

Resource Adequacy in the West: A Snapshot

NARUC Resource Adequacy Concepts and Planning Approaches

December 5, 2023





Today's Presentation: RA in the West

Backdrop: RA Reform Initiatives

 Regional Updates:
The Western Resource Adequacy Program

➢ Redesigning RA and IRP in California

➤Future Trends



WECC's Emerging Resource Adequacy Landscape

Key Trends Driving RA Reform in California









Context: RA in the West



Background: Western RA Basics

Relative to the Eastern Interconnection, RA in the West is complex and balkanized:

- CAISO: California LSEs have participated in organized, bilateral RA program since mid-2000s
- Non-CAISO: Outside of CAISO, RA typically lives within state- or utility-level reliability programs, often nested within an Integrated Resource Plan

Escalating reliability anxiety is driving greater regional coordination:

- At the Utility Level: Utilities and Commissions are striving to better reflect reliability risk in IRPs with improved modeling, data, and longer-term planning
- At the Regional Level: The Western Resource Adequacy Program (WRAP), the first multi-jurisdictional RA program outside of an ISO, will will eventually cover ~2/3 of non-CAISO WECC load



Western Resource Adequacy Program Bilateral RA Programs (CAISO, SPP) Central Capacity Markets (PJM, MISO, NYISO, ISO-NE)

Evolving Reliability Dynamics

The WECC is undergoing a series of dramatic physical shifts:

- Retirements: Conventional resources are exiting the system for policy and economic reasons (e.g. -13.4GW of coal)
- Clean Resources: Solar and storage deployment is accelerating, with significant benefits but also saturation effects
- Climate Change: Climate-induced drought and severe weather (esp. heat) are adding long tails to hydroelectric availability and peak demand
- Load Growth: Surging load growth, led by data centers and followed by electrification

CHANGING RESOURCE MIX

The resource mix in the Western Interconnection will continue to change over the next decade.

Net Change in Resources 2023-2032	
Coal	-13.4 GW
Nuclear	-1 GW
Natural Gas	4.7 GW
Hydro	2.3 GW
Solar	31.9 GW
Wind	9.2 GW
Battery Storage	18.3 GW

Planned Resource Additions and Retirements 2023–2032 (GW)



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The West's Changing Resource Mix

Shifting Hours of Risk

The cumulative effect of these dynamics:

- Flexibility: Increased need for flexible resources, e.g. storage or fast-ramping thermal, leads to...
- Shift in Net Peak: Hours of risk shift later into the evening after solar decline, leads to...
- Saturation Effects: 4-hour storage effectiveness declines as the narrow net peak is saturated, leads to...
- Clean Firm Needs: Widening reliability and decarbonization needs to meet off-peak energy demand



Evolving System Risk in CAISO



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Shifting Hours of Risk



Data source: California Independent System Operator (CAISO)

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Regional Updates: WRAP

Excerpts from GridLab's September 2023 WRAP: Considerations for Planners and Policymakers (report, slides)



WRAP: Key Takeaways

- WRAP, a first-of-its-kind non-ISO regional Resource Adequacy program, represents a major step forward toward regional reliability analysis, planning, and coordination for the non-CAISO West
- WRAP has the potential to help address a major collective action problem for the region the ability to proactively assess and drive resolution of regional reliability needs through data collection, analysis, and the establishment of binding requirements
- While WRAP is a major step forward, achieving WRAP's full economic and reliability potential will require:
 - Integration with Planning: Effective integration of WRAP into utility-level planning and procurement activities, including both near-term compliance and long-term planning
 - Modeling Gaps: Program evolutions to address near-term modeling gaps and extend analysis beyond the current limited planning horizon
 - Data Insights: Enhanced data transparency to facilitate the integration of WRAP's data insights into utility modeling workflows
 - **Transmission Friction:** Resolving transmission rights friction unique to WRAP as a non-ISO regional Resource Adequacy program



WRAP, CAISO, and the Broader WECC

WRAP Basics

- WRAP is a regional reliability program providing an accounting and compliance framework to ensure Participants (utilities) have sufficient resources (capacity) to meet a desired reliability standard
- Mechanically, WRAP consists of two phases:
 - Forward Showing (FS Program):
 - o Defines a regional reliability requirement using a probabilistic model
 - o Allocates responsibility to Participants and establishes reliability values for all resources
 - o Requires participants to show portfolios meeting their assigned reliability requirement
 - Operations Program (Ops Program):
 - o Supports real-time transactions between Participants during periods of scarcity
- At its outset, WRAP is expected to have 22 Participants and will cover approximately 2/3 of non-CA WECC load
 - Non-participants include Colorado, rural electric co-operatives, and others
- WRAP will fill some (but not all) of the reliability functions that would be served by a regional Independent System Operator



WRAP Participant Footprint

WRAP will cover the majority of non-CA WECC load

Planning: The Forward Showing (FS Program)

- The Forward Showing is the centerpiece of WRAP's planning and procurement compliance program.
- Compliance requirements will be established 1 year prior to the showing deadline
- Advisory compliance requirements will be established 4 years prior to the showing deadline; however, these will change as the portfolio evolves
- Unlike most RA programs, the FS Program bifurcates generation and transmission, requiring participants to procure both



Planning Horizon – WRAP and IRPs

WRAP will be helpful for near-term adjustments, but will not inform long-term

planning needs - a common challenge for capacity markets and RA programs



Illustrative Summer Season Showing

Note variations in monthly load and resource values

ELCC: Planning on a Surface in Multiple Dimensions

- WRAP accreditation for solar, wind, and storage will utilize Effective Load Carrying Capability (ELCC) calibrated to WRAP portfolio
 (ELCC values not specific to each utility's portfolio)
- ELCC, by design, adjusts as a function of the portfolio including significant saturation and interactive effects
- While adjustment is directionally predictable, participants will have limited foresight into regional portfolio (and corresponding ELCCs) beyond immediate compliance years
 - In contrast to ELCC in IRPs, ELCC is an exogenous compliance input
 - In contrast to a capacity market, the onus is on the utility to fill any open position – in a market not known for short-term liquidity
- ELCC predictability concern is a symptom of the broader challenge of aligning modeled aspirations with procurement realities



Illustrative ELCC Curve

ELCC trajectory dependent on level of storage and solar (among other factors)



WRAP: Big Snaps and Remaining Gaps

WRAP has the potential to:

- Significantly improve RA analysis and needs identification in the short-run (1-5 years)
- Establish a formal framework for assigning responsibility for procurement, with penalties for non-compliance
- Enable reduced reserve requirements through regional load and resource diversity
- Facilitate more liquid reserve sharing during scarcity events

In its current form, WRAP will not:

- Displace the need for utility- and state-level resource planning and modeling
- Have predictable, "bankable" resource accreditation and PRM values beyond 1 year (but more mid- and long-term planning could)
- Address physical and contractual transmission friction (but an ISO could)
- Provide for optimized, least-cost dispatch across the region (but EIM / SPP+ / an ISO could)

Regional Updates: California



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California's Planning Reform: RA, IRP, and CPE

California's resource planning landscape is undergoing a full reconstruction:

- Resource Adequacy is unfolding from monthly to "monthhourly" with Slice of Day beginning in 2025
- An impending Integrated Resource Planning proposal will establish multi-year reliability and emissions compliance standards
- A Central Procurement Entity has been established by the Legislature to procure "hard stuff" unlikely to be procured by LSEs



Moving from ELCC to Slice of Day



Slice of Day replaces ELCC by disaggregating the ELCC 'stack' into hourly profiles intended to enable LSEs to predict, plan for, and procure to portfolio dynamics

- Upside: Explicit representation of resource dynamics provides LSEs more tangible representation of "ELCC effects" (saturation, interactive effects) and internalizes to LSE portfolio
- Downside: Hourly disaggregation is complex and implies false precision like ELCC, must be grounded in probabilistic reliability analysis of integrated portfolio; significant increase in complexity for market participants countered by improved visibility into long-term needs



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A Big Jump in Complexity? Sort Of



- Slice of Day replaces MCC buckets a simplified set of restrictions on use-limited resources, especially storage and demand-response, intended to require all LSEs to shape their portfolios to the system load shape
- > CPUC staff were adamant that any RA reform proposal **must either retain or enhance the MCC Buckets**
- Slice of Day attempts to provide LSEs a more granular and flexible approach to meeting the load-matching requirement

How is Slice of Day Calibrated?

Load: Utilizes 1-in-2 load forecast for each LSE (trued up to ensure sum of LSE loads equal state forecast)

>Resources:

- Firm Resources: Equal to Net Qualifying Capacity for 24 hours (same as today)
- Solar and Wind: Regional profiles using exceedance tuned to "worst days" in recent historical record
- Storage and Demand Response: Limited to dispatch (energy / duration) of specific resource

Planning Reserve Margin: Tuned to align compliance requirement with portfolio tested in probabilistic model (Loss of Load Expectation = 0.1)

Additional Details: <u>Workshops</u> and <u>Report</u>



Recent ELCC History (Monthly Average ELCC)



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Orientation: The Three Worlds of Resource Adequacy



Modeling World

LOLE analysis determines resource need

Compliance World

LSE contracts for resources to meet .xlsx-based requirements

Operations World

Resources available to CAISO for commitment and dispatch







IRP Reform and Central Procurement

IRP Reform and Central Procurement are slated for additional policy development in 2024

 \geq IRP reform is expected to:

Establish a multi-year reliability framework, expanding from one-off procurement orders to a more holistic portfolio assessment for each LSE

Establish a clean energy / emissions framework above and beyond the statutory renewable energy requirements

The Central Procurement Entity has been statutorily authorized, but expectations for its use to procure resources (e.g. offshore wind) remains ambiguous



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Western RA Outlook

Challenges and Opportunities



Key RA Trends in the West

- Fundamentals: Market tightness is the new reality the confluence of retirements, load growth, extreme weather, and other factors, has rapidly realigned the west from a region of surplus to one of scarcity:
 - > Generation: Significant decline in fossil and nuclear capacity coupled with reduced confidence in hydroelectric resources
 - > **Demand:** Load growth, extreme heat, and increasingly correlated regional demand spikes
- Long-Term Planning: Utility-level analysis is increasingly dominated by reliability concerns as long-planned retirements collide with a sharp drop in the reliability of market resources during extreme conditions utilities and regulators scrambling to reform and enhance planning frameworks:
 - Modeling Tools: Increasing reliance on advanced modeling tools, including probabilistic RA parameters (e.g. ELCC surfaces and LOLE-defined PRMs) coupled with ex post probabilistic review
 - > Inputs & Assumptions: Weather simulation, climate effects, thermal outage risks, import limits
- Regional Collaboration: Significant regional efforts are underway to establish frameworks for coordination and semi-organized "non-market" markets:
 - > Western Power Pool: Establishment of WRAP, emerging transmission coordination group (WTEC)
 - Regionalization: Competing efforts to bring organized markets to the west (e.g. CAISO WEIM / SPP Markets+)

Three Horizons of Resource Adequacy



Near-Term (2020s?)

Thermal + Hydro Dominant RE + Storage Emerging



Mid-Term (2030s?)

RE + Storage Dominant Clean Firm + LDES Emerging



Long-Term (2040s?)

?



What's on the Horizon for the West?

≻The 2020s:

- > Which regional frameworks will emerge, and will it/they be successful? WRAP, ISO formation, transmission collaboration
- Will utility planning frameworks rise to the near- and long-term planning challenge? Modeling workflows, data inputs, staffing challenges
- > Will key resource development bottlenecks be alleviated? Supply chain, interconnections
- > Will planned retirements be executed or delayed? Capacity challenges, local reliability concerns, conservative reliability mentality

≻The 2030s:

- Which near-term emerging technologies will materialize, and how will they perform? Hydrogen, geothermal, long-duration energy storage
- > Will decarbonization efforts be overwhelmed by demand growth? *Electrification, industrial load growth, and extreme weather*
- > Will grand plans for a transmission revival be realized? Local opposition, wildfires, cost

➤The 2040s:

Nuclear fusion (arriving December 2043)



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Three Worlds of Resource Adequacy



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Three Worlds of Resource Adequacy – Key Issues



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Three Worlds of Western RA



CPUC / CAISO RA

State / ISO capacity requirement (bilateral, competitive, IPP-heavy)



WPP WRAP

Regional capacity exchange / requirement (bilateral, noncompetitive, UOG-heavy)



Vertical Regulation

State/locally-driven planning and procurement processes



Three Worlds of Western RA – Key Issues



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Three Horizons of RA



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Thermal + Hydro Dominant RE + Storage Emerging



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?



Three Horizons of RA



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Background: RA as a Data Compression Exercise

- In a competitive RA market, LOLE results need to be translated to simple data outputs for use in (typically) Excel based compliance tools.
- ELCC is one method of producing summary reliability statistics from the LOLE study portfolio, providing a fungible resource attribution metric across all resources
- > How do we generate comparably robust 'data compression' on an hourly basis?







The ELCC-Human Interface

- For ELCC to be successful, it must be comprehensible and predictable to utilities, market participants, regulators, and other stakeholders.
- > Fundamentally, market participants *don't get* ELCC:
 - X "ELCC is the same as expected output at the net peak."
 - X "ELCC values should be fixed in perpetuity at the time of investment."
 - X "ELCC is more of a solar thing, it can't be applied to coal or natural gas."
 - X "ELCC of 4-hour storage is about 1, I'll use that to replace my whole fleet."
 - X "If we use ELCC, market forces replace the need for planning."

