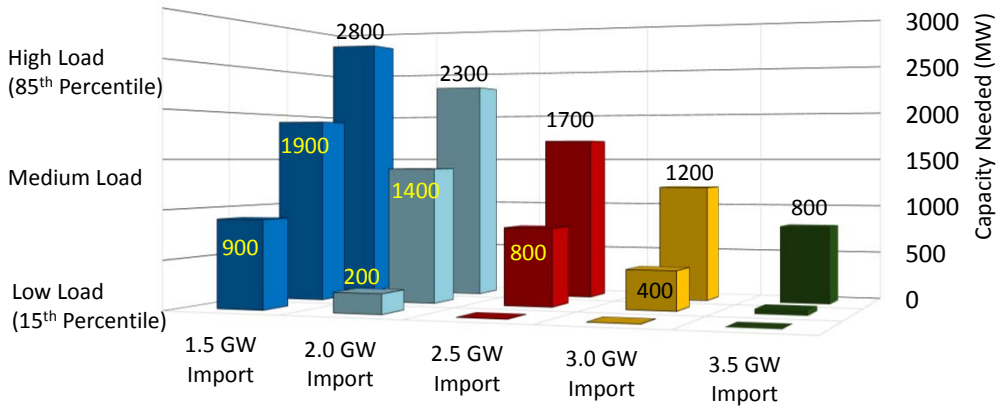
- Out-of-region spot market supply
  - Region is connected to many other areas
  - Largest sharing between NW and SW
- Economic load growth
  - Non-temperature affected changes in long-term load
  - Economic growth or lack thereof
  - Possible immigration into region (climate change?)
  - Change in electrical use patterns (e.g. electric vehicles)

Sensitivity to Markets and Load Growth

SW Market Availability (MW)

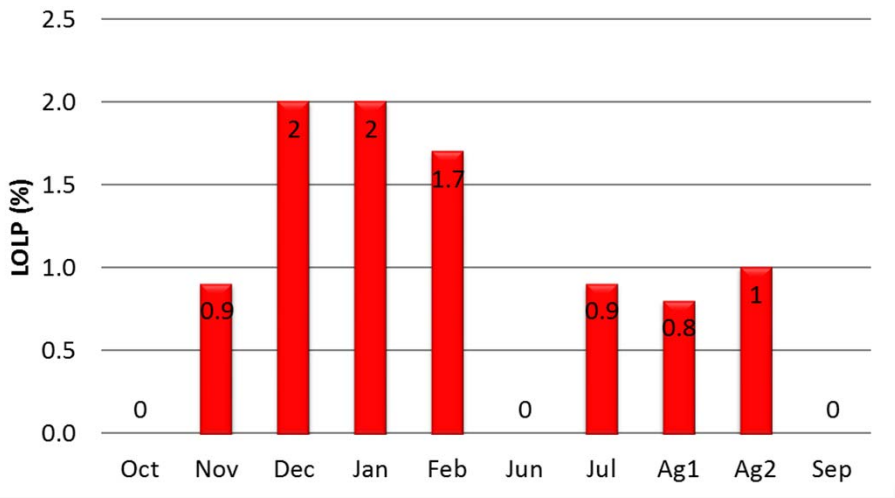
LOLP (%)	1500	2000	2500	3000	3500
High Load (85th Percentile)	21.1	18.0	16.0	14.4	12.0
Medium Load	12.5	10.2	8.2	6.9	5.2
Low Load (15th Percentile)	7.0	5.2	4.0	3.1	2.0

Estimated 2024 Capacity Need[1] (MW)



[1]The amount of capacity needed to maintain adequacy depends on replacement resource type. The estimates in this chart assume that acquired resources are non-hydroelectric and dispatchable generators (e.g. CCCTs).

2024 LOLP by Period[1]

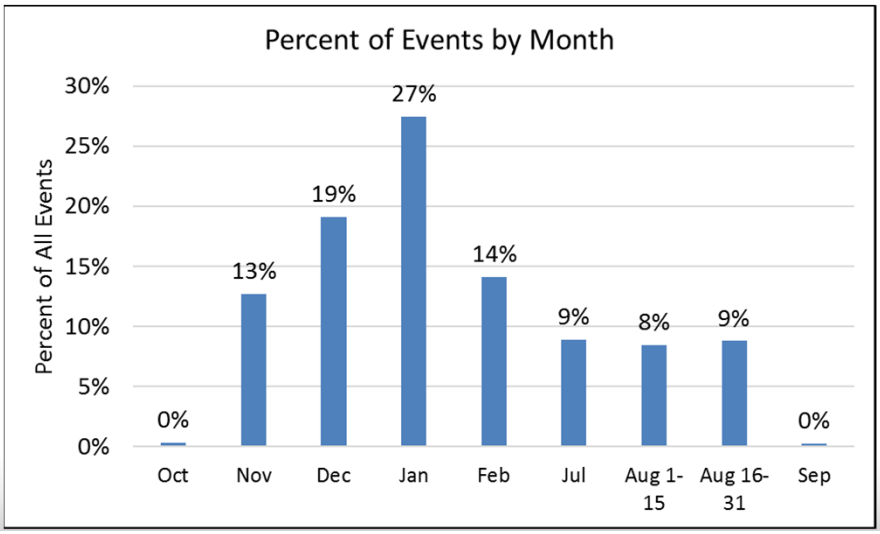


[1]Sum of monthly LOLP values is often greater than the annual LOLP due to years with curtailment events in different months.

2024 Curtailment Statistics

Statistic	Value	Units
Number of simulations	5,520	Number
Simulations with a curtailment	455	Number
Loss of load probability (LOLP)	8.2	Percent
Number of curtailment events	880	Number
Loss of load events (LOLEV)	0.16	Events/year
Average time between events	6	years
Average event peak-hour curtailment	1,400	MW
Average event magnitude	32,700	MW-hours
Average event duration	19	hours
Conditional value at risk (CVaR) peak	2,623	MW
Conditional value at risk (CVaR) energy	104,470	MW-hours
Expected un-served energy (EUE)	5,338	MW-hours
Expected curtailed hours per year (LOLH)	3.0	Hours

2024 Percent Events by Month



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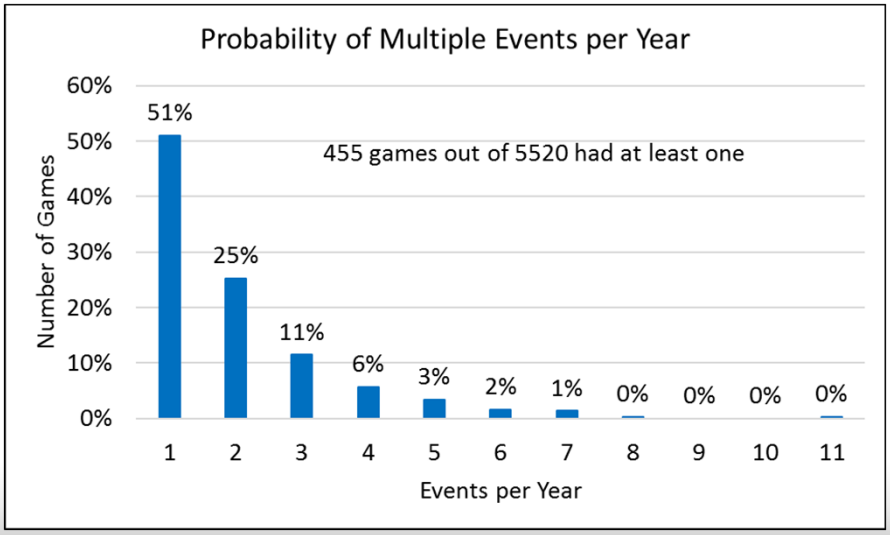
2024 Probability of Multiple-event Years



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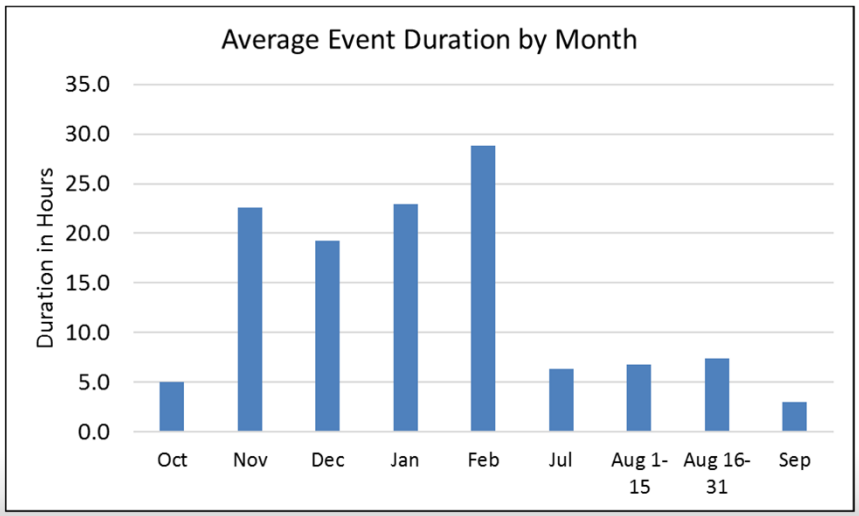
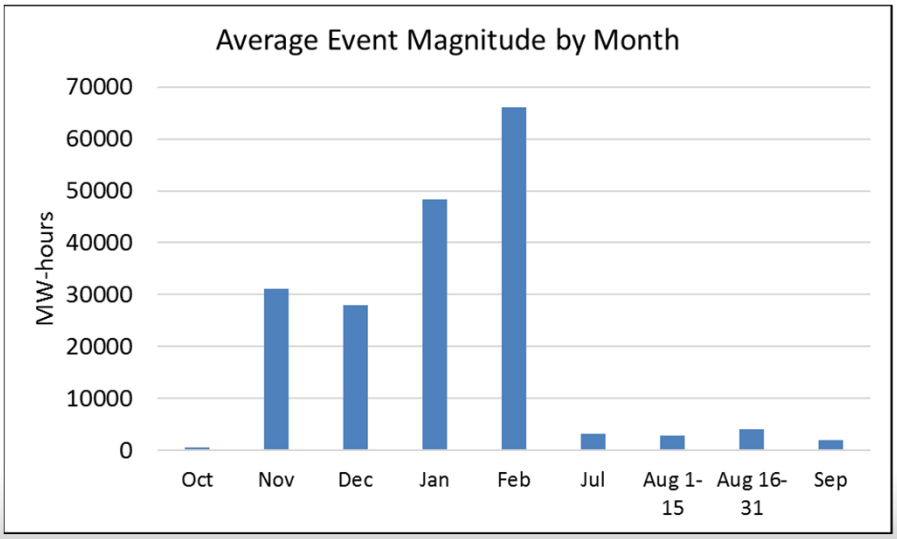
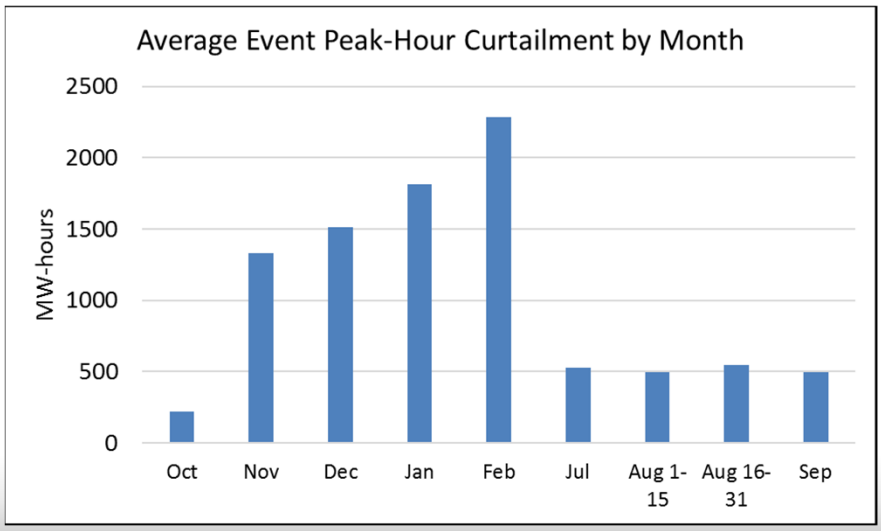
2024 Average Event Duration by Month



2024 Average Event Magnitude by Month



2024 Average Peak-hour Curtailment



GENESYS Model Enhancements

1. Explicit modeling of out-of-region resources and loads
2. Hourly simulation of individual hydro projects
3. Multiple NW node configuration (as opposed to 2-node)
4. Unit commitment
5. Dynamic allocation of balancing reserves
6. Forecast error effects (true-up stage)

Action Items Proposed by the RAAC

- Base the 2024 Resource Adequacy Assessment on the classic GENESYS model results
- Complete the new GENESYS model vetting
- More in-depth analysis of out-of-region market supplies from all interconnected regions
- More in-depth analysis of transmission transfer capabilities and reliability
- Add the ability to limit imports in the new GENESYS