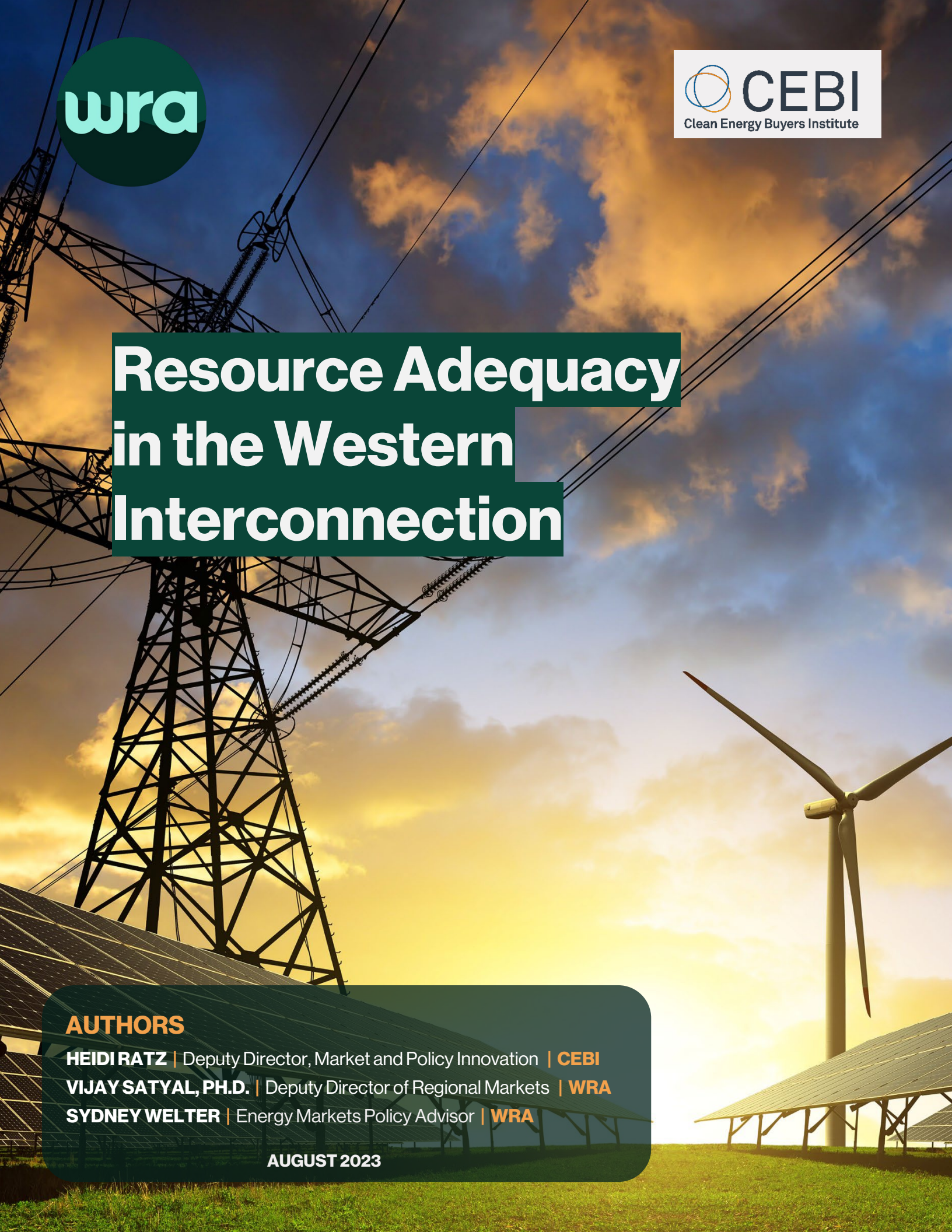

Resource Adequacy in the Western Interconnection

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About Us

Western Resource Advocates

Western Resource Advocates is a regional nonprofit advocacy organization fighting climate change and its impacts to sustain the environment, economy, and people of the West. From deep and scientific policy analysis to highly effective legal strategies, the organization is creating a healthier and more equitable future for local communities. As the region's go-to experts for more than three decades, WRA's on-the-ground work advances clean energy, and protects air, land, water, and wildlife. Learn more at: WesternResoureAdvocates.org.

The Clean Energy Buyers Institute

The Clean Energy Buyers Institute (CEBI) is a public benefit charity dedicated to solving the toughest market and policy barriers to achieving a carbon-free energy system by proving expert thought leadership for energy customers and others. CEBI's 21st Century Electricity System Program provides engagement, research, and education related to the recommendations found in CEBI's 2021 report "Designing the 21st Century Electricity System: How electricity buyers can accelerate change." Among other recommendations, the 2021 report identified resource adequacy and organized wholesale market expansion as two focus areas for large energy customers seeking to decarbonize the grid. Learn more at: cebi.org.

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I. INTRODUCTION

What is Resource Adequacy?

Resource adequacy is generally defined as the ability of energy resources to meet load, also referred to as demand, across the bulk power system [1], except in the most extreme circumstances. Ideally, resource adequacy requirements are implemented over a long-term horizon – between 1 and 20 years – and incorporate risk analysis of different scenarios for weather, demand, and other factors.

While resource adequacy is a planning construct widely used by power system planners, there can be substantial variability in the planning constructs and processes used to achieve sound and robust resource adequacy. Federal and regional agencies and compliance monitors, state regulators, various types of utilities, and other entities all play different roles in maintaining a resource-adequate bulk power system. At times, even similar entities who play the same role may take different approaches to resource adequacy assessment or planning.

This paper introduces the various roles and frameworks for resource adequacy assessment and planning currently used in the Western Interconnection. [2] Understanding the degree of authority different Western entities have related to resource planning, as well as their goals and approaches, is critical to understanding proposed changes to resource adequacy constructs and the future of the rapidly changing Western electric grid.

Why is Resource Adequacy Planning Important?

Resource adequacy planning is vital in ensuring reliable, continuous access to electricity in the face of evolving resource profiles and changing climate conditions. Traditionally, resource adequacy assessments were fairly straightforward: forecast peak demand [3] over time and make sure there are enough resources to meet that demand plus a margin of error (typically a percentage of peak demand), requiring planners to forecast demand and then target a buffer amount of additional resources needed above peak demand – the highest amount of electric demand within a particular period of time. [4] Today, the integration of low-cost, low-carbon, but more variable energy resources – such as wind and solar power – requires new hours of reliability risk be examined beyond the peak hour. Increasing extreme weather events, demand variability and changes to seasonal load are also necessitating evolution of resource

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[1] The bulk power system is described as "the electricity power generation facilities combined with the high-voltage transmission system, which together create and transport electricity around North America." This definition points out that the bulk power system covers wholesale-level segments of the utility industry as opposed to retail electric power sales or local distribution of power. Please see NERC's Frequently Asked Questions, August 2013.

[2] The U.S. is divided into three major grids, or interconnections. Western Electricity Coordinating Council covers 14 Western U.S. states, 2 Canadian provinces, and a portion of Baja California. The Western Interconnection (wecc.org)

[3] Peak demand is the highest amount of electric demand within a period of time (e.g., an hour). California Energy Commission, A Peek at Net Peak, 2021.

[4] The State of California, Id.

adequacy approaches.[5] Maintaining a reliable grid will require resource adequacy planning that adapts to these drivers.

Failure to plan acceptable levels of resource adequacy could create large-scale interruptions of power supply that can also impact human safety. In August 2020, California residents faced forced rolling outages due to insufficient capacity during a heightened period of demand stemming from a climate-change-induced heat wave and planning targets that had not kept pace with changing demand and generation profiles.[6] Outages are especially dangerous for low-income populations, disproportionately impacted communities, the elderly, unhoused individuals, and those who rely on electric medical equipment. A recent Western Electricity Coordinating Council (WECC)[7] assessment indicates that resource adequacy risk and degree of magnitude will increase across the region over the next 10 years, and the variability of supply and demand that drives risk is also increasing.[8] National-level reports indicate Texas and central and upper regions of the Midwest also remain at high risk for seasonal outages due to extreme weather.[9]

What Components of Resource Adequacy Planning Are Important to Understand?

This paper introduces the main frameworks for resource adequacy assessment and planning that are in place across the Interior West. We provide a brief overview of how resource adequacy is generally planned across the U.S. in Section II. In Section III, we describe the role of federal versus regional entities in terms of resource adequacy assessments. Section IV walks through the main entities in the West that play a role in resource adequacy assessments and planning.

In each section, three key components are introduced: goals, approach, and resource adequacy authority or roles. We introduce each entity and its stated goals in terms of resource adequacy. Approach includes the specific process they use for assessing resource adequacy challenges, how targets are set or how an entity may plan to meet resource adequacy targets. Resource adequacy authority summarizes the roles and responsibilities that each entity has in maintaining resource adequacy across the West. Understanding these elements of Western resource adequacy is important for energy developers and buyers, regulators, policymakers, and stakeholders working in the public interest to understand regional market expansion efforts and regional resource adequacy initiatives. This knowledge will help all these groups advocate for strong resource adequacy frameworks that can overcome challenges and facilitate innovation.

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[5] For more information on the changes that are impacting resource adequacy planning, see these resources from the Energy Systems Integration Group (ESIG) ESIG-Redefining-Resource-Adequacy-2021-b.pdf.

[6] California Independent System Operator, California Public Utilities Commission, California Energy Commission, Final-Root-Cause-Analysis-Mid-August-2020-Extreme-Heat-Wave.pdf (caiso.com), January 13, 2021.

[7] The Western Electricity Coordinating Council footprint covers WA, OR, CA, NV, UT, ID, AZ, MT, WY, CO, and NM.

[8] Western Electricity Coordinating Council, *Western Assessment of Resource Adequacy Overview Presentation* (wecc.org), February 2, 2023.

[9] Peter Behr, Jason Plautz, Grid monitor warns of U.S. blackouts in 'sobering report' - E&E News (eenews.net), May 19, 2022.

II. MEASURING AND PLANNING FOR RESOURCE ADEQUACY

Which Metrics and Analysis are Used to Measure?

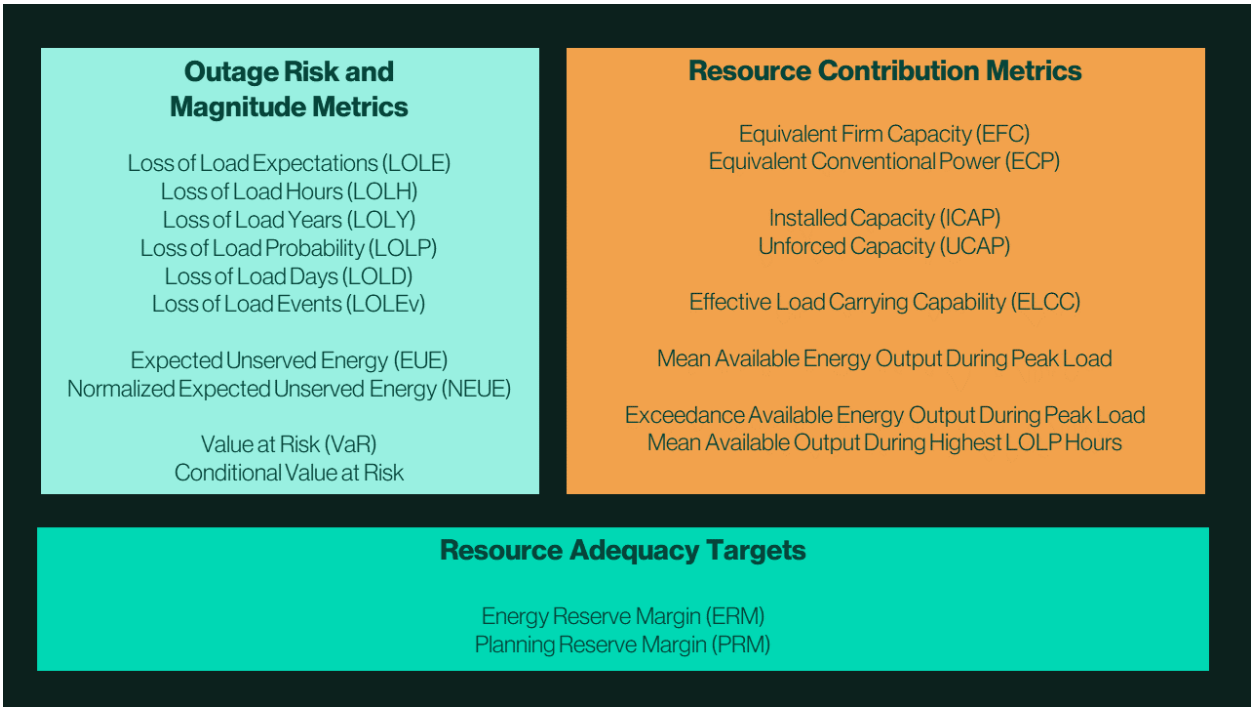
An electric system is resource-adequate if it can supply the aggregate electrical demand and energy requirements of customers at all times, taking into account scheduled and reasonably expected unscheduled outages of system elements.[10] The resource mix includes all resources (centralized or distributed, thermal power or renewable power, demand response and energy efficiency) that can provide energy, capacity, or flexibility to the system.[11] Because resource adequacy planning not only facilitates short-term energy sharing but also guides investment decisions, it is generally planned over a long time period due to the lead time needed when developing new resources. Determining what resources are needed to maintain resource adequacy includes considering the risk of scenarios where demand exceeds the supply of resources. Resource adequacy planning does not target continuous power, even during the most extreme conditions, because of the rising costs that come with achieving perfect power supply. Instead, planners balance the cost of incrementally higher levels of resource adequacy versus the cost of interrupted power. In addition, the cost that the public bears increases if utilities individually plan high levels of resources and decreases if utilities can share energy and capacity resources.

An important element of resource planning is the choice of metrics used to guide planning and achieve what planners consider a reasonable level of resource adequacy. Figure 1 below summarizes several metrics. Traditional metrics tend to measure capacity and shortfalls in terms of average risk and define the number of days or hours load is not served. A common metric used is Loss of Load Expectation (LOLE). Assessing LOLE involves an analysis of resources, transmission system, and projected load to determine, over a specified time period, the expected number of days in which one or more outages might occur, with a common target of one event day per 10 years, most often translated into a LOLE threshold of 0.1 event-days per year.

[10] Resource adequacy is a major component of reliability. A power system is reliable if it is both adequate and secure. A secure system is one that can withstand sudden disturbance, such as electric short circuits or unanticipated loss of system elements. https://www.nerc.com/AboutNERC/Documents/Terms AUG13.pdf

[11] EPRI, Welcome to Resource Adequacy Assessment Resource Center - EPRI GO&P Resource Center, May 11, 2022.

Figure 1: Resource Adequacy Metrics [12]



Note: This list is not exhaustive and illustrative only.

Source: Adapted from "Evolution of Adequacy Metrics," The Electric Power Research Institute's (EPRI's) Resource Adequacy Assessment Resource Center.

Additional metrics used in resource adequacy planning describe the magnitude of outages. For example, Expected Unserved Energy (EUE) measures the average amount of energy not served, generally over an entire year, instead of the number of times outages occur. [13] Metrics that describe outages in terms of size, frequency, duration, and timing are increasingly needed to better match resource profiles to the system needs. [14]

Finally, other metrics are used to determine the different contributions potential resources can provide to the grid to maintain a certain level of risk (sometimes called resource contribution or capacity accreditation). Metrics may be based on simple generation capacity (the maximum possible output of a generator) or energy (the true output of a generator over a specific period of time).

Unforced Capacity (UCAP) is a metric often used for thermal plants that estimates the amount of a resource's nameplate capacity available to the grid after accounting for "forced outages" when a plant is taken offline for unexpected service or repair. Other metrics, such as Effective Load Carrying Capability (ELCC), reflect the extent to which specific resource types contribute to overall system adequacy when considered within a portfolio. ELCC has gained popularity for its ability to consider the relationship between the amount of resource added, the overall resource mix, and the load profile.

[12] EPRI, Adequacy Metrics - EPRI GO&P Resource Center, May 10, 2022.
[13] Derek Stenclik, Beyond 1-day-in-10-Years: Measuring Resource Adequacy for a Grid in Transition, November 19, 2021.
[14] Rob Gramlich, Ensuring Low-Cost Reliability: Resource Adequacy Recommendations for a Clean Grid, November 2021.

How are Resource Adequacy Targets Set and Achieved?

Resource adequacy analysis measures the risk that load might not be met across a system, but it needs to be converted into targets or requirements to impact resource planning and investment. Regulators, utilities, or grid operators responsible for resource adequacy can administratively set a target based on using the metrics discussed above and often use "reserve margin analysis" to set a Planning Reserve Margin (PRM). A PRM identifies the amount of surplus capacity needed above the expected peak demand to "maintain reliable operation while meeting unforeseen increases in demand (e.g., extreme weather) and unexpected outages of existing capacity."[15] Setting the PRM involves probabilistic[16] analysis of scenarios based on a set desired level of reliability and can make use of metrics such as LOLE. Metrics that determine the "capacity accreditation," such as UCAP or ELCC, help planners understand how different resources can contribute to meeting the PRM. The table below provides more detail into the inputs that inform reserve margin analysis.

Table 1: Inputs to Reserve Margin Analysis[17]

Primary Inputs	Additional Considerations	Description and Examples
Resources	Availability / Performance	Forced-outages; fuel supply (all resources); environmental policy restrictions (e.g., run time limitations); minimal operating reserves (NERC Standard)
	Imports/Exports	Imports with firm delivery contracts are usually treated the same as availability resources within the area; firm exports committed to neighboring areas are subtracted from total resources
	Variability	Utility-scale wind and solar; run of river hydro (seasonal)
	Demand Response	Varying programs; controllable vs. non controllable; industrial customer contracts, limitations
	Deliverability	Transmission limitations; constraints; reactive-power limitations; under voltage load shedding; under frequency load shedding; protection devices
Load	Forecasting Models	Load forecasting error, weather uncertainty, extreme conditions (heat waves & polar vortex); coincident vs. non-coincident
	Distributed Resource (Behind-the-Meter) Impacts	Rooftop photovoltaic serves the end-use customer and reduces system load; impacted by cloud cover; customer must use on-site storage or utility supply after sunset
	Local Load Growth	Rapid commercial and industry growth (North Dakota oil sands, data centers)

[15] Western Electricity Coordinating Council, Western Assessment of Resource Adequacy, 2021. Western Assessment of Resource Adequacy 2021.pdf (wecc.org). The definition quoted is WECC's definition. Ultimately PRM could be more generally defined as a target that provides sufficient surplus capacity to cover reasonably expected variations in load and in generation. More specifically, it covers increases in load due to extreme weather, unexpected generator outages, and variations in wind, solar, and hydro generation. It should also include (explicitly or implicitly) contingency reserves and balancing reserves (used to offset within-hour forecast errors for load and for wind and solar generation.

[16] Deterministic analysis and metrics assume fixed inputs and answer a discrete question, while probabilistic (sometimes called stochastic) analysis and metrics examine probabilities as inputs and provide a range of potential outcomes.

[17] NARUC 2021, https://pubs.naruc.org/pub/752088A2-1866-DAAC-99FB-6EB5FEA73042.

While reserve margin analysis is widely used in resource adequacy planning, changes to the system are requiring evolution of this approach or new approaches to complement it. For example, entities in the West have often used peak demand in one season as the basis for their PRM, but some Western entities are now seeing "dual peaking" systems with peaks in both the summer and winter. [18] Increasingly, as peak demand itself is not enough to describe the pressures on the bulk power system, planners are also making use of hourly assessments or targets. In addition to planning for capacity needs, it is also critical to consider the energy provided, through metrics like Expected Unserved Energy (EUE) and Energy Reserve Margins (ERMs).

The mechanisms for planning resources to meet these targets depend on the regulatory structure in place. However, there is variation – both in approach and state authority – within regions. In regulated, vertically integrated utility systems, such as in those found in the West, the PRM is used for resource planning (such as Integrated Resource Planning) and procurement. In other parts of the U.S. with deregulated utilities, such as the Northeast, the PRM determines the amount of capacity required by the organized wholesale market. In regions with vertically integrated utilities and organized markets, such as the Midwest, a blend of market and utility planning helps achieve resource adequacy targets. In the following sections, we provide an explanation of the role of various entities in either assessing or achieving resource adequacy targets.

III. RESOURCE ADEQUACY IN THE WEST: FEDERAL, REGIONAL, MULTI-STATE, AND STATE-LEVEL

What Role Do Federal Agencies Have Over Resource Adequacy?

The North American Electric Reliability Corporation (NERC) is the Electricity Reliability Organization (ERO) for North America and plays a role providing resource adequacy assessments across all regions of the U.S., Canada, and northern Baja California. [19] The agency is subject to oversight by the Federal Energy Regulatory Commission (FERC), and NERC's seasonal and long-term reliability assessments of the BPS are developed to inform industry, policymakers, and regulators. Their annual Long-Term Reliability Assessment (LTRA) examines the 10-year reliability of the electricity system and is complemented by supplemental winter and summer seasonal reports. The LTRA is developed with data and

[18] Western Electricity Coordinating Council, State of the Interconnection, 2023.
[19] North American Electric Reliability Corporation, About NERC, 2023.

narrative analysis from six regional entities, including WECC, which are the organizations charged with ensuring that NERC Reliability Standards are met in their respective regions. The data include projected on-peak demand and system energy needs, demand response resource capacity, and transmission projects. The assessment includes several baseline assumptions, including industry forecasted supply and demand, and demand projections. The Reliability Assessment Subcommittee (RAS), per NERC's Reliability and Security Technical Committee, provided peer review for the LTRA.

What Regional Entities Have a Role in Resource Adequacy in the West?

WESTERN ELECTRICITY COORDINATING COUNCIL

Goals

The WECC is authorized by NERC to ensure the reliability of the Western Interconnection and is the largest, most geographically diverse of NERC's six regional entities. In 2022, WECC released its third Western Assessment of Resource Adequacy (WARA), which examines resource adequacy over the next decade in the Western Interconnection, with subregion-specific analysis.[20] The WARA recommends actions for entities "to mitigate near-term risks and prevent long-term risks" to reliability in the West in light of changing grid circumstances.[21] The WARA supplements NERC's assessment and supports "the effective and efficient reduction of risks to the reliability and security of the grid" that serves 334 million people in North America, and compliance with federal bulk-power system law.[22] It also complements analysis from entities such as WPP and California Independent System Operator (CAISO) by providing a high-level review of risks so that other stakeholders can probe deeper into issues and develop plans in response.

Approach

WECC's assessment examines resource adequacy across the Western Interconnection using an energy-based probabilistic approach, which provides another perspective for the West when considered alongside other capacity-based approaches. The analysis creates a metric called the Demand at Risk Indicator (DRI) by looking at hourly demand and expected resource availability reported by Balancing Authorities to identify hours over the next ten years when there is a risk that demand won't be met. The WARA also analyzes the sufficiency of existing planning reserve margins through its Planning Reserve Margin Index (PRMI). The PRMI does not prescribe a PRM but does predict what reserve margin would be needed to meet a One Day in Ten Years (ODITY) standard based on planned resources.

[20] 2022 Western Electricity Coordinating Council, Western Assessment of Resource Adequacy.
[21] Western Electricity Coordinating Council, Western Assessment of Resource Adequacy, 2021.
[22] North American Electric Reliability Corporation, 2021 Long-Term Reliability Assessment, December 2021.

In 2021 the WARA expanded its analysis to include a deterministic scenario analysis in addition to probabilistic analysis. This additional scenario analysis examines three cases: expected generation and demand, high demand, and drought conditions.

This examination identified three areas that need to change to maintain reliability in light of increasing variability in demand and in resource availability and a high risk of load loss in all subregions of the West in the next few years. These prescribed changes are:

1. Calculate planning reserve margins (PRMs) based on energy instead of capacity.
2. Use the most strained (variable) times on the system to determine the PRMs instead of relying on the assumption that if the peak is covered, all other times will be covered too.
3. Regularly recalibrate PRMs when there are significant changes to resources or demand that may increase the variability on the system. [23]

This is consistent with NERC's 2021 LTRA for WECC, which concludes that the Northwest and Southwest "have increasingly variable resource profiles, raising the risk of energy shortfalls" and "the need for regional coordination and resource adequacy planning is growing." Both the LTRA and WARA also point to extreme weather as a risk factor in future reliability. [24]

In 2022, WECC analyzed DRI under three scenarios: one where the resources and imports indicated in resource plans materialized; one where no new resources planned were developed but imports were available; and one where all resources were developed but imports were not available. WARA found that entities were able to reduce DRI through 2025, but at-risk hours would continue to rise subsequently for all regions. Increased imports from other subregions could allow entities to tap into the resource and load diversity across the Western Interconnection, requiring robust transmission to support resource adequacy.

Resource Adequacy Authority or Roles

While WECC plays a role in NERC monitoring compliance with reliability standards, its role in resource adequacy planning is focused on developing comprehensive assessments to provide objective information to regulators and decision makers. WECC does not have any authority over the utility investment or planning decisions; it develops its assessments with input from industry, policymakers, and regulators, and makes use of stakeholder engagement to improve production and dissemination of the analysis. WECC also plays a convening role by providing public education resources and facilitating conversations between stakeholders.

[23] Western Electricity Coordinating Council, Western Assessment of Resource Adequacy, 2021.
[24] North American Electric Reliability Corporation, 2021 Long-Term Reliability Assessment, 2021.

WESTERN POWER POOL'S WESTERN RESOURCE ADEQUACY PROGRAM

Goals

The Western Power Pool or WPP (formerly the Northwest Power Pool) is a nonprofit, membership-based organization that "serves as a clearinghouse for operational data and provides guidelines for power system operations and operations planning."[25] WPP has also provided its members with a program for sharing contingency reserves, which are energy resources that can maintain system balance if a generator unexpectedly disconnects. In 2021, WPP released a detailed design for a forward-looking Western Resource Adequacy Program (WRAP).[26] WRAP will be administered by the Southwest Power Pool (SPP) and will provide a platform for sourcing capacity resources needed for resource adequacy during unplanned outages.[27] WRAP describes its primary purpose as ensuring reliability for participants, improving effectiveness and efficiency through an expanded geographic footprint, improving visibility and coordination for participants to make informed planning and procurement decisions, and developing fair and unbiased rules and practices.[28]

Approach

Recognizing changing grid economics related to the retirement of thermal resources and increasing integration of variable renewable resources, WPP facilitated a coalition to examine future needs to ensure reliability for customers across the West. This led to over two years of collaborative work to develop WRAP with stakeholder buy-in. WRAP is beginning operation as a *non-binding* forward-showing program with around 20 participants and will continue to grow its membership. To join WRAP, participants need to meet several requirements, including signing the WRAP agreement with a data sharing and confidentiality component.[29] WRAP will transition to a *binding* forward-showing, operational program in 2024 at the earliest.

The program sets a regional reliability metric seven months in advance, using a regional minimum PRM, and a consistent approach to counting resources using capacity accreditation metrics. WRAP makes use of a Loss of Load Probability (LOLP) target of 1-day-in-10-years. It is a "forward-showing" program in that participants will need to demonstrate that they have enough capacity to meet the regional PRM target and that they have reserved at least 75% of the transmission needed to deliver those resources. As the program becomes "binding," the fine for noncompliance will be set as a deficiency payment based on the Cost of New Entry for a new peaking gas plant.[30]The modeling of areas for LOLE employs a "pipes and bubble" methodology for modeling the transmission system, where the pipes represent the imports and exports across Load Resource Zones (LRZs), and bubbles represent the loads and resources.

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[25] Northwest Power and Conservation Council, Northwest Power Pool (nwcouncil.org), 2023.
[26] Northwest Power Pool, NWPP Resource Adequacy Program - Detailed Design, July 2021.
[27] Robert Mullin, Implementation Underway for NWPP's Western RA Market, December 12, 2021.
[28] Northwest Power Pool, Resource Adequacy Program Conceptual Design, July 2020.
[29] Northwest Power Pool, NWPP Resource Adequacy Program - Detailed Design, July 2021.
[30] Northwest Power Pool, Resource Adequacy Program - Conceptual Design, July 2020.

Resource Adequacy Authority or Roles

WPP included governance considerations in its program design and worked with stakeholders to develop a proposal in January 2022 that established an independent board and stakeholder process for the program. While WRAP is not a market, but a regional planning platform to enable resource pooling, WPP was required to file its tariff with FERC for approval and meet their requirements for board independence as a public utility. FERC approved the WRAP tariff on Feb. 10, 2023, which allowed WPP to continue working to set terms and conditions for participation and evolve program governance changes.

WRAP is a significant step forward and will help harmonize the resource adequacy planning language used across the Western utilities that have joined the program. While WRAP increases coordination and visibility across participants, it will not fundamentally change the role of utilities in developing resource plans or the role of state commissioners in approving those plans. States and utilities will still have authority over the resource mix and specific generation sources that are used to meet regional targets.

The most recent design proposal for WRAP envisions harmonization of the resource adequacy projections between the integrated resource planning processes of participating utilities and the projections made through the WRAP effort. Ensuring the resource adequacy assumptions used by the participating utilities in their integrated resource plans (IRPs), particularly the capacity accreditation for various resources or assumptions around transmission availability, are not significantly different from those used by the WRAP will be a critical coordination issue in the near future.[31]

Federal Power Marketing Administrations

The U.S. Department of Energy (DOE) oversees four federal Power Marketing Administrations (PMAs) which operate federally owned hydroelectric dams developed for irrigation, flood control, and local electrification. PMAs were developed to market excess electricity at low, cost-based rates, with preference for serving utility districts and cooperatives.[32] PMA electric rates are FERC-regulated to ensure that they recover federal facility costs across hydropower beneficiaries. However, FERC has much more limited authority over PMAs than it does over investor-owned utilities (IOUs).[33] The PMAs in the West are the Bonneville Power Administration (BPA), which manages 31 dams in the Northwest United States, and the Western Area Power Administration (WAPA), which manages 57 hydropower plants in the West and Central United States.[34, 35, 36]

[31] Western Energy Interstate Board, Implications of a Regional Resource Adequacy Program on Utility Integrated Resource Planning, November 2020.
[32] Congressional Research Service, The Power Marketing Administrations: Background and Current Issues, 2019, pg. 2.
[33] Congressional Research Service, The Power Marketing Administrations: Background and Current Issues, 2019, pg.2.
[34] Department of Energy Office of Enterprise Assessments, Power Marketing Administrations, n.d.
[35] Bonneville Power Administration, About, n.d.
[36] Western Area Power Administration, About, March 20, 2023.

WESTERN AREA POWER ADMINISTRATION

Goals

The WAPA aims to "safely provide reliable, cost-based hydropower and transmission to our customers and the communities we serve."[37] WAPA serves preference customers – such as federal and state agencies, communities, rural cooperatives, public utility districts, irrigation districts, and Native American tribes – which then provide retail electricity directly to consumers.[38] WAPA also provides wholesale electricity power to military bases, joint power authorities, transportation districts, regional transmission organizations, and independent system operators. As a large transmission system owner and wholesale electricity provider across the West, WAPA has indicated that it chooses to voluntarily follow many FERC rules, despite the limited authority FERC has over PMAs.[39] FERC can approve, deny, or request further study of WAPA's proposed rates through authority delegated by the DOE.

Approach

WAPA's long-term firm power[40] customers are required to submit IRPs (or alternative reports) every five years, per the Energy Policy Act of 1992 and WAPA's Energy Planning and Management Program.[41] Regulations dictate the required elements of a WAPA customer IRP, which include load forecasting, a comparison of energy efficiency and energy supply resource options, reporting on "efforts to minimize adverse environmental effects of new resource acquisitions," and opportunities for public input.[42, 43, 44] The IRP must evaluate the full range of alternatives to provide adequate and reliable service to a utility's electric consumers at the lowest system cost.[45] WAPA's utility customers may also submit IRPs to state regulators, if their state's statute requires it. WAPA uses a set of IRP criteria and alternatives for small customers who may not meet the requirements to be part of the standard IRP process.[46]

There are several alternative requirements for certain classes of WAPA's customers. Small customers – those with annual sales or use of less than 25 GWh, regardless of their association with a joint action agency or member-based association – may request to submit a Small Customer Plan (SCP) instead of an IRP.[47] Customers with service territories in state or Tribal jurisdictions that mandate a minimum investment requirement (MIR) may request to submit an MIR instead of an IRP.[48] Customers who are required by state, federal, or Tribal law to invest a portion of their resources in demand-side management (DSM) initiatives, including energy efficiency and load management, and/or renewable energy activities, may request permission to provide a copy of that report instead of an IRP.[49] In fiscal year 2021, WAPA

[37] Western Area Power Administration, About.
[38] Western Area Power Administration, About WAPA. harmonize
[39] Western Area Power Administration, Industry Participation.
[40] Power or power-producing capacity, intended to be available at all times during the period covered by a guaranteed commitment to deliver, even under adverse conditions. Energy Information Administration (EIA).
[41] Western Area Power Administration, EPAMP IRP, 2020.
[42] Western Area Power Administration, Power Marketing - EPAMP, IRP, February 11, 2020.
[43] Western Area Power Administration, Integrated Resource Planning Guidelines, January 13, 2020.
[44] Western Area Power Administration, Energy Services - Integrated Resource Planning, March 23, 2023.
[45] Western Area Power Administration, Integrated Resource Plan, 2023.
[46] Western Area Power Administration, https://www.wapa.gov/PowerMarketing/IRP/Pages/guidelines.aspx
[47] Western Area Power Administration, Small Customer Plan Review, February 25, 2020.
[48] Western Area Power Administration, Minimum Investment Report Checklist, February 25, 2020.
[49] Western Area Power Administration, Energy Efficiency/Renewable Energy Report Review and Evaluation Checklist, February 25, 2020.

received 129 IRPs from individual customers, 407 plans from cooperatives, 62 minimum investment reports, 132 small customer plans, and one energy efficiency/renewable energy report. [50]

Resource Adequacy Authority or Roles

Western Area Power Authority does not have authority to regulate resource planning roles of the IOUs or public power entities it serves. This is the role of state public utility commissions, co-op boards, or city governments. WAPA does encourage customers to engage in IRP planning with the planning entities and increases transparency by making the plans public through its website.

BONNEVILLE POWER ADMINISTRATION

Goals

Bonneville Power Administration (BPA) sells wholesale electrical power from 31 federal dams operated by the U.S. Army Corps of Engineers and the Bureau of Reclamation to communities and public utility districts across Idaho, Oregon, Washington, western Montana, and small parts of eastern Montana, California, Nevada, Utah, and Wyoming. BPA's goals target adequate, efficient, economical, and reliable power supply as well as needed transmission to support electrical reliability, stability, and mitigation of negative impacts on fish and wildlife from hydroelectric projects.

Approach

The Northwest Power Act in 1980 authorized Idaho, Montana, Oregon, and Washington to form the Northwest Power and Conservation Council. Through Section 5(b) of the Act, the Council is given authority to develop a regional acquisition strategy with long-term, independent planning to serve the public and consumer interest in the Northwest. Each year, the Council, with the aid of its Resource Adequacy Advisory Committee (RAAC), assesses the adequacy of the regional supply five years out, counting existing resources and existing reserve levels, and assuming no new energy efficiency measures. [51, 52] Analytical results are based on the Council's GENESYS model, which performs a chronological hourly simulation of the power system's operation over an entire year. Each study simulates the year's operation many times with different combinations of river flows, temperatures (demand), and wind and solar generation. The Council's current resource adequacy standard limits the probability of a future year experiencing one or more shortfall events to no more than 5%, limiting the annual LOLP to a maximum of 5% . [53] However, the Council is testing the use of a multi-metric resource adequacy standard, which limits the frequency of shortfall events and the size and duration of unlikely but potentially high-impact events (sometimes referred to as "tail end" events).

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[50] Western Area Power Administration, Annual Report 2021, pg. 35, 2021.
[51] Northwest Power and Conservation Council, Resource Adequacy Advisory Committee, 2023.
[52] Bonneville Power Administration, Resource Adequacy: Meeting the Region's Energy Needs.
[53] Northwest Power and Conservation Council, Resource Adequacy Advisory Committee, 2023. https://www.nwcouncil.org/energy/energy-advisory-committees/resource-adequacy-advisory-committee

Every five years, the Council develops a power plan to ensure an adequate, efficient, economical, and reliable supply for the region.[54] The Council contributes greatly to the Western region's understanding of hydro resources and their contributions through its studies and public information.

The Northwest Power Act also led BPA to launch a Resource Program to assess BPA power and reserves needs as well as develop a related acquisition strategy. The 1980 Power Act mandates BPA's acquisition strategy to be consistent with the Council's power plan but does not require BPA to adopt the Council's resource adequacy standard. BPA's resource adequacy standard focuses on four elements: annual energy needs; monthly 10th percentile heavy-load-hour energy needs; monthly 10th percentile super-peak-hour energy needs; and weekly, 18-hour sustained capacity needs. In addition to its Resource Program[55], BPA releases an annual Pacific Northwest Loads and Resources Study (called the "White Book") which provides an accounting of forecast loads and existing resources over the ensuing 10 years.[56]

State statutes dictate IRP requirements for investor-owned utilities that are BPA customers. For example, in Washington, utilities that have more than 25,000 customers and are not 100% BPA customers submit an Energy Integrated Resource Plan every two years; utilities that have fewer than 25,000 customers and are 100% BPA customers submit a Resource Plan every two years. These two types of plans include 5- and 10-year load and resource forecasting, but utilities that are not 100% BPA customers have more extensive reporting requirements on average and peak energy, as well as contracts for unspecified power.

Resource Adequacy Authority or Roles

In areas served by BPA, collaboration with and input from the Council contribute to BPA's assessment of adequacy and planning for future resources. For example, the Resource Adequacy Advisory Committee charter requires one co-chair from the Council and one co-chair from BPA.[57] The Northwest Power Act also requires the Council's plan to "set forth a general scheme for implementing conservation measures and developing resources pursuant to section 839d of this title to reduce or meet the Administrator's obligations with due consideration by the Council for (A) environmental quality, (B) compatibility with the existing regional power system, (C) protection, mitigation, and enhancement of fish and wildlife and related spawning grounds and habitat, including sufficient quantities and qualities of flows for successful migration, survival, and propagation of anadromous fish, and (D) other criteria which may be set forth in the plan."[58] Power plan requirements include an assessment of BPA's resource needs and obligations, an estimate of the amount of resource capability needed to meet those obligations, and the types of resources that are most appropriate for meeting those obligations.[59, 60] However, the Council is required to set forth only "a general

[54] Northwest Power and Conservation Council, Power Planning, 2022. https://www.nwcouncil.org/power-planning
[55] Bonneville Power Administration, 2022 Resource Program, October 2022.
[56] Bonneville Power Administration, Resource Planning.
[57] Northwest Power and Conservation Council, 2022 – 2024 Resource Adequacy Advisory Committee Charter, Page 2, June 2022. https://nwcouncil.app.box.com/s/y606q8817chyyrg8ad0qi67xrwciw0ul
[58] Northwest Power and Conservation Council, Pacific Northwest Electric Power Planning And Conservation Act 16 United States Code Chapter 12H (1994 & Supp. 1995). Act of Dec. 5, 1980, 94 Stat. 2697. Public Law No. 96-501, S. 885, Page 92.
[59] Northwest Power and Conservation Council, 2021 Northwest Power Plan, Page 11, March 10, 2022. https://www.nwcouncil.org/fs/17680/2021powerplan_2022-3.pdf
[60] Northwest Power and Conservation Council, 2021 Northwest Power Plan, Pages 97-101, March 10, 2022.

scheme," not a specific resource acquisition plan for BPA. The Act requires BPA's resource acquisition strategy to be consistent with the Council's power plan, in particular regarding the level of energy efficiency measures that the plan estimates BPA should acquire.

Even though the only legal link provided in the Northwest Power Act to the Council's power plan is to BPA and its resource acquisition decisions and conservation implementation, the Council's power plan affects entities that purchase power from BPA because it is the primary provider and marketer of electric power in the region. In addition, the State of Washington's Energy Independence Act tied Washington utilities' conservation potential directly to the Council's methodology for conservation. [61]

State-Level Resource Adequacy

INTEGRATED RESOURCE PLANNING

Goals

An integrated resource plan is a utility plan for meeting forecasted annual peak and energy demands, plus some established reserve margin, through a combination of supply-side and demand-side resources over a specified future period. [62] Utilities produce IRPs to lay out their energy resource management goals to maintain reliability over a long period and communicate that plan to stakeholders. IRPs are overseen primarily by state regulators, though the degree of state oversight varies across the West. Because of their long-term horizon, approved IRPs are not seen as *binding* and any near-term resource retirement or acquisitions and resulting rate changes are still subject to approval by regulators.

Approaches

Western states establish varied requirements on the timing and process but generally do not dictate the planning metrics of methodologies used by utilities. Typically, utilities file IRPs that encompass a 10-to-20-year outlook every 2 to 4 years with their state commissions. For example, Colorado requires investor-owned utilities to submit an Electric Resource Plan (ERP) every 4 years to the Public Utilities Commission. ERPs must contain specific information, including an annual electric demand and energy forecast, planning reserve margins and contingencies, and emissions and water consumption. [63] Arizona requires load-serving entities to submit a 15-year resource plan every even-numbered year to the Arizona Corporation Commission. These plans must include information such as a "complete description and documentation of the plan, including supply and demand conditions, availability of transmission, costs, and discount rates utilized." [64]

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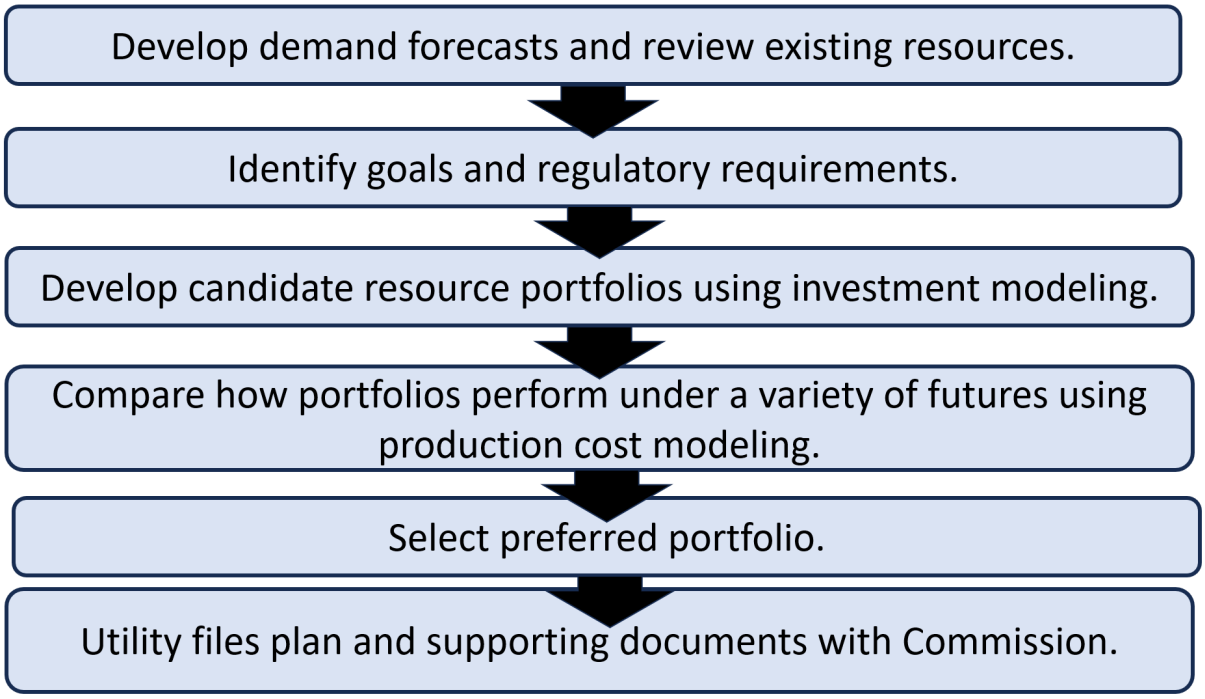
[61] Northwest Power and Conservation Council, 2021 Northwest Power Plan, Page 12, March 10, 2022.
[62] Rachel Wilson, Bruce Biewald, Regulatory Assistance Project, Best Practices in Electric Utility Integrated Resource Planning 2013, Page 2, June 2023.
[63] Code of Colorado Regulations, Section 4 CCR 723-3-3604 - Contents of the Resource Plan.
[64] Arizona Corporation Commission Utilities Division, Public Service Corporations, Corporations and Associations, Securities Regulation, Chapter 2, March 31, 2022. 14-02.pdf (azsos.gov)

Figure 2 below provides an illustration of the typical process for an IRP. Despite the similarities in planning processes, individual methodologies for forecasting, setting resource adequacy targets, capacity accreditation, and portfolio selection vary greatly.

Figure 2: Generalized Steps of Integrated Resource Planning



Notes: IRP processes vary by state and utility but largely follow a similar path.

Source: Heidi Ratz, Lori Bird, Pathways to Integrating Customer Clean Energy Demand in Utility Planning, World Resource Institute, October 2019, Page 10.

Resource Adequacy Authority or Roles

Typically, investor-owned utilities are required by state regulations to file an IRP on a periodic basis with the state utility commission. [65] In each state in the Western Interconnection, the state utility commission was established by either the state constitution or through legislative directive and consists of three or five commissioners who are either elected [66] or appointed [67] by the governor. With authority derived from the state, these commissioners execute their fiduciary duties of reviewing and approving or rejecting an IRP. There are two types of processes that occur after an IRP is filed with the state utility commission. In certain states, the commission has the regulatory authority to either approve or not approve the IRP, while in other states in the West, commissions have the authority to either acknowledge or not acknowledge the IRP. [68]

[65] The official name of the utility commission varies by state; it is often called a Public Service Commission (PSC) or a Public Utility Commission (PUC), with notable exceptions being the Arizona Corporation Commission and the Washington Utilities and Transportation Commission. For the purposes of this report, we refer to the state agency that regulates investor-owned utilities as the state utility commission.
[66] Commissioners in Arizona, Montana, and New Mexico are elected.
[67] Commissioners are appointed in California, Colorado, Idaho, Nevada, Oregon, Utah, Washington, and Wyoming.
[68] NARUC, Resource Adequacy Primer for State Regulators, July 2021.752088A2-1866-DAAC-99FB-6EB5FEA73042 (naruc.org)

MULTI-STATE INVESTOR-OWNED UTILITY EXAMPLE: PACIFICORP

Goals

In some cases, a utility will span several states and meet the unique requirements of each state while still using their own methodology over a broader region. PacifiCorp operates in six states: Utah, Oregon, Wyoming, Washington, Idaho, and California. PacifiCorp files an IRP with each of the six states' utility commissions every odd-numbered year. PacifiCorp was selected because it is the biggest multi-state utility in the West, not because it is representative of all utilities. In each of its states except California, PacifiCorp receives notification of acknowledgment of the IRP, if it meets applicable standards and guidelines in that state. In Oregon, for example, acknowledgment "means the PUC finds the IRP reasonable based on all the information presented." [69]

PacifiCorp describes the essential components of its IRP as "a finding of resource need, focusing on the first 10 years of a 20-year planning period; the preferred portfolio of supply-side and demand-side resources to meet this need; and an action plan that identifies the steps we will take during the next two to four years to implement the plan." Each IRP cycle includes a series of public presentations and opportunities for stakeholder comment to develop the plan. [70]

Approach

PacifiCorp's 2023 IRP, in hundreds of pages of content and appendices, describes the company's plan to develop a least-cost, least-risk resource portfolio that maintains reliability and affordable prices for customers while complying with applicable federal and state laws. To develop the IRP, PacifiCorp produced numerous studies, models, and analyses to evaluate factors, including coal retirements, transmission rights, portfolio reliability, flexible reserves, energy storage potential, smart grid technology, and many other aspects of the company's landscape of resources, potential risks, and opportunities. Their study also references WECC resource adequacy assessments, risks identified by the Northwest Power and Conservation Council's resource adequacy assessment, and future involvement in WRAP.

To balance supply and demand and mitigate risk, the IRP includes evaluation of load and resources on both an energy and capacity basis, considering weather and wildfire mitigation. [71] The 2023 IRP plans toward a 13% hourly planning reserve margin. In many instances, load-serving entities and WRAP have identified the need for seasonal PRM limits. The 13% PRM was developed using a Loss of Load Probability method years ago. However, PacifiCorp uses the PRM only in the Long-Term capacity expansion model (LT). Once a portfolio is created, PacifiCorp then runs it through the hourly Short-Term model (ST) to identify "Energy Not Served." They then add resources that address the reliability needs of the portfolio and reoptimize it. This reoptimized portfolio becomes the "Reliability-Modified Portfolio."

[69] Oregon Public Utility Commission, FAQ - LC 74 Idaho Power Integrated Resource Plan, n.d.
[70] PacifiCorp, Integrated Resource Plan, 2023.
[71] PacifiCorp, 2021 IRP Volume I, March 31, 2023.

A 2021 review of utility IRP planning metrics illustrates the variation among criteria and methodologies used by utilities, using the Northwestern as an example in Figure 3 below.

Figure 3: Northwestern Resource Adequacy Metrics Comparison [72]

Utility	Reliability Criteria	Capacity Contribution Methodology
Puget Sound Energy	LOLP (5%/year)	ELCC EUE adjusted for energy limited resources
Portland General Electric	LOLE (0.1 days/year)	Marginal ELCC
PacifiCorp	LOLH (2.4 hours/year)	LOLP based Capacity Factor
NorthWestern Energy	LOLE (0.1 days/year)	ELCC
Avista	LOLP (5%/year)	ELCC
Northwest Power and Conservation Council	LOLP (5%/year)	ASCC

Resource Adequacy Authority or Roles

PacifiCorp has an obligation to plan for a cost-effective, reliable system, and in so doing evaluates reliability (or resource adequacy) metrics. Then state regulatory commissions determine if the plan is reasonable and follows standards and guidelines. Other multi-state utilities in the West conduct their own IRP processes. [73]

CALIFORNIA: CPUC, CAISO, AND CEC

Goals

In California, three entities coordinate to determine resource adequacy: the California Public Utilities Commission (CPUC), the California Independent System Operator (CAISO), and the California Energy Commission (CEC). The CPUC is ultimately responsible for managing system-wide resource adequacy in the state, regulating load serving entities and their IRPs. The CPUC cites two goals for the resource adequacy program: "to ensure the safe and reliable operation of the grid in real time providing sufficient resources to the CAISO when and where needed," and "to incentivize the siting and construction of new resources needed for future grid reliability." [74] The 2000-2001 electricity crisis in California spurred a series of reliability regulations and, as previously described, increasing extreme weather events and variable demand necessitate strong resource adequacy planning in California. The recent 2020 reliability events have also led to more aggressive resource adequacy planning, including increased procurement of preferred resources, longer-term planning, and a new "slice of day"

[72] PSE, Resource Adequacy and ELCC Primer, 2021.
[73] For example, the Tri-State Generation and Transmission Association, which operates in Colorado, Nebraska, New Mexico, and Wyoming, files its IRP/ERP with the Colorado PUC and the Western Area Power Administration.
[74] State of California, Public Utilities Commission, Resource Adequacy Homepage, 2023.

component. The CAISO and CEC conduct studies and modeling to support flexible, local, and system resource adequacy on a monthly and annual basis.[75]

Approach

The CPUC sets distinct requirements for each Load Serving Entity (LSE) to maintain system, local, and flexible resource adequacy. LSEs include investor owned-utilities, community choice aggregators, direct access providers, and energy service providers. To develop broad, system-level resource adequacy requirements that ensure peak demand can be met reliably, each LSE forecasts its load based on a 1-in-2 probability, baselined against a CEC forecast, and then a 15% reserve margin is added.[76] Local resource adequacy requirements are focused on ensuring that LSEs can still meet demand when a local transmission grid emergency occurs. They are based on a CAISO 1-in-10 weather year and contingency study which are used to generate targets for the next three years. Lastly, flexible resource adequacy is a newer planning framework to address increasing system variability of ramping (the time to start or stop a generating resource as needed) due to the changing resource mix and higher levels of variable renewable energy. CAISO conducts a study of ramp rates and load-serving entities that must demonstrate procurement of 90% of their system obligation for flexibility in the coming year.[77] For each of these metrics, LSEs show compliance both annually and monthly. Annual compliance showings are filed each October and show LSEs have procured a portion of their requirement. [78] However, LSEs must demonstrate, 45 days in advance of each month, that they have procured 100% of that month's anticipated energy requirements.

Recent adjustments to California's resource adequacy planning have been made to address the changing resource mix and the declining capacity of use-limited resources[79] as their penetrations increase. These adjustments have included use of Effective Load Carrying Capacity (ELCC) for solar and wind capacity accreditation, proposed use for storage and demand response, and restrictions on use-limited resources through Maximum Cumulative Capacity constraints ("MCC Buckets"). In 2025, California's Resource Adequacy program will evolve with the introduction of the "Slice of Day" framework. This framework attempts to move resource adequacy planning away from analysis of peak hour capacity toward a 24-hour assessment using hourly profiles of both capacity and energy sufficiency.

Resource Adequacy Authority or Roles

Resource adequacy determination in California is led by the CPUC and guided by ensuring reliable electric service. The CAISO and CEC provide supporting roles in that their data and analysis are IRP inputs. Ultimately, the requirements set by the CPUC guide utility procurement.

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[75] State of California, Public Utilities Commission, Resource Adequacy Homepage, 2023.
[76] CPCU, Resource Adequacy Presentation for LAO, May 15, 2019.
[77] State of California, Public Utilities Commission, Resource Adequacy Homepage, 2023.
[78] State of California, Public Utilities Commission, Resource Adequacy Homepage, 2023.
[79] CAISO considers resources that have operational or environmental restrictions that limit production hours but can operate for a minimum set of consecutive trading hours to be "use-limited." See: Accurate Network Modeling Supports Efficient Market Operations.

Summary

Through this introduction of the entities and processes across the West that influence resource adequacy, it's clear that there are layers of involved entities and variation across methodologies. While NERC and WECC play key roles in assessing resource adequacy risk and proposing future recommendations, the West relies primarily on utility planning processes. Investor-owned utility resource planning varies greatly in terms of planning metrics, assumptions, transparency, and the degree of state regulatory oversight. California's resource adequacy planning differs significantly from the rest of the West and is continuing to evolve. Federal power marketing agencies cover significant amounts of Western land and resources, adding even greater variation. The Western Resource Adequacy Program is an important step forward for Western utilities that joined and could create greater consistency across resource adequacy planning processes and improve regional coordination. As Western regionalization progresses, important connections between WRAP and utility planning will be needed. The WRAP's short-term resource adequacy standard and assessment methodology may differ widely from utility and state regulator policies. It will be critical to establish a strong collaborative effort to identify and address potential differences in resource acquisition goals, such as planning reserve margins, between each long-term planning entity and the WRAP.