Resource Adequacy in the Pacific Northwest

What is Resource Adequacy? Why is it essential in the context of decarbonization?

Resource Adequacy is the ability of an electric power system or grid to have enough supply of electricity (or "electrical capacity") to reliably match customer demand (or "load") across a variety of weather and system conditions. The grid requires coordination among owners, operators and users to maintain high levels of long-term reliability.[1]

To reach decarbonization targets in the region, electric utilities are required to transition to energy resources that include clean and non-emitting sources of generation and complementary resources such as energy storage and demand response.[2] This document provides a regional picture of load and resource balance in the PNW, an overview of the current science and principles of resource adequacy and procurement,[3] and an emphasis on the important role of coordination among different entities in the electricity sector.

Who is responsible for maintaining resource adequacy?

States or state regulatory commissions are responsible for elements of resource adequacy such as siting and permitting electric facilities, establishing retail electric rates, and overseeing the reliability of the distribution system.[4] As economic regulators, state commissions review and approve utility investment proposals and resource plans that have long-term impacts on overall reliability of both local distribution grids and the bulk regional system. These responsibilities, together with the rapidly evolving grid and new emerging technologies, require state commissions to actively consider and evaluate reliability risks in concert with technical standards set by National Electric Reliability Council (NERC) and regional entities like Western Electricity Coordination Council (WECC). WECC is a regional Electric Reliability Organization (ERO) under the purview of NERC in the West.

It is important to note that while resource adequacy and reliability are related, they are not exactly the same. Resource adequacy means having enough electrical capacity to provide power when it's needed, while reliability refers more broadly to a system's ability to provide power and avoid outages. Most outages have nothing to do with resource adequacy, but instead are caused by disruptions at the distribution level (i.e. a squirrel chewing through a wire's insulation).

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[1] Resource Adequacy Primer for State Regulators. 2021. https://pubs.naruc.org/pub/752088A2-1866-DAAC-99FB-6EB5FEA73042

[2] Demand response involves shifting or reducing electricity demand to provide flexibility in wholesale power markets, helping to balance the grid.

[3] Procurement is the process of identifying and sourcing electricity generating facilities to be used by a utility.

[4] The distribution system is infrastructure used to distribute electricity to end users, such as substations, poles, wires and transformers.

What are the recent trends in electricity demand and generation resources in the Pacific NW?

- The regional annual load (or energy need) in the Northwest is forecasted to grow 0.9% over the next 10 years. This is comparatively ***lower*** than other regions in the country, which are seeing more rapid load growth. Changes in load forecasting methodology due to climate change assumptions and use of recent historical data suggest that energy and ***capacity needs are increasing in the summer***, thereby converting what had been winter-peaking utilities to now dual-peaking utilities.
- Hydropower still remains the dominant energy resource in the region. Overall, ***79% of generating resources in the region are carbon-free***. Conventional thermal power generation such as ***coal-fired power plants are retiring*** across the western region. Just over 2,100 MW of electricity from coal-fired power plants have already retired in the Northwest, with more to come.
- ***Declining capital costs*** of solar, wind and energy storage resources are creating opportunities for utilities to provide ***cheap electricity to customers and reduce dependence on volatile fossil fuels***. Resources such as offshore wind and long-duration energy storage are also providing opportunities for electric utilities to ensure reliability.
- The natural gas system is prone to extreme price volatilities (i.e. high peaks and troughs due to weather, geo-political situations and demand). This creates additional resource adequacy and financial risk for customers who end up paying high electricity bills.
- Cost-effective capacity solutions, such as battery storage mixed with renewables and standalone batteries, are being acquired to adequately accommodate the transition. A variety of distributed generation resources such as rooftop solar & energy storage and demand side resource options are also being explored, tested, and added to the system.
- The Western Resource Adequacy Program developed by the Western Power Pool and recently approved by FERC is a landmark shift in near-term adequacy planning and operational sharing of resources across the Pacific Northwest and Desert Southwest region. The added load and resource diversity of participating utilities across the region should lead to more coordination on both generation and transmission resources to meet load together instead of operating islanded systems.

Do we have enough available and planned generation resources to meet load across varied conditions?

- NERC in their 2022–2023 Winter Reliability Assessment[5] stated that “expected resources in the western region meet operating reserve requirements under normal and extreme peak-demand scenarios. The risk of load shedding is low due to the expected availability of transfers from neighboring areas.”

[5] https://www.nerc.com/pa/RAPA/ra/Reliability%20Assessments%20DL/NERC_WRA_2022.pdf

- Northwest Power & Conservation Council's 2027 Resource Adequacy Assessment[6] states that the region will be resource adequate if planned resources of around 5,410 MWs of renewables, 720 MWs new demand response, 1,000 MWs of energy efficiency and 6,000 MWs of reserves (including flexible resources such as battery storage and pumped hydro) are added (See Fig. 1)
- WECC's 2022 Western Assessment of Resource Adequacy[7] found that "demand at risk" improved significantly in the near-term for the NWPP-Northwest sub-region with negligible risks until 2027. The report does find that increased variability in hydro and renewable supply may cause challenges but that these challenges can be met with flexible resources like energy storage.
- GridPath's Resource Adequacy Assessment[8] highlights the importance of studying inter-regional coordination and weather-synchronized simulations of the Western power system. The analysis suggests that the Northwest region (majorly under the WRAP sub-area) is adequate in this decade considering planned flexible resource additions from utilities and energy from neighbors like California and the broader west (See Fig. 2).

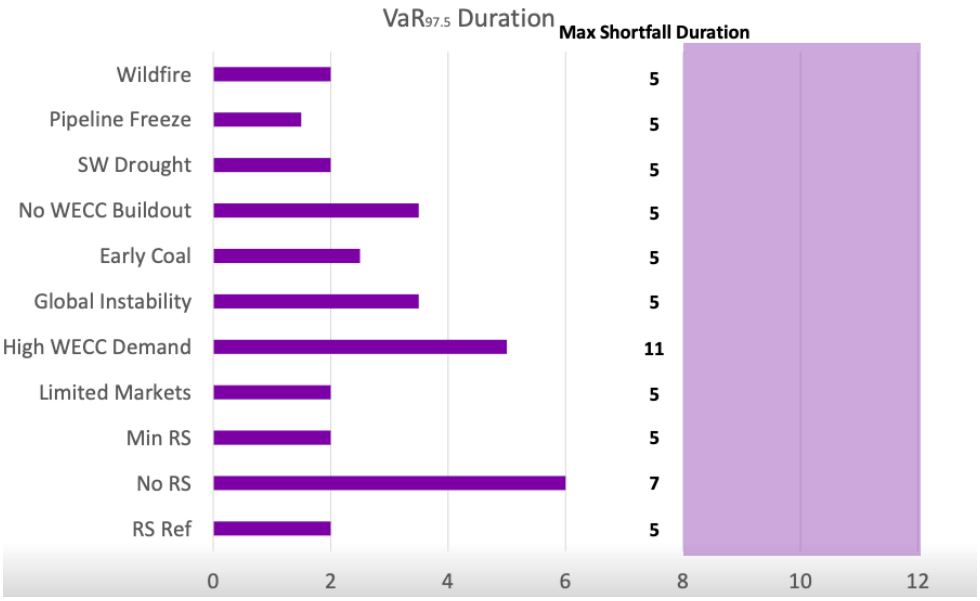

Fig 1. Results from the Power Council analyses show that the PNW is resource adequate if utilities procure enough renewable and energy storage resources.

[6] https://www.nwcouncil.org/fs/18144/2023_01_p1.pdf

[7] https://www.wecc.org/Reliability/NWPP-NW%20Subregional%20Assessment%202022.pdf
https://gridlab.org/wp-content/uploads/2022/10/GridLab_RA-Toolkit-Report-10-12-22.pdf

[8] https://gridlab.org/wp-content/uploads/2022/10/GridLab_RA-Toolkit-Report-10-12-22.pdf

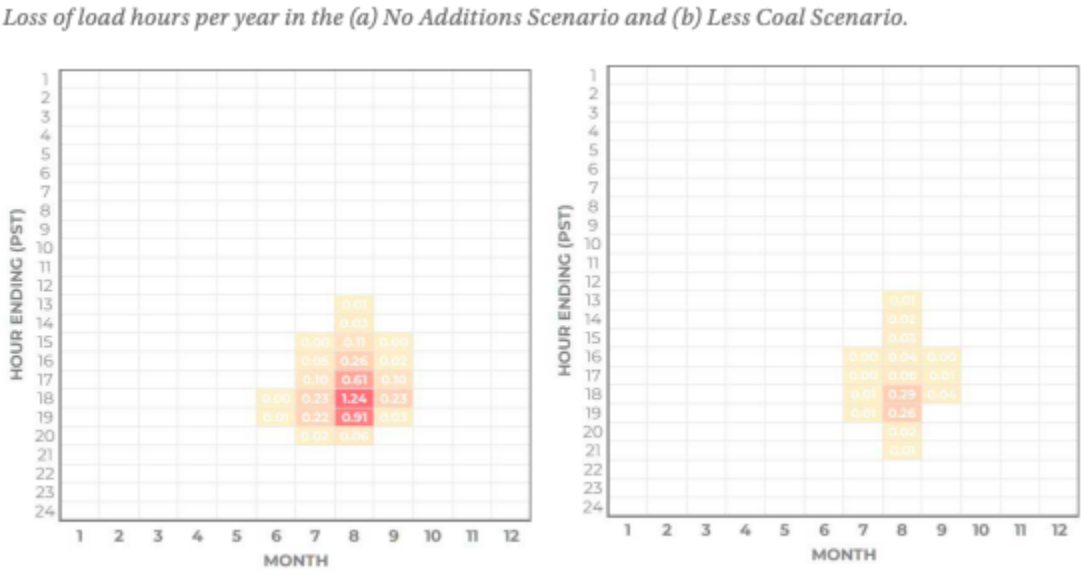

Fig 2. Results from the GridPath RA analyses show that the entire west only faces stressed conditions during summer evenings.

What are the key takeaways?

- The Pacific Northwest is poised to be resource adequate in this decade if utilities continue to invest in and procure renewable, energy storage, and demand response resources.
- There are measurable benefits of regional cooperation, including savings in the cost of producing electricity, savings in the cost of procuring electrical capacity, emission reductions, and enhanced reliability, especially under stressful conditions. A geographically larger operational footprint tends to yield greater benefits due to greater resource and load diversity.
- Resource adequacy assessments need to pivot to updated metrics and standards to accommodate the changing climate, load, and resource mix in the region.

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Appendix

Study	Adequacy Metrics	Results	Adequate or not?
Power Counci's 2027 Resource Adequacy Assessment	LOLEv, Duration VAR, Peak VAR and Energy VAR	All metrics under Reference Scenario are under the limit. Additional stress scenarios cause metrics to go over the limit.	Yes, provided Reference Case resources are built including multi-GW operating reserves.
WECC's 2022 Western Assessment of Resource Adequacy	Demand at risk (or DRI)	The DRI for the NWPP-NW subregion substantially improves till 2026 then increases between 2026 and 2030, but decreases again from 2031 because number of imports increase by an order of magnitude over 2023 levels.	No, needs near-term resource capacity additions.
GridPath Resource Adequacy Assessment	Loss of Load Expectation, Loss of Load Hours, Expected Unserved Energy	The West is short around 9 GW capacity, but states that identified shortage was much smaller than the amount of capacity additions in current utility plans in the West.	Yes, provided the West builds around 9 GW of flexible capacity.

How can we analyze resource adequacy for a modern grid?

The Resource Adequacy paradigm has shifted considerably from traditional methods of deterministic analysis to more stochastically inclined assessments due to multiple factors including change in load forecasting methods, diversity in resource mix and increasing impacts of climate change. Recent events in California and Texas underscore the need for modernization of resource adequacy thinking for the modern grid. This can be perfectly characterized by the "Modern Resource Adequacy Principles[9]" proposed by Energy Systems Integration Group (ESIG):

[9] https://www.esig.energy/resource-adequacy-for-modern-power-systems/#:~:text=Principle%201%3A%20Quantifying%20size%2C%20frequency,such%20thing%20as%20perfect%20capacity.

Principle	In Practice
Quantifying size, frequency, duration, and timing of capacity shortfalls is critical to finding the right resource solutions.	Systems with similar LOLE or LOLH can have completely different risk profiles and types of shortfalls. For ex., two systems may be short for 3 hours but have a different magnitude of shortfall.
Chronological operations must be modeled across many weather years.	This is particularly important for integrating the capacity value of energy storage and demand response resources, especially long-duration storage.
There is no such thing as perfect capacity.	Recent analysis and events have shown that there is no resource which can provide 100% firm capacity. In fact, recent winter weather events in Texas and PJM have led to discussions on de-rating thermal resources by about 20-25% due to fuel unavailability and other issues.
Load participation fundamentally changes the resource adequacy construct.	Customer load flexibility and Distributed renewable and energy storage resources are providing additional tools for operators to adjust the load-resource balance.
Neighboring grids and transmission should be modeled as capacity resources.	The development of a WRAP to tap load and resource diversity of the region is a perfect example of how resource adequacy planning should not be islanded but become more inclusive of external loads and resources.
Reliability criteria should be transparent and economic.	Entities conducting resource adequacy planning should be transparent with the pros and cons of conducting resource adequacyA assessments with certain metrics.

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