Unlocking Efficiency in California's Resource Adequacy Program

The Case for Hourly Load Obligation Trading

California Community Power — January 2026

1. Executive Summary

California's evolving electricity system depends on a reliable foundation of Resource Adequacy (RA) — the program that ensures load-serving entities (LSEs) secure enough power generation capacity to meet customer needs during peak electricity demand. Recent reforms by the California Public Utilities Commission (CPUC), including the Slice of Day (SOD) framework, are designed to improve reliability by requiring that sufficient resources are available to meet LSEs' peak demand in every hour, not just during the California Independent System Operator's (CAISO) system peak.

While these reforms strengthen reliability, they have also introduced new inefficiencies. LSEs must now meet 24 hourly obligations independently, even when their load and resource portfolios complement one another at a CAISO system level. This has increased costs, reduced flexibility, and led to inefficiencies in the market resulting in excess capacity procurement that California can ill afford given increasing concerns around affordability in the state and challenges of bringing on new generation and storage resources due to interconnection and permitting delays in the state.

Analysis conducted by GDS Associates (GDS) for California Community Power (CC Power) shows that introducing hourly load obligation trading could transform the RA program. Enabling LSEs to trade hourly load obligations unlocks portfolio diversity benefits, improves battery utilization, and reduces overall demand for capacity. The study found that the approach could generate over $6 million in aggregate benefits across just five summer months among 8 of CC Power's community choice aggregator (CCA) members studied[1], while maintaining or improving compliance with CPUC RA showing requirements.

Hourly load obligation trading is a practical and valuable improvement to California's RA SOD program. CC Power and its members encourage the CPUC to consider implementing hourly load obligation trading within the RA compliance program.

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[1] These 8 members of CC Power represent about 10.8% of the total load served in the CAISO Balancing Authority Area.

2. Introduction

California's RA framework has evolved significantly in response to rising renewable penetration and growing reliance on battery energy storage. The SOD design requires that LSEs demonstrate energy sufficiency in every hour of the most constrained day of a compliance month, rather than only covering the CAISO system's peak demand hours. The framework makes updates to the role renewables play in meeting an individual LSE's peak load needs. Additionally, LSEs must now demonstrate sufficient deliverable energy generation capacity is procured to charge energy storage resources for use towards their individual peak load requirements.

This shift was deemed essential to address reliability challenges that have particularly been exacerbated through rapid electrification, interconnection delays, and the continued shift towards renewables and energy storage resources, but it has created new complexities and inefficiencies, including:

- Reduction of System Diversity Benefits: Each LSE must secure compliance independently for its own unique peak load profile, rather than its share of the CAISO system peak. This has led to certain LSEs having winter peaking RA needs and others being responsible for a greater share of the CAISO system peak. This diminishes the value of the diverse, offsetting load profiles, and the contributions that the CAISO's generation and energy storage resources can provide by disaggregating resource procurement requirements. This also has made it more challenging for market participants to value RA resources, as each LSE will have different needs and ascribe different value to each technology that can be used to meet those needs.
- Increased Complexity in Sourcing Needs: With the ability to allocate energy storage resources across multiple hours based on need, after accounting for generation resources, it is more challenging for LSEs to define and source procurement volumes in specific hours, since such need could change as batteries are reoptimized in the SOD showing.
- Under-utilized Resources: Batteries and renewable portfolios are often shown sub-optimally when considered in isolation. Given that a peak capacity requirement must be met for the month, extra hours of generation or energy storage capacity may be shown in excess of what is needed to meet the SOD hours of need.
- Higher Costs: As a result of these inefficiencies and less alignment between market participants, many entities must procure additional capacity, which raises costs, or else face penalties, even when adequate capacity exists elsewhere in the system to ensure reliability for the grid.

In effect, California's RA system has become more reliable but less efficient due to SOD implementation. Without a mechanism to unlock diversity benefits across LSEs' portfolios, customers ultimately bear unnecessary costs.

3. Example of Hourly Load Obligation Trading

Consider two LSEs of similar size, wherein Entity A has met its hourly SOD obligations and Entity B has not, as shown below on the left in Figures 1 and 2. Entity A has met its peak load requirement through the showing of 40 MW of 4-hour battery capacity in Hour Ending (HE) 19. Entity B has insufficient resources to meet its peak load requirement, despite optimizing its batteries to minimize the hourly short position. Supposing hourly load trading were enabled, Entity B could enter into an agreement with Entity A to take on its load obligation in HE 18, 21, and 22, increasing the battery capacity utilization in each hour. There would be no incremental risk for Entity A, as the same battery resource capacity is already being used for Entity A's peak load requirement. Given there is no incremental resource capacity being shown by Entity A, there is also no incremental exposure to RAAIM penalties. Entity A would simply be better utilizing its battery's energy storage capacity by dispatching up to the full 40 MW capacity in more hours to satisfy the load obligation it has taken on from Entity B. Entity B, meanwhile, would have satisfied its own RA SOD obligations by reducing its showing requirement in several hours to match the resources it has available on its own supply plan. By pursuing this approach, no incremental resources must be procured from the market, thus reducing excess demand in the system for capacity, saving costs, and better utilizing resources that have already been procured.

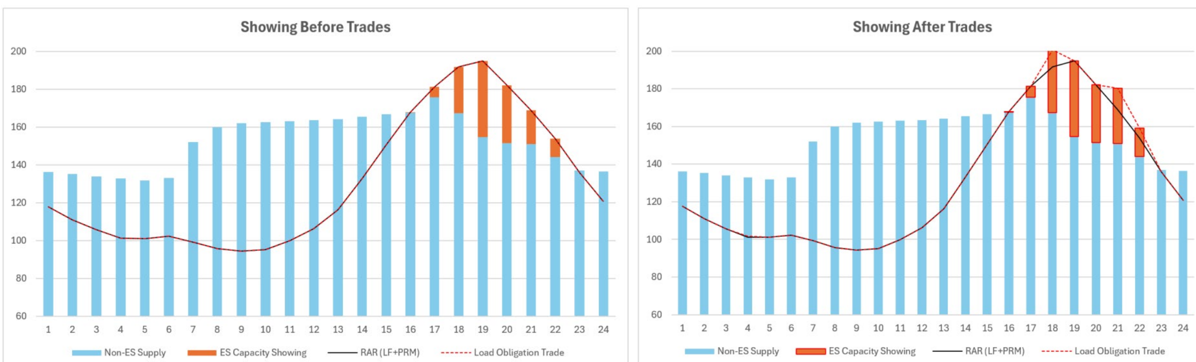

Figure 1: RA Showing Before and After Entity A Receives Load Obligation

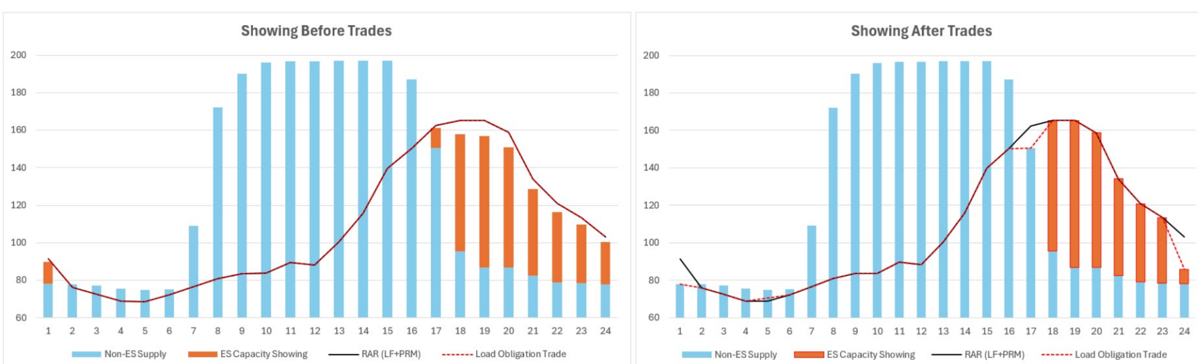

Figure 2: RA Showing Before and After Entity B Gives Away Load Obligation

Through this obligation swap (i) both entities achieve compliance, (ii) no additional capacity is purchased from third parties, (iii) batteries are used more effectively, and (iv) in theory, the broader market sees less demand pressure, helping moderate RA prices. This simple example illustrates how hourly obligation trading can turn the inefficiencies of disaggregated RA procurement obligations into mutual reliability and affordability gains.

4. Benefits Analysis Results

Modeling based on actual 2025 year-ahead RA plan data for CC Power's 8 participating members shows that hourly load obligation trading can deliver substantial aggregate benefits.

In the modeling, members provided their year-ahead RA filings, and their positions were used to model the procurement requirements for the month-ahead RA filings for the summer months. Each LSE's procurement position was optimized to allocate generation resources first towards meeting the compliance position, and then the batteries were optimally allocated to minimize the short position for each hour of the showing month. The analysis removed thermal[2] capacity that was in excess of an individual LSE's needs for achieving compliance in the month-ahead RA filings. Similarly, any excess storage capacity was withheld from the showings for the optimization, such that each long LSE had its shown capacity adjusted down to just meet its month-ahead compliance requirement. Any such excess capacity could theoretically be monetized by the LSE through resale into the market or could be held as replacement capacity in the event of any resource outages.

Once a baseline was established for each individual LSE's compliance within the monthly RA filing or via minimization of any short position, an optimization was run across the 8 members' modeled RA filing positions to model how generation, storage, and hourly load obligation trades could be used to solve for or at least further minimize any remaining deficiencies across the various LSEs. Given that no LSEs entered the optimization with excess capacity and, based upon their actual RA showings, no LSEs had any energy sufficiency shortfalls for charging energy storage resources, the only mechanism for trading that was applicable for solving for short LSEs' needs was the execution of hourly load obligation trades. These trades enabled better utilization of various LSEs' battery storage resources by allocating the hourly load obligation trades to hours wherein the energy storage resources had remaining spare capacity.

In aggregate, in the modeling, CC Power's 8 members realized $6.14 million in total benefits[3] across the five summer months (May–September 2025), either through avoided procurement (among short LSEs) or via generating revenue by taking on hourly load obligations from other entities (among long LSEs). These are benefits that would directly flow to retail customers through reduced wholesale electricity procurement costs. The optimization realized full resolution of LSE-specific deficiencies in three of the five months, with significant reductions in capacity shortfalls in the tightest months (70% reduction in July, 38% in August), which would remain to be procured by those short LSEs prior to the month-ahead RA showing deadline. In total about 1,200 MWh of hourly load obligation trades were exchanged between the 8 modeled participants over the five months. If additional LSEs were to have been included in the optimization, particularly LSEs with more diverse SOD profiles, compliance in all months may have been achievable and greater savings could have been realized. If more LSEs participating were to resolve the remaining July and August deficiencies, the benefits to the 8 studied LSEs would increase by another $1.96M to $8.10M.

These results confirm that hourly trading among LSEs covers shortfalls more efficiently, reducing the need for new procurement or risking the imposition of penalties. This was because hourly load

[2] i.e., gas-fired generation

[3] See Appendix A for more detailed information on how benefits are calculated

obligation trades reduced short positions and allowed batteries to be re-optimized across the pool, concentrating use in the most constrained hours. By reducing aggregate demand for incremental RA capacity, hourly load obligation trading has the potential to lower statewide RA prices, producing positive spillover effects for all California consumers.

5. Feasibility

CC Power understands that the CPUC has expressed concerns over the ability to track and monitor the hourly load obligation trades. In its modeling, the actual number of transactions does not seem to be overly burdensome to include in the LSEs' supply plans for confirmation as part of the CPUC's supply plan validation process. Between the 8 LSEs, there was a maximum of 21 transactions (each representing one SOD hour) in a given month and the traded capacity volumes were relatively modest. However, these small volumes would, in reality, result in a large potential benefit through avoiding procurement of the last bit of incremental resource capacity that would be the hardest to find and transact and thus, would be the most expensive, in the market. Each transaction would show up on the RA supply plan as a positive or negative one-hour resource and could easily be cross-referenced by referring to the other transacting LSE's supply plan to confirm the opposite volume of capacity was also being shown.

	May 2025	Jun 2025	Jul 2025	Aug 2025	Sep 2025
Total Trade Volume (MWh)	206.25	300.43	330.12	49.93	313.00
Max Trade Volume (MWh)	61.43	64.80	57.20	10.86	73.25
Average Trade Volume (MWh)	41.25	20.02	15.72	3.32	16.47
Number of Transactions	7	15	21	15	20
Net Payers (give load)	1	2	2	1	3
Net Receivers (receive load)	4	4	3	3	3
Net Even (no load traded)	3	2	3	4	2

Figure 3: Monthly Trade Statistics

6. Conclusion

Hourly load obligation trading offers a win-win solution for California's evolving RA framework.

- Efficiency: Unlocks diversity benefits across LSEs.
- Savings: Produces millions of dollars in avoided procurement costs every month.
- Reliability: Facilitates SOD compliance among LSEs.
- Scalability: Benefits grow as more entities participate, particularly as greater diversity is realized, e.g., between coastal and inland or northern and southern LSEs.

Enhancing the RA program with this tool is both timely and necessary as California continues to face challenges of increasing load growth, delays in interconnecting and permitting renewable energy and storage resources, and maintaining reliability through uncertainty. By enabling LSEs to collaborate through hourly load obligation trades, California can reduce costs for customers while maintaining its commitment to a clean, reliable grid. Hourly load obligation trading should be adopted by the CPUC to facilitate LSEs' RA SOD compliance.

Appendix A: Methodology for Benefits Analysis

The analysis conducted by GDS Associates applied a simple optimization model to the actual 2025 RA plans of multiple load-serving entities using the following methodology.

1. CC Power collected 8 of its members' year-ahead RA plans.
2. GDS assessed the shown resources on each LSE's year-ahead supply plan and compared the total shown supply against the month-ahead obligations, starting with thermal assets, then renewable assets and finally energy storage assets.
3. For LSEs with a long month-ahead RA position, GDS removed excess thermal assets and then excess energy storage assets from the showing, to have the total shown capacity match the month-ahead load obligation, and to allow any such excess capacity to be monetized by the LSE through resale into the market or such that it could be held as replacement capacity in the event of any resource outages.
4. GDS aggregated each generation resource into a single static 24-hour shaped resource for each technology for each LSE.
5. The GDS optimization model included a "load obligation" resource for each LSE and selected negative or positive "load obligation" values.
6. The model included a single representative battery resource for each LSE that assumed an 80% roundtrip efficiency and could select positive energy values.
7. The model ensured that the representative battery resource was used within its capacity limit, its continuous energy limit, and only to the extent that the LSE's individual excess energy minus roundtrip efficiency losses was sufficient, while also accounting for load obligation trade impacts on excess energy.
8. The model selected hourly load obligation quantities and hourly energy storage quantities for each LSE during the critical 9-hour period from HE16 through HE24. In addition to this critical period, the model supported selection of load obligation trade quantities only (not energy storage quantities) in HE1 through HE7 to resolve isolated deficiencies in these hours when they could not be resolved by the batteries. This simplification was made in the morning hours due to the abundance of excess capacity among LSEs in those hours.
9. The optimization prioritized resolving deficiencies using energy storage and would only engage in load obligation trades if energy storage resources could not resolve deficiencies.
10. The optimization prioritized the assignment of load obligation sales to those entities that entered the pool having met their SOD peak capacity requirement. However, it assigned load obligation sales to entities that were not in compliance only when such assignment was the only way to resolve the deficiency without seeking additional capacity from outside the pool.
11. Cost parameters were used to tune trading and ensure a certain degree of "friction" in transactions.
12. GDS analyzed the results to ensure the load obligation trades and battery usage were feasible and then conducted a post-process to parse the needed load obligation trades and calculate the aggregate and individual net benefits attributable to each LSE.

13. The aggregate net benefits are calculated based upon the cost that short LSEs would incur to purchase RA externally multiplied by the quantity of the shortage the pool resolves. For instance, an LSE that is 10 MW short in June would need to purchase 10 MW of RA from a thermal generator at an external market price of $11.00/kW-month. If the pool resolves this deficiency, the aggregate net benefit shared by the short entity and the long entities in the pool would be $110,000. The hourly load obligation trading price allocates this $110,000 benefit between the short entity and long entity, with the short entities paying the long entities to take hourly load obligation positions. The allocation is somewhat irrelevant as it merely allocates an avoided procurement cost savings between the two entities. The short entities receive a higher portion of the $110,000 benefit at lower internal pool prices, while the long entities receive a higher portion of the $110,000 benefit at higher internal pool prices, as they are providing a benefit to the short entities.
14. Transaction prices between the LSEs in the optimization were calculated based upon the monthly external market price of RA multiplied by 4/24 (i.e., the market value of RA is conservatively estimated to be set by a 24-hour gas-fired resource and is pro-rated for the 4-hours that a standard 4-hour battery could contribute to the SOD capacity showing (4/24) to determine the value that 1 hour of SOD capacity should be worth). Essentially, to solve for 1 hour of need, an LSE would need to alternatively procure at least a 4-hour energy storage project's capacity, and thus would avoid the cost of such a 4-hour resource to solve for the 1-hour of need.
15. The external market prices of RA were drawn from analysis compiled by CalCCA[4] of FERC's EQR data from October 31, 2023 to the final RA filing date 45 days prior to the start of the operating month.

[4] Andrew Mills, CalCCA, Section 5.3.5, "Effective Mechanisms for Slice-of-Day RA Trading," April 16, 2025. https://cal-cca.org/wp-content/uploads/2025/04/4.24.25_Effective-Mechanisms-for-Slice-of-Day-RA-Trading.pdf