PRIMER

EVOLVING RESOURCE ADEQUACY APPROACHES ACROSS THE UNITED STATES

CEBI

Clean Energy Buyers Institute

INTRODUCTION

Resource adequacy planning varies across different regions of the United States and often depends on the regulatory structure in place. Climate goals, extreme weather, and changing resource mix are key factors driving the evolution of resource adequacy planning. This planning impacts large energy customers' goals of ensuring electricity reliability, minimizing energy costs, and procuring more clean energy.

For large energy customers engaged in utility planning or market design reforms in a region, understanding resource planning and future industry innovation can support their ability to evaluate reforms that can enable a low-cost, reliable, and decarbonized grid. Where significant regulatory changes are underway, such as the development of new organized wholesale electricity markets or resource adequacy reforms, a basic understanding of how resource adequacy planning works can provide clarity as new proposals arise.

Planning and procurement for resource adequacy can include federal or regional assessments, regional coordination through markets or programs, and utility planning and procurement with state oversight. As changing weather patterns add stress to the grid and utilities transition away from fossil fuels to clean energy, grid planners are now rethinking resource adequacy planning.

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RESOURCE ADEQUACY BASICS

In the Clean Energy Buyers Institute's (CEBI's) 2021 primer *Resource Adequacy Approaches and Importance to Energy Buyers*, CEBI explored the basics of resource adequacy and introduced general steps for planning. The three major steps are:

1. Forecasting demand
2. Determining a target reserve margin
3. Using market and/or planning mechanisms to meet the target reserve margin

Grid operators may be utilities or regional transmission organization (RTO) and independent system operator (ISO) staff. They begin by forecasting how much demand must be met in a planning area. This information is used to determine a target reserve margin, sometimes also called a planning reserve margin. A reserve margin is the amount of additional resources above targeted demand needed to protect against outages.

Reserve margins are usually expressed as a percentage calculated as:

RESERVE MARGIN = (EXPECTED MAXIMUM AVAILABLE RESOURCES – FIRM PEAK DEMAND) / (FIRM PEAK DEMAND)[1]

Overall, the cost that all customers bear decreases when utilities can share energy and capacity resources instead of individually planning high levels of resources. Consistent resource adequacy targets and metrics that share the same language and assessments can be easily compared and increase the ability of a region to harmonize planning and share resources across utility footprints or other planning boundaries.

Depending on a region's regulatory structure, market mechanisms or utility planning can be used to procure enough future resources to meet this target. RTOs/ISOs or other regional planning entities often look out over one- to five-year time horizons to set resource adequacy targets. Because resource adequacy planning can facilitate near-term energy sharing and guide investment decisions, resource adequacy may also be planned over a longer time period due to the lead time needed when developing new resources. For example, utility planning for resource adequacy is often an element of an integrated resource plan (IRP) for the coming 10 to 15 years.

To understand the differences between current resource adequacy planning constructs in different regions, two major elements to consider are who and how. Across different regions of the United States, different entities play different roles in planning resource adequacy. The "who" can span several layers of planning at once, including federal agencies, regional entities, and utilities. Resource adequacy metrics also vary in how they gauge the degree of resource adequacy and what level of grid reliability they target.

1 U.S. Energy Information Administration. Reserve electric generating capacity helps keep the lights on. June 2012. https://www.eia.gov/todayinenergy/detail.php?id=6510.

ENTITIES THAT
ASSESS, PLAN, OR PROCURE FOR RESOURCE ADEQUACY

NORTH AMERICAN ELECTRIC RELIABILITY CORPORATION AND ITS REGIONAL ENTITIES

The role of the North American Electric Reliability Corporation (NERC) is one constant across all regions. NERC has no authority to set a resource adequacy standard or target reserve margin but does have a role in assessing resource adequacy levels. NERC provides independent, public assessments of reliability, adequacy, and associated risks for future seasons and over the future 10-year period.[2]

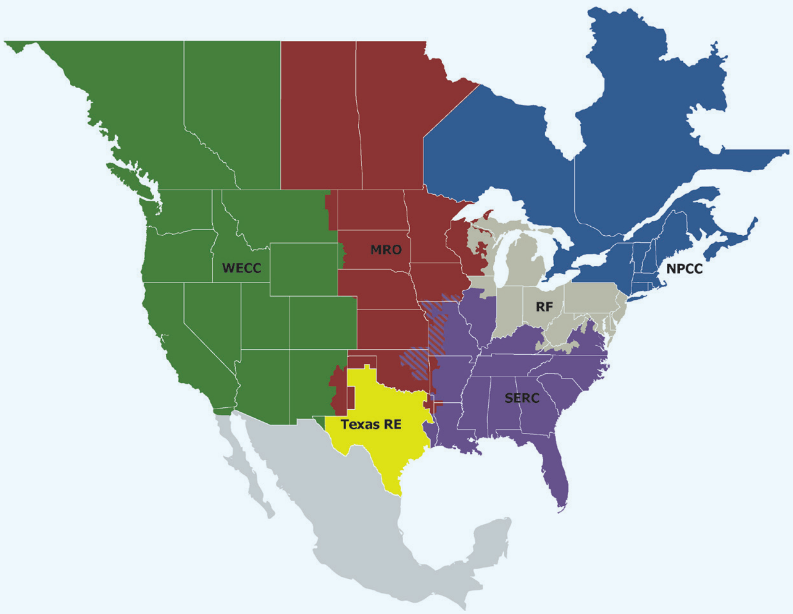
NERC also may examine specific risks through targeted assessments or task forces. The Federal Energy Regulatory Commission (FERC) has designated NERC as the nation's electricity reliability organization, and NERC sets reliability standards that NERC's regional entities enforce across their region. NERC's six regional entities are shown in the map below and develop regionally focused data about projected on-peak demand and system energy needs, demand response resource capacity, and transmission projects.

RESOURCE ADEQUACY VERSUS RELIABILITY

Resource adequacy assessments consider whether the current or projected energy resource mix is sufficient to meet capacity and energy needs for a particular grid. Resource adequacy is a component of overall grid reliability.

Reliability refers to the ability to deliver the resources to the loads. While advance planning to have resources in place supports reliability, real-time disturbances such as short circuits or line failures in the distribution or transmission grid also impact reliability.[3]

NERC REGIONAL ENTITIES



Source: *North American Electric Reliability Corporation*

2 NERC's website has a range of reliability reports, including long-term assessments, winter assessments, and summer assessments: https://www.nerc.com/pa/RAPA/ra/Pages/default.aspx.

3 Madeline Geocaris. Assessing Power System Reliability in a Changing Grid Environment. August 2022. National Renewable Energy Laboratory. https://www.nrel.gov/news/program/2022/assessing-power-system-reliability-in-a-changing-grid-environment.html.

RTOS/ISOS AND REGIONAL PROGRAMS

In regions of the United States where RTOs or ISOs exist, these independent, nonprofit entities operate the bulk power system under FERC regulation. RTOs/ISOs play many key roles that include supporting reliability across the region, managing regional transmission planning processes, and performing resource adequacy assessments. Every RTO/ISO also has a mechanism for state input in market operation.[4]

The way each RTO/ISO region approaches its resource adequacy role varies greatly; however, they all provide useful coordination that covers a wide footprint. RTOs/ISOs also can facilitate synergies between transmission service, interconnection, energy markets, resource adequacy, and transmission planning.

In the Northeast, where vertically integrated utilities were restructured,[5] some RTOs/ISOs have also implemented capacity markets to support their assessments and planning processes by driving procurement of resources for adequacy. These markets provide a revenue stream to generators that can commit to having capacity[6] available in the near future and may enforce penalties if they are not available as committed. Capacity markets are used by the New York Independent System Operator (NYISO), Independent System Operator of New England (ISO-NE), and PJM Interconnection.[7]

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While the Electric Reliability Council of Texas (ERCOT) is also a market where vertically integrated utilities have been restructured, this market takes a unique approach to ensure resource adequacy and relies on price spikes in the energy market during times of resource scarcity to incentivize investment. ERCOT's target for resource adequacy is also considered an economically determined target rather than a physical target, because the amount of resources ultimately procured is linked to the willingness to pay for additional levels of reliability.

In the Midwestern market operated by the Midcontinent Independent System Operator (MISO), a residual capacity market complements the role of states and utilities. MISO aggregates forecasted demand within its footprint and determines a planning reserve margin for the region that meets the standard of 1 in 10 loss of load expectation. Utilities must show they have sufficient resources in place to meet those requirements. Utilities expecting shortfalls can purchase capacity through an annual planning resource auction. If needed, individual states also have the ability to set their own planning reserve margins that differ from the MISO-wide target.

The two remaining U.S. markets, the California Independent System Operator (CAISO) and Southwest Power Pool (SPP), operate resource adequacy programs based on utility-led procurement and bilateral trading, without use of capacity markets. SPP uses the standard of 1 in 10 loss of load expectation and sets a market-wide planning reserve margin. In SPP, the Regional State Committee has a strong role in resource adequacy and determines what the regional planning reserve margin will be.

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4 Please see our Primer on RTO/ISO Governance: US-Organized-Wholesale-Electricity-Market-Governance-Primer.pdf (cebi.org). In addition, the National Association of Regulatory Utility Commissioners' (NARUC's) Resource Adequacy for State Utility Regulators: Current Practices and Emerging Reforms provides a more detailed review of the state influence present in each RTO/ISO.

5 U.S. Environmental Protection Agency. Power Market Structures, 2023. https://www.epa.gov/green-power-markets/power-market-structure.

6 The U.S. Energy Information Administration (EIA) refers to capacity as the maximum output of electricity that a generator can produce under ideal conditions. Energy is the amount of electricity that is produced and consumed over time. Energy is measured in megawatt hours (MWh).

7 PJM is a legacy acronym that used to stand for Pennsylvania, New Jersey, and Maryland; the market now covers 13 states.

CAISO is a single-state RTO/ISO that shares resource adequacy planning with the California Energy Commission and the California Public Utilities Commission. These two state commissions forecast demand and assess resource needs. CAISO then creates a transmission plan that feeds into a resource plan that utilities meet through their planning and procurement. Within this process, the state Public Utilities Commission sets a planning reserve margin, though there isn't a clear standard of reliability behind the target.

Beyond RTOs and ISOs, a new regional program for resource adequacy has emerged in the West. The Western Resource Adequacy Program (WRAP) was developed by the Western Power Pool, and FERC approved the program in February 2023. The program will improve transparency in utility planning in the West and establish a shared planning reserve margin. This will help harmonize planning reserve margin and capacity accreditation[8] approaches to enable Western states to share power more easily during conditions that stress grid reliability. More information on this program can be found in a white paper by CEBI and Western Resource Advocates: *Resource Adequacy Planning in the Western Interconnection*.

While RTO/ISO models for establishing shared targets for resource adequacy vary, these markets provide some consistency and opportunities for enhanced power sharing. The development of the WRAP program in a non-RTO area demonstrates the ability of a region to find new solutions and continue to evolve resource adequacy constructs to meet the needs of states and energy customers.

8 Capacity accreditation refers to the metrics planners use to describe the different contributions potential resources can provide to the grid to maintain a certain level of risk.

PUBLIC UTILITY COMMISSIONS AND UTILITIES

Most electric utilities in the United States are vertically integrated and own all levels of the supply chain for generating, transmitting, and distributing electricity to their customers. They also plan for resource adequacy through IRPs and then procure generation resources to maintain resource adequacy, with varying levels of oversight from state utility commissions. IRPs outline how a utility will meet 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.

Utilities produce IRPs to compare different strategies for resource development and communicate their final plan to stakeholders and regulators. Because of the long-term horizon of IRPs, approved plans are not seen as binding, and any near-term resource retirement or acquisitions and resulting rate changes are still subject to approval by regulators.

While IRPs primarily are overseen by state regulators, the degree of state oversight can range from simple regulatory commission recognition that a plan has been prepared to fully litigated proceedings where regulators can potentially reject plans if the underlying analysis is not sound or robust. In Wyoming, for example, the commission just acknowledges a plan has been completed. In other states, such as New Mexico and North Carolina, the commission approves a plan as long as basic elements are included. States with the most authority over resource planning, such as Colorado and South Carolina, require the commission to approve or deny plans based on the quality of analysis or allow regulators to request additional analysis.[9]

Most IRP processes follow these steps:

1. Forecasts of demand and assessment of existing resources
2. Identification of state and utility goals and regulatory requirements
3. Development of possible resource portfolios
4. Comparison of portfolios
5. Identification of a preferred portfolio
6. Submission of the plan and portfolio to the state regulatory commission for recognition or approval

Beyond these steps, individual utilities each have their own unique planning approaches, metrics, and assumptions. For example, determination of a planning reserve margin can use either a deterministic method (one single forecasted peak hour is considered and a set reserve margin is added) or a probabilistic method (a more complex modeling of multiple hours including assumptions about resource performance). Even when the same approach is used, differences between methodologies make it difficult to compare utility plans.[10] Inability to assess resource adequacy consistently across utility plans is amplified by the varying levels of transparency provided on metrics and assumptions in publicly filed plans.

9 Integrated Resource Plan (IRP) Support Package. 2021. American Cities Climate Challenge. Page 7. https://cityrenewables.org/wp-content/uploads/edd/2021/06/Integrated-Resource-Plan-Support-Package.pdf

10 The National Association of Regulatory Utility Commissioners. Resource Adequacy Primer for State Regulators. July 2021. Page 52. https://pubs.naruc.org/pub/752088A2-1866-DAAC-99FB-6EB5FEA73042.

BROAD RESOURCE ADEQUACY CHALLENGES

Resource adequacy assessments in the past have been fairly straightforward and could focus on forecasting peak demand to ensure sufficient resources could meet demand plus a margin of error. Today, increasing incidence of extreme weather events and demand variability mean resource planning must evolve to meet new needs. The integration of low-cost, zero-carbon, and more variable energy resources such as wind and solar power requires greater focus on a wider range of reliability risk beyond the peak hour.

These changes in resource adequacy planning will impact all corporate and institutional energy customers seeking low-cost, reliable clean energy supplies. Failure to respond to these trends will ultimately result in higher costs to end use customers, limit the optimization of clean energy resources, and lower levels of reliability.

Some trends in resource adequacy assessments include:

INCREASED NEED FOR POWER SHARING AND COORDINATION BETWEEN PLANNERS: Regions and states should consider resource adequacy tools that maximize the benefits of power sharing. Extreme weather in the form of destructive storms, prolonged droughts, and heat waves is putting unprecedented stress on the grid. These severe events often are geographically concentrated. Neighboring regions can assist each other in meeting demand through resource adequacy and reliability coordination, increasing the benefits to customers.[11] A huge driver of greater resource sharing is the presence of a regional market or program. Regional consistency across planning metrics and practices assists entities in pooling resources more efficiently and helps maintain a level playing field for new resources.

EVOLVING PLANNING METRICS AND CALLS FOR EXPANDED WEATHER DATA: Planners increasingly recognize the need to adapt resource adequacy metrics and planning approaches in order to meet new grid needs. For example, planners are more actively evaluating the interactions of portfolios of resources rather than the hypothetical contribution of one resource in isolation as resources become more weather dependent. While traditional metrics like loss of load expectation are an important baseline and minimum for planning, new metrics are beginning to more clearly account for the magnitude of outages or their relation to each other. Experts have begun to call for new weather data to better predict future weather patterns and expanded demand for electricity through building and vehicle electrification. Experts and large energy customers also are interested in better integrating the economic value of reliability for different customers or use cases.

11 Robert Walton. "'Modest' transmission buildout would have yielded millions in benefits in December storm: ACORE." Utility Dive. February, 2023. https://www.utilitydive.com/news/modest-transmission-buildout-would-have-yielded-millions-in-benefits-in-d/642374/.

POTENTIAL CONNECTIONS BETWEEN RESOURCE ADEQUACY AND OTHER PLANNING: As a key enabler of resource adequacy, transmission allows electricity resources to be delivered across broader geographies, time zones, and weather patterns. Grid planners could begin to integrate transmission planning with resource adequacy considerations to maximize benefits. The connections between customer-sited demand-side resources and bulk power planning also could be better integrated, to more fully support resource adequacy.

Several grid experts and think tanks have developed resources and best practices for future evolution of resource adequacy frameworks. These resources include the Energy Systems Integration Group's Five Principles of Resource Adequacy for Modern Power Systems and the Lawrence Berkeley National Laboratory's Guide for Improved Resource Adequacy Assessments in Evolving Power Systems.

IMPLICATIONS FOR CUSTOMERS IN EXISTING AND EMERGING MARKETS

Corporate and institutional energy customers have a key role in expressing their priorities to decision makers and identifying best practices that will improve resource adequacy planning in their region. Resource adequacy is important to customers because it is a key driver of cost and a critical component for ensuring reliable electric service, which is a top priority for many energy customers because outages can result in significant economic loss. Electric outages also can endanger public safety and disproportionately impact vulnerable and low-income communities.

Understanding the current structures and processes in place for planning and procurement to meet resource adequacy targets helps large energy customers evaluate the feasibility of their own new developments or future innovative approaches. As grid challenges increase, evolutions in resource adequacy planning will allow regional entities, states, and utilities to meet the future demands of the grid and serve the needs of customers.

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