

Exploring a Resource Adequacy Program for the Pacific Northwest

An Energy System in Transition

Executive Summary

The Northwest electricity system is in transition. The resource mix of the past—dominated by hydro but supplemented by thermal generation—is materially different than the emerging paradigm that includes large amounts of renewables. The impending retirement of a number of generators in the region has led to questions about whether the region will continue to have an adequate supply of electricity.

In the past several years, a number of groups—the Bonneville Power Administration (BPA), the Pacific Northwest Utilities Conference Committee (PNUCC), and the Northwest Power and Conservation Council (Power Council), and consulting firm Energy & Environmental Economics (E3)—have examined how anticipated changes to loads and resources in the Pacific Northwest will affect utilities’ ability to meet customer needs reliably. Despite differences in assumptions and methodology, these studies identify an urgent and immediate challenge to the regional electricity system’s ability to provide reliable electric service. Two key conclusions are of particular concern:

- 1. The region may begin to experience capacity shortages as soon as next year; and***
- 2. By the mid-2020s, the region may face a capacity deficit of thousands of megawatts.***

These developments threaten to upset the balance of loads and resources within the region and, if not properly addressed, could bring an end to a period of stability dating back to the end of the Western energy crisis of 2000-2001.

Meeting customer demands reliably, even on the coldest days of winter or the hottest days of summer, requires a significant amount of advanced planning. Utilities must forecast electric loads years into the future, not just for an average day but for the most extreme weather conditions. They must plan and procure sufficient generation and demand-side resources to meet these projected electricity demands, taking into consideration that not all resources will be available when needed whether due to unanticipated mechanical problems, lack of available water, wind, sunlight or fuel supplies, or transmission constraints. And because no electricity system can be made perfectly reliable, utilities must grapple with the question of how much reliability they should ask their customers to pay for.

The term that is most often used to describe an electricity system's ability to meet demand under a broad range of conditions, subject to an acceptable standard of reliability, is "resource adequacy." Resource adequacy is becoming an increasingly prominent topic in the Northwest and across North America as the continent's resource mix transitions away from coal and towards cleaner generating sources. Wind and solar energy have expanded their market share dramatically in recent years, while the pace at which aging coal-fired generators are being retired has accelerated. The loss of this "firm" generation—generation that can be turned on at will (with sufficient advance notice)—threatens to create a reliability gap if not replaced with equivalent capabilities. Wind, solar and even hydroelectric energy are limited in their ability to replace this firm generation because their energy supplies are dependent on the weather. Despite exciting developments in the field of electric energy storage, currently commercial technologies cannot fully substitute for firm resources because they have limited duration and rely on energy produced by other resources for charging. Many recent studies have shown that it is possible to cost-effectively replace coal generation with a combination of lower-carbon resources and significantly reduce electricity sector carbon emissions¹. However, careful planning is required to ensure that resource adequacy is maintained during and after this transition.

The Northwest has faced resource adequacy challenges before. In the late 1990s, the effects of load growth, resource retirements, a lagging pace of new resource development, and California's experiment

¹ See, for example, E3 "Pacific Northwest Low Carbon Scenario Analysis", <https://www.ethree.com/projects/study-policies-decarbonize-electric-sector-northwest-public-generating-pool-2017-present/>.

with electricity deregulation left the Western Interconnection in a situation of tight electricity supplies. A severe drought in 2000-2001 combined with manipulation of California's electricity market by Enron and other companies created the Western energy crisis, during which many utilities in the Northwest scrambled to find electricity supplies to keep the lights on for their customers. The cost of this crisis was high; average electricity rates across the region rose by over 25% between January of 2000 and June of 2002², and electricity-intensive manufacturers such as aluminum smelters that had been an important source of family-wage jobs in some communities shut down for good.

In the aftermath of the crisis, a number of natural gas-fired power plants were developed throughout the west and policies were put in place in California to ensure resource adequacy going forward. In the Northwest, over 5,000 MW of natural gas generation capacity were constructed between 2001 and 2010, some 75% of it by independent power producers³. As a result of these developments and the significant reductions in electricity demand following the energy crisis and, later, the 2008 recession, the region has enjoyed a resource surplus for over 15 years. Significant efforts by the region's utilities to implement all cost-effective energy efficiency also contributed to much lower levels of load growth than in the past.

Recent developments are rapidly changing this picture. Construction of new gas generation has slowed dramatically; only four natural gas plants have come online since 2011 in the Northwest, totaling 1,100 MW of capacity. Instead of developing new capacity resources, many utilities in the region have opted to rely on "front office transactions"—planned purchases of energy and capacity through the region's wholesale electricity market—to meet their reliability needs. In addition, driven by environmental imperatives and increasingly adverse economics, nearly 2,000 MW of coal-fired generating capacity will retire in 2020 and additional retirements numbering in the thousands of megawatts are expected over the next decade. While construction of gas generation has slowed, renewable resource development has accelerated; as of 2019, the Northwest now has 450 MW of grid-scale solar and 9,400 MW of wind capacity⁴. However, while renewables can readily replace the *energy* that coal resources have

² Energy Information Administration, Electricity Data Browser, <https://www.eia.gov/electricity/data/browser/>, original data Electric Sales and Revenue series.

³ Northwest Power and Conservation Council, Map of power generation in the Northwest, <https://www.nwcouncil.org/energy/energy-topics/power-supply/map-of-power-generation-in-the-northwest>.

⁴ Ibid.

traditionally provided, they cannot easily replace the *capacity* that is needed for resource adequacy due to the variable nature of their energy sources.

As a result of these developments, after years of surplus, the region now finds itself once again looking at significant resource deficits of thousands of megawatts now and into the future. Deficits of this magnitude pose risks of both extraordinary price volatility and unacceptable loss-of-load; indeed, the Power Council's most recent studies find that the region's Loss-of-Load Probability in 2024 could exceed what was calculated in 1999, just prior to the Western Energy Crisis⁵, if coal plant retirements accelerate beyond current published closure dates as many expect.

The scale and scope of this challenge has led a broad coalition of electric utilities across the Pacific Northwest to agree that collective action is necessary. Acting through the Northwest Power Pool, these utilities have undertaken an effort to explore the nature of the challenge and investigate mechanisms that will assure a high likelihood of supply and demand being in balance. The Northwest Power Pool convened working groups during the summer of 2019 to examine different dimensions of the current situation. The working groups consisted of utility members of NWPP with an interest in the topic of regional resource adequacy. These working groups were responsible for five tasks:

1. Review existing regional studies of resource adequacy;
2. Review current resource adequacy planning practices among Northwest utilities;
3. Survey best practices for resource adequacy programs throughout the country and world;
4. Investigate implications of possible constraints on fuel supply and transmission deliverability; and
5. Communicate results and findings to the appropriate audiences.

The following questions were posed to the working groups:

1. How are changes in loads and resources in the region expected to affect its capacity position in the coming years?
2. Are current practices in the region well-equipped to meet the upcoming resource adequacy challenges?

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3. What lessons can the Northwest learn from experiences in other regions?
4. How should electricity transmission constraints be considered when assessing resource adequacy needs?
5. How should the availability of fuel supplies be considered when assessing resource adequacy needs?

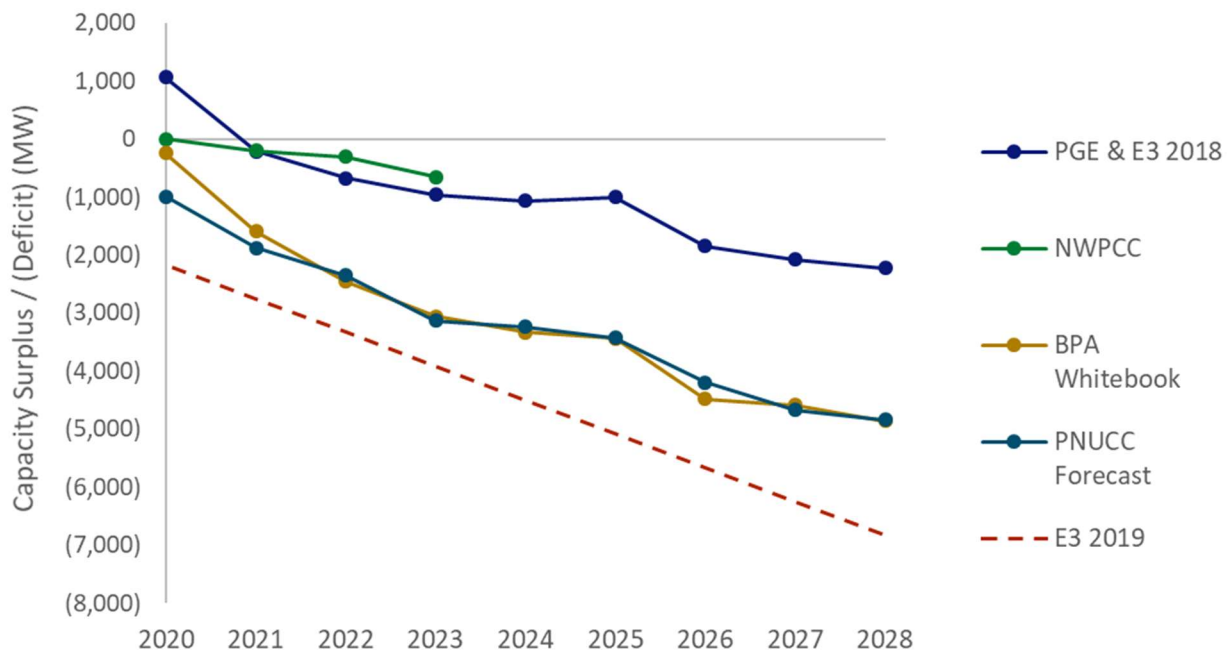
This report summarizes the findings of these working groups and offers some potential paths forward for the region to establish new institutions to help ensure that reliable electric service is maintained during the ongoing clean energy transition.

Findings of the Working Groups

1. *How are changes in loads and resources in the region expected to affect its capacity position in the coming years?*

There is general consensus among regional studies that the Northwest is, or will soon be, short on capacity resources. This consensus has emerged as several research groups and regional entities have outlined the current and forecasted outlook for resource adequacy in the Northwest, as summarized in Figure 1 below. A common finding that holds across these studies' different scopes and methods is that the Northwest electricity system is either not resource adequate today or will become so within the next two years.

Figure 1: NW Forecasted Load and Resource Balance



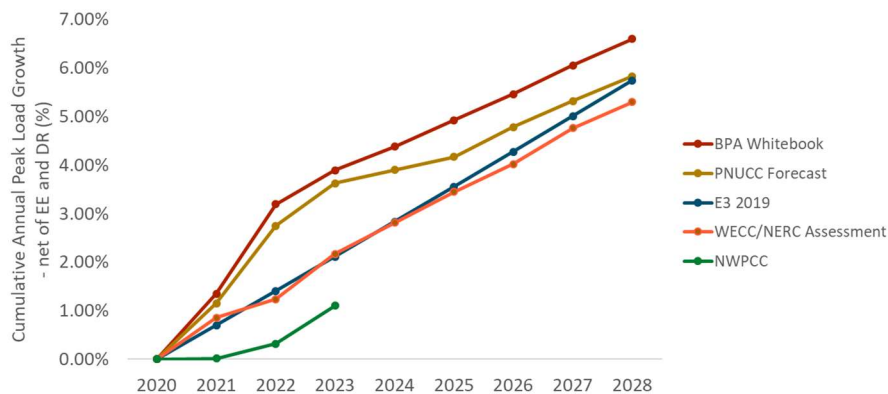
Note: This figure shows the central case from each study. The E3 2019 line is a linear interpretation of results for 2018 and 2030 in that study. The work groups also considered WECC's report to NERC in its Long-Term Reliability Assessment. However, that study was excluded from this figure because it examines the load and resource balance of the NWPP region in the summer, where the other studies agree that the largest challenges for the region are in the winter.

These studies attribute the region's resource adequacy challenges to two key factors:

1. **Changing Electricity Supply Mix.** Planned and prospective coal retirements will decrease the amount of firm capacity available to the Northwest region and the entire Western Interconnection. Most of the new resources installed across the NWPP region in recent years are variable energy resources, a trend that is expected to continue. Those resources do not emit pollutants and are increasingly low-cost, but do not provide the same amount of effective capacity for resource adequacy purposes.

2. **Load growth.** After nearly two decades of relatively flat growth, both annual and peak electricity loads are forecasted to increase in the region, even after accounting for the impacts of energy efficiency. While load growth is uncertain, new loads from data centers and agriculture are emerging as substantial and tangible considerations. Furthermore, the prospect of load growth from electrifying transportation and buildings—identified by recent studies as a key means to reduce carbon emissions in those sectors—could substantially increase both annual and peak loads in the medium-to-long term.

Figure 2: Electricity load growth projections for 2020-2030 from regional resource adequacy studies



2. *Are current practices in the region well-equipped to meet the upcoming resource adequacy challenges?*

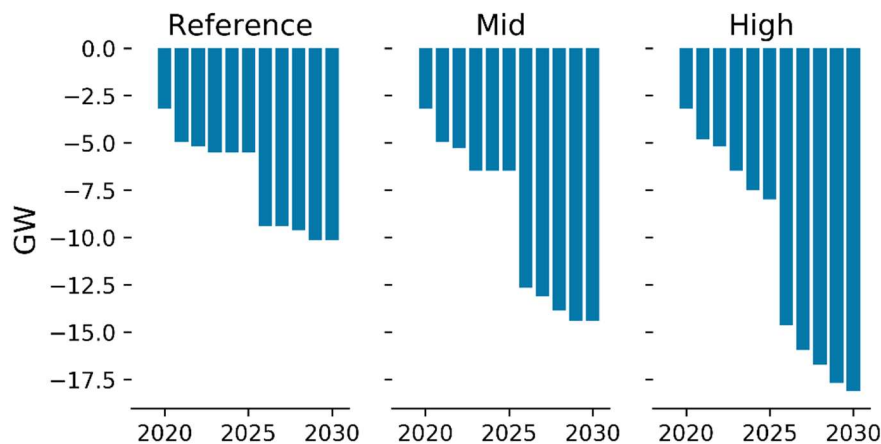
The Northwest’s electric utilities have been and continue to be ultimately responsible for maintaining resource adequacy. However, there is no uniform method for measuring resource adequacy and no standard for how much reliability is enough. Resource planning in the Northwest is currently done on a utility-by-utility basis, typically through integrated resource planning (IRP) processes. Given the wide variety of utilities in the region, each of these processes operates differently. For example, IRPs in the region may use altogether different methodologies for forecasting electric loads or determining the capacity contribution of hydroelectric resources.

The current patchwork approach to resource adequacy inhibits the ability of utilities, regulators, and stakeholders alike to fully understand the region's capacity position and how that relates to any individual utility's resource plan. In the absence of a centralized, transparent program to administer resource adequacy within the region, utilities either plan their systems to meet their own resource adequacy needs, irrespective of potential benefits from the greater regional grid; or they make assumptions on the availability of market capacity to contribute to their resource needs, which may or may not align with the amount of physical capacity actually available.

Relying on market purchases can be beneficial to consumers because owners of existing resources are typically willing to contract for sales at a much lower price than the cost of developing new generation. However, this benefit only exists in a market with surplus capacity. If all utilities plan to rely on low-cost market purchases and new construction lags as a result, a surplus condition may soon turn to a deficit and low-cost purchases may not be available. This appears to be the situation the region finds itself in today. Indeed, recent market price events—like that of March 2019 when wholesale electricity prices at Mid-Columbia reached nearly \$900/MWh during a natural gas pipeline contingency event—underscore the region's increasingly precarious capacity supply situation.

The region's planning challenges will be made more acute by impending thermal plant retirements. Forecasted deficits of this size suggest increased exposure to extraordinary price volatility and outage risks that far exceed historical standards. To avoid this outcome, utilities will need to replace thousands of megawatts of retiring capacity over the next five to 10 years (Figure 3). Doing so will require proactive planning by utilities and careful oversight by regulators during a period of transition for the region's resource mix.

Figure 3: WECC Coal Retirement Scenarios



Note: Coal retirement scenarios developed by NWPP IRP Team. From research of announced and potential retirements from across the US WECC.

At the same time, the region's increasing reliance on non-firm resources to meet clean energy policy goals—particularly wind, solar, and electric energy storage—will necessitate development of advanced analytical techniques to quantify the contributions these resources can make toward meeting regional resource adequacy needs. Attributing capacity values to a portfolio of non-firm resources will become increasingly complex due to interactive effects among those resources. For example, solar and wind have complementary profiles that increase the capacity contribution of both resources when added in combination; solar's ability to meet energy needs during daylight hours shifts the most significant potential reliability events to the evening hours, when wind energy output tends to be higher. As a result, commonly used approaches based on rules of thumb that were adequate when wind and solar were a small component of the total portfolio will need to be revisited to ensure adequacy as the region moves toward 50% renewable energy and beyond.

Taken as a whole, these observations suggest that the region's current resource planning practices are not well-suited to handle the challenge of ensuring regional resource adequacy. Clear and robust market signals are important to procure the resources needed to maintain reliability in the Northwest. The disparate practices and distributed responsibility for resource adequacy identified by the working groups will likely prevent utilities and their regulators from efficiently providing those signals. As a result,

members of the Northwest Power Pool have concluded that continuation of current practice is no longer a tenable approach to meeting the region's resource adequacy needs.

3. *What lessons can the Northwest learn from experiences in other regions?*

One of the key tasks undertaken by the Power Pool's working groups was a review of existing resource adequacy programs throughout the country. The working groups found that resource adequacy programs fulfill the following general functions:

1. Develop a transparent and robust assessment of regional resource adequacy needs, including identifying potential local or zonal needs based on regional transmission constraints;
2. Allocate regional capacity procurement responsibilities among member utilities;
3. Establish consistent, accurate methodologies for assessing the capacity contributions of supply- and demand-side resources;
4. Implement a framework through which utilities demonstrate they are resource adequate on a year-ahead or longer basis; and
5. Ensure that resources committed to provide capacity to the region do so when called upon.

Even with these common features, resource adequacy programs implemented around the world take many different forms, as illustrated by the wide variety of procurement mechanisms used. Centralized mechanisms, like the capacity auctions used in the U.S. Northeast, place procurement responsibility largely in the hands of a single market operator. Centralized capacity markets have provided important sources of revenue for generation developers in jurisdictions with restructured retail electricity markets. More decentralized approaches, like those used in the Midwest, rely on owned resources and bilateral contracts, which arguably affords utilities and jurisdictions more autonomy in procuring the resource mixes that best meet their needs, preferences, and policy goals. Decentralized approaches have evolved in regions that are still largely or exclusively served by vertically-integrated utilities.

One example of a regional RA program that may be a useful starting point for the Northwest is the Southwest Power Pool (SPP). Like the Northwest, retail electric service in the SPP region is provided largely by vertically-integrated utilities. Unlike other Regional Transmission Organizations (RTOs), the SPP does not

operate a formal capacity market, an important consideration for the Northwest which lacks an RTO. Instead, the SPP RA construct serves primarily to assess regional and sub-regional RA needs, allocate those needs to utilities, and accredit participating resources. Capacity procurement is accomplished entirely via self-supply or bilateral contracts. Importantly, despite being a FERC-jurisdictional RTO, SPP's resource adequacy program is overseen by representatives from member states' public utility commissions and the region's public power community.

4. How should electricity transmission constraints be considered when assessing resource adequacy needs?

Electricity generation sources must be connected to the loads they are intended to serve with adequate electric transmission capability. The Northwest region has benefited from a robust high-voltage transmission network constructed and operated by the Bonneville Power Administration and the region's large, mostly investor-owned utilities. There are significant constraints on the transmission system's ability to deliver energy into congested load pockets such as the Puget Sound area and the Willamette Valley. These constraints must be considered as part of any regional resource adequacy program. In other regions, this is generally accomplished through the establishment of specific zonal procurement requirements informed by transmission "deliverability" assessments. The number and specific configuration of zonal requirements in the Northwest system, and the nature of the deliverability assessment in a region where transmission access is still governed through physical transmission rights, will be important considerations in the design of a Northwest RA program.

5. How should the availability of fuel supplies be considered when assessing resource adequacy needs?

Just as wind and solar generators cannot produce energy in the absence of wind and sunlight, thermal generators cannot produce energy in the absence of fuel supplies. If a thermal generator cannot obtain fuel supplies in a timely manner, its ability to be available to the region when needed may be jeopardized. RA programs in some, but not all, jurisdictions require thermal generators to demonstrate that they have access to firm fuel supplies either by storing fuel on-site or by contracting with interstate pipeline systems for firm (rather than interruptible) transportation service. Available evidence indicates that the Northwest's network of interstate pipelines and underground natural gas storage facilities is largely at

capacity and may need to be expanded if new natural gas generation capacity is constructed. Hence, mechanisms to assure firm fuel supplies will also be a key design element for a Northwest RA program. This is especially true considering that the Northwest's electricity and gas systems both peak during the coldest days of the year.

Recommendations

The Northwest Power Pool working groups offer the following three recommendations to the region. While the structure of the working groups was informal and no votes were taken, these recommendations enjoy broad support among those that participated.

First, the region should take further steps to develop a regional resource adequacy program. In the face of the impending risks and challenges described above, working group participants agree that further investigation of a regional resource adequacy program is warranted. Participants believe that a regional program should be established for several reasons, including:

- To maintain reliability during a period of significant transition for the region's electricity system;
- To promote increased transparency and uniformity that will provide utilities, regulators, and stakeholders alike with a clear understanding of the region's resource adequacy position;
- To allow utilities and their customers to safely realize the full benefits of the load and resource diversity that exists across the region while maintaining reliability;
- To provide a platform for utilities to share planning reserves and make optimal use of existing resources; and
- To encourage timely identification and development of new investments when and where they are needed to meet regional requirements.

Second, the design of a resource adequacy program for the Northwest should be tailored to reflect the unique qualities and characteristics of the region. A resource adequacy program in the Northwest would help the region navigate reliability and cost challenges given its evolving resource mix. There are many examples of such programs in other regions, and the Northwest can benefit from the experience of those who have gone before. However, the Northwest's electricity system is unique in many respects, not least

with regard to the outsized role played by the region's hydroelectric systems and the prominent role of public power. The topography of the electricity transmission and natural gas pipeline systems will also necessitate the development of specific sub-regional locational requirements for new assets. The structure of a Northwest resource adequacy program would need to be developed with the region's unique features in mind.

Third, the resource adequacy program should not usurp authority that is currently vested with the utilities and their governing bodies to determine the best way to meet resource adequacy requirements. Resource adequacy is currently addressed within utilities' Integrated Resource Plans. A regional RA program should not stipulate how member utilities meet their capacity obligations. That responsibility should remain under local control, with integrated resource plans continuing to be the basis for long-term planning and procurement decisions. Furthermore, a regional RA program would operate on a different timescale than most IRP processes; whereas IRPs in the Northwest examine utility resource needs over a 10- or 20-year horizon, a regional RA program would have a much shorter time-horizon of one to five years. The program must be voluntary to join with exit provisions that are not unduly burdensome.

At the same time, to be meaningful an RA program must include binding commitments for each member to do its share to maintain regional reliability. In practice, this means that the RA program would need to have exclusive authority over some elements of current planning practices such as near-term load forecasts and capacity accreditation for existing and new resources.

To summarize, the RA program would determine the *quantity* of resources that each member would need to procure and the *contribution* of existing and candidate resources toward meeting the regional need, but the decision about which resources to procure to satisfy the regional obligation would fall exclusively to utilities and their governing bodies.

Next Steps

The NWPP working groups recommend moving forward with development of a resource adequacy framework that ensures reliable, clean and cost-effective power supply for the Northwest. To that end,

NWPP proposes to initiate an **RA program design development process**. This process will explore in more detail the features of an RA program that matches the needs and unique characteristics of the Northwest's energy system. The process will incorporate substantial stakeholder input, including a Stakeholder Advisory Committee that will be regularly consulted throughout the design phase. NWPP members have set an ambitious, but achievable, goal of standing up a voluntary regional RA program by spring of 2022. Achieving that goal will no doubt involve an intensive process for all parties involved, but such an effort is warranted given the importance of reliable electricity for the region's economy and consumers.