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BEFORE THE PUBLIC UTILITIES COMMISSION
OF THE STATE OF CALIFORNIA

Order Instituting Rulemaking to Oversee the Resource Adequacy Program, Consider Program Reforms and Refinements, and Establish Forward Resource Adequacy Procurement Obligations.	R.25-10-003

CALIFORNIA COMMUNITY CHOICE ASSOCIATION'S TRACK 1 PROPOSALS ON TRANSACTABILITY ISSUES

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March 3, 2026

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CalCCA proposes the Commission:

- Adopt hourly load obligation trading to allow LSEs to transact at the same granularity as the SOD requirements to promote affordability while maintaining reliability requirements;
- Invest in the software and systems to automate the RA validation process, given it appears the existing manual process is interfering with the adoption of fully vetted and well-supported policy proposals; and
- If the Commission declines to invest in automation of the RA validation process, adopt temporary guardrails to aid in assessing compliance.

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[1] Acronyms used herein are defined in the body of this document.

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CALIFORNIA COMMUNITY CHOICE ASSOCIATION'S
TRACK 1 PROPOSALS ON TRANSACTABILITY ISSUES

California Community Choice Association[2] (CalCCA) submits these proposals pursuant to the *Assigned Commissioner's Scoping Memo and Ruling*[3] (Scoping Ruling), dated December 12, 2025, and *Administrative Law Judge's Ruling on Energy Division's Transactability Report and Modifying Track 1 Schedule*,[4] dated February 24, 2026.

I. INTRODUCTION

Energy Division's *Report on Transactability within the Slice of Day Resource Adequacy Framework*,[5] authorized in Decision (D.) 25-06-048,[6] severely misses the mark in finding that,

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2 California Community Choice Association represents the interests of 24 community choice electricity providers in California: Apple Valley Choice Energy, Ava Community Energy, Central Coast Community Energy, Clean Energy Alliance, Clean Power Alliance of Southern California, CleanPowerSF, Desert Community Energy, Energy For Palmdale's Independent Choice, Lancaster Energy, Marin Clean Energy, Orange County Power Authority, Peninsula Clean Energy, Pico Rivera Innovative Municipal Energy, Pioneer Community Energy, Pomona Choice Energy, Rancho Mirage Energy Authority, Redwood Coast Energy Authority, San Diego Community Power, San Jacinto Power, San José Clean Energy, Santa Barbara Clean Energy, Silicon Valley Clean Energy, Sonoma Clean Power, and Valley Clean Energy.

3 *Assigned Commissioner's Scoping Memo and Ruling*, Rulemaking (R.) 25-10-003 (Dec. 12, 2025).

4 *Administrative Law Judge's Ruling on Energy Division's Transactability Report and Modifying Track 1 Schedule*, R.25-10-003 (Feb. 24, 2026).

5 *Report on Transactability within the Slice of Day Resource Adequacy Framework*, R.25-10-003 (Feb. 2026) (Report).

6 D.25-06-048 authorizes Energy Division to, "conduct an evaluation after a full year of [SOD] implementation to assess the need, benefits, and feasibility of an hourly load obligation trading

"[g]iven the limited evidence of need, uncertain magnitude of benefits, and heightened implementation risks, … the potential gains do not outweigh the added complexity and risk of unintended consequences," of hourly load obligation trading.[7] The Report:

- Applies the wrong standard in its assessment, focusing on whether the measure is "necessary" rather than seizing the opportunity to adopt a tool that will bring greater efficiency and affordability to resource adequacy (RA) procurement as market conditions change;
- Materially understates the potential affordability benefits this optimization tool could deliver for ratepayers by ignoring the increased cost resulting from slice-of-day (SOD) implementation;
- Presents a "penny wise, pound foolish" approach to RA regulation, failing to acknowledge the criticality of automating RA compliance; and
- Continues to seek cover behind potential "unintended consequences".

Energy Division's recommendation to continue monitoring market performance leaves CalCCA's fully vetted and well-supported proposal with the potential to offer significant cost savings hanging in the balance at ratepayers' expense.

As discussed below, the Energy Division assertions are not well supported and do not address the core issue hourly load obligation trading is intended to address: the exorbitant costs caused by making the Commission's RA program exceedingly difficult to comply with, while at the same time assessing severe penalties on those who cannot comply.[8] CalCCA addresses several shortcomings of the Report below and will provide a more detailed response in its opening comments due on March 16, 2026.

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mechanism. D.25-06-048, *Decision Adopting Local Capacity Obligations for 2026-2028, Flexible Capacity Obligations for 2026, and Program Refinements*, R.23-10-011 (June 26, 2025), Ordering Paragraph 11, at 125.

[7] Report at 7.

[8] These penalties include a financial consequence with a multiplier effect for multiple infractions and, for ESPs and CCAs, a restriction on expansion plans. The severity of these penalties has been readily noticed by LSEs, who will likely procure expensive RA even if it is not necessary to meet their reliability requirements.

Hourly load obligation trading offers an opportunity to chip away at the affordability crisis at a time when the Commission should be seizing every opportunity to reduce procurement costs. The inability for load-serving entities (LSE) to transact at the same granularity as the compliance requirement forces LSEs to procure more RA than needed to meet pre-determined reliability targets, unnecessarily driving up RA procurement costs that fall directly on ratepayers. CalCCA's analysis, attached to this proposal as Appendix A, suggests hourly obligation trading could save all LSEs $144-$179 million each year. At a time when Californians are struggling to manage rapidly increasing electric bills, dismissing a proposal with such significant potential for cost savings is misguided.

The proposal also recommends guardrails for the initial year of implementation to help manage new administrative tasks that may be necessary to validate showings with load obligation trades. CalCCA is concerned that Energy Division's continued rejection of hourly load obligation trading is driven largely by the fact that the existing RA compliance mechanisms are no longer sufficient to operate the SOD program. The RA program has become increasingly complex in its over 20-year history, and continued reliance on spreadsheets for validation should not be a barrier to the adoption of sound policy proposals. Given the significant potential benefits of hourly load obligation trading, the Commission should invest in the necessary tools to make the validation process more automated and manageable for Energy Division staff. Still, if the Commission is concerned with the amount of administrative effort this proposal would create, guardrails could help keep those efforts manageable.

In summary, CalCCA recommends that the Commission:

- Adopt hourly load obligation trading to allow LSEs to transact at the same granularity as the SOD requirements to promote affordability while maintaining reliability requirements;

- Invest in the software and systems to automate the RA validation process, given it appears the existing manual process is interfering with the adoption of fully vetted and well-supported policy proposals; and
- If the Commission declines to invest in automation of the RA validation process, adopt temporary guardrails to aid in assessing compliance.

II. THE REPORT DIMINISHES THE PROBLEMS WITH SOD AND DOES NOT ADDRESS THE CORE AFFORDABILITY ISSUE HOURLY LOAD OBLIGATION TRADING IS INTENDED TO ADDRESS

The Report attempts to answer the question of whether transactability issues exist by evaluating whether the measure was necessary to achieve compliance with 2025 RA requirements. The Report finds that "LSEs were able to procure and trade sufficient capacity to meet hourly obligations, with no evidence of unresolved deficiencies or structural market barriers attributable to SOD."[9] Using this information to imply that there is insufficient justification for hourly load obligation trading ignores the core affordability issue hourly load obligation trading is intended to address. This rationale also ignores the potential for capacity scarcity to return in the future causing an apparent shortfall based on the compliance framework while no actual system reliability gap exists. CalCCA demonstrated this effect with the 2024 test case. While the Report states that over-procurement was "modest" because September 2025 month-ahead showings in the tightest hour showed surplus procurement of 262 megawatts (MW),[10] this does not tell the whole story.

In 2025, LSEs procured significantly more RA capacity than needed to meet their compliance obligations when compared to prior years. This phenomenon can be observed by evaluating aggregated historical RA procurement data from the California Independent System Operator (CAISO), as discussed below. To be clear, CalCCA does not contend that the lack of

9 Report at 6.
10 *See* Report at 34.

transactability has caused ***all*** of the incremental procurement observed. Rather, if the new SOD RA mechanism is going to force the procurement of significantly more RA than previously, the system must be made as efficient as possible to avoid unnecessary costs, given the magnitude of the change.

The CAISO annually presents data on the resources shown to meet RA needs.[11] The CAISO data includes the years 2019 through 2025. The CAISO data shows a significant increase in the number of RA resources shown starting in 2025, the first year of SOD implementation. The CAISO uses a single daily value for RA and while SOD uses hourly values, the data is informative in showing the significant increase in the amount of RA shown. This increase comes at a cost. As shown in Figure 1, below, using the 2025 final market price benchmark (MPB) for RA of $11.21/ kilowatt (kW)-month[12], the increased cost of SOD is nearly $339 million for the months of May through October.

Figure 1: Average Procurement Relative to RA Target

Figure 1. Average Procurement to RA Target						
	May	June	July	August	September	October
Prior to SOD (% of target shown) 2019 -2024	103%	104%	102%	101%	100%	103%
SOD (% of targe shown) 2025	109%	118%	118%	109%	114%	108%
Difference	6%	14%	15%	8%	14%	5%
2025 RA Requirement (MW)	38,996	47,496	52,349	50,856	52,091	41,872
Amount of Procurement in 2025 Beyond the Normal Procurement in 2019-2024 (MW)	2,384	6,512	8,002	4,170	7,219	1,948
2026 RA Market Price Benchmark ($/kW-mo)	$ 11.21	$ 11.21	$ 11.21	$ 11.21	$ 11.21	$ 11.21
Total Incremental Cost ($/mo)	$ 26,720,203	$ 73,000,172	$ 89,698,883	$ 46,748,335	$ 80,929,640	$ 21,837,678

Total Incremental Cost
$ 338,934,910

California's customers served by LSEs that must comply with the Commission's SOD regulations should be afforded every opportunity possible to efficiently transact given the significant impact on affordability that the move to SOD has caused.

[11] *See* CAISO Historical Resource Adequacy Showings Aggregate Data.

[12] *See* CPUC MPB Calculations 2025 (Oct. 1, 2025) (2025 MPBs).

Data provided in the Report similarly provides evidence of this over-procurement, well beyond the "modest" 262 MW the Report identifies. *First*, the net qualifying capacity (NQC) of resources under contract in September 2025 "increased by approximately 3,725 MW (8.2 percent)"[13] relative to 2024, while requirements went down by 1,555 MW (3.1 percent),[14] a net gain of 5,280 MW of NQC relative to 2024. *Second*, the achieved reserve margin in September 2025 was far above the required 17 percent. Because reliability is a system attribute, the achieved reserve margin depends on the total contracted resources and the total system requirements. The storage contracted for September 2025 could have contributed to meeting system RA at much greater levels than suggested in the Report. The Report dispatches storage only to meet the requirements and then allocates the 16,269 MW hours of "unused storage" evenly throughout the day.[15] Alternatively the "unused storage" could have been allocated to maximize the avoidable thermal generation. Allocating the "unused storage" in the manner shown in Figure 2, below, achieves a reserve margin of at least 23 percent in all hours of September 2025 or allows 2,175 MW of thermal capacity to be removed while maintaining at least a 17 percent reserve margin in all hours.[16] At the current RA MPB, 2,175 MW of capacity beyond that needed to meet RA is valued at $24 million for this single month.[17] If instead we assume that the 2,175 MW of highest priced RA transactions between the year-ahead and month-ahead deadlines could have been avoided, the savings would be almost $37 million for the single month.[18]

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[13] Report at 21.

[14] Report at Table 7 (comparing 2024 requirements to 2025 HE18 requirements).

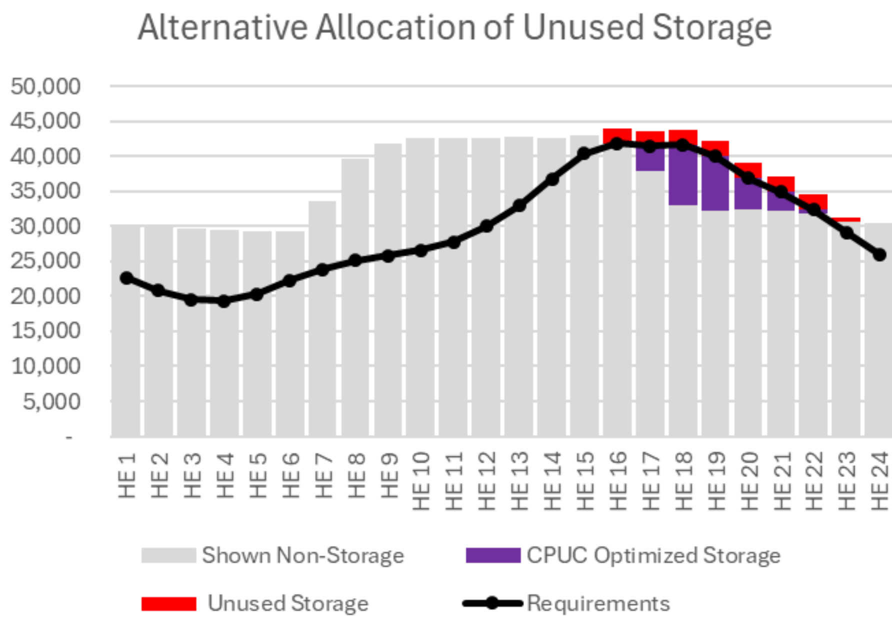
[15] Report at 28.

[16] CalCCA verified that the charging energy remains sufficient for the storage even after removing 2,175 MW of thermal capacity from the September 2025 portfolio.

[17] MPB $11.21/kW-month * 2,175 MW * 1,000 (conversion of MW to kW) = $24,381,750. *See* 2025 MPBs.

[18] Capacity transactions are from FERC electronic quarterly reports downloaded from https://eqrreportviewer.ferc.gov/ and cleaned by CalCCA. Included transactions have California LSE as

Figure 2. Alternative Allocation of Unused Storage Achieves 23% Reserve Margin in September 2025



The Report states that "this incremental margin is not simply "excess" capacity, but represents additional contracted, deliverable resources that may provide value under conditions that exceed forecasted load."[19] This implies an intent to ensure reliability by making compliance exceedingly difficult and allowing the system to lean on LSEs that must procure excess RA to meet their SOD requirements, rather than through transparent and defined reliability standards. The Commission is obligated through Public Utilities Code section 380(h)(4)[20] to ensure that the RA program "can reasonably maintain a standard measure of reliability, such as a one-day-in-10-year loss-of-load expectation or a similarly robust reliability metric adopted by the commission..." The Commission should meet the objectives of section 380 by planning for pre-

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the buyer for delivery in September 2025 with a trade date between November 1, 2024, and July 31, 2025. CalCCA sorted these transactions from highest to lowest price and summed the transaction cost for the highest priced transactions up to a cumulative capacity of 2,175 MW.

19 Report at 35.

20 All subsequent code sections cited herein are references to the California Public Utilities Code unless otherwise specified.

determined reliability targets established through the Commission's loss-of-load expectation study process and planning reserve margin, rather than by imposing transactional barriers that force over-procurement.

Energy Division finds that the potential gains of hourly load obligation trading do not outweigh "risk of unintended consequences."[21] This is a red herring. Throughout the five years of discussing hourly load obligation trading, no party has been able to articulate an "unintended consequence" that CalCCA has not addressed.[22] If there are "unintended consequences" that arise following the implementation of hourly load obligation trading, the Commission has the power to modify the rules to close any reliability or compliance gaps that may emerge. The Commission should not decline to adopt measures with demonstrated affordability benefits based upon undefined "unintended consequences."

III. HOURLY LOAD OBLIGATION TRADING SHOULD BE ADOPTED TO ALLOW LSES TO TRANSACT AT THE SAME GRANULARITY AS THE SOD REQUIREMENTS

The Commission should adopt CalCCA's proposal in R.23-10-011 to allow LSEs to transact load obligations on an hourly basis.[23] Under existing rules, LSEs are restricted in how they can transact with other entities to ensure RA compliance. Adjustments to an LSE's portfolio are limited to transacting a product for all hours it is available for the whole month, even though obligations are unique to each hour. This mismatch means LSEs must purchase more RA than they need to meet their obligations, creating artificial market scarcity and unnecessarily driving up RA demand (and prices). CalCCA's proposal would provide LSEs with the flexibility to

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[21] Report at 7.

[22] *See California Community Choice Association's Opening Comments on the Proposed Decision*, R.23-10-011 (June 11, 2025).

[23] *See California Community Choice Association's Proposals on Track 3*, R.23-10-011 (Jan. 17, 2025) (CalCCA Track 3 Proposals), at 8-18.

transact load obligations at the hourly level in order to reduce costs to consumers. If RA requirements are set on an hourly basis, some or all of the products should be transactable on an hourly basis.

CalCCA's analysis of 2025 year-ahead RA filings submitted in R.23-10-011 demonstrates significant affordability benefits to increasing the transactability of the RA SOD program.[24] CalCCA expects that all LSEs would benefit from a load obligation trading structure and expects that transactions among investor-owned utilities, community choice aggregators (CCA), and electric service providers (ESP) would occur. The larger the market, the more efficient the outcome. Since its analysis of 2025 year-ahead RA filings, CalCCA has issued a Whitepaper, attached as Appendix A, further documenting the benefits of hourly trading by simulating competitive market trades between LSEs. CalCCA has also performed additional analysis on 2025 month-ahead RA showings from CCAs demonstrating that, averaged across five peak summer months, CCAs in aggregate, purchased about 540 MW more RA capacity each month than they would have needed had a mechanism like hourly load obligation trading been available.[25] At the 2025 final RA MPB,[26] those excess purchases cost CCA consumers more than $30 million in the summer of 2025. If the tight market conditions observed in the summer of

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24 *See* CalCCA Track 3 Proposals, at 8-11.

25 To quantify the excess RA capacity that could have been avoided with hourly load obligation trading, CalCCA first calculated the amount of thermal capacity each individual CCA could have sold from their final month-ahead portfolio, while still remaining compliant. To perform this calculation, CalCCA adjusted the way that an individual CCA would show its contracted storage capacity such that it maximized the amount of thermal capacity that could be removed. Next, CalCCA aggregated all CCA portfolios and requirements, and recalculated the excess thermal capacity from the aggregate showing. The aggregation is a proxy for what could be achieved through frictionless trade between LSEs, which is enabled through a policy like hourly load obligation trading. Finally, the excess RA capacity that could be avoided through hourly load obligation trading was calculated as the difference between the excess of the aggregate and the excess for individual CCAs. On average across the five peak months from May to September, CalCCA observed 540 MW of excess thermal capacity that could have been avoided with hourly load obligation trading.

26 *See* 2025 MPBs.

2024 arise again, as suggested by the Commission's recommendation for additional procurement in R.25-06-019,[27] demand for capacity and RA prices could rise again to the levels observed in 2024. The CCAs' excess RA purchases valued at the 2024 RA prices described in CalCCA's RA Whitepaper would cost CCA customers nearly $51 million. Using similar assumptions about the indirect price reduction effect from lowering RA demand and the potential benefit of hourly load obligation trading across all Commission-jurisdictional LSEs, CalCCA's findings from the 2025 month-ahead RA data suggest hourly obligation trading could save all LSEs $144-$179 million each year. These savings could then directly improve affordability for ratepayers.

Throughout R.23-10-011, CalCCA thoroughly addressed all critical concerns with its proposal expressed by Energy Division and parties by: (1) explaining why existing trading mechanisms are insufficient for the SOD program; (2) proposing a potential guardrail that would limit the amount of load an LSE can trade (of which CalCCA expands upon below); and (3) addressing how penalties would apply to LSEs using load obligation trades that are found noncompliant.[28] The proposal received support from a broad range of stakeholders, including LSEs, suppliers, ratepayer advocates, and environmental groups,[29] and as described above, is supported by extensive analysis of cost benefits. For these reasons, the Commission should adopt hourly load obligation trading.

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27 *Administrative Law Judge's Ruling Seeking Comments on Electricity Portfolios for 2026-2027 Transmission Planning Process and Need for Additional Reliability Procurement*, R.25-06-019 (Sept. 30, 2025).

28 *See California Community Choice Association's Opening Comments on the Proposed Decision*, R.23-10-011 (June 11, 2025).

29 *See* Opening Comments filed in R.23-10-011 on or about March 3, 2025: American Clean Power – California Opening Comments, at 15; Alliance for Retail Energy Markets Opening Comments, at 3; The Public Advocates Office at the California Public Utilities Commission (Cal Advocates) Opening Comments, at 10-11; Clean Energy Buyers Association Opening Comments, at 7; Center for Energy Efficiency and Renewable Technologies Opening Comments, at 3; California Environmental Justice Alliance Opening Comments, at 11- 12; Hydrostor, Inc. Opening Comments, at 9; Microsoft Corporation Opening Comments, at 12-13; and Shell Energy North America (US), L.P. Opening Comments, at 4-5.

IV. THE COMMISSION SHOULD INVEST IN SOFTWARE AND SYSTEMS TO AUTOMATE THE RA VALIDATION PROCESS

Energy Division's manual RA validation process may result in the Commission passing up significant efficiency improvements over concerns with the administrative effort they would add to existing processes. Currently, all LSEs submit to the Commission a RA showing in Excel on an annual and monthly basis. Over the 20-plus year history of the RA program, the Excel spreadsheet has grown to include 14 visible sheets, 18 hidden sheets (used to perform calculations and validations), six macros, and requires a 58-page user guide to navigate. Energy Division's continued rejection of hourly transactability as an affordability measure appears largely driven by the fact that the existing RA compliance review processes are no longer sufficient to operate the SOD program. The RA program procures billions of dollars of capacity annually and carries strict fines that can be up to $26.64/kw-month. In addition, the program is a major component in grid reliability. With the program's growing complexity, including hourly verification, customized storage showings by hour, and charging sufficiency verifications, the compliance program has outgrown spreadsheets. The RA program needs a more robust and user-friendly compliance program to evaluate RA showings quickly and effectively.

Continued reliance on spreadsheets for validation of an increasingly complex RA program should no longer be a barrier to the adoption of sound policy proposals. The Commission regularly authorizes millions of dollars of IT work for a variety of purposes; for example, Item 6 on the February 26, 2026, Consent Agenda contemplates a $2.6 million increase for improvements to the California Distributed Generation Statistics Website. Given the critical importance of the RA program – supporting both reliability and affordability -- the Commission should invest in tools to make the validation process more automated and manageable for Energy

Division staff. If the Commission's existing budget is inadequate, CalCCA would gladly support any Budget Change Proposal for the IT funding necessary for this project.

V. IF THE COMMISSION DECLINES TO INVEST IN SYSTEMS TO AUTOMATE THE RA VALIDATION PROCESS, IT SHOULD ADOPT TEMPORARY GUARDRAILS TO AID IN ASSESSING COMPLIANCE

If the Commission foregoes these investments and is concerned with the amount of administrative effort this proposal would create, the Commission should adopt two temporary guardrails that would help keep validation efforts manageable. Then, the Commission should scope into the RA proceeding a process to revisit the necessity of these guardrails after a year of implementation.

First, on an interim basis, the Commission could set an initial trading limit of no more than 25 percent of an LSE's compliance obligation, as proposed in CalCCA's March 3, 2025, Opening Comments in R.23-10-011.[30] Given this limit may prohibit the use of hourly load obligation trading by smaller LSEs, the Commission should also adopt a de minimis threshold allowing LSEs with RA requirements less than 200 MW to trade up to 50 MW of their obligation. Furthermore, if the Commission is concerned with the administrative burden of multiple layers of load obligation trades, the Commission can require that if an LSE purchases a load obligation trade and then sells it to another LSE, that sale will count towards that LSE's 25 percent limit.

*Second***,** if the Commission believes Energy Division will have administrative difficulties validating showings with hourly load obligation trades, then on an interim basis the Commission could require hourly load transactions to be shown five business days prior to the RA showings to provide Energy Division staff with additional time to validate the showings. This change is not

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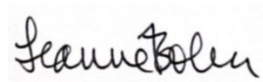
[30] *California Community Choice Association's Opening Comments on the Assigned Commissioner's Amended Scoping Memo and Ruling*, R.23-10-011 (Mar. 3, 2025) at 10-11.

ideal because CalCCA anticipates hourly load obligation trades would be used to fill marginal deficiencies after first procuring resources to fill open positions. However, it would be worth pursuing if it enables hourly load obligation trades to be a feature of the RA program.

VI. CONCLUSION

CalCCA respectfully requests consideration of the proposals herein and looks forward to an ongoing dialogue with the Commission and stakeholders.

Respectfully submitted,



Leanne Bober,
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CALIFORNIA COMMUNITY CHOICE ASSOCIATION

March 3, 2026

APPENDIX A
TO
CALIFORNIA COMMUNITY CHOICE ASSOCIATION'S
TRACK 1 PROPOSALS ON TRANSACTABILITY ISSUES

EFFECTIVE MECHANISMS FOR SLICE-OF-DAY RA TRADING
April 24, 2025

Effective Mechanisms for Slice-of-Day RA Trading

Andrew Mills[1]

April 24, 2025

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1. Introduction

California is in the first year of a new Slice-of-Day (SOD) resource adequacy (RA) program. In the new SOD program, Load Serving Entities (LSEs) must show a portfolio of resources that are sufficient to meet all 24-hours of a peak load day in each month of the year. Experience from the 2024 test year, in which LSEs submitted a non-binding SOD filing in parallel with their binding legacy filings for a single monthly RA product, shows many LSEs had resources that exceeded their RA obligations during the same hours when other LSEs were short.[2] This dynamic – whereby some LSEs possess excess RA while others are short – suggests there are additional opportunities for trade that are currently unrealized due to regulatory barriers. At present, rules set by the California Public Utilities Commission (CPUC) only allow trade of resources at a monthly level, not individual hourly obligations. CalCCA has advocated for hourly obligation trading, noting that a program that assigns obligations on an hourly basis should allow trade on an hourly basis to reduce costs to consumers.[3] This analysis quantifies the value of trade, contrasts trading in a SOD policy environment with trading in the more familiar legacy RA program, and demonstrates the advantages of hourly obligation trading.

In addition to the 24-hour obligation, a primary feature of the SOD program is 24-hour accreditation of resources. Conventional thermal powerplants, such as natural gas fired generators, geothermal, and biomass plants are generally accredited with constant generation over all 24 hours. Variable resources, like wind and solar, on the other hand, are accredited based on a technology and region-specific exceedance profile of generation on peak days.[4] Storage accreditation is constrained by the storage power rating, energy storage capability, and availability of excess energy to charge storage on the peak day. Altogether, the value of a resource depends on its contribution to the LSE's assigned RA obligation coupled with its interaction with other resources in the LSEs portfolio.

To quantify the potential benefits of hourly trading, we developed a tool to simulate competitive market trades between LSEs. In the simulations, we quantify the benefits of trade for both monthly resource trading, which is currently allowed by CPUC rules, and hourly obligation trading, which has not yet been authorized. Hourly obligation trading allows an LSE with excess resources to take on a portion of the obligation of another LSE in individual hours. We simulate monthly resource trading and hourly obligation

[2] CPUC Energy Division, 2024. *Report on Resource Adequacy Slice of Day Implementation and Year Ahead Showings.* February. Available at: https://www.cpuc.ca.gov/-/media/cpuc-website/divisions/energy-division/documents/resource-adequacy-homepage/resource-adequacy-compliance-materials/slice-of-day-compliance-materials/energy-division-report-on-ra-sod-implementation-and-year-ahead-showings.pdf

[3] CalCCA 2024. California Community Choice Association's Comments on Assigned Commissioner's Scoping Memo and Ruling. January 17. Available at: https://docs.cpuc.ca.gov/PublishedDocs/Efile/G000/M524/K571/524571013.PDF

[4] Exceedance profiles are set by the CPUC program rules across all variable resources and are not unique to LSEs or specific generators.

trading in the same manner with a broker announcing prices and LSEs responding with bids and offers for obligations in specific hours.

Broadly, the simulations are based on an intermediary, like a broker, announcing prices for SOD RA products and LSEs simultaneously responding with bids to buy or offers to sell RA products at the announced prices. The LSE bids and offers take into consideration the requirement that their portfolios meet their obligations in each hour. The LSEs develop their bids and offers by minimizing their cost, net of any revenue from selling RA products.[5] The broker matches bids and offers between participants with the goal of maximizing internal trading opportunities, or conversely, minimizing the amount of RA products that must be purchased from external sources to meet obligations. The broker's objective includes taking advantage of favorable opportunities for LSEs to sell any excess resources, not needed by participants, to external markets. In an auction-like process, the broker continuously revises the announced prices and collects additional bids and offers from LSEs until settling on final prices and quantities that maximize the trading opportunities. LSEs then make bilateral trades at the designated prices and quantities. The final quantities and prices are equivalent to the solution of a centralized optimization, in which an intermediary uses each LSE's obligation and resource portfolio to come to an optimal reallocation of resources between participants. In the case of a broker and LSE bidding process, however, the LSEs only announce responses to prices without needing to hand over their commercially sensitive RA filings to the intermediary.

The direct benefits for participants are the gains from trade – the difference between the LSEs' costs before trade, in which they must purchase external RA products to meet their obligations on their own, and the costs after trade.[6] The costs of internal trades across all participants nets to zero, since each purchase is met by an equivalent sale to another participant, such that the total gains from trade is simply the reduction in the need to purchase RA products from external sources and the revenue from selling excess resources to external markets. For these simulations, we assume that excess resources would be sold to utilities under the rules of the Western Resource Adequacy Program (WRAP),[7] at prices that are only 1/10th of the assumed cost of RA products for California LSEs.[8]

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[5] We assume that all LSEs behave as cost-minimizing price-takers and do not consider any potential strategic bidding behavior that may impact prices in a non-competitive manner.

[6] Our analysis is limited to the short-run gains from trade because we assume the initial LSE resource portfolios do not change depending on the policy environment. In the long run, LSEs may alter their procurement decisions depending on exposure to different trading environments. We ignore these potential long-run impacts when quantifying the gains from trade.

[7] WRAP. 2024. *Review of Preliminary, Non-Binding WRAP Regional Data for the Current Participating Footprint for the Summer 2025 and Advisory Data for the Summer 2028.* January 31. https://www.westernpowerpool.org/private-media/documents/2024-1-16_Webinar_Summer_2025_and_2028_Data_updated_2024-12-12.pdf

[8] Because the WRAP program has not yet gone into effect, the volume of market-based capacity transactions outside of California is low, making it difficult to estimate the value of capacity outside of California. From the limited set of non-California capacity transactions, we see that recent capacity prices are on average lower than in California. Based on the thin volume and lower prices, we simply assume that sales of capacity outside of California would occur at a price of 1/10th of the price in California. We expect

Notably, trade between participants also provides indirect benefits to all California LSEs due to the reduction in demand for RA products. Reduced demand for RA products lowers the price of RA, which lowers the cost of meeting RA obligations to all California LSEs. The magnitude of the indirect benefits depends on the avoided external RA purchases by the participants, the price elasticity of RA products, and the quantity of RA bought at market prices by California LSEs. Reducing the cost of RA in California has grown in importance in recent years following the rapid increase in RA prices. While the weighted-average price for RA was $2.77/kW-mo in 2019,[9] tight market conditions[10] caused the weighted-average price to rise by a factor of nine to $26.26/kW-mo in 2024.[11] The ability for trade to reduce the cost of RA has significant affordability implications for all of California.

To compare trading in the new SOD program with trading in the legacy RA program, we also simulate resource and obligation trading with a single monthly RA product. In the legacy RA program, resource accreditation is based on an effective load carrying capability (ELCC) and obligations are based on the highest demand in each month. Although a broker is used to coordinate trading in the legacy RA program simulations, the broker is not strictly necessary. LSEs that are long could simply match with LSEs that are short and trade directly, resulting in the same outcome as with a broker. Hourly obligation trading offers a similar opportunity for LSEs simply matching long and short hours without an intermediary to coordinate trades. We call hourly obligation trading without an intermediary "uncoordinated hourly obligation trading," because this simple matching does not consider inter-temporal coupling nor the potential economic benefits of selling excess resources to external markets. An analogous uncoordinated approach for resource trading would be to only match LSEs that have excess thermal capacity with LSEs that are short in any hour.[12] We call the simple matching of LSEs with excess thermal and LSEs that are short on thermal resources "uncoordinated resource trading". We compare the effectiveness of uncoordinated trading to coordinated trading within the new SOD program.

The simulation results that follow are based on the confidential SOD RA filings for a subset of California LSEs, 24 community choice aggregators (CCAs), for the 2024 test

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non-California markets for RA to become more robust in the future with the implementation of WRAP, enabling better estimates of market prices.

[9] CPUC. 2019. Calculation of the 2019 True Up and Forecast 2020 Market Price Benchmarks for the Power Charge Indifference Adjustment. R. 17-06-026. November. Available athttps://webproda.cpuc.ca.gov/-/media/cpuc-website/divisions/energy-division/documents/community-choice-aggregation-and-direct-access/2019-final-calculation-of-the-pcia-market-price-benchmarks.pdf

[10] CalCCA. 2024. California's Constrained Resource Adequacy Market: Ratepayers Left Standing in a Game of Musical Chairs. January. : Available at: https://cal-cca.org/wp-content/uploads/2024/02/CalCCA-Stack-Analysis-2023-2026-updated-01_16_24-.pdf

[11] CPUC. 2025. *Market Price Benchmark Calculations 2024* (Revised). November. Available at https://www.cpuc.ca.gov/-/media/cpuc-website/divisions/energy-division/documents/community-choice-aggregation-and-direct-access/2024-market-price-benchmarks-revised-20241105.pdf

[12] Presumably other resources or bundles of resources could be chosen as the resource to trade in an uncoordinated fashion. We chose thermal resources for the simplicity of being able to quantify how much excess or how much shortage of thermal resources an LSE has. An LSE is long on thermal by the amount the aggregate resource showing exceeds their obligation in the tightest hour. An LSE is short on thermal by the amount the aggregate showing is less than their obligation in the hour with the greatest deficit.

year and the first binding year of 2025. The 2025 filings are "year-ahead" filings in which the obligations were set at 90% of the final requirements for the operating month. To quantify the gains from trade, we scaled the year-ahead obligations to the full 100% requirements and, in effect, ask how much of the remaining RA purchases for each CCA could be met through trade with other CCAs instead of going out to the market to buy incremental RA from external sources.

2. Results and Discussion

2.1 Trade Between CCAs Creates Substantial Value

Across the five summer months in 2025, simulated trading between CCAs directly reduces costs to participants by $60 million per year[13] and the reduced demand for RA products produces $50 million per year in indirect benefits to all Californians.

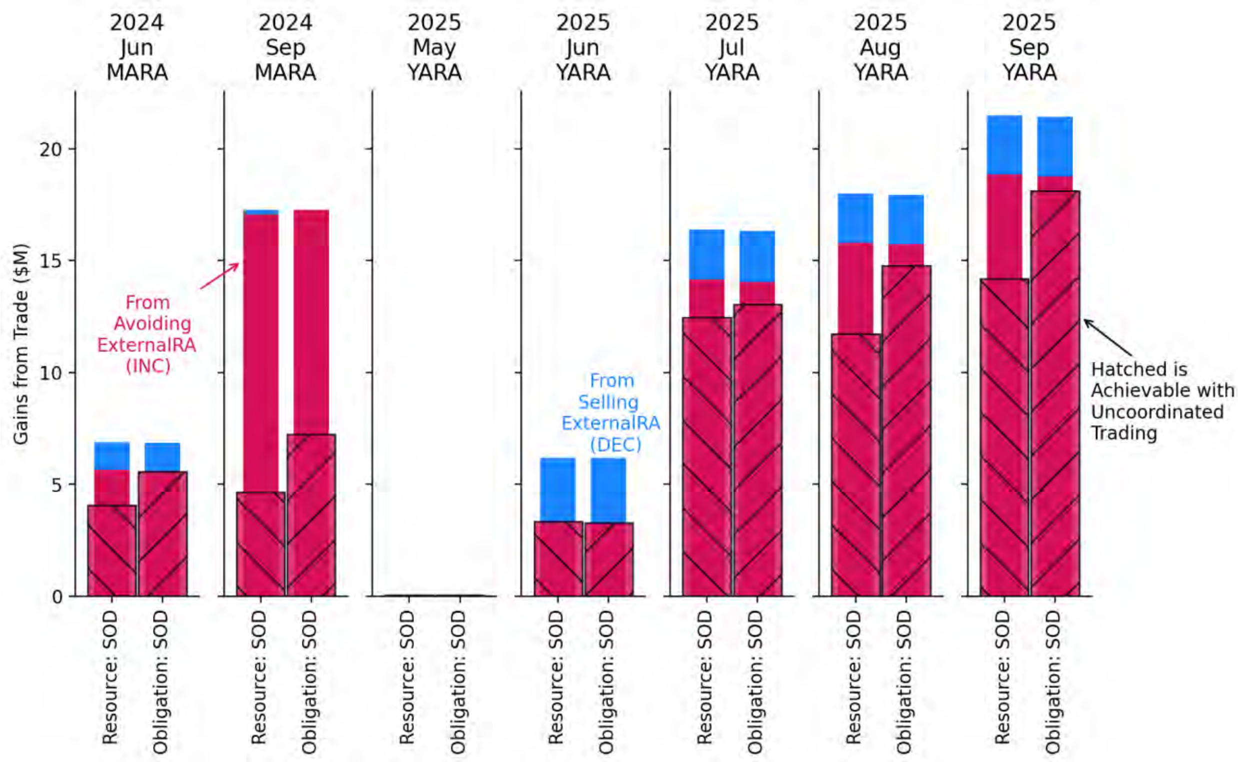
2.1.1 Direct Benefits

For 2025, over 85% of the direct benefits of trade are from the reduced purchases of RA products from external sources while the remaining 15% are from the sales of excess resources to external markets. The gains from trade occur primarily in the months of July, August, and September when loads are highest and the accreditation of variable resources is lowest (see Figure 1).

The June gains from trade are also lower due to lower prices for external RA products in June compared to later months. The gains from trade are zero in May because each of the CCAs could meet their obligations on their own, obviating the need to purchase external RA even before trade, and the lack of a binding requirement for WRAP utilities in May.

The gains from trade in the June and September 2024 test-year filings are similar to the gains from trade in the corresponding month of the 2025 binding year. One exception is that sales of excess RA in September 2024 were near zero because the participating CCAs did not have sufficient resources to meet the obligations on their own, even after trade (see Table 1). As a result, some CCAs needed to purchase incremental RA from external sources even after trading with other CCAs.

[13] The direct benefits of trade are proportional to the avoided purchases of external RA (or increased sales of external RA in cases with a net excess) and the assumed price of external RA. The external RA prices in this analysis are based on observed sales of capacity to California LSEs reported in FERC Electronic Quarterly Reports, as described in Section 5.3. Actual external RA prices faced by LSEs are uncertain, though the direct benefits would increase or decrease commensurate with changes in the external RA prices.



Note: Further details of gains from trade for September 2024 and 2025 are in Table 1 and Table 2, respectively. Gains from trade in all months are described in Appendix C.

Figure 1. Total gains from trade across all 24 CCAs with the 2024 test-year and 2025 year-ahead Slice-of-Day filings, with either resource trading (Resource: SOD) or hourly obligation trading (Obligation: SOD). Gains from trade with uncoordinated trading, without an intermediary to coordinate trades, is shown by the wide, hatched bar.

2.1.2 Indirect Benefits

The $50 million per year in indirect benefits stem from the reduced demand for external RA products after trade and the downward pressure that places on RA prices. Across the five summer months of 2025, trade reduces purchases of RA from external sources by 455 MW on average. Based on our observations of the average RA price and the net surplus from year to year,[14] we estimate that average RA prices decrease by $1/kW-mo for every 1 GW demand reduction.[15] In 2024, California LSEs purchased roughly 20 GW of RA products at market prices in each summer month.[16] Altogether, trade between CCAs lowers demand for RA products and reduces costs for all California LSEs (CCAs, ESPs, IOUs, and POUs).

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[14] CalCCA. 2024. *California's Constrained Resource Adequacy Market: Ratepayers Left Standing in a Game of Musical Chairs*. January: Available at: https://cal-cca.org/wp-content/uploads/2024/02/CalCCA-Stack-Analysis-2023-2026-updated-01_16_24-.pdf

[15] Estimating the sensitivity of RA prices to shifts in RA demand is particularly challenging because of the bilateral nature of the California RA market. We describe our approach for estimating the sensitivity of RA prices to RA demand in Appendix B.

[16] CalCCA analysis of FERC EQR capacity transactions downloaded from https://eqrreportviewer.ferc.gov/.

2.1.3 Benefits Would Grow if Participants Extended Beyond CCAs

While trade between the 24 CCAs creates substantial direct and indirect benefits, the benefits would be even greater if trades occurred between all CPUC-jurisdictional entities (CCAs, ESPs, and IOUs). The CPUC's analysis of 2024 test-year SOD filings[17] identified short positions that were about 70 percent greater than the short positions of CCAs alone. Based on this finding, we estimate that trade between all CPUC-jurisdictional LSEs could reduce RA demand by 70 percent more than trade between CCAs. The greater reduction in RA purchases and further downward pressure on RA prices could increase the benefits of trade to more than $180 million per year ($105 million of direct benefits and $77 million of indirect benefits).

		Short Position (a.k.a., ExternalRA INC)			Internal Trades				
	Scenario	Before Trade (MW)	After Trade (MW)	Gains from Trade ($M)	Volume (MW)	Count	Average Connections	Monetary Transfer ($M)	Requires Intermediary
I.	Resource: ELCC	467	0	12.3	467	22	1.9	1.2	No
II.	Obligation: ELCC	467	0	12.3	467	22	1.8	1.2	No
III.	Resource: SOD	926	269	17.3	2,642	185	15.4	23.4	Yes
IV.	Obligation: SOD	926	261	17.3	3,591	150	12.5	11.7	Yes
III.*	Uncoordinated Resrc.: SOD	926	748	4.7	185	7	1.8	N/A	No
IV.*	Uncoordinated Oblg.: SOD	926	645	7.2	4,654	122	10.2	N/A	No

Table 1. Summary of trade between CCAs across policy environments with September 2024 test-year data

		Short Position (a.k.a., ExternalRA INC)			Internal Trades				
	Scenario	Before Trade (MW)	After Trade (MW)	Gains from Trade ($M)	Volume (MW)	Count	Average Connections	Monetary Transfer ($M)	Requires Intermediary
I.	Resource: ELCC	541	0	15.1	541	22	1.9	1.4	No
II.	Obligation: ELCC	541	0	15.1	541	22	1.8	1.4	No
III.	Resource: SOD	727	0	21.5	3,500	167	13.9	6.7	Yes
IV.	Obligation: SOD	727	0	21.4	8,062	163	13.6	2.4	Yes
III.*	Uncoordinated Resrc.: SOD	727	182	14.2	561	16	1.9	N/A	No
IV.*	Uncoordinated Oblg.: SOD	727	27	18.1	6,613	120	10.0	N/A	No

Table 2. Summary of trade between CCAs across policy environments with September 2025 binding-year data

2.2 With an Intermediary, Resource Trading and Hourly Obligation Trading Achieve the Same Benefits

In the simulations of trade, the broker coordinates trades between LSEs, ensuring that any opportunity for an LSE to meet its obligations by purchasing RA products from a

[17] CPUC Energy Division, 2024. *Report on Resource Adequacy Slice of Day Implementation and Year Ahead Showings.* February. Available at: https://www.cpuc.ca.gov/-/media/cpuc-website/divisions/energy-division/documents/resource-adequacy-homepage/resource-adequacy-compliance-materials/slice-of-day-compliance-materials/energy-division-report-on-ra-sod-implementation-and-year-ahead-showings.pdf

participant is realized, without adversely affecting the other LSEs ability to meet its own obligations or to sell to an external market if more lucrative. LSEs participate by responding to broker-announced prices with bids and offers of RA products at quantities that are both feasible, in the sense that the LSE's obligations will be met if the bids and offers are accepted, and minimize costs to the LSE. With this sophisticated trading mechanism, trading either resources or hourly obligations achieve roughly the same reduction in purchases of external RA and the same gains from trade, Figure 1. Later sections discuss important differences between resource trading and hourly obligation trading, in terms of differences in internal monetary transfer between participants in Section 2.4 and ability to trade without the need for an intermediary in Section 2.5, but in terms of aggregate benefits, the two policy environments produce similar direct and indirect benefits.

2.3 Benefits of Participation are Widespread, Though Uneven

For a participant, the most salient question is whether it benefits from trade, not necessarily the aggregate benefits to all participants. We find that all participants are economically better off by participating in the coordinated trades than on their own. Individual CCA gains from trade across the five summer months of 2025 are quantified in Figure 2, shown as a percentage of the LSEs' maximum cost if they met all of their RA obligations by buying RA from external sources (ExternalRA INC). We normalize the individual gains from trade in this manner to remove the effect of CCA size on the individual LSE gains from trade.

While all participants benefit from trade, some LSEs benefit more than others. For the summer months of 2025, roughly half of the participants reduce compliance costs by 10-30% through trade, while the remaining half see less than 5% reductions in cost.

The only contributor to gains from trade with uncoordinated trading are the avoided costs of purchasing RA from external sources (ExternalRA INC). This is because the way we simulate uncoordinated trading does not involve internal monetary transfer and does not involve sales of RA to external markets (ExternalRA DEC). Therefore, the only beneficiaries from uncoordinated trading in the simulations are LSEs that are short prior to trade.

Comparison of the beneficiaries of trade with uncoordinated and coordinated resource or hourly obligation trading in Figure 2 reveals that the LSEs that benefit the most from trade in 2025 are those that are short prior to trade. LSEs that are long prior to trade see proportionally smaller benefits from selling RA products internally or to external markets. The relatively low benefits to participants that are long prior to trade is in part due to low internal RA prices in the summer of 2025 resulting from coordinated trades eliminating the short positions of all participants even in September 2025 (see Table 2). In contrast, internal RA product prices remain high in September 2024, when some participants still must purchase RA from external sources (ExternalRA INC) even after trade (see Table 1), and therefore LSEs that are long prior to trade see proportionally higher benefits from trade.[18]

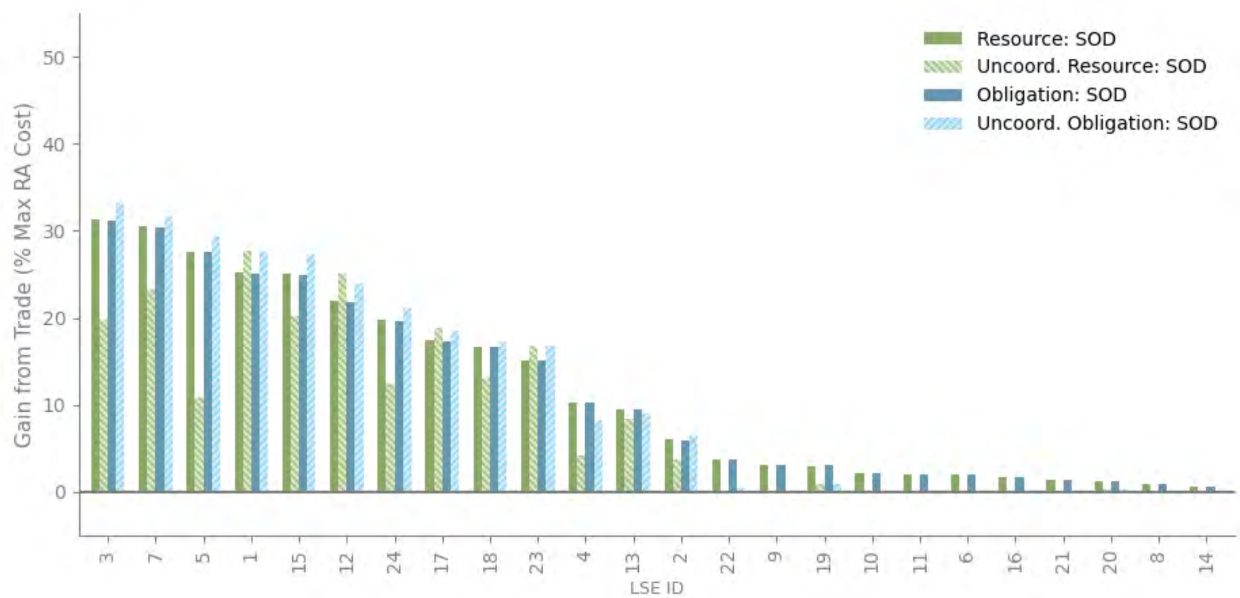


Figure 2. Aggregate direct benefits across May to September 2025 for each CCA, scaled by the CCA's maximum RA cost if it met all obligations at the assumed external RA price.

2.4 Hourly Obligation Trading Targets Periods with Scarce Resources

Even though the simulations show that hourly obligation trading and resource trading yield similar gains for participants, we observe important differences between the two policy environments. One difference is the way that hourly obligation trading directs internal monetary transfer toward hours that are most constrained in aggregate.

With the September 2024 test-case data, trade reduced the need to purchase RA products from external sources (ExternalRA INC), but it did not eliminate it entirely (see Table 1). We illustrate differences in internal monetary transfer in this constrained month by showing the trade volume and final prices with resource trading and hourly obligation trading for September 2024 in Figure 3. The product of the trade volume for the internal RA product and its corresponding price sums to the total internal monetary transfer. The product of external RA volume and prices, in contrast, is the post-trade external RA cost which is minimized by the broker by coordinating trades.

Final prices for internal RA products from the broker auctions differ across resources or hours, for policy environments that allow resource trading or hourly obligation trading, respectively, depending on how much another increment of that product

[18] Relatively low benefits of trade for LSEs that are long prior to trade raises the question of whether these entities would participate in trade. We find that even if LSEs that are long prior to trade decide to abstain from trade, there continue to be trading benefits for the LSEs that are short prior to trade. The direct benefits of trade when only short LSEs participate are $20-21 million in 2025, which is 42-44% of the gains the short participants would have realized if all of the LSEs were to participate.

would reduce the need to buy RA from external sources (ExternalRA INC). With hourly obligation trading, the only hour with a final non-zero price was hour ending 19 (HE19). In all other hours the final price for hourly obligations was zero because participating LSEs could easily take on additional obligations in hours other than HE19 without triggering the need to buy additional RA from external sources. Even though hourly obligation trading involves a large volume of internal trades, the final auction price of zero for hourly obligations in most hours results in monetary transfers being concentrated only in the subset of trades involving obligations in HE19.

With resource trading, on the other hand, final prices are non-zero for all RA products, meaning that every internal trade also requires an internal monetary transfer between participants. The internal monetary transfer is largest for trades involving natural-gas fired thermal resources, unspecified imports, and 4-hour batteries. Prices for wind and solar resources are lower and therefore contribute less to the internal monetary transfer even though the internal trade volume is large. For some participants, favorable trades involve selling one high-cost resource, such as a battery, while simultaneously buying a high-cost resource with different characteristics, such as a thermal resource, to marginally lower the participant's net cost. Such a trade involves a large internal monetary transfer yet only contributes a small amount to the overall gains from trade. Similar transactions were not required in the policy environment with hourly obligation trading.

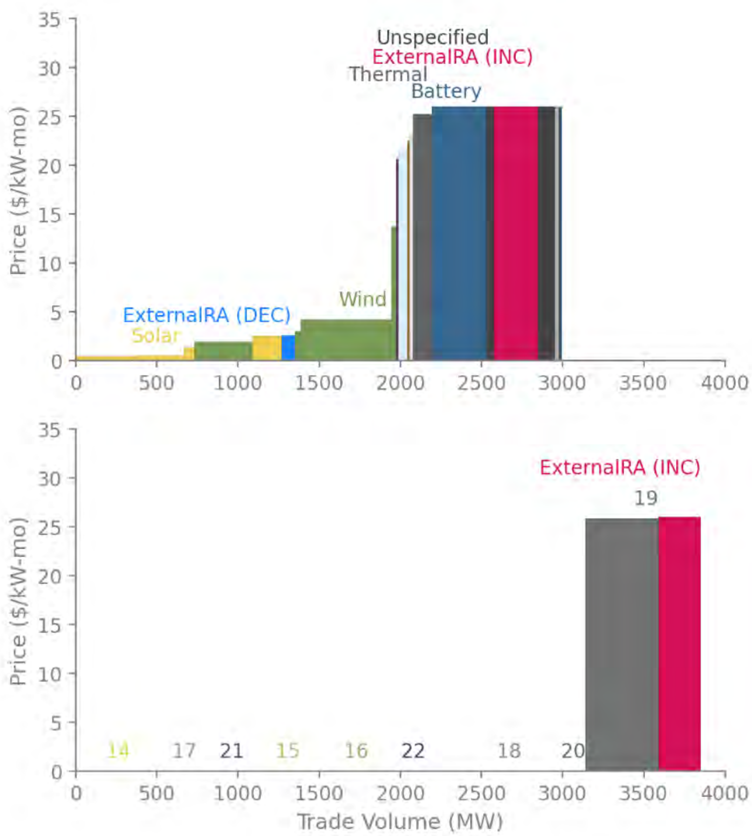


Figure 3. Comparison of SOD trade volume and price using September 2024 test-year data with the resource (top) and obligation (bottom) trading policy

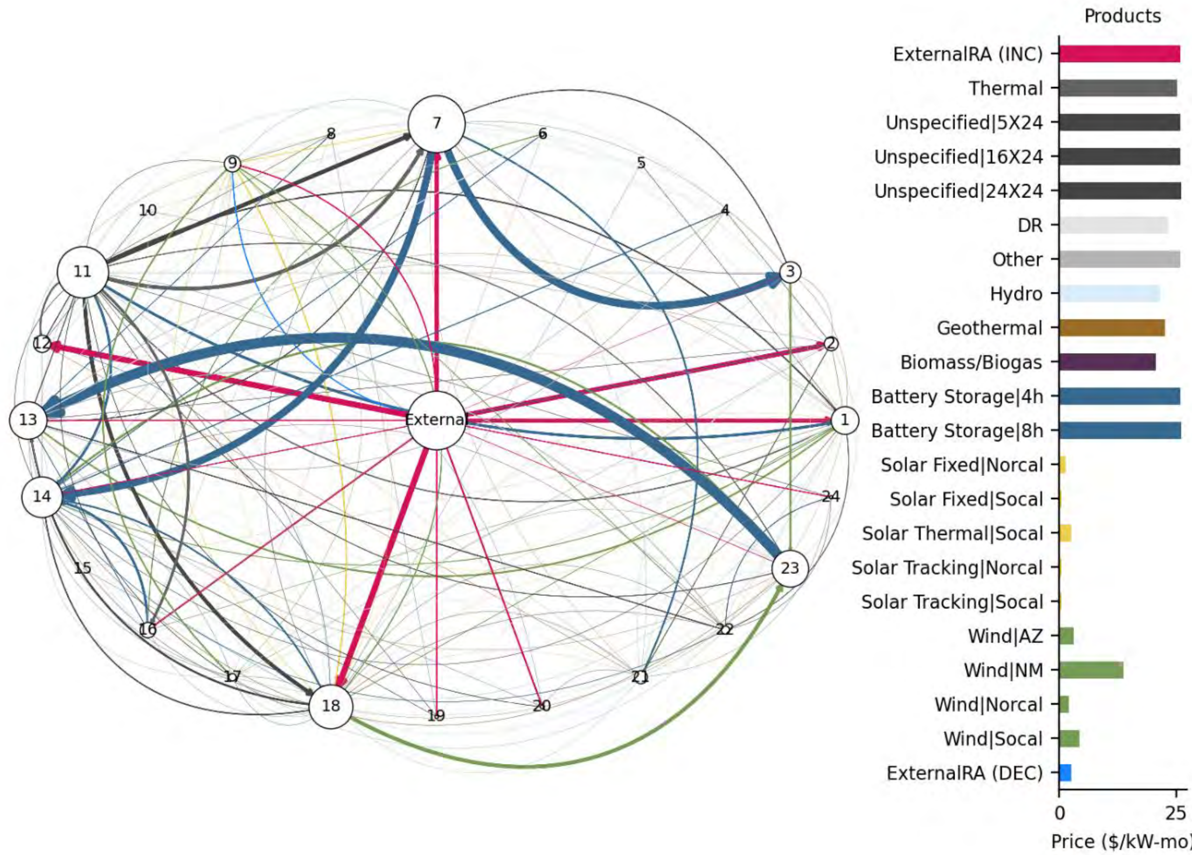
2.5 Slice-of-Day Trading is 6-9 Times More Complex

Gains from trade are not unique to the new SOD RA program. Even with the legacy RA program, where different resources would be converted to a comparable RA product with a single qualifying capacity value through an accreditation factor called the ELCC, LSEs that are long can benefit from selling excess RA to LSEs that are short. What is unique to the SOD RA program is the complexity of trades required to achieve the benefits. Overall, we estimate SOD trading to be 6-9 times more complex than trading with the legacy RA program.

We quantify the complexity of internal trade through three related metrics: volume, transaction count, and average number of connections.[19] These metrics are shown for each of the policy environments with September 2024 test-year data and September 2025 binding data in Table 1and Table 2, respectively. In the legacy RA program, every internal trade results in a comparable reduction in the short position of the purchasing LSE meaning that the trade volume is equal to the reduction in short positions before and after trade. In contrast, trading with SOD products across the summer months of 2025 requires an internal trade volume that is nine times the reduction in purchases of external RA. The count of transactions with SOD trading is more than 6 times the count of transactions in the legacy RA policy environment, where a unique transaction is the bundle of all RA products sold by one LSE to another. Finally, the average number of trading partners with SOD trades is 6 times more than in the legacy RA policy environment.

To illustrate the complexity of SOD resource trading, we visualize the trading network between 24 CCAs and external sources of RA using September 2024 test-year data, Figure 4. Each node represents a CCA, with the size of the bubble proportional to the CCA's transaction costs (price times quantity). Each edge of the network is a transaction involving a particular type of RA resource, with arrows showing the direction from seller to buyer and the width of the arrow based on the transaction cost. Even though the volume of wind and solar RA product trades is large, the low prices for these products leads to smaller transaction costs and less prominent edges.

[19] As is common in any optimization-based simulation, numerical issues can sometimes lead to trades with very small quantities being included in the final allocation, impacting metrics such as transaction count and number of trading partners. For these two metrics, we exclude any transaction with a quantity below 0.5 MW in the tally of transaction count and trading partners.

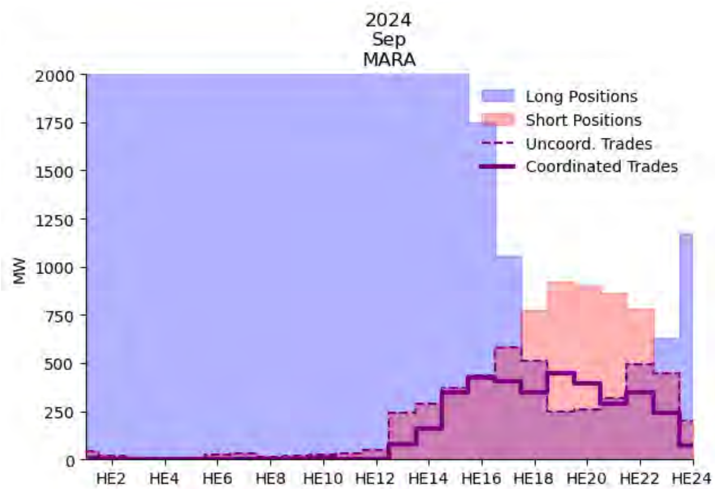


Note: Bubbles are CCAs, sized based on transaction costs. Lines are transactions sized by transaction cost.

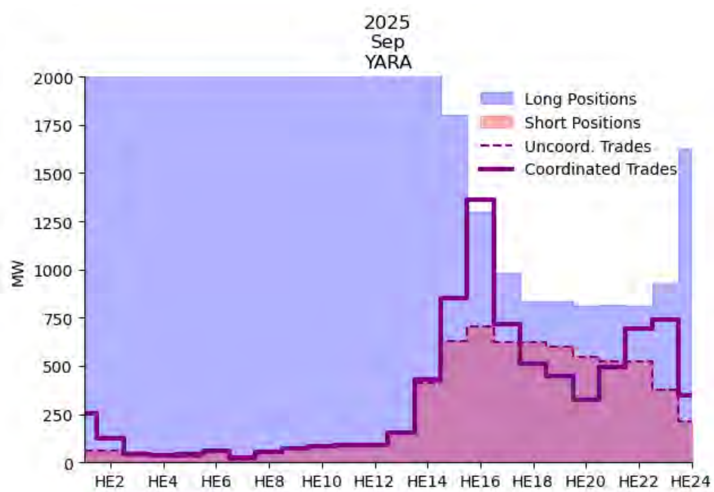
Figure 4. Visualization of trading networks in the SOD resource trading policy environment using September 2024 test-year data

2.6 Hourly Obligation Trading Allows Simple Trades without an Intermediary

With the increased complexity of SOD trading, it is important for policy makers to provide LSEs with tools necessary to simplify trade to manage the risk that LSEs forgo trading and instead purchase additional unnecessary external RA products, at the expense of ratepayers. Previous results demonstrated that hourly obligation trading can achieve the same benefits as resource trading when an intermediary is available to coordinate trades (Sections 2.2) and that hourly obligation trading can target hours where aggregate resources of participants are insufficient to meet the aggregate obligation (Section 2.4). One more potential advantage of hourly obligation trading is that it provides a pathway for LSEs to achieve some of the same benefits of coordinated trades without the need for an intermediary. In the simplest form, participants that show resources in excess of their obligations in some hours can take on the obligations of LSEs that are short in those hours. Trades made in this manner, without further consideration of impacts on storage charging energy or impacts to opportunities to sell excess to external markets, is what we call uncoordinated hourly obligation trading and is illustrated for September 2024 and 2025 in Figure 5. For the summer months of 2025, even the uncoordinated trades achieve 80% of the gains from trade observed with a sophisticated intermediary to coordinate trades (see Figure 1).



(a)



(b)

Figure 5. Comparison of uncoordinated and coordinated hourly obligation trades when CCAs have (a) a net deficit of resources in September 2024 or (b) a net surplus of resources in September 2025.

The uncoordinated approach is not always as effective, however. With the September 2024 test-year some of the participants still need to purchase RA products from external sources, even after trades coordinated by an intermediary. For this month, the uncoordinated hourly obligation trading only achieved 35% of the gains of trade possible with an intermediary. In this case, the intermediary helps to find trading opportunities involving HE19 that come from adjusting storage charging, storage discharge, and obligations of LSEs to better align with overall needs. The possibility of these adjustments to generate gains from trade is not evident with uncoordinated hourly obligation trading alone, as shown in Figure 5a.

In months where long positions exceed short positions in all hours, as in the September 2025 filings, there are again differences in trading opportunities identified by uncoordinated hourly obligation trading and with an intermediary to coordinate trades, as in Figure 5b. However, the differences are much less impactful on the gains from trade since trades from both approaches can largely eliminate the need to purchase RA from external sources. Allowing hourly obligation trading opens a pathway for LSEs to begin to realize the benefits of trade without the need to develop a novel sophisticated intermediary to coordinate trades.

3. Practical Considerations for Implementing Trading Mechanisms

The previous results are based on simulations comparing alternative policy environments. Moving from simulation to real-world implementation would require a much more in-depth investigation. Here we describe some of the important practical considerations but note that much more work on this question remains.

Three different mechanisms for SOD trading have been mentioned in this analysis: (1) a centralized optimization; (2) a broker running an auction; and (3) uncoordinated trades. *First*, a centralized optimization across all participating LSEs involves an intermediary having access to each LSEs confidential resource portfolio and obligations then using that information to reallocate resources an optimal manner. *Second*, a broker running an auction-like process would involve LSEs responding to announced prices with bids and offers. While both mechanisms lead to the same solution and gains from trade, under the auction approach, the LSEs can maintain the confidentiality of their portfolios and obligations. *Finally*, even an uncoordinated form of trade could achieve significant benefits without requiring an intermediary. In this case, trading could be as simple as participating LSEs posting hourly bids and offers to a bulletin board and making bilateral trades from there. Although this would not achieve all the benefits available with an intermediary, it would still maintain confidentiality and would be simple to implement. These high-level considerations are summarized in Table 3.

	Centralized Optimization	**Broker Running an Auction**	**Posting Hourly Obligation Bid/Offers to a Bulletin Board**
LSEs keep contracts confidential	No	Yes	Yes
Achievable without intermediary	No	No	Yes
Maximizes trading opportunities	Yes	Yes	No

Table 3. Comparison of slice-of-day trading mechanisms

4. Conclusions

Hourly obligation trades can create substantial value. In the five summer months of 2025, simulated trading between the 24 CCAs could provide as much as $60 million per year in direct benefits from avoiding the need to buy incremental RA from external sources and even enabling sales of excess resources to external markets. The benefits of trade are widespread across all participants, though CCAs that are short prior to trade benefit more than CCAs that are long. Furthermore, the trade between CCAs lowers overall demand for RA products. Lower demand reduces RA prices for all California LSEs, creating a collective indirect benefit of $50 million per year.

With some form of sophisticated intermediary to coordinate trades, resource and hourly obligation trading can both achieve these benefits. An advantage of hourly obligation trading is that it requires only 2/5 of the internal monetary transfer between participants yet achieves the same benefits of resource trading. If part of the justification for the SOD program is a fair allocation of the costs of maintaining a reliable system, hourly obligation trading is better suited to valuing hours of the day with scarcity at the aggregate level.

Implementing an effective trading mechanism with the SOD program will not be easy. Trading in the SOD policy environment is 6-9 times more complex than that of the legacy monthly RA product. It will require a greater volume of trades, more transactions, and more trading partners. Achievement of the full benefits of trade requires a much more sophisticated coordination mechanism than participants might be accustomed to. Hourly obligation trading allows for simple trades without an intermediary, while still achieving 80% of the benefits.

With rapidly rising electricity costs in California, all ratepayers would benefit from having more flexibility in the way RA obligations are met. Trade is important and fundamentally more complex in the new SOD program. Policy makers should support the development of effective trading mechanisms that go hand in hand with the transition to SOD. Otherwise, the SOD RA program will drive up costs for consumers with no direct benefit to reliability.

5. Methods and Data

5.1 Policy Environments and ExternalRA

We developed a common analysis approach to compare trading under four different policy environments: two with RA based on a single monthly product where resources are accredited by an ELCC and two based on the SOD accreditation. With either ELCC or SOD accreditation, we compare resource trading and obligation trading, Table 4.

		Accreditation	
		ELCC	**SOD**
Trading Product	**Resources**	I: Resource trading with ELCC	**III.** Resource trading with SOD
	Obligations	**II.** Obligation trading with ELCC	**IV.** Hourly obligation trading with SOD

Table 4. Four policy environments in RA trading analysis

The trading analysis is based on a simulation of LSEs each having obligations and resources characterized in a regulatory filing for the CPUC called an RA filing. All participants in the trade are CPUC jurisdictional and subject to common RA program rules. Any RA obligations that are not met by internal trades with participants or any short positions prior to trade are met through incremental purchases of RA from external sources (ExternalRA INC), Figure 6. Assuming transmission capacity is available, the source of external RA can be from any resource in the western interconnection, whose reliability is assured by the Western Electricity Coordinating Council (WECC). We assume that purchases of ExternalRA INC contribute to a participant's portfolio similar to an unspecified resource available 24-hours a day (Unspecified|24X24). All ExternalRA INC is purchased at a single price, varying only by month of the year.

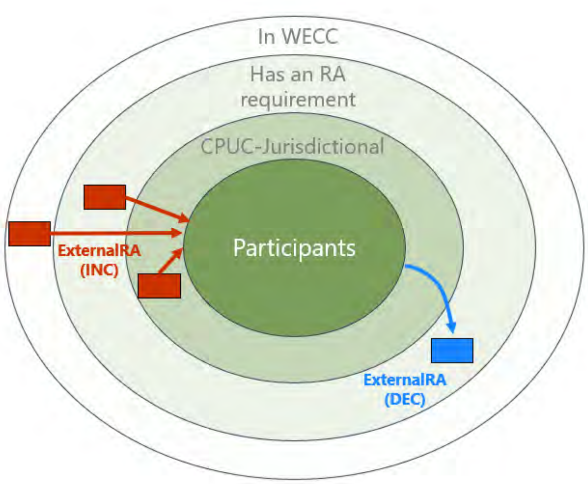


Figure 6. Illustration of the relationship of ExternalRA INC and DEC to participants in trade

In cases where an LSE's resources exceed its obligations, it may also be able to sell that excess to an external market (ExternalRA DEC). We assume that the purchaser of external RA would be an entity in WECC that has an RA requirement but is not CPUC jurisdictional. This assumption allows us to set a single price for external sales each month. An LSE that sells a resource to an external market removes the resource from its portfolio and converts it to ExternalRA DEC using the ELCC factors applicable to the external market.

The primary driver of the gains from trade is the reduction in purchases of ExternalRA across all participants before and after trade. Figure 7 illustrates how purchases of internal RA products can reduce the need to purchase ExternalRA across all four policy environments.

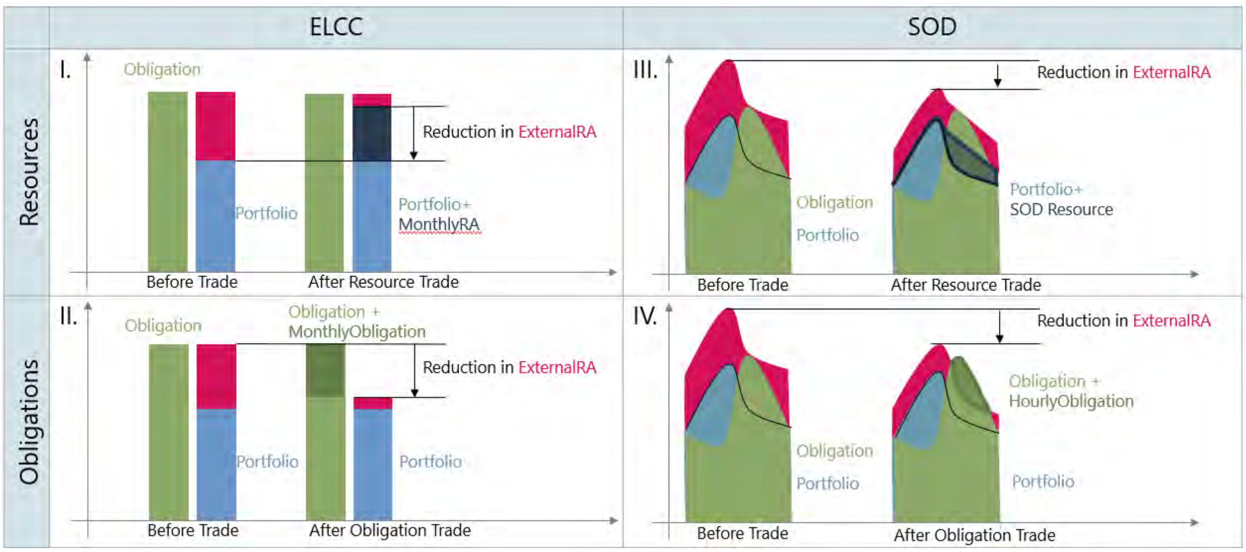


Figure 7. Illustration of the effect of trade on the need to purchase ExternalRA in each of the four policy environments

5.2 Trade Simulation

The Broker and LSE Bidding Strategy models are derived from a Central Optimization Problem in which the costs of meeting all LSE obligations are minimized, as in an RA pool. In the Central Optimization, a planner uses its visibility into the obligations and resources of every participating LSE to reallocate RA products (either resources or obligations, depending on the environment), such that the residual need to purchase RA products from an external source (ExternalRA INC), is minimized.

5.2.1 Central Optimization Problem

At a high level, the Central Optimization Problem is formulated as follows:

Central Optimization Problem:

Minimize: $ExternalCosts + TradeFriction$

Subject To:

$ExcessDemand_p = 0$, for each p in set of internal RA Products

$Deficit_l = 0$, for each l in the set of participating LSEs

$ExternalRA^{INC}_l <= Max\_Deficit\_Prior\_to\_Trade_l$, for each l in set of LSEs

Where:

$ExternalCosts = ExternalRA^{INC} * ExternalRA^{INC}\_Price - ExternalRA^{DEC} * ExternalRA^{DEC}\_Price$

$TradeFriction = \Sigma_p(InternalPurchase_p + InternalSale_l) * UnitFrictionCost$

$ExcessDemand_p = InternalPurchase_p - InternalSale_p$

The disadvantage of the Central Optimization is that each participant must share information about its full portfolio of RA contracts and its RA obligation with the entity operating the optimization. Such information is confidential and commercially sensitive, potentially limiting the set of LSEs willing to participate.

5.2.2 Decomposition to Broker and LSE Bidding

An alternative is to have an independent broker operate an auction-like process where it announces prices and participants respond with bid/offer quantities at those prices. The broker revises prices and continues to collect bids until it can balance supply and demand for RA products between participants while maximizing the gains from trade. The Broker/LSE Bidding Strategy models arise from a Dantizg-Wolfe Decomposition of the Central Optimization Problem.[20] The Broker is equivalent to the master problem and the LSE Bidding Strategy is part of the subproblem. The decomposition yields an equivalent solution to the Central Optimization, though it is solved through an iterative process rather than a single optimization.[21] More importantly, the Broker needs to only collect bid/offer responses from LSEs and does not need confidential information on each LSE participant's resource contracts or obligations.[22]

Broker:

Minimize: $\Sigma_r((ExternalCost_r + TradeFriction_r) * weight_r)$

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[20] Conejo, A.J., Castillo, E., Minguez, R. and Garcia-Bertrand, R., 2010. *Decomposition Techniques in Mathematical Programming: Engineering and Science Applications*. Springer Science & Business Media.
[21] The use of Dantizg-Wolfe decomposition to model coordinated markets has been used elsewhere in the literature, e.g., Najafi, F. and Fripp, M., 2023. "Market-based Coordination of Price-responsive Demand Using Dantzig-Wolfe Decomposition Method". *Energy and AI*, 14, p.100277. https://doi.org/10.1016/j.egyai.2023.100277
[22] The code used to create the simulations of trade in all policy environments is available at: https://github.com/CalCCA-Data-Team/agent_based_ra_market

Subject To:

$\Sigma_r\ (weight_r) = 1$

$\Sigma_r(ExcessDemand_{r,p}{*}weight_r) <= 0$, for each p in the set of internal RA products

<u>LSE Bidding Strategy:</u>

Minimize: $ExternalCost_l + TradeFriction_l + InternalCost_l$

Subject To:

$Deficit_l = 0$

$ExternalRA^{INC}_l <= Max\_Deficit\_Prior\_to\_Trade_l,$

Where:

$InternalCost_l = \Sigma_p\ (InternalRA\_product\_price_p{*}(Internal\_RA\_bought_{p,l} - Internal\_RA\_sold_{p,l}))$

5.2.3 LSE Bidding

In each round of the auction, LSEs respond to the Broker's prices with bids to purchase or offers to sell RA products. The bid/offers include both internal RA and external RA (INC or DEC) products. The LSE chooses bid/offers that minimize its cost of eliminating deficiencies. We further assume that LSEs will not purchase more ExternalRA_INC during trade than they would have had to purchase before trade. In other words, for LSEs that were already in compliance with RA requirements before trade, their ExternalRA_INC bids will always be zero.

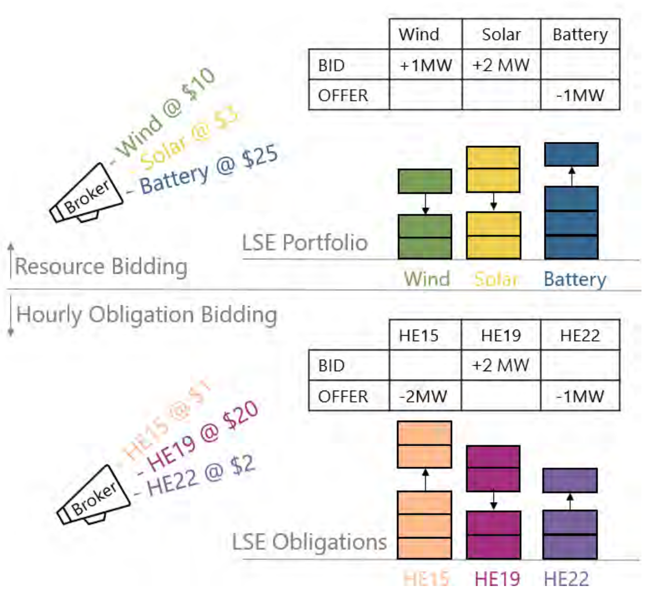


Figure 8. Illustration of LSE bidding either resources (top) or hourly obligations (bottom) in response to prices announced by the broker

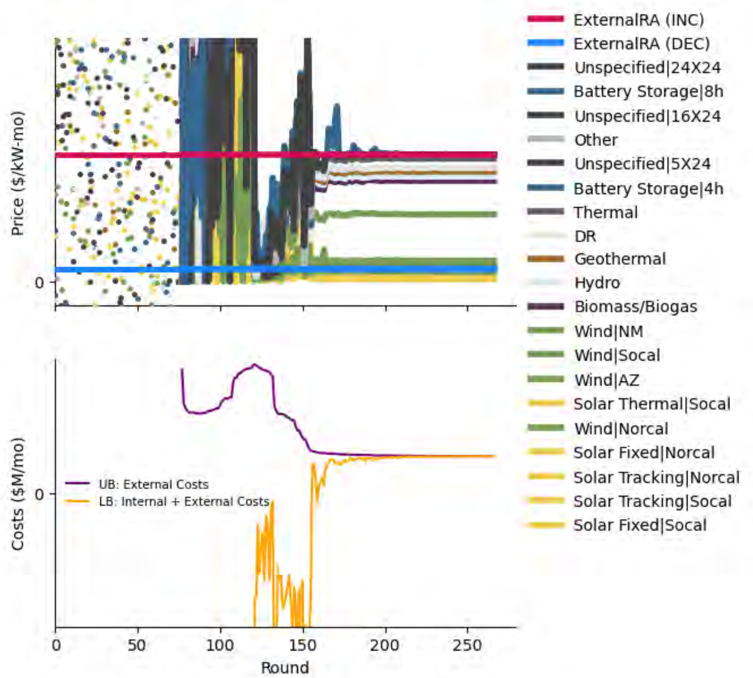
Figure 8 illustrates the process of a broker announcing prices for RA products and an LSE responding with bids to purchase or offers to buy the RA products at those prices. The LSE's bids and offers are made with the expectation that all bids and offers will be successful. In other words, there is no risk that an LSE offers to sell a product and then their bids for other RA products are unmet causing a deficiency. As described next, an important role of the broker is to collect all feasible bids and offers at different price points, then coordinate trades based on a final determination of quantities and prices that maintains feasibility for each participating LSE.

5.2.4 Broker Auction

In every auction round, *r*, the Broker finds weights to place on previous rounds to minimize costs, while ensuring that supply and demand for internal RA products are balanced. The shadow value of the supply and demand balance constraint for each product, representing the marginal reduction in total costs from another unit of supply, sets the prices for next round of the auction.[23]

The Broker continues the auction process until the Broker finds no further opportunity to reduce total costs. More precisely, the auction is completed when the weighted sum of all external RA costs matches the sum of the costs across all LSEs in the most recent auction round.[24] The final allocation of trades is based on applying the final weights to the bids collected in previous auction rounds. LSEs trade RA products with the other participants at the final auction prices. An example of the history of RA product prices and the convergence of external costs with the sum of LSE costs across auction rounds is shown in Figure 9.

[23] To begin the auction process, the Broker first collects bids based on randomly chosen prices. Bids in response to random prices are used to initialize the model. After initializing, all subsequent prices are from the shadow value of the supply and demand balance constraint in the Broker problem.
[24] We continue until the gap is less than 0.05% of the total costs across LSEs.



Note: UB is upper bound and LB is lower bound as defined in the Dantizg -Wolfe decomposition by Conejo et al (2010).

Figure 9. Example of auction process using September 2024 test-year data

5.2.5 Bilateral Matching

The broker tells participants their final quantity of RA product purchases and sales along with announcing final prices. Participants then bilaterally trade these products with other participants at the specified prices. We randomly match sellers of an RA product with buyers of a product, setting the transaction quantity to the lower of the bid or offer. Any residual quantity is again randomly matched with another buyer or seller in the list of participants. The bilateral matching ends when the final quantities specified by the broker are met.

5.3 Data and Assumptions

5.3.1 Slice-of-Day RA Filings

All data used in this analysis is from the confidential SOD RA filings provided by the 24 CCA members of CalCCA to the CPUC. The June and September 2024 filings were test-year filings that were not binding. The May-September 2025 filings were the year-ahead binding filings submitted to the CPUC at the end of October 2024. CalCCA preserves all confidential information and reports only anonymized or aggregate results that mask the original filer.

5.3.2 LSE Portfolio and Obligations

The SOD RA filings contain the confidential hourly obligations and the contracts with resources to meet the obligations. With the 2024 test-year filings, we use the obligations directly provided in the CCA filing. In the 2025 year-ahead filings, however, CCAs are only required to demonstrate sufficient resources to meet 90% of the operating month's obligation. To determine how much more resources CCAs must procure between the year-ahead filing and the operating month, we scale the obligation in the YARA filing to the full 100% obligation.

We characterize the CCA's portfolio based on the contracted nameplate capacity of each technology type, accounting for regional variation in resource portfolios. We also extract the 24-hour profile the CCA uses for each non-storage contract. For storage contracts, we ignore the profile and instead dispatch the storage within the LSE bidding process based on power, energy capacity, and charging sufficiency constraints.

5.3.3 Slice-of-Day RA Product Definitions

The 24-hour profiles often vary across CCA filings, even for the same technology type. To simplify the analysis, we create standard RA product definitions with common profiles and parameters. The standard hydro RA product, for example, is the contracted-capacity weighted average of all hydro profiles across the CCAs (varying only by hour and month, but not by CCA). Similarly, we group batteries by duration (1, 2, 4, or 8 hour) and then use the weighted-average efficiency and duration for the standardized product. For Unspecified resources, we group them by the average capacity factor into three standard buckets: 5X24, 16X24, and 24X24. Within each of these buckets we use the capacity-weighted average profile.

5.3.4 Legacy Monthly RA

Data from the CCAs' SOD filings are also used in create the parameters necessary for simulating trade in the legacy RA program. We estimate each CCA's monthly RA obligation as the maximum hourly obligation. We estimate the monthly RA portfolio by converting the contracted nameplate to contracted net qualifying capacity using the 2024 technology factors by technology and month reported by the CAISO.[25]

5.3.5 External RA INC Prices

We estimate the cost of purchasing RA from external sources based on the recently observed capacity-weighted average price of RA sold to California LSEs during the period between the year-ahead filings (October 31, 2023) and the final RA filing date 45 days before the start of the operating month. CalCCA collects and cleans public RA transaction data from FERC Electronic Quarterly Reports. Assumed prices for purchases of external RA (ExternalRA INC) in each month are listed in Table 5. Because FERC EQR data only reports historical prices, we assume the same prices for analysis of both the 2024 test-year and 2025 binding year filings.

[25] CAISO. 2024. Final Net Qualifying Capacity for Compliance Year 2024.Available at: https://www.caiso.com/documents/final-net-qualifying-capacity-report-for-compliance-year-2024.xlsx

Month	Weighted-average RA price ($/kW-mo)
May	11.7
June	13.2
July	21.1
August	25.5
September	26.0

Table 5. Assumed prices for purchases of RA from external sources (ExternalRA INC)

5.3.6 External RA DEC Prices and ELCC factors

We assume that sales of excess resources to external markets would be based on the conversion of the nameplate capacity to an external RA product based on the ELCC factors announced by WRAP.[26]

Few sales for RA products to non-California loads are reported in the FERC EQRs, especially for the period between the year-ahead filing and operating month. Rather than set the price for sales of RA to external markets based on this thin volume of transactions, we instead assume that the price for ExternalRA DEC is 1/10th of the price of External RA INC, reported in Table 5.

[26] WRAP. 2024. *Review of Preliminary, Non-Binding WRAP Regional Data for the Current Participating Footprint for the Summer 2025 and Advisory Data for the Summer 2028.* January 31. https://www.westernpowerpool.org/private-media/documents/2024-1-16_Webinar_Summer_2025_and_2028_Data_updated_2024-12-12.pdf

Appendix A. Sensitivity of Gains from Trade to Changes in Portfolio Composition

Across California, LSE portfolios are transitioning toward a greater share of renewables and storage and away from thermal generation. In 2019, 67% of the resources shown for compliance with September resource adequacy compliance were from natural gas-fired generation and unspecified imports, while less than 0.2% was from battery storage. By 2024, the share of RA from natural gas and unspecified imports dropped to 56% while the share from energy storage and hybrid plants increased to over 17% of the September showings.[27] Pathways to achieving greenhouse gas emission reduction goals associated with California's SB 100 policy continue the trend of adding energy storage and reducing reliance on natural-gas generation.[28] This transition of the LSE portfolios impacts the gains from trade.

To quantify the impact, we evaluate the September 2025 gains from trade as thermal capacity is swapped out with 4-hour duration battery storage capacity, Figure 10. Prior to trade, we ensure replacement of thermal capacity with 4-hour battery does not worsen the LSE's maximum deficits by increasing the size of the replacement 4-hour battery when needed. As more of the thermal capacity is replaced, the size of the replacement battery relative to the thermal capacity also grows to maintain the same level of pre-trade compliance. We cap the ratio of replacement 4-hour battery to thermal capacity at 4:1. We therefore allow maximum pre-trade deficits to increase if it would otherwise require more than a 4:1 ratio of replacement 4-hour battery to thermal capacity.

[27] CAISO Historical Resource Adequacy Aggregate Data as of January 22, 2025: https://www.caiso.com/documents/historicalresourceadequacyaggregatedata.xlsx
[28] CEC *2021 SB 100 Joint Agency Report, Achieving 100 Percent Clean Electricity in California: An Initial Assessment* https://efiling.energy.ca.gov/EFiling/GetFile.aspx?tn=237167&DocumentContentId=70349

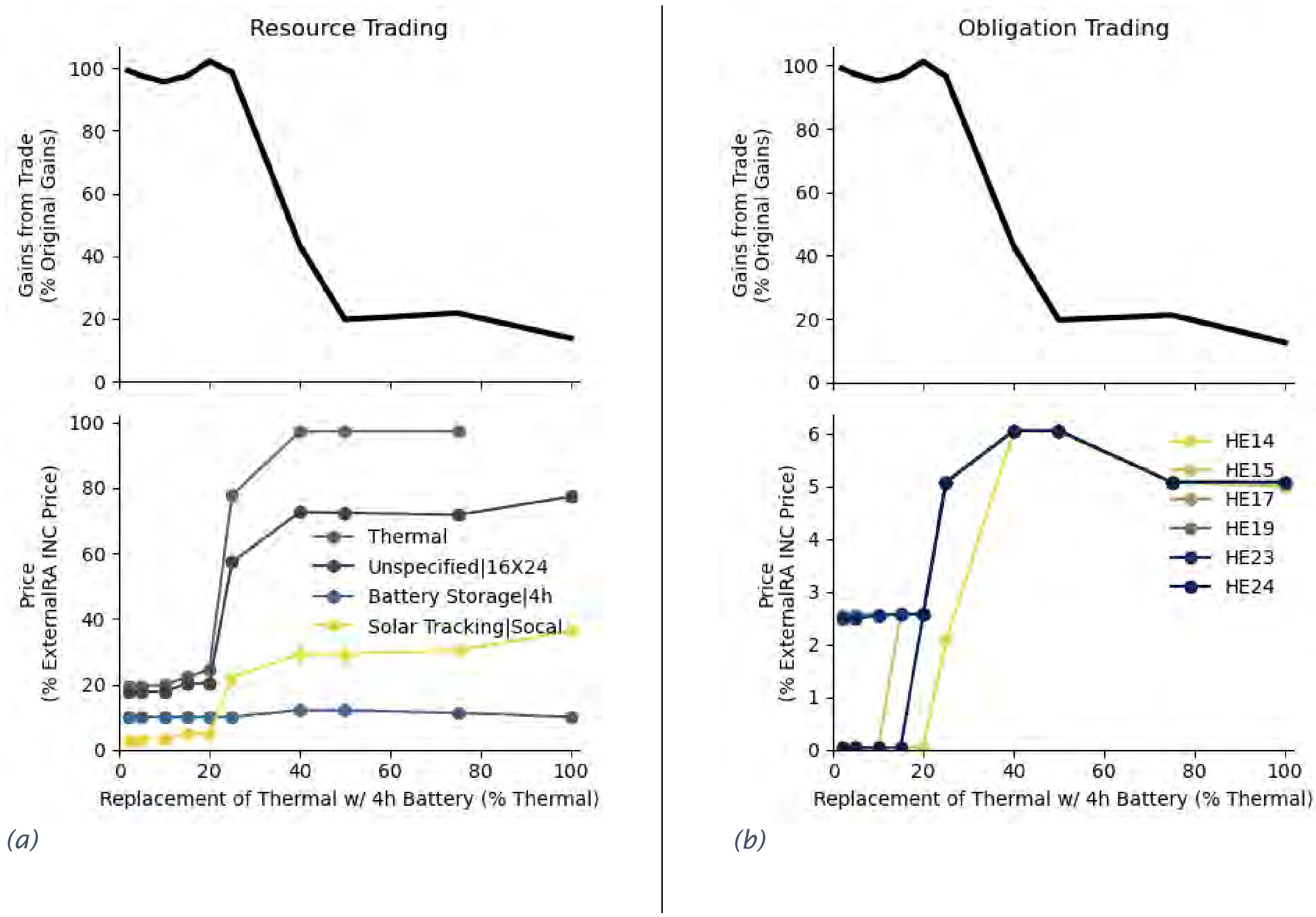


Figure 10. Sensitivity of September 2025 Gains from Trade to LSE Portfolio Composition with (a) SOD Resource Trading and (b) SOD Obligation Trading.

Modest shifts in the LSEs' portfolios from thermal capacity to 4-hour battery capacity of up to 25% of the original thermal capacity, have little impact on the gains from trade with both resource trading and obligation trading. After about 25% of the thermal capacity is replaced, however, the gains from trade rapidly decline. By the time all thermal capacity is replaced with 4-hour batteries, the gains from trade are only 10% of the gains with the original portfolio.

Changes in the internal prices of RA products with shifts in the portfolio composition help explain the reasons for the decline in the gains from trade. With the original portfolios, the aggregate accreditation of the resources in the LSE portfolios exceeded the aggregate obligations, allowing trades between LSEs to offset the need to purchase external RA. After about 20% of the thermal capacity is replaced by storage, the price of RA from thermal resources jumps to the level of the price of purchasing ExternalRA INC, indicating the aggregate surplus relative to obligations has disappeared. At this point trade between participants continues to be as high as with the original portfolios, though as thermal capacity is further removed, the ability for 4-hour battery storage to meet obligations begins to decline. At 20% reduction in thermal capacity, the price of solar and other sources of charging energy increases, and the price of hourly obligations outside of the traditional early evening peak net load hours also starts to increase. The broadening of hours where energy is needed to meet obligations reduce the diversity across LSEs and lowers the potential trading opportunities.

Future changes to the composition of LSE portfolios are uncertain. However, replacing 25% of the thermal resources by 4-hour battery storage would likely take multiple years. In the interim, mechanisms to enable trading between LSEs will continue to provide benefits comparable to the levels calculated with 2025 portfolios.

Appendix B. Calculating the Indirect Benefits of Reduced RA Demand

Mechanisms to enable trade between LSEs lowers demand for RA products from the external RA market. Lower demand for RA puts downward pressure on RA prices, indirectly lowering the costs of RA for all California LSEs. A general framework for quantifying these sorts of benefits to consumers comes from the "Demand Response Induced Price Reduction" or DRIPE that is used in Northeastern states as part of their evaluation of the costs and benefits of demand-side measures.[29] At a conceptual level, this indirect benefit of trade is illustrated in Figure 11. Small reductions in prices can create significant consumer savings when consumers purchase a large volume at market prices.

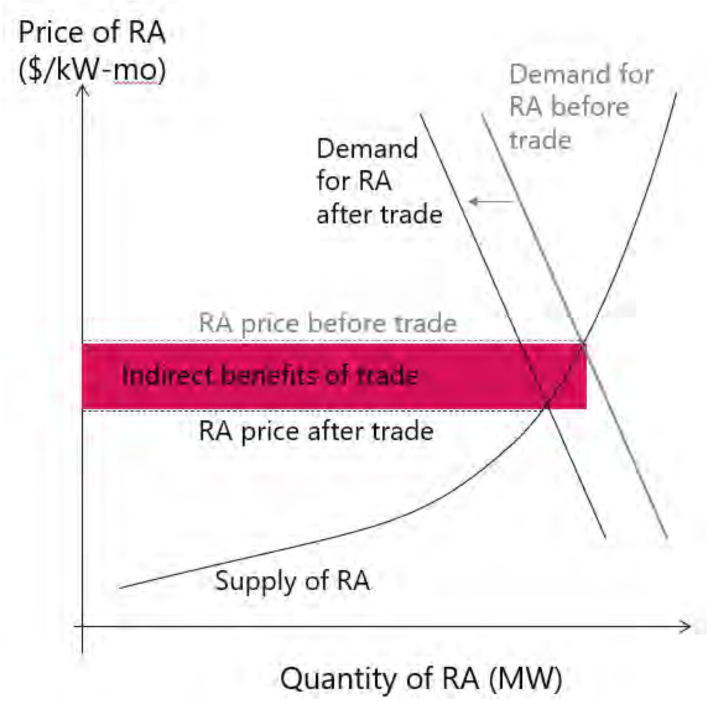


Figure 11. Illustration of the indirect benefits of trade from lower RA market prices

The indirect benefits are the area of the red rectangle. The height of the rectangle depends on the sensitivity of RA prices to RA demand (represented as *E*) and the reduction in RA demand attributable to trade (represented as *D*). The width of the rectangle is the volume of RA purchases that see the lower price due to decreased RA demand (represented as *Q*). Indirect benefits of trade are therefore $E*D*Q$.

One important caveat is that from an economic perspective, the price reduction effect is often seen as a transfer between suppliers and consumers rather than a net welfare

[29] State and Local Energy Efficiency Action Network (2015*). State Approaches to Demand Reduction Induced Price Effects: Examining How Energy Efficiency Can Lower Prices for All.* Prepared by: Colin Taylor, Bruce Hedman, and Amelie Goldberg from the Institute for Industrial Productivity under contract to Oak Ridge National Laboratory. Available at: https://www.energy.gov/sites/default/files/2021-07/SEEAction-DRIPE.pdf

gain. From a consumer perspective, however, lower prices do make consumers better off at least in the short run. In addition, the California Public Utilities Commission recently suggested that high prices in the RA market are due in part to the exercise of market power.[30] Under non-competitive market conditions, mechanisms that provide additional pathways for trade between participants can mitigate suppliers' ability to raise prices. Lowering prices through increasing the competitiveness of markets can create a net increase economic welfare by reducing the deadweight loss associated with non-competitive behavior.[31]

The most uncertain parameter is the sensitivity of RA prices to RA demand (*E*). To estimate the price sensitivity, we compare the weighted-average price of RA sold to California LSEs in September to our estimate of the net supply in September for the California resource adequacy market for 2019 to 2024. The net supply is based on an RA stack analysis which compares the available supply of RA to the demand for RA using the legacy capacity accreditation approach based on ELCC factors.[32] As a coarse approximation, the sensitivity of RA price to RA demand is estimated as the slope of simple regression across these data points. The resulting slope of -1.0, seen in Figure 12, represents a decrease in the weighted-average RA price of $1.0/kW-mo for every GW decrease in RA demand (*E* = $1.0 kW/mo per GW).

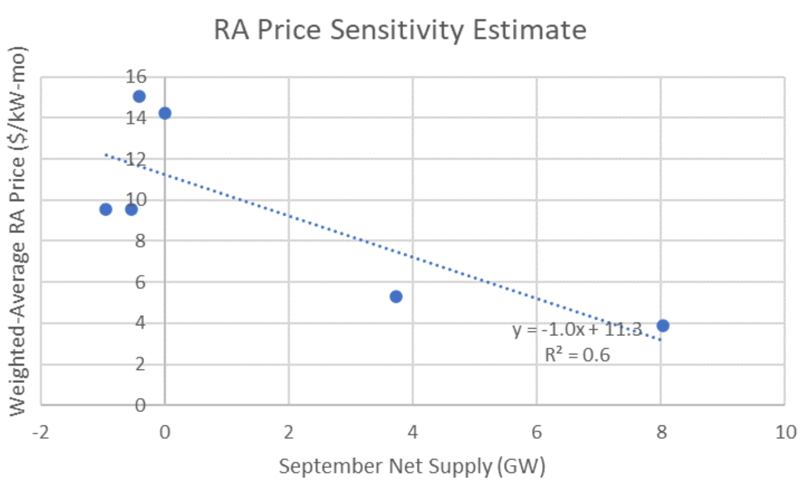


Figure 12. Approximation of sensitivity of RA prices to RA demand using September data from 2019-2024

The reduction in RA demand resulting from trade (*D*) is a direct result of our analysis of the CCA's 2025 year-ahead RA filings for the months of May through September, with

[30] Energy Division Staff Report of the 2024-2025 Resource Adequacy Market Price Benchmark (Feb., 26, 2025). Available at: https://docs.cpuc.ca.gov/PublishedDocs/Efile/G000/M557/K608/557608990.PDF
[31] For an example of deadweight loss arising from non-competitive behavior in California electricity market see Borenstein, S., Bushnell, J.B. and Wolak, F.A., 2002. Measuring market inefficiencies in California's restructured wholesale electricity market. *American Economic Review*, *92*(5), pp.1376-1405.
[32] CalCCA. 2024. *California's Constrained Resource Adequacy Market: Ratepayers Left Standing in a Game of Musical Chairs.* January. : Available at: https://cal-cca.org/wp-content/uploads/2024/02/CalCCA-Stack-Analysis-2023-2026-updated-01_16_24-.pdf

obligations scaled to 100% the final obligations. Across the five summer months, we find that trade between CCA lowers demand for external RA (ExternalRA INC) by roughly 500 MW per month (*D* = 0.5 GW per mo). Additional details on the reduction in demand for external RA with trade in each month are provided in Appendix C.

Finally, we estimate the volume of RA that would be purchased at lower prices due to the reduction in RA demand (*Q*). This is again a difficult number to quantify with precision. We observe RA purchases by California LSE's of about 20 GW of capacity products on average across summer months in the FERC EQR dataset (*Q* = 20 GW each month).

Altogether, the indirect benefits of trade between the CCAs (*E*D*Q)* total approximately $50 million per year.

Appendix C. Gains from Trade in All Months

Table 1 and Table 2 detail the gains from trade across different policy environments using data from September 2024 and 2025. For completeness, we present the calculations for all months in Table 6.

Month and Year		Scenario	Short Position (a.k.a., ExternalRA INC) Before Trade (MW)	Short Position (a.k.a., ExternalRA INC) After Trade (MW)	Gains from Trade ($M)	Internal Trades Volume (MW)	Internal Trades Count	Internal Trades Average Connections	Internal Trades Monetary Transfer ($M)
June 2024	I.	Resource: ELCC	258	0	3.7	257	20	1.8	0.3
	II.	Obligation: ELCC	258	0	3.7	257	21	1.9	0.3
	III.	Resource: SOD	433	0	6.9	2,921	124	10.3	2.4
	IV.	Obligation: SOD	433	0	6.9	5,632	172	14.3	0.5
	III.*	Uncoordinated Resrc.: SOD	433	123	4.1	321	21	1.8	N/A
	IV.*	Uncoordinated Oblg.: SOD	433	6	5.6	3,752	112	9.3	N/A
September 2024	I.	Resource: ELCC	467	0	12.3	467	22	1.9	1.2
	II.	Obligation: ELCC	467	0	12.3	467	22	1.8	1.2
	III.	Resource: SOD	926	269	17.3	2,642	185	15.4	23.4
	IV.	Obligation: SOD	926	261	17.3	3,591	150	12.5	11.7
	III.*	Uncoordinated Resrc.: SOD	926	748	4.7	185	7	1.8	N/A
	IV.*	Uncoordinated Oblg.: SOD	926	645	7.2	4,654	122	10.2	N/A
May 2025	I.	Resource: ELCC	31	0	0.3	31	3	1.0	0.0
	II.	Obligation: ELCC	31	0	0.3	31	2	1.0	0.0
	III.	Resource: SOD	5	5	0.0	0	0	0.0	0.0
	IV.	Obligation: SOD	5	5	0.0	0	0	0.0	0.0
	III.*	Uncoordinated Resrc.: SOD	5	0	0.1	5	3	1.2	N/A
	IV.*	Uncoordinated Oblg.: SOD	5	0	0.1	14	7	1.8	N/A
June 2025	I.	Resource: ELCC	289	0	5.7	288	20	1.8	0.4
	II.	Obligation: ELCC	289	0	5.7	288	20	1.8	0.4
	III.	Resource: SOD	252	0	6.2	2,325	158	13.2	2.3
	IV.	Obligation: SOD	252	0	6.2	4,244	155	12.9	0.6
	III.*	Uncoordinated Resrc..: SOD	252	0	3.3	263	15	1.4	N/A
	IV.*	Uncoordinated Oblg.: SOD	252	1	3.3	1,923	87	7.3	N/A
July 2025	I.	Resource: ELCC	590	0	13.4	590	23	1.9	1.2
	II.	Obligation: ELCC	590	0	13.4	590	23	1.9	1.2
	III.	Resource: SOD	674	0	16.4	2,255	177	14.7	4.2
	IV.	Obligation: SOD	674	0	16.3	8,201	171	14.2	1.8
	III.*	Uncoordinated Resrc.: SOD	674	83	12.5	616	20	1.9	N/A
	IV.*	Uncoordinated Oblg.: SOD	674	49	13.1	6,297	134	11.2	N/A
August 2025	I.	Resource: ELCC	480	0	13.3	480	23	1.9	1.2
	II.	Obligation: ELCC	480	0	13.3	480	23	1.9	1.2
	III.	Resource: SOD	623	0	18.0	3,620	128	10.7	6.5
	IV.	Obligation: SOD	623	0	17.9	7,564	181	15.1	2.3
	III.*	Uncoordinated Resrc.: SOD	623	163	11.7	478	22	1.9	N/A
	IV.*	Uncoordinated Oblg.: SOD	623	40	14.8	4,839	127	10.6	N/A
September 2025	I.	Resource: ELCC	541	0	15.1	541	22	1.9	1.4
	II.	Obligation: ELCC	541	0	15.1	541	22	1.8	1.4
	III.	Resource: SOD	727	0	21.5	3,500	167	13.9	6.7
	IV.	Obligation: SOD	727	0	21.4	8,062	163	13.6	2.4
	III.*	Uncoordinated Resrc.: SOD	727	182	14.2	561	16	1.9	N/A
	IV.*	Uncoordinated Oblg.: SOD	727	27	18.1	6,613	120	10.0	N/A

Table 6. Summary of trade between CCAs across policy environments with data from all months