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CALIFORNIA'S CONSTRAINED RESOURCE ADEQUACY MARKET: RATEPAYERS LEFT STANDING IN A GAME OF MUSICAL CHAIRS

Updated June 22, 2023

1. Introduction

The Resource Adequacy (RA) supply available within the California Independent System Operator (CAISO) balancing area for 2023 appears inadequate to meet the RA program compliance requirements. The "stack" analysis in Figure 1 below, which compares RA requirements with the available RA supply, demonstrates that the margin is razor thin "on paper."[1] The recent Joint Agency Reliability Planning Assessment by the California Energy Commission (CEC) and California Public Utilities Commission (CPUC), which is based on an hourly analysis of anticipated supply and projected demand, roughly substantiates this conclusion. When the stack analysis is viewed in the context of regulatory dynamics and Western market constraints, however, the razor-thin margin becomes a material supply deficiency.

A wide range of factors have contributed to these conditions:

- Weather conditions are more extreme, increasing load and reducing generation output.
- Hydro resource availability has declined under drought conditions.
- New resources are delayed due to permitting, interconnection, and supply chain challenges.
- The entire Western region is constrained, reducing the availability of imports to California[2] and risking increased exports of California resources to meet other Western region requirements (*e.g.,* Western Resource Adequacy Program (WRAP)).
- CPUC reduction in effective load carrying capacity values reduced reliance on wind and solar resources to meet RA requirements.
- CPUC's increase in planning margins (PRMs) to 16%, with a 20-22.5% "effective" PRM for investor-owned utilities (IOUs), increased RA requirements.
- CPUC's definition of "incremental" procurement to meet the effective PRM encouraged IOUs to cannibalize the existing RA resource stack, reducing supply for other LSEs.
- Unnecessarily restrictive requirements for energy imports under the CPUC's RA program reduced the availability of imports to the CPUC-jurisdictional RA market.

The RA supply deficiency will prevent collective compliance by CAISO load-serving entities (LSEs) despite their best efforts to procure and willingness to pay exorbitant prices. Some LSEs subject to the CPUC's RA program were unable to obtain enough supply to comply with their

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[1] The stack analysis focuses on the sufficiency of supply to enable load-serving entities to comply with RA program requirements and does not analyze the likely sufficiency of energy to meet Summer 2023 needs.

[2] Historical RA import data from the CAISO demonstrates that the amount of imports in year-ahead RA showings declined from 5,900 MW in 2020 to 3,600 MW in 2022. RA imports from unspecified declined from 4,300 MW to 1,300 MW over the same period. Historical year-ahead RA data: http://www.caiso.com/Documents/HistoricalYearAheadResourceAdequacyAggregateData.xlsx.

year-ahead RA compliance requirements despite numerous formal solicitations and substantial bilateral outreach. Recent experience suggests the problem will only grow in the month-ahead RA compliance process absent a substantial increase in hydro output, imports, or expedited deployment of new resources.

Not all LSEs start the game with the same odds. IOUs hold most "legacy" supplies built prior to the recent growth of community choice aggregation (CCA) and the expansion of Direct Access (DA). As CCA or DA load has departed the IOU portfolio, the IOUs have retained for their remaining bundled load the supply previously procured for the departed load. Consequently, as conditions have changed, the burden of finding new supply to meet requirements has shifted largely to CCA and DA customers. The challenges in getting new steel in the ground thus have had a graver effect on these customers.

Under these conditions, RA program compliance has become a game of musical chairs: some chairs are occupied by the IOUs and some have been grabbed by out-of-state entities, leaving some California LSEs without a chair when the music stops. Until more new resources come online, the race to find a chair in the game will have detrimental consequences for all consumers. The RA shortfall has driven up prices paid by consumers. Resources that garnered $3.63 kilowatt (kW)-month in 2019[3] rose to prices as high as the mid-$40 kW-month for summer 2023 and are increasingly unavailable at any price. Sellers are the only market participants who benefit from this pressure.

RA penalties for LSEs unable to secure supply in a deficient market do nothing to get new resources in the ground; they unnecessarily add to customer costs and indirectly increase the cost of supply. Resource development is properly addressed in the CPUC's Integrated Resource Planning process and procurement mandates.

2. RA Supply/Demand Balance: 2023 RA Stack Analysis

The RA stack analysis in Figure 1 below compares the demand for system RA for peak months in 2023 to the total supply of RA, including RA from resources in the CAISO footprint and estimated RA imports. RA supply is primarily derived from the CAISO's net qualifying capacity list, while RA demand is the forecasted median load in the CAISO plus a planning reserve margin.

As shown in Figure 1 below, demand for RA exceeds the available supply of RA by 433 MW, even after accounting for imports and expected addition of resources, in September 2023. Supply is similarly razor thin compared to demand in August 2023. The scarcity of supply makes it difficult, if not impossible, for every LSE to meet its RA requirements.

[3] https://www.cpuc.ca.gov/-/media/cpuc-website/divisions/energy-division/documents/resource-adequacy-homepage/2019rareport-1.pdf, at 22.

Figure 1

		Jun	Jul	Aug	Sep
1	CAISO 1-in-2 Load	42,354	45,510	46,074	46,829
2	Reserve Margin (16%)	6,777	7,282	7,372	7,493
3	**Total RA Demand**	**49,131**	**52,792**	**53,446**	**54,322**
4	2023 NQC List	48,809	49,245	48,166	47,618
5	Event-Based Demand Response	995	1,045	1,077	1,090
6	Imports	6,000	6,000	6,000	6,000
7	Thermal Plant Derate	(719)	(719)	(719)	(719)
8	Excess IOU Resources Above PRM (D.21-12-015)	(794)	(925)	(664)	(206)
9	Supply-Side Emergency Reliability Procure. (D.21-12-015)	(883)	(933)	(824)	(1,125)
10	Retention for Substitution	(619)	(619)	(619)	(619)
11	**Total RA Supply**	**52,789**	**53,094**	**52,418**	**52,039**
12	Surplus Supply (Deficit)	3,659	303	(1,028)	(2,282)
13	Estimate of Contracted Resources	450	1,849	1,849	1,849
14	Surplus Supply (Deficit) with Contracted Resources	4,109	2,152	821	(433)

3. Sources and Explanation of the RA Stack

Figure 1 uses both familiar data in assessing RA supply sufficiency and also integrates information not typically considered in a supply analysis. This information, reflected in rows 11 through 13, stems from regulatory changes implemented by the CPUC that had the effect of eroding supply available to other LSEs. The table below documents the sources of data used in Figure 1.

Row(s)	Source
1	CAISO 1-in-2 Load Forecast. Monthly peak demand forecast for a median (1-in-2) weather year from the CEC's 2022 Integrated Energy Policy Report Planning scenario.[4]
2	Planning Reserve Margin per CPUC D.22-06-050[5]
4	California ISO 2023 NQC List. The CAISO lists the net qualifying capacity (NQC) for all resources in the CAISO footprint for 2023.[6] We exclude from the list all resources with a commercial online date after 12/31/2022 and instead account for those resources in the CPUC's estimate of contracted new resources in row 13. We find the commercial online

[4] Monthly maximum managed net load forecast for 2023 from the California Energy Demand 2022 Hourly Forecast for CAISO in the Planning Scenario: https://efiling.energy.ca.gov/GetDocument.aspx?tn=248359&DocumentContentId=82768

[5] D.22-06-050, *Decision Adopting Local Capacity Obligations For 2023 - 2025, Flexible Capacity Obligations For 2023, and Reform Track Framework*, R.21-10-002 (June 23, 2022): https://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M488/K540/488540633.PDF.

[6] CAISO 2023 NQC List: https://www.caiso.com/Documents/2023-net-qualifying-capacity-values-for-resource-adequacy-resources.html.

Row(s)	Source
	date by matching the resource identification number (resource ID) in the NQC list to the resource ID in the CAISO Master Generating List.[7]
5	Event-Based Demand Response. Demand response quantities are from the CPUC's Resource Adequacy Compliance Materials.[8] Demand response totals include avoided losses and are from event-based programs at PG&E, SCE, and SDG&E.
6	Imports. Imports reflect the CEC's assumed RA imports available to the CAISO market.[9]
7	Thermal Plant Derate. Many thermal generators cannot produce maximum output at certain temperatures, leading to plant derates. For this reason, resource owners may not sell their full NQC as RA capacity. For thermal plants whose NQC is listed as equivalent to their Net Dependable Capacity, we apply a technology-specific thermal derate estimated from historical ambient temperature derates within the CAISO.[10] Our approach parallels recent CPUC discussions regarding the need to include thermal derates in reliability modeling.[11]
8	D.21-12-015 allowed: "excess resources from an IOU's *existing* portfolios may be used to meet or supplement these procurement targets up to the upper end of its contingency procurement target."[12] Line 11 represents the total of the three IOUs' excess resources from their portfolios as filed in the IOU 2022 Excess Resources Report.[13]
9	D.21-12-015 authorized the IOUs to "continue their procurement efforts and endeavor to meet and exceed their respective incremental procurement targets to achieve the range of additional procurement authorized in this decision for months of concern… As noted previously, a combination of RA eligible and non-eligible resources will be used to meet the contingency procurement target range."[14] While these resources were intended to be incremental to supply available to LSEs to meet their 16% requirement, a significant amount appears to erode existing supply.[15] This erosion occurs because many of the resources are

[7] CAISO Master Control Area Generating Capability List: oasis.caiso.com.

[8] 2023-2025 Demand Response Totals: https://www.cpuc.ca.gov/industries-and-topics/electrical-energy/electric-power-procurement/resource-adequacy-homepage/resource-adequacy-compliance-materials.

[9] Joint Reliability Planning Assessment - SB 846 Second Quarterly Report, at Table 4: https://efiling.energy.ca.gov/GetDocument.aspx?tn=250176&DocumentContentId=84899. The CEC's assumed imports increased from 5,500 MW in the February 2023 assessment to the May 2023 assessment based on agency staff assessments of market conditions.

[10] Ambient derate data can be found in the CAISO's daily Curtailed and Non-Operational Generator Prior Trade Date Reports: http://www.caiso.com/market/Pages/OutageManagement/CurtailedandNonOperationalGenerators.aspx.

[11] ED Staff Proposal for Derating Thermal Power Plants based on Ambient Temperature: https://www.cpuc.ca.gov/-/media/cpuc-website/divisions/energy-division/documents/resource-adequacy-homepage/r21-10-002/4_ed-proposal-for-phase-3-derates.pdf.

[12] D.21-12-015 at 103

[13] https://www.cpuc.ca.gov/industries-and-topics/electrical-energy/electric-power-procurement/resource-adequacy-homepage/resource-adequacy-compliance-materials.

[14] D.21-12-015 at 101-102.

[15] The additional resources procured under this authorization are described in the CPUC's RA materials with additional detailed provided in advice letters filed by the IOUs. 2022 IOU Excess Resource reports: https://www.cpuc.ca.gov/industries-and-topics/electrical-energy/electric-power-procurement/resource-adequacy-homepage/resource-adequacy-compliance-materials.

Row(s)	Source
	qualified to provide RA and, were it not for the IOU procurement, could provide RA to other LSEs to meet their RA compliance requirements.[16]
10	Retention for substitution. IOUs are entitled to retain RA beyond their bundled needs for substitution during planned outages. While 2022 data are not yet available, this assessment relies on the 2021 resources retained by IOUs as reported in the 2021 IOU Excess Resource reports.[17]
13	Expected contracts for new-build resources. June is based on resources online by the end of Q1 2023, while July, August, and September is based on resources online by the end of Q2 2023.[18]

4. Tight Conditions Are Likely to Persist Through 2026

Extending the RA stack for September through 2026, Figure 2 below shows that the tight market conditions continue. The challenge of meeting RA requirements is exacerbated by rising load, increasing planning reserve margins, and retirement or removal from the RA market of resources like Diablo Canyon Power Plant (DCPP) and several once-through cooling plants. Deployment of new capacity to meet the CPUC's procurement requirements helps, though projects are likely to be delayed at least in the next few years. Though not reflected here, the RA market will undergo a fundamental shift in design, changing to a 24-hour slice of day approach starting in 2025.[19]

The sources and assumptions in this extended stack analysis are similar to the 2023 stack in Figure 1, with the following exceptions:

- The planning reserve margins for 2024-2026 increase to 17%;[20]
- In line with the assumptions of the Joint Agency Reliability Planning Assessment, described in the next section, DCPP is retired in 2025 and the remaining once-through-cooling plants are assumed to be procured by DWR[21] and

[16] CalCCA used the amounts in the IOU reports and removed those resources that would not otherwise qualify for RA (*e.g.*, Emergency Load Reduction Program). The resources included in row 12 include firm energy imports, additional RA contracts, tolling agreements, extension of existing contracts that are RA eligible, and contracts for increased output where the efficiency upgrades likely could have been financed by an RA contract with an LSE.

[17] https://www.cpuc.ca.gov/industries-and-topics/electricalenergy/electric-power-procurement/resource-adequacy-homepage/resource-adequacy-compliancematerials.

[18] Estimated online dates for contracted capacity is from the Joint Reliability Planning Assessment - SB 846 Second Quarterly Report, at Table 2: https://efiling.energy.ca.gov/GetDocument.aspx?tn=250176&DocumentContentId=84899. LSE contracting activity may lead to additional resources in the future to meet CPUC requirements and IRP plans.

[19] D.22-06-050 at 128.

[20] D.22-06-050 at 125 requires a 17% PRM for 2024, we assume the same for 2025-26.

[21] The capacity of once-through-cooling plants at risk of retirement is based on the CAISO's Announced Retirement and Mothball List: http://www.caiso.com/planning/Pages/ReliabilityRequirements/Default.aspx.

- Excess IOU procurement for a higher effective PRM continues through 2025.[22]

Figure 2

	September NQC	2023	2024	2025	2026
1	CAISO 1-in-2 Load	46,829	47,475	47,987	48,487
2	Reserve Margin (16% in '23, 17% after)	7,493	8,071	8,158	8,243
3	**Total RA Demand**	**54,322**	**55,546**	**56,145**	**56,730**
4	2023 NQC List	47,618	47,618	47,618	47,618
5	Event-Based Demand Response	1,090	1,105	1,111	1,111
6	Imports	6,000	6,000	6,000	6,000
7	Estimate of Contracted Resources	1,849	7,297	9,168	9,409
8	Thermal Derates from 2023 NQC List	(719)	(719)	(719)	(719)
9	Remove Diablo from Planning	-	-	(2,280)	(2,280)
10	OTC, Retired or Contracted by DWR	-	(3,692)	(3,692)	(3,692)
11	Excess IOU Procurement for Higher Effective PRM	(206)	(1,700)	(1,700)	-
12	Supply-Side Emergency Reliability Procure. (D.21-12-015)	(1,125)	-	-	-
13	Retention for Substitution	(619)	(619)	(619)	(619)
14	**Total RA Supply**	**53,888**	**55,290**	**54,886**	**56,827**
15	Surplus Supply (Deficit) [Assuming Loss of Diablo]	(433)	(256)	(1,258)	98

5. Results Generally Align with Joint Agency Reliability Assessment.

The Joint Agency Reliability Planning Assessment, issued on February 9, 2023, assessed hourly supply sufficiency across each year between 2023-2032. Here we focus on the Joint Agency results during critical hours in the month of September 2023-2026 using their assumption that new resources are based on ordered procurement with a delay rate of 40%. This assessment differs from the CalCCA assessment above because it focuses on hourly supply sufficiency, rather than RA sufficiency for compliance purposes. Consequently, the Joint Agency assessment:

- Projects a lower completion of new resources for September 2023 (1,750 MW vs. 1,849 MW);
- Uses hourly production of wind and solar on peak demand days, resulting in a contribution of 1,819 MW from wind and solar to meeting demand in Hour 19 of September, compared to the 2,412 MW of wind and solar NQC in the RA stack;
- Uses earlier data for the 2023 NQC list and assumptions for imports (5,500 MW vs. the more recent 6,000 MW assumption);

[22] Excess procurement of 1,700 MWs for 2024 and 2025 is pursuant to a proposed decision in R.21-10-002, representing the minimum targeted procurement defined by the CPUC. IOUs would be authorized to procure as much as 3,200 MWs for those same years, potentially increasing the deficits shown in Figure 2.

- Uses demand response estimates that may include programs that are not typically used to meet RA requirements;
- Assumes the full contribution of thermal plants are available each hour without accounting for ambient thermal derates associated with high temperatures;
- Does not need to consider the effect of the IOUs' retention of capacity for substitution, since those resources will be available supply unless they are actually substituted for a resource on outage;
- Does not need to consider the effect of the IOUs' incremental "effective" PRM procurement; although the supply may not be available to LSEs to meet their RA requirements, the resources will be a part of the actual supply.

Despite these differences, which tend to present a more positive view of supply, the assessment shows a very tight supply margin, for Hour 19 in September – arguably the most challenging hour to meet. The Joint Agency assessment is summarized below in Figure 3, which was prepared by CalCCA using Joint Agency data.[23]

Figure 3

	Hour 19 Assessment in the Month of September	2023	2024	2025	2026
1	CAISO 1-in-2 Load	46,827	47,472	47,933	48,424
2	Reserve Margin (16% in '23, 17% after)	7,492	8,070	8,149	8,232
3	**Total Hourly Demand**	**54,319**	**55,542**	**56,082**	**56,656**
4	Existing Resources Except Wind and Solar	44,817	44,817	44,817	44,817
5	Supply from Wind	1,810	1,810	1,810	1,810
6	Supply from Solar	9	9	9	9
7	Estimated Completion of CPUC Mandated Procurement	1,750	6,431	10,381	11,755
8	Demand Response	1,274	1,274	1,274	1,274
9	Imports	5,500	5,500	5,500	5,500
10	Remove Diablo from Planning	-	-	(2,280)	(2,280)
11	OTC, Retired or Contracted by DWR	-	(3,757)	(3,757)	(3,757)
12	**Total Hourly Supply**	**55,159**	**56,084**	**57,753**	**59,128**
13	Surplus Supply (Deficit)	840	542	1,672	2,472
14	Incremental Demand with 2020 Equivalent Event	3,044	2,611	2,636	2,663
15	Add'l. Incremental Demand with 2022 Equivalent Event	1,639	1,662	1,678	1,695
16	Surplus Supply (Deficit) with Extreme Weather	(3,843)	(3,731)	(2,642)	(1,887)

6. The Impact of Weather on Capacity

[23] CalCCA created the table from the underlying data used in the Joint Reliability Planning Assessment (https://efiling.energy.ca.gov/GetDocument.aspx?tn=248714&DocumentContentId=83233 consistent with a conversation with CEC staff on Jan. 31, 2023.

The changes in precipitation levels from 2022 to 2023 have been an extreme that helps to demonstrate the impact of weather on capacity. As of June 14, 2023, the California Department of Water Resources (CDWR) reports that the water content of snowpack for the State is at 333 percent of normal.[24] On the same day in 2022, CDWR reported that the snow-pack had already melted leaving the state at zero percent of normal. In addition to the snow-pack, rain has helped to fill reservoirs prior to the snow melt placing many of California's reservoirs above their historical average as early as March.[25]

Using data from the CEC from the past 20 years, 2006 had the highest amount of energy production from hydroelectric generating facilities at 48,559 GWh. This high was reached on installed capacity of 13,557 MW of large and small hydro in California at the time for a capacity factor of 40.9 percent. This compares with 2022 where the CEC shows energy generation of 17,612 GWh from an installed capacity of 14,035 MWs for a capacity factor of 14.3 percent.[26] Simply put, more water yields more energy. Since the amount of installed capacity in 2023 from large and small hydro is at least as much as it was in 2006, given the amount of available water, it is reasonable to expect that the energy production in 2023 will be similar to that in 2006.

The RA program counts capacity from resources based on their capability of providing that level of output in a sufficient number of hours to meet system load needs. The RA program will therefore derate the amount of capacity from hydroelectric facilities to account for water available for use at the facility. In 2022, this amount was at historic lows. In fact, the process for RA had the Year-Ahead showing for 2023 occurring in October 2022. At that point in time, CDWR reported snow-pack levels at zero percent of normal. Without knowing that the 2022-2023 precipitation season would be as good as it turned out, the amount of hydroelectric generation for RA was likely assumed to be at very low levels for the Year-Ahead showing process. These expectations likely had a significant effect on the amount of hydro output offered as RA in the Year-Ahead process.

This issue does not only impact California. Hydroelectric generation is prevalent in the Pacific Northwest and there are significant quantities in the Southwest as well. With uncertainty surrounding the amount of precipitation that either of those areas would receive, entities were unwilling to sell significant amounts of import capacity for the Year-Ahead process.

With conditions better known in June, significant amounts of hydroelectric generation in and out of state are now likely to be available, easing the tight capacity market. High hydro conditions are good news for 2023 for California's Month-Ahead RA process but does little to cure the lack of capacity for the already complete Year-Ahead RA process. Importantly, it further has little bearing on what the hydroelectric conditions will bring for 2024 onward.

7. Challenges With New Resource Uncertainty

[24] https://cdec.water.ca.gov/snowapp/sweq.action

[25] https://cdec.water.ca.gov/reportapp/javareports?name=STORSUM.202303

[26] https://www.energy.ca.gov/data-reports/energy-almanac/california-electricity-data/electric-generation-capacity-and-energy

New resources bring new challenges. The RA program allows a new resource to count in the Year-Ahead process from the month of its expected on-line date. However, if the resource fails to reach commercial operation at that date, the resource may not be counted in the Month-Ahead process and the LSE must find a different resource to meet their RA needs. The challenge this presents is that an LSE is unlikely to sell any excess RA in the Year-Ahead process if that excess is contingent on a new resource achieving commercial operation. Why sell off excess resources only to find the new resource did not come on-line and have to buy another resource at potentially a higher price than the excess was sold for? In addition, it is becoming relatively common for entities to offer sales of capacity contingent on the new resource achieving commercial operation. That is, a seller that is long capacity if the new resource comes online will sell the excess contingent on the resource achieving commercial operation and thus move the non-compliance risk to the buyer.

Much like the hydroelectric discussion in section 6, the availability of new build expected to come on line in a compliance year is likely more constrained than the Month-Ahead process when the commercial operation date is known. To the extent the resource has come online, the LSE is now willing to sell excess RA so that their customers get the value of the resource without a risk that it will make them non-compliant with their RA requirements.

The only way to ease the current capacity constraints of the RA market is to continue to build new resources. However, this new build is likely to ease constraints in the Month-Ahead RA market and not in the Year-Ahead market due to the uncertainty of achieving commercial operation from the resource.

8. Conclusion

The supply of Resource Adequacy is insufficient to meet 2023 demand. This insufficiency made it impossible for all LSEs to comply with year-ahead requirements, and the insufficiency likely will carry into month-ahead compliance requirements absent a significant increase in hydro RA availability. The only durable solution is to bring new resources online, yet new resources continue to face supply chain, interconnection, and permitting challenges. Until those challenges are met holistically, RA supply will remain tight and prices paid by consumers will remain high. In addition, the potential variability of RA supply between Year-Ahead and Month-Ahead RA showings creates a new issue that must be recognized in the RA program.

Five interim actions should be considered.

1) Expressly recognize the RA supply insufficiency and its consequences in the CPUC's next RA decision.
2) Establish a "safety valve," through a discretionary waiver structure for LSEs left deficient in meeting their requirements despite best efforts, to prevent the exercise of market power by suppliers.

3) Consider the potential for waiving Year-Ahead penalties if an LSE meets its obligation in the Month-Ahead showing.
4) Increase the likelihood that California LSEs can secure imports for RA compliance by increasing the CPUC-imposed energy market bid cap on imports – currently set at $0/MWh -- to reduce sellers' risk of financial loss.
5) Prevent erosion of the supply stack available to LSEs to meet their RA requirements by limiting any IOU "effective PRM" procurement to truly incremental, non-RA resources.
6) Increase market transparency by providing aggregated compliance data to reveal (a) trends in the categories of resources (e.g., imports, storage) used for compliance and (b) the extent of California resource exports.