

Strategies for Success in CAISO

The IRA Era in California’s Wholesale Power Market, Q3 2022 – Q1 2025

A period retrospective for utility-scale solar, wind, and battery storage developers and investors

Revised edition — August 2026 (original edition Q1 2025; research closed Q4 2024)

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All market data in this edition is stated as of the close of the first quarter of 2025 (March 31, 2025) unless otherwise noted. “The period” means August 16, 2022 (enactment of the Inflation Reduction Act) through March 31, 2025 — the quarter in which the market stopped committing to new projects and waited for the reconciliation bill that became the One Big Beautiful Bill Act. The IRA’s wind and solar credits remained law until July 4, 2025; that interval is covered in Chapter 8 (The Interregnum), and everything after the signing appears in the Epilogue.

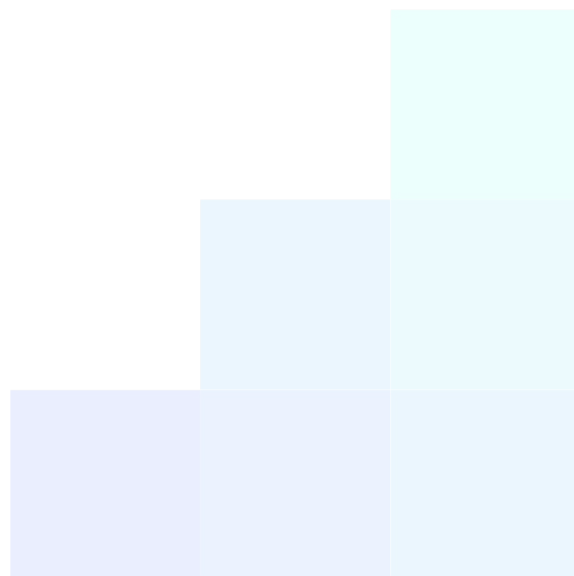
Preface to the Revised Edition

The first edition of this paper was researched in the fourth quarter of 2024 and published in the first quarter of 2025, in the same weeks in which a new federal administration began to reverse the policy architecture the paper described. It was released with limited distribution. Rereading it eighteen months later, two conclusions follow: the market it described no longer exists in the same form, and the strategies that succeeded in that market are worth recording precisely because the conditions were unusual.

The IRA was signed on August 16, 2022, and its wind and solar credits were not repealed until the One Big Beautiful Bill Act was signed on July 4, 2025. We nonetheless close the period at the end of the first quarter of 2025, because that is when the market closed it. From January 2025 the question in every investment committee, sell-side process and tax-credit negotiation was not what the law said but what it was about to say; new commitments stopped while existing positions were locked in. The first quarter of 2025 saw \$7.9 billion of announced clean-energy projects cancelled, closed or downsized nationally — more than three times the total of the previous thirty months [1] — while, in the same quarter, capital deployment into already-committed projects peaked as developers safe-harbored equipment and sold credits ahead of the change [2]. A market that simultaneously cancels its future commitments and secures its existing positions is a market in suspension. The three months between the close of the period and the signing are treated in Chapter 8 as an interregnum, and the law that followed is the subject of the Epilogue.

This revised edition therefore does three things. It corrects and updates every figure to the close of the first quarter of 2025, which we treat as the end of the IRA era for planning purposes. It reframes the material as a retrospective: what the California Independent System Operator (CAISO) market looked like, what a successful entry and investment strategy looked like, and why. And it adds an epilogue recording what changed after March 2025, so that no reader mistakes a period piece for current advice.

The analytical conclusion has not changed. Between 2022 and early 2025, CAISO became the deepest utility-scale battery storage market in the world, and it did so through a specific combination of federal tax credits, state procurement mandates, and a capacity (resource adequacy) framework that rewarded four-hour storage. Developers and investors who organized around that combination did well. Those who organized around offshore wind, speculative queue positions, or solar without storage generally did not.



Executive Summary: The Period in Brief

What CAISO looked like at the close of the period

By early 2025 the CAISO balancing authority area served roughly 32 million consumers and about 80% of California's demand across approximately 26,000 circuit-miles of transmission [3]. Its installed renewable fleet stood at 32,572 MW — 20,739 MW of utility-scale solar (63.6%), 8,346 MW of wind, 1,610 MW of geothermal, 1,147 MW of small hydro and 730 MW of biofuels [3] — and its battery fleet, which had been approximately 500 MW in 2020, had reached roughly 13,000 MW of active capacity by December 2024 (11,454 MW under CAISO's stricter fully-commercial count as of January 31, 2025) [4, 3]. Resource adequacy net qualifying capacity was 50,852 MW against a 2024 peak of 48,323 MW and an all-time peak of 52,061 MW set on September 6, 2022 [3, 5].

The period had clear bookends. It opened with the Inflation Reduction Act (August 16, 2022) and, three weeks later, the September 2022 heat wave that pushed CAISO to its all-time peak and real-time prices to the \$2,000/MWh cap [6, 3] — the event that made the value of dispatchable storage evident to regulators and investors alike. It closed in a single fortnight in January 2025: Constellation's agreement to acquire Calpine (January 10) [7], the fire that destroyed Vistra's 300 MW Moss Landing Phase 1 battery (January 16) [8], and the executive actions of January 20 — a national energy emergency declaration, a pause on IRA and infrastructure-law disbursements pending review, and a presidential memorandum halting offshore wind leasing and approvals [9, 10, 11]. By the end of March the reconciliation bill that would become the One Big Beautiful Bill Act was in drafting, cancellations of announced projects had tripled the total of the prior thirty months, and the safe-harbor effort had begun [1, 2]. Market activity had ceased in anticipation of a statute that would follow on July 4.

What a successful strategy looked like

Seven elements recur in the projects and platforms that created value in CAISO during the period:

1. **Storage first.** Four-hour lithium-ion batteries, standalone or co-located with solar, concentrated in the SP15 zone where solar saturation created the widest daily price spreads and the tightest evening capacity need.
2. **A resource adequacy contract as the anchor.** Long-term RA or tolling agreements with investor-owned utilities and community choice aggregators, procured under the CPUC's mid-term reliability orders (11,500 MW of net qualifying capacity for 2023–2026, plus 4,000 MW for 2026–2027) [12, 13], with merchant energy and ancillary-service revenue layered on top.
3. **A capital stack built on the IRA.** The 30% investment tax credit extended for the first time to standalone storage; 10-point adders for domestic content and energy communities; and transferability, which turned tax credits into a \$30 billion market in 2024 at 92.5 cents (ITC) and 95 cents (PTC) on the dollar [14].
4. **Queue position and zonal alignment.** Holding earlier-cluster interconnection positions, siting inside the zones prioritized in CAISO's transmission plans, and meeting the readiness tests introduced when CAISO reset its process after the 354 GW Cluster 15 window [15].

5. **Permitting and community readiness.** Using the CEC’s AB 205 opt-in certification where local pathways were uncertain, engaging early with counties and fire authorities, and treating battery safety as a licence-to-operate issue before Moss Landing made it one.
6. **Tariff-aware procurement.** Managing solar anti-dumping and countervailing duties, the scheduled increase in Section 301 tariffs on Chinese batteries, and the first IEEPA tariffs of February–March 2025 through diversified sourcing, safe-harbor purchases and domestic-content planning.
7. **Disciplined exit timing.** Selling development pipelines at ready-to-build or shortly after commercial operation, when strategic buyers and infrastructure funds paid premiums for contracted CAISO capacity — a valuation marker set in January 2025 when Constellation agreed to pay 7.9× 2026 EBITDA for Calpine’s dispatchable fleet [7].

The chapters that follow document the market that made these choices correct, and the epilogue records how much of that market survived.

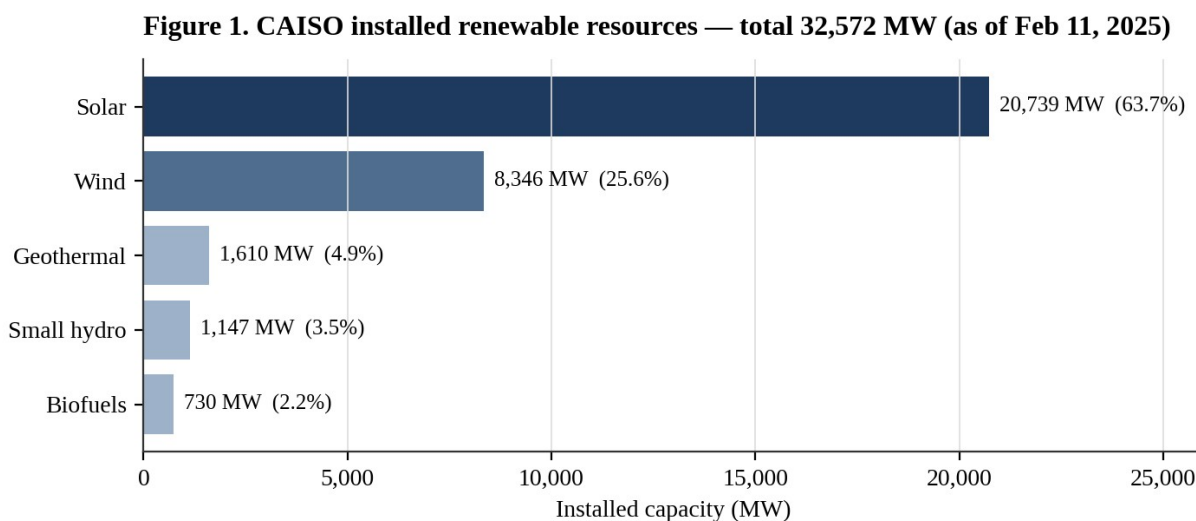
Chapter 1: Market Trends — The IRA Era in CAISO

1.1 The snapshot at the close of the period

Table 1 sets out the figures used throughout this edition. All are drawn from CAISO’s own statistics as published in February 2025 or from the CAISO Department of Market Monitoring’s 2024 battery report [3, 4], so that every figure in the paper reconciles to a single dated source.

Table 1. CAISO at the close of the period: principal market statistics

Metric	Value	As of	Source
Installed utility-scale solar	20,739 MW (63.6% of renewables)	Feb 11, 2025	CAISO Key Statistics
Installed wind	8,346 MW (25.6%)	Feb 11, 2025	CAISO Key Statistics
Geothermal / small hydro / biofuels	1,610 / 1,147 / 730 MW	Feb 11, 2025	CAISO Key Statistics
Total installed renewables	32,572 MW	Feb 11, 2025	CAISO Key Statistics
Battery capacity — fully commercial	11,454 MW	Jan 31, 2025	CAISO Key Statistics
Battery capacity — active in market	~13,000 MW (5,800 standalone; 5,700 co-located; ~1,500 hybrid)	Dec 2024	CAISO DMM
Battery additions in 2024	~4.0 GW	2024	Modo Energy (CAISO data)
Resource adequacy NQC	50,852 MW	Jan 31, 2025	CAISO Key Statistics
2024 peak demand	48,323 MW (Sept 5, 2024)	2024	CAISO 2024 Statistics
All-time peak demand	52,061 MW (Sept 6, 2022)	Record	CAISO Key Statistics
Solar generation record	19,650 MW (Aug 23, 2024)	Record	CAISO Key Statistics
2024 wind and solar curtailment	3.4 TWh (+29% vs 2023; 93% solar)	2024	EIA (CAISO data)
Statewide utility-scale wind + solar	28.2 GW (9.7 GW in 2014)	End 2024	EIA
Statewide battery capacity	13,391 MW (fall 2024)	2024	CEC

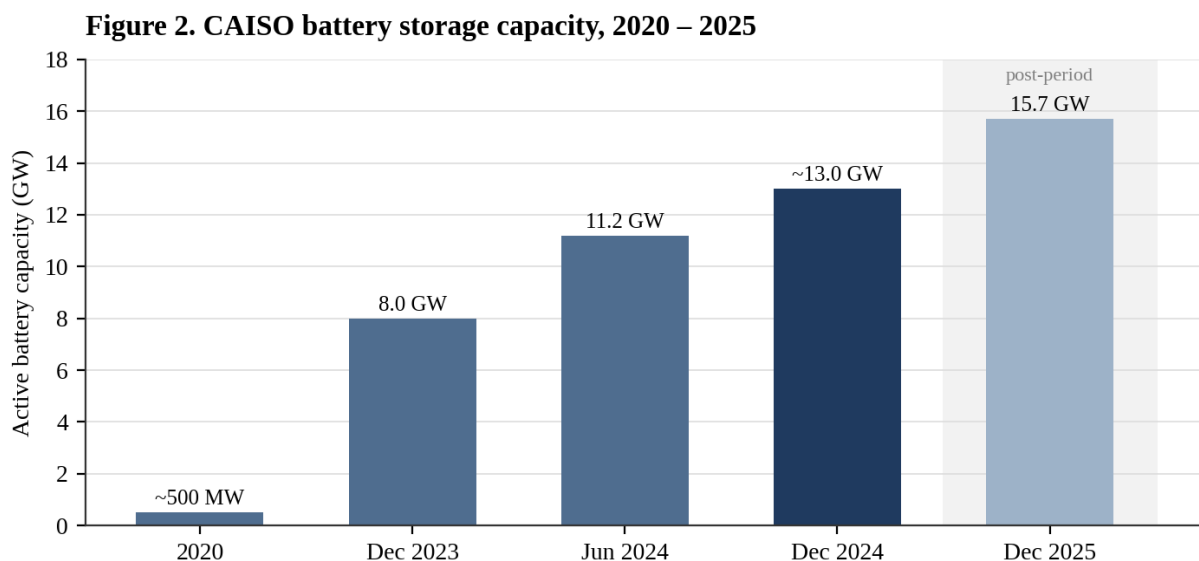


Source: California ISO, Key Statistics, January 2025 (installed renewable resources as of 2/11/2025). Battery storage is reported separately: 11,454 MW fully commercial as of 1/31/2025 (CAISO); ~13,000 MW active in December 2024 (CAISO DMM).

1.2 The battery build-out

The defining trend of the period was the speed of storage deployment. CAISO's active battery capacity grew from about 500 MW in 2020 to 11,200 MW by June 2024 and approximately 13,000 MW by December 2024 [4, 16], with 2024 alone adding about 4 GW [17] — a record that 2025 would exceed. By the end of 2024 slightly more than half of that capacity was physically paired with solar under CAISO's co-located or hybrid models, sharing a point of interconnection with generation [4]; the balance was standalone, the segment that would dominate additions from 2025 onward.

Operationally the fleet changed the shape of the grid. In 2024 battery charging represented about 14.7% of CAISO load between hours-ending 10 and 13, up from 8.3% in 2023 [4], absorbing midday solar that would otherwise have been curtailed or exported. In the evening the same fleet displaced gas: in 2023 batteries supplied on average 5.6% of electricity between 5 and 9 p.m. [18], and by the spring of 2024 CAISO was reporting the first evenings on which batteries were the single largest supply resource on the system after sunset. The Department of Market Monitoring found that local market power mitigation had minimal effect on battery dispatch, with only about 363 MW per hour on average subject to bid reductions [4] — evidence that the fleet was competing rather than being constrained.

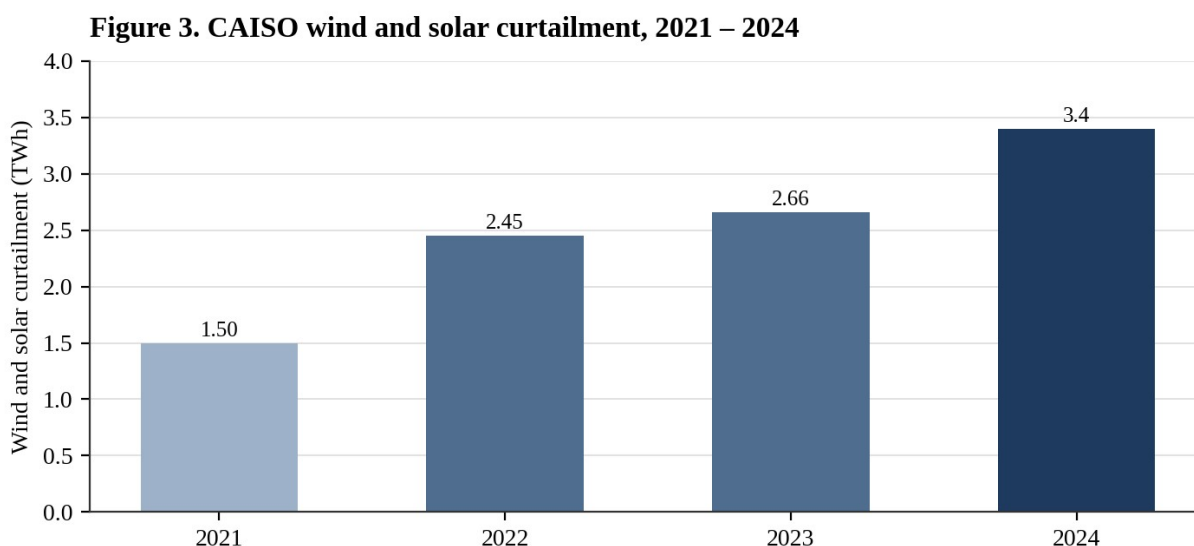


Source: CAISO Department of Market Monitoring, 2024 Special Report on Battery Storage (Dec 2024 ≈ 13,000 MW; ~500 MW in 2020); EIA (8.0 GW, 2023); CAISO via Amperon (11,200 MW, June 2024); Modo Energy (15.7 GW, Dec 31, 2025).
 Note: Active/operating capacity; CAISO's fully-commercial count is lower (11,454 MW at 1/31/2025). Dec 2025 shown for context — after the period covered by this paper.

1.3 Solar saturation, curtailment, and negative prices

Solar remained the largest renewable resource, and its success created the period's central operating problem. CAISO curtailed 2.4 TWh of wind and solar in 2022 and 2.66 TWh in 2023 [19, 20], and 3.4 TWh in 2024 — a 29% year-on-year increase, 93% of it solar and most of it in the spring, when output is high and heating and cooling loads are low [21]. Trading in the Western Energy Imbalance Market avoided a further 274 GWh of curtailment in 2024, about 8% of the total [21]. Statewide, utility-scale wind and solar capacity nearly tripled over the decade, from 9.7 GW in 2014 to 28.2 GW at the end of 2024 [21].

For developers the implication was direct. Solar-only projects in SP15 faced deepening midday price collapse and rising curtailment exposure, while any project that could shift energy four hours into the evening captured both an energy spread and a capacity payment. The economics of the period pushed capital toward storage, and toward co-location, where a single interconnection could serve both.



Source: CAISO wind and solar curtailment totals (2021: 1,504,840 MWh; 2022: 2,449,247 MWh; 2023: 2,659,527 MWh); EIA, Today in Energy, May 28, 2025 (2024: 3.4 TWh, +29% vs 2023, 93% solar).

1.4 Prices: PPAs rose, not fell

Contrary to the cost-curve narrative that dominated forecasts written in 2022, contracted prices rose through the period. LevelTen Energy’s North American solar P25 index — the most competitive quartile of offers on its marketplace — stood at \$56.76/MWh in the fourth quarter of 2024, and CAISO posted the largest increases of any ISO in the index: 8.2% quarter-on-quarter and 24.7% year-on-year [22]. Higher interest rates from 2022 onward, tariff uncertainty on modules and cells, and interconnection scarcity all pushed in the same direction. Wind PPA offers across North America averaged \$67.81/MWh in the same quarter, marking fifteen consecutive quarters in which solar had priced below wind [22].

Long-run cost curves still pointed down. NREL’s 2024 Annual Technology Baseline projected that overnight capital cost for utility-scale PV-plus-battery would fall from roughly \$2,100/kW in 2024 to roughly \$1,060/kW by 2050, and that PV-plus-storage levelized cost would decline from the high-\$70s to the mid-\$50s per MWh (conservative) or low-\$30s (advanced) [23]. The cost curves were not wrong; the period demonstrated that in a capacity-short market with rising rates and tariffs, the equilibrium contract price is set by scarcity rather than by the cost curve.

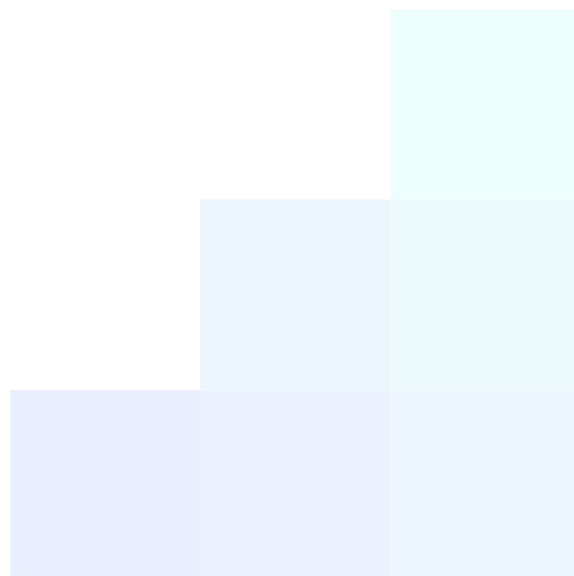
1.5 Load growth arrived late in the period

For most of the period California’s load story was flat-to-declining demand offset by electrification. That changed at the end. The CEC’s 2025 forecast projected CAISO’s 1-in-2 peak rising 15% from 46,094 MW in 2025 to 52,940 MW in 2030, and annual energy from 217,686 GWh to 271,992 GWh over the same window [24]. CAISO’s own transmission planning, drafted in the spring of 2025, raised its assumed year-on-year rate of peak growth from 0.99% to 1.53%, and to 2.14% in the Greater Bay Area, on the strength of transportation and building electrification and data-center interconnection requests [25]. The last quarter of the IRA era was therefore also the first quarter in which CAISO participants began to plan for a growing, rather than a static, system.

1.6 Policy drivers and constraints, as they stood at March 31, 2025

Drivers. California’s Renewables Portfolio Standard (60% renewable retail sales by 2030) and SB 100 (100% renewable and zero-carbon by 2045), tightened by SB 1020 (2022) to 90% by 2035 and 95% by 2040 [26, 27]; the CPUC’s integrated resource planning orders requiring 11,500 MW of new net qualifying capacity for 2023–2026 and a further 4,000 MW for 2026–2027 [12, 13]; the IRA’s technology-neutral credits, standalone-storage ITC, bonus adders and transferability [6]; and a resource adequacy market that, on the CPUC’s own account, recorded 82 transactions above \$100/kW-month during 2023–2024 [28].

Constraints. An interconnection queue that exceeded 500 GW after the April 2023 Cluster 15 window (541 requests, roughly 354 GW, on top of about 188 GW of active earlier-cluster projects) [15]; eight-to-ten-year lead times for major transmission; curtailment and negative midday prices; local land-use and permitting friction, including the Williamson Act; wildfire and extreme-heat exposure; and, from January 2025, federal policy risk that had moved from hypothetical to declared.



Chapter 2: Market Structure and Operations

2.1 The balancing authority and the Western markets

CAISO operates the day-ahead and real-time markets for its balancing authority area and, since 2014, the Western Energy Imbalance Market (WEIM), a real-time market that by the end of 2024 had 22 active participants across 11 states with two more preparing to join, and had produced \$6.62 billion in gross benefits since launch [3]. For a CAISO developer the WEIM's practical value was as an outlet for surplus midday solar and as a source of imports during evening ramps; its value was indirect rather than a distinct revenue stream.

The period also settled the structure of the West's day-ahead markets. FERC accepted CAISO's Extended Day-Ahead Market (EDAM) tariff in December 2023 [29]. By the end of the period PacifiCorp (implementation agreement April 2024; go-live May 1, 2026), Portland General Electric (June 2024), the Balancing Authority of Northern California (November 2024) and the Los Angeles Department of Water and Power (January 13, 2025) had signed implementation agreements, with NV Energy, Idaho Power, BHE Montana and PNM publicly leaning toward EDAM [30]. The competing Southwest Power Pool Markets+ received conditional FERC approval on January 16, 2025, with Bonneville's choice — the largest single swing factor — still pending at the close of the period [31]. The West was heading toward two day-ahead markets with a long seam between them.

2.2 Resource adequacy: the anchor of the revenue stack

California does not run a centralized capacity market. Instead the CPUC requires each load-serving entity (LSE) — investor-owned utility, community choice aggregator, or electric service provider — to demonstrate system, local and flexible resource adequacy (RA) against its forecast load plus a planning reserve margin, and CAISO backstops any shortfall. The planning reserve margin was 17% for the 2024 and 2025 compliance years, with an “effective” procurement target of roughly 22.5% for the summer months, and the CPUC's new Slice-of-Day framework — under which each LSE must show sufficient capacity in every hour of the month's worst day — took effect for the 2025 compliance year [32, 33].

Two features of this framework built the battery fleet. First, RA is contracted bilaterally, so a developer with a signed long-term RA or tolling agreement from an IOU or CCA had bankable revenue years before commercial operation, and the CPUC's mid-term reliability orders obliged those buyers to sign. Second, Slice-of-Day explicitly rewards resources that can cover the post-sunset hours — that is, four-hour storage. Scarcity pricing reinforced the effect: the CPUC recorded 82 transactions above \$100/kW-month during 2023–2024 [28]. By the end of the period the market had begun to loosen as the 2024 additions came online, but RA remained the revenue line on which every CAISO storage financing was underwritten.

2.3 The procurement mandates

The CPUC's integrated resource planning proceeding converted state policy into purchase orders. Decision 19-11-016 required 3,300 MW of new capacity for 2021–2023 [34]. Decision 21-06-035 (June 2021) required 11,500 MW of new net qualifying capacity from zero-emitting or RPS-eligible resources between 2023 and 2026 — at the time the largest single procurement order in the state's history [12] — and Decision 23-02-040 (February 2023) added 4,000 MW for 2026–2027 [13]. These orders, allocated

across the IOUs and CCAs by load share, are the demand side of every RA contract signed in the period. In parallel, AB 1373 (2023) authorized the Department of Water Resources to procure centrally on behalf of LSEs for resources with long lead times — long-duration storage, geothermal and offshore wind — a channel that was still in design at the close of the period [35].

2.4 Interconnection: the queue and the reset

Interconnection was the binding constraint of the period. CAISO's Cluster 14 window (2021) drew 151 GW of requests; Cluster 15, in April 2023, drew 541 requests totaling roughly 354 GW, against an informal survey that had anticipated about 300 requests in total [15]. With approximately 188 GW of earlier-cluster projects still active, the queue exceeded 500 GW — more than ten times the system's peak load [15].

CAISO's response, the Interconnection Process Enhancements (IPE) 2023 initiative, reset the rules for every project in the queue. Track 2, approved by FERC in the Appendix KK "Resource Interconnection Standards" tariff (Docket ER24-2671) in 2024 [36], introduced a zonal approach tied to the CPUC and CEC resource portfolios; a scoring system weighting project viability (site control, engineering progress), system need (including local RA), and commercial interest from LSEs and non-LSEs; and a cap on the capacity studied per zone at 150% of available transmission capability. Cluster 15 requests were required to be resubmitted through a window that ran from October 1 to December 2, 2024, and were being scored as the period closed [15]. FERC's Order 2023 (July 2023) provided the federal backdrop, though CAISO obtained regional variations for most of its reforms [37].

For developers the reset changed the definition of a good queue position. Positions in earlier clusters became scarcer and more valuable; new positions were worth little without site control, LSE interest and a location inside a portfolio zone. The IPE scoring also elevated the strategic value of surplus interconnection capacity at existing points of interconnection, which is one reason co-location and repowering at existing solar sites gained ground.

2.5 Transmission planning

CAISO's 20-Year Transmission Outlook (May 2022) estimated \$30.5 billion of transmission would be needed to integrate the state's 2040 portfolio, and its annual plans began to deliver it [38]. The 2022-2023 plan approved 45 projects at \$7.3 billion [39]. The 2023-2024 plan, approved May 23, 2024, added 26 projects at \$6.1 billion, of which \$4.59 billion was for three lines to bring North Coast (Humboldt) offshore wind to the Bay Area — a new Humboldt 500 kV substation with an HVDC line to Collinsville and a 500 kV AC line to Fern Road, both opened to competitive solicitation [40]. CAISO's chief executive framed the planning task as adding roughly 7,000 MW of new resources every year to meet state goals [25]. At the close of the period the draft 2024-2025 plan was weeks from publication; it would shift emphasis from policy-driven offshore lines toward reliability-driven upgrades and reconductoring for load growth.

Chapter 3: Competitive Landscape

3.1 Buyers

Market participants in the period are best described in two groups: those who procured capacity and those who developed it.

Investor-owned utilities. Pacific Gas and Electric (PG&E Corporation revenue \$24.4 billion in 2023 [41]), Southern California Edison (Edison International revenue \$16.3 billion in 2023; serving about 15 million people [42]) and San Diego Gas and Electric (in operation since 1881) carried the largest shares of the CPUC’s procurement orders and remained the counterparties of choice for lenders because of their credit and the CPUC’s cost-recovery framework — even after PG&E’s 2019–2020 bankruptcy had taught the market to price wildfire liability. PG&E also operated Diablo Canyon, the 2,240 MW nuclear plant whose retirement was reversed by SB 846 (September 2022) with a state loan of up to \$1.4 billion and a federal Civil Nuclear Credit award of up to \$1.1 billion; its license-renewal application was pending at the NRC through the period, and the plant supplied about 10% of the state’s electricity in 2024 [43, 44].

Community choice aggregators. CCAs — Clean Power Alliance, MCE, Silicon Valley Clean Energy, Peninsula Clean Energy, San Diego Community Power and their peers — grew through the period into a buyer group that rivaled the IOUs for new-build storage and solar-plus-storage RA contracts, often with faster procurement cycles and greater appetite for co-located projects. Their credit was thinner than the IOUs’, which affected pricing and security packages, but the CPUC’s central procurement entities for local RA and the sheer volume of mandated procurement kept them active throughout.

Publicly owned utilities. LADWP and SMUD are outside the CAISO balancing area and procure separately (LADWP joined the WEIM in 2021 and signed an EDAM agreement in January 2025 [30]), but both were large buyers of desert solar-plus-storage delivered at CAISO seams.

Corporate and public offtakers. Technology companies remained active buyers of California renewable energy, generally through financial or virtual PPAs; California state agencies were required by SB 1020 to procure 100% clean electricity by 2035 [27]. Neither group was a source of RA revenue, which is why in CAISO the corporate PPA was a complement to, not a substitute for, an LSE contract.

The state itself. AB 1373 added the Department of Water Resources as a central buyer for long-lead resources, and the DWR Strategic Reliability Reserve, created in 2022, procured emergency capacity directly [35, 45].

3.2 Builders

The CAISO storage ecosystem at the close of the period comprised roughly 75 active owner-developers and nearly 500 battery projects under construction or in development totaling well over 100 GW, according to Yes Energy’s 2025 count [18]. The most prolific by project count included EIG-backed platforms, NextEra Energy Resources, Arevon, Hecate Energy and Cultivate Power; the largest operating sites included Vistra’s Moss Landing complex, the Edwards and Sanborn solar-plus-storage project in Kern County, and a series of standalone SP15 batteries built by AES, Calpine (Nova Power Bank), Terra-Gen, REV Renewables, esVolta and others. NextEra, AES and EDF Renewables North America are independent power producers and developers rather than utilities; their relevance to a new entrant is as competitors for sites, queue positions and contracts.

Table 2 summarizes the principal buyers and builders active in CAISO during the period. Figures are limited to those verifiable from company filings and public sources.

Table 2. Principal buyers and builders in CAISO, Q3 2022 – Q1 2025

Company	Role in CAISO	Period facts
Pacific Gas and Electric (PG&E Corporation)	Investor-owned utility; buyer; transmission owner; Diablo Canyon operator	2023 revenue \$24.4 billion [41]; approximately 16 million people served; Diablo Canyon (2,240 MW) extended to 2029/2030 under SB 846 [43].
Southern California Edison (Edison International)	Investor-owned utility; buyer; transmission owner	Edison International 2023 revenue \$16.3 billion [42]; approximately 15 million people served; largest single procurer by load share under the CPUC mid-term reliability orders [12].
San Diego Gas and Electric (Semptra)	Investor-owned utility; buyer	In operation since 1881; approximately 3.7 million people served in San Diego and southern Orange counties.
NextEra Energy / NextEra Energy Resources	Developer and independent power producer	NextEra Energy 2023 revenue \$28.1 billion [46]; among the most active battery developers in CAISO by project count [18].
The AES Corporation	Developer and independent power producer; owner of early utility-scale CAISO batteries (Alamitos, Huntington Beach)	2023 revenue \$12.7 billion [47]; exit from coal targeted for the end of 2025.
EDF Renewables North America	Developer and independent power producer; Riverside East solar-plus-storage (Desert Harvest, Maverick, Arica and Victory Pass)	Principal Riverside East developer through the period [48].
Calpine Corporation	Independent power producer; Geysers geothermal complex (approximately 725 MW); California gas fleet; Nova Power Bank storage (Menifee)	Fleet of approximately 27 GW; agreement to be acquired by Constellation announced January 10, 2025 (net purchase price \$26.6 billion; 7.9× 2026 EV/EBITDA) [7]; transaction completed January 7, 2026 [49].
Vistra Corp.	Independent power producer; Moss Landing Energy Storage Facility (750 MW across three phases)	Phase 1 (300 MW / 1,200 MWh) destroyed by fire on January 16, 2025 [8, 50].
Terra-Gen; Arevon; Intersect Power; Clearway; REV Renewables; esVolta; Hecate Energy; Cultivate Power	Developers and independent power producers active in SP15 storage and in Kern and Riverside County solar-plus-storage	Edwards and Sanborn (Terra-Gen, Kern County) is among the largest solar-plus-storage facilities in the world; Arevon, Hecate and Cultivate each had eight or more CAISO battery projects in development [18].

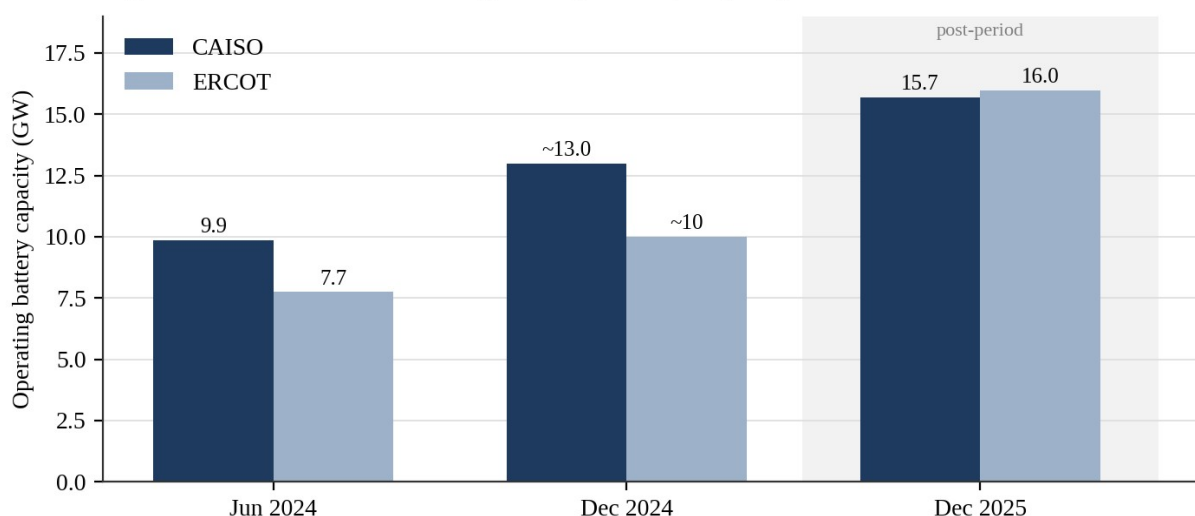
3.3 CAISO versus ERCOT: the two storage markets

The only inter-ISO comparison that carried analytical weight in the period was with Texas. At mid-2024 CAISO had 9.87 GW of operating batteries to ERCOT's 7.74 GW [51]; by the end of 2024 the figures were approximately 13 GW and 10 GW [4, 52]. The two markets reached similar scale by opposite routes. CAISO's fleet was built on bilateral RA contracts with LSEs under CPUC mandates, supported by the IRA's storage ITC; ERCOT's was built merchant, on energy and ancillary-service revenue in an energy-only market with a \$5,000/MWh cap. CAISO offered bankable contracted cash flows and slower, more expensive development; ERCOT offered faster interconnection and higher but more volatile returns. Investors who understood the difference allocated accordingly, and the question that dominated 2024 investment committees — whether merchant ERCOT storage revenue would hold as the fleet grew — did not arise in CAISO's contracted model. ERCOT would overtake CAISO in installed capacity in the second quarter of 2025 [52], but not in contracted capacity.

Table 3. CAISO and ERCOT storage markets compared

	CAISO	ERCOT
Batteries operating, mid-2024	9.87 GW	7.74 GW
Batteries operating, end-2024 (approx.)	~13 GW (DMM)	~10 GW (14.2 GW by end-Q2 2025, when ERCOT passed CAISO — S&P)
Installed wind / solar	8.3 GW / 20.7 GW (Feb 2025)	~40 GW / ~30 GW (40.0 / 32.7 GW by Jul 2025 — ERCOT)
Customers; transmission	32 million; ~26,000 circuit-miles	27 million (~90% of Texas load); 54,100+ miles
Peak demand (record)	52,061 MW (Sept 2022)	85,508 MW (Aug 2023)
Primary storage revenue model	Contracted RA / tolling with LSEs; merchant energy on top	Merchant energy and ancillary services
Capacity mechanism	Bilateral resource adequacy under CPUC mandates	None (energy-only market)
Interconnection	Cluster study, 500+ GW queue, IPE reforms	“Connect and manage,” faster and cheaper
Offer cap	\$2,000/MWh (hard)	\$5,000/MWh

Sources: [3, 4, 51, 52, 53].

Figure 4. CAISO vs. ERCOT operating battery capacity

Source: S&P Global Commodity Insights (Q2 2024: CAISO 9.867 GW, ERCOT 7.74 GW); CAISO DMM (Dec 2024 ≈ 13 GW); ERCOT ≈ 10 GW at end-2024 (approx.; 14.17 GW by end-Q2 2025 per S&P, when ERCOT passed CAISO); Modo Energy (CAISO 15.7 GW) and ERCOT (15,981 MW), Dec 2025.
 Note: ERCOT end-2024 value interpolated between S&P Global's reported Q2 2024 and Q2 2025 figures. CAISO capacity is largely under RA or tolling contracts with load-serving entities; ERCOT capacity is largely merchant.

3.4 The M&A marker: Constellation–Calpine

On January 10, 2025, Constellation Energy agreed to acquire Calpine from Energy Capital Partners, CPP Investments and Access Industries for an equity price of approximately \$16.4 billion (50 million Constellation shares plus \$4.5 billion in cash) and the assumption of about \$12.7 billion of net debt — a net purchase price of \$26.6 billion after expected interim cash generation and tax attributes, or 7.9× 2026 EV/EBITDA [7]. Calpine's roughly 27 GW fleet includes the Geysers geothermal complex and a large California gas and storage portfolio. For CAISO participants the transaction was the period's clearest

statement of what dispatchable, capacity-earning assets in a tightening Western market were worth to a strategic buyer, and it set the reference multiple against which contracted storage platforms were marked in the following months.

3.5 SWOT, restated

Table 4. Strengths and weaknesses of the CAISO market at the close of the period

Strengths	Weaknesses
Deepest contracted storage market in the world (~13 GW active, Dec 2024) with mandated demand of 15.5 GW NQC through 2027. Bankable IOU/CCA counterparties under a CPUC cost-recovery framework. World-class solar resource in the desert Southwest and a transmission plan funded to \$6.1 billion (2023-24) on top of prior approvals.	Interconnection queue above 500 GW and a multi-year reset of the process. Curtailment rising 29% a year; midday prices frequently negative. High development cost and long timelines relative to ERCOT; wildfire and extreme-heat exposure; local opposition and Williamson Act constraints.

Table 5. Opportunities and threats as assessed at the close of the period

Opportunities (as seen at Q1 2025)	Threats (as seen at Q1 2025)
Slice-of-Day RA rewarding four-hour and longer storage; AB 1373 central procurement for long-duration storage and geothermal. Load growth from electrification and data centers reversing a decade of flat demand. EDAM widening the market for surplus solar from 2026.	Federal policy reversal — declared on January 20, 2025 and, by March, visibly moving from disbursement pauses toward legislation. Battery safety backlash after Moss Landing translating into local moratoria and state setback legislation. Tariffs: solar AD/CVD, Section 301 on Chinese cells, and the first IEEPA tariffs; PPA price inflation squeezing offtaker appetite.

Chapter 4: Regulatory and Policy Framework (as of March 31, 2025)

4.1 State framework

Table 6. California statutory and regulatory framework as of March 31, 2025

Instrument	What it did	Why it mattered in CAISO
Renewables Portfolio Standard (SB 350, 2015) [54]	60% of retail sales from RPS-eligible renewables by 2030; annual compliance reporting.	Baseline demand for solar and wind PPAs; 42.9% achieved in 2023.
SB 100 (2018) [26]	100% of retail sales and state loads from renewable and zero-carbon resources (including large hydro and nuclear) by 2045; joint agency report every four years.	Set the long-run portfolio; 67% zero-carbon achieved in 2023.
SB 1020 (2022) [27]	Interim targets of 90% by 2035 and 95% by 2040; 100% clean for state agencies by 2035.	Pulled procurement forward into the period.
CPUC integrated resource planning — D.19-11-016, D.21-06-035, D.23-02-040 [34, 12, 13]	3,300 MW (2021–23); 11,500 MW NQC (2023–26); 4,000 MW NQC (2026–27) of new zero-emitting or RPS-eligible capacity, allocated to all LSEs.	The demand side of every RA and tolling contract signed in the period.
Resource adequacy (CPUC R.21-10-002; R.23-10-011) [32, 33, 28]	17% planning reserve margin for 2024–25; effective PRM ~22.5% in summer; Slice-of-Day 24-hour showings from the 2025 compliance year (D.24-06-004).	Made four-hour storage the highest-value RA resource; scarcity pricing in 2023–24.
AB 2514 (2010) storage mandate [55]	CPUC target of 1,325 MW of utility storage procurement by 2020 (installed by 2024).	The original seed of the storage market; long since exceeded.
AB 205 (2022) [45, 56]	Created the CEC opt-in certification program for renewable and storage projects of 50 MW or more — a single state permit with a 270-day decision target after application completeness — and the DWR Strategic Reliability Reserve.	Alternative to county permitting where local opposition or capacity was a constraint.
SB 846 (2022) [43]	Extended Diablo Canyon (2,240 MW) to 2029/2030 with up to \$1.4 billion in state loans; federal Civil Nuclear Credit of up to \$1.1 billion.	Kept ~10% of state energy on the system; reduced near-term RA scarcity.
AB 1373 (2023) [35]	Authorized DWR to procure centrally for long-lead resources (long-duration storage, geothermal, offshore wind).	Created a state channel for resources LSEs would not contract alone.
SB 38 (2023) [57]	Required emergency response and communication plans for battery storage facilities.	The baseline safety regime in force when Moss Landing burned.
Cap-and-Trade (AB 32; AB 398 extension to 2030) [58]	Economy-wide carbon price; proceeds fund California Climate Investments.	Supported the clean-energy premium in wholesale prices; reauthorized beyond 2030 in 2025 (see Epilogue).
CEQA; Williamson Act; county general plans	Environmental review; agricultural land preservation contracts; local zoning.	The everyday permitting friction of desert and Central Valley siting.

4.2 Federal framework

Table 7. Federal statutory, regulatory and trade framework as of March 31, 2025

Instrument	What it did	Why it mattered in CAISO
Inflation Reduction Act (Aug 16, 2022) [6, 59, 60]	Extended the \$48 ITC (30% with prevailing wage and apprenticeship; 6% base) and \$45 PTC (2.75¢/kWh in 2023–24, inflation-indexed); made both technology-neutral from January 1, 2025 as \$48E and \$45Y (final regulations January 7, 2025); extended the ITC to standalone energy	The single largest driver of the period. The standalone storage ITC and transferability are the reason CAISO's battery fleet was financeable at the scale the CPUC ordered.

Instrument	What it did	Why it mattered in CAISO
	storage for the first time; added +10-point adders for domestic content and energy communities; created transferability (\$6418) and elective pay (\$6417); created the \$45X manufacturing credit. Original CBO estimate ~\$369 billion; uncapped.	
Transferability in practice [14]	2023 market \$7–9 billion; 2024 ~\$30 billion (\$24 billion spot plus \$6 billion forward); average pricing 92.5¢ (ITC) and 95.0¢ (PTC); 75%+ of ITC deals insured.	Replaced or supplemented scarce tax equity; opened the capital stack to mid-market developers.
FERC Order 841 (2018) [61]	Required storage participation in wholesale markets.	Foundation for CAISO’s storage market models.
FERC Order 845 (2018) [62]	Interconnection reforms including surplus interconnection service and option to build.	Made co-location and repowering at existing POIs practical.
FERC Order 2222 (2020) [63]	Distributed energy resource aggregation in wholesale markets.	Limited direct effect on utility-scale projects.
FERC Order 2023 (July 2023) [37]	Cluster studies, readiness deposits and withdrawal penalties nationwide.	Backdrop for CAISO’s IPE 2023 reforms.
FERC Order 1920 (May 2024) [64]	Long-term regional transmission planning and cost allocation.	Reinforced CAISO’s 20-year outlook approach.
Trade measures [65, 66, 67, 68]	Section 201 solar safeguard (extended February 2022); antidumping and countervailing duties on cells and modules from Cambodia, Malaysia, Thailand and Vietnam (preliminary determinations October–December 2024); Section 301 tariff on Chinese non-EV lithium-ion batteries scheduled to rise from 7.5% to 25% on January 1, 2026 (announced May 2024); IEEPA tariffs on Chinese goods of 10% (February 4, 2025) and a further 10% (March 4, 2025).	Drove safe-harbor purchasing of cells and modules in late 2024 and early 2025; raised the value of domestic-content strategies.
Executive actions of January 20, 2025 [9, 10, 11]	National energy emergency declaration; “Unleashing American Energy” order pausing disbursement of IRA and infrastructure-law funds pending review; presidential memorandum withdrawing Outer Continental Shelf areas from wind leasing, pausing new or renewed federal approvals for wind projects, and ordering a review of existing leases.	Ended the period. Direct hit on California offshore wind; signal of legislative risk to the tax credits themselves.

4.3 Interconnection and permitting requirements

CAISO’s generator interconnection process during the period ran through the Generator Interconnection and Deliverability Allocation Procedures (GIDAP): interconnection request and cluster study, transmission-plan deliverability allocation, contract development and interconnection agreement, queue management, new resource implementation, and finally synchronization, trial operation and market participation. From Cluster 15 onward the front end was replaced by the IPE 2023 intake process described in Chapter 2 — zonal screening, scoring and a 150% study cap — with resubmission required between October 1 and December 2, 2024 [15].

Permitting ran on two tracks. The county track applied CEQA, local general plans and, in the desert counties, the federal Desert Renewable Energy Conservation Plan (DRECP) on BLM land. The state track, the CEC opt-in certification created by AB 205 in 2022, offered projects of 50 MW or more a single consolidated permit with a 270-day decision target after the CEC deemed an application complete,

with CEQA lead-agency status held by the CEC [45, 56]. In the period this was the fastest reliable path available for a contested site.

Chapter 5: Site Selection — Two Archetypes Revisited

5.1 Resource availability

California's resource endowment did not change during the period, but its ranking did. Direct normal irradiation in the Mojave and Colorado Desert reaches the highest values in the continental United States (in the range of 7–8.5 kWh/m²/day on the World Bank/Solargis Global Solar Atlas [69]), which is why the Riverside East Solar Energy Zone and the corridors along I-10 and State Route 177 remained the core of utility-scale solar development. Offshore, NREL's 2022 assessment of the Morro Bay and Humboldt wind energy areas found annual mean wind speeds at hub height in the 8–10 m/s range, with Humboldt the stronger of the two [70] — a resource of the first rank that could not, in the period, be developed at acceptable cost.

5.2 Riverside County: solar-plus-storage on public land

The Riverside East Solar Energy Zone, designated by the Bureau of Land Management under the Western Solar Plan and refined by the DRECP to protect the approaches to Joshua Tree National Park, offered flat basins, sparse vegetation, proximity to the I-10 corridor and existing SCE and IID transmission, and a county Eligible Renewable Energy Resource Development policy that explicitly supported solar paired with storage [48, 71]. CAISO's 20-Year Outlook assumed roughly 12,266 MW of new solar in the SDG&E area and 4,001 MW in the IID area — 16,267 MW in the region — and prioritized the transmission to deliver it [38]. The trade-offs were known: significant wildfire and extreme-heat exposure (First Street projected 39 extreme-heat days a year by mid-century [72]), a 2–3 GW seasonal surplus that deepened curtailment, and BLM leasing timelines. The archetype worked. Solar-plus-storage and standalone storage in the eastern SCE and IID footprint were the most heavily contracted assets of the period, and the SEZ's remaining developable area (about 147,910 acres per BLM) remains the state's largest single reservoir of development-ready solar land [48].

5.3 Morro Bay: floating offshore wind on federal water

The Morro Bay Wind Energy Area covers about 240,898 acres roughly 20 miles off the central coast. In the December 2022 BOEM auction — the first for floating wind in the United States, raising \$757 million across five California leases — the three Morro Bay leases went to Equinor, Golden State Wind (a joint venture of Ocean Winds and Canada Pension Plan Investment Board) and Invenenergy (Even Keel Wind) [73, 74]. The state's AB 525 planning goals of 2–5 GW of offshore wind by 2030 and 25 GW by 2045 — statewide goals, of which Morro Bay's three leases represented roughly 3 GW — and CAISO's 20-Year Outlook allowance of 5,400 MW for Morro Bay made it the most policy-supported wind site in the state [75, 38]. The 2023-2024 transmission plan nonetheless directed its \$4.59 billion of offshore-wind investment to Humboldt, not Morro Bay [40], and AB 1373's central procurement mechanism — the only realistic buyer for a \$3,000/kW-plus resource — was still in design.

At the close of the period the leases were intact, no construction and operations plans had been approved, and the January 20, 2025 memorandum had frozen new federal approvals and ordered a review of existing leases [11]. The reasonable assessment in March 2025 was that Morro Bay had moved from a 2030s project to an option on a change in federal policy. The epilogue records what became of that option.

5.4 The lesson of the two archetypes

Sites that won in the period shared four attributes: existing or planned transmission within the CAISO plan, a resource that could be firmed with four-hour storage on the same interconnection, a permitting path with a state backstop (AB 205 or BLM/DRECP), and no dependence on a federal approval that a change of administration could withdraw. Riverside East had all four. Morro Bay had two. Table 8 summarizes the assessment of the two sites as of the close of the period.

Table 8. Site assessment at the close of the period: Riverside East and Morro Bay

Criterion	Riverside County (solar and BESS)	Morro Bay (floating offshore wind)
Resource	DNI among the highest in the U.S.; summer peak; no hail risk.	8–10 m/s mean wind at hub height; strongest in summer.
Grid access	Within the CAISO 20-Year Outlook’s SDG&E/IID solar zone (16,267 MW); existing SCE and IID lines; SCE Eastern upgrades.	5,400 MW assumed in the 20-Year Outlook; no funded transmission in the 2023-24 plan (Humboldt prioritized).
Land and tenure	BLM lease within the Riverside East SEZ (~147,910 developable acres); private land under Williamson Act constraints.	BOEM leases (Dec 2022); state lands and port infrastructure for landfall and assembly.
Permitting	CEQA and county, or CEC AB 205 opt-in; DRECP conservation exclusions.	BOEM construction and operations plan, Coastal Commission, state agencies — all paused federally from Jan 20, 2025.
Community	Local opposition mitigated by community benefit agreements and job commitments.	Mixed; commercial fishing litigation; REACT Alliance opposition.
Logistics	I-10 and SR 177 access; flat terrain.	Port of Long Beach or Humboldt for assembly; Morro Bay or Port San Luis for O&M.
Climate and safety	Wildfire and extreme heat; battery fire risk (NFPA 855, SB 38, GO 167-C).	Low seismic exposure offshore; hurricane-free; corrosion and mooring risk.
Economics (NREL ATB 2024) [23]	PV-plus-battery capital cost ~\$2,100/kW (2024) falling to ~\$1,060/kW (2050); 30% ITC plus adders; RA revenue.	Floating offshore wind ~\$3,190/kW (2024) falling to ~\$2,310/kW (2050); PTC 2.75¢/kWh; no RA contract path outside AB 1373.
Policy dependence	State; federal exposure limited to BLM leasing and tax credits.	Federal lease, federal permit, federal tax credit, state central procurement — every link exposed.
Outcome in the period	Heavily contracted; the core of the storage build-out.	Stalled; two of three leases surrendered in 2026 (Epilogue).

Chapter 6: What a Successful CAISO Strategy Looked Like, Q3 2022 – Q1 2025

This chapter describes the strategy as it was executed by the developers, independent power producers and investors who created value in the period, organized around seven pillars, three archetypes and the approaches that did not succeed.

6.1 The seven pillars

Pillar 1 — Storage first, SP15 weighted

The asset that defined the period was a four-hour lithium-ion battery, sized to the CPUC's RA counting rules, located in the SP15 zone where solar saturation created the deepest midday-to-evening spreads and the highest local RA premiums, and interconnected either standalone or co-located with solar at a shared point of interconnection. Co-location captured the ITC on the storage, shared gen-tie and interconnection costs, and — after FERC Order 845 and CAISO's co-located resource model [62] — allowed the battery to charge from the grid as well as from the paired solar. Standalone batteries took over as additions shifted from 2024 to 2025 because they could use surplus interconnection capacity at existing sites and were simpler to contract.

Pillar 2 — A resource adequacy contract as the anchor

Every financeable CAISO storage project in the period began with a signed long-term RA-only, tolling or hybrid PPA with an IOU or CCA, typically 10–20 years, procured under the mid-term reliability orders [12, 13]. The contract fixed the capacity revenue that lenders and tax-credit buyers underwrote; energy arbitrage, ancillary services and, from 2025, Slice-of-Day-driven hourly value were upside. Successful developers ran parallel RFO campaigns with the three IOUs and the larger CCAs, understood the CPUC's net qualifying capacity and effective-load-carrying-capability rules before they sized the project, and structured for local RA premiums where the site allowed. They also priced counterparty risk: IOU paper was cheaper to finance than CCA paper, and the difference showed up in the offer.

Pillar 3 — A capital stack built on the IRA

The period's capital stack was ITC-led. For storage, the 30% ITC (with prevailing wage and apprenticeship compliance from January 2023) was frequently lifted to 40% by the energy-community adder, which many desert and Central Valley sites qualified for, and occasionally to 50% with domestic content. Tax equity remained available for large sponsors, but transferability changed the market for other sponsors: 2024 transfers reached about \$30 billion, with ITCs clearing at 92.5 cents and PTCs at 95 cents on the dollar, and larger deals pricing higher [14]. Successful sponsors locked transfer agreements early, insured ITC deals (three-quarters of ITC transfers carried insurance), and treated the Treasury's prevailing wage, apprenticeship and domestic-content rules as a compliance function rather than a legal afterthought. Debt was sized to the contracted RA revenue and priced through a rate cycle that took the ten-year Treasury from under 2% in early 2022 to above 4.5% at points in 2023–2024.

Pillar 4 — Queue position and zonal alignment

Interconnection determined who could build. Developers who held Cluster 13 or 14 positions, or interconnection agreements from earlier clusters, had an asset that appreciated throughout the period;

those who filed in Cluster 15 discovered in 2024 that the rules had changed [15] and that their positions were worth little without site control, LSE commercial interest and a location inside a CPUC/CEC portfolio zone. The strategy that worked was to align siting with CAISO's transmission plan zones before filing, to secure a memorandum of interest from a load-serving entity ahead of the scoring window, to pursue surplus interconnection service at existing plants (FERC Order 845), and to treat the December 2024 resubmission as a competitive bid rather than a formality. Queue speculation — filing broadly and selling positions — ended with Cluster 15.

Pillar 5 — Permitting, community and safety readiness

The permitting decision of the period was county versus CEC. Where a county had capacity and a supportive general plan, the local route was faster; where it did not, AB 205's opt-in certification offered a 270-day state decision with the CEC as CEQA lead agency [45]. Either way, successful projects arrived with community benefit agreements, local hiring commitments, wildlife and visual mitigation, and — decisively after January 16, 2025 — a battery safety package built to NFPA 855 (2023 edition), the SB 38 emergency response plan [57], and the CPUC's General Order 167 regime, with outdoor containerized systems, deflagration venting and early engagement with the local fire authority. The Moss Landing fire (a 300 MW / 1,200 MWh indoor system with roughly 100,000 cells, about 55% of them damaged, with evacuations, a reignition on February 18 and immediate state legislative response [50, 8]) converted safety from an engineering specification into a condition of the licence to operate.

Pillar 6 — Tariff-aware procurement

Supply chain risk in the period was tariff risk. Solar sponsors managed the Section 201 safeguard and the 2024 antidumping and countervailing duty investigations on Southeast Asian cells and modules; storage sponsors watched the Section 301 tariff on Chinese non-EV lithium-ion batteries, scheduled to rise from 7.5% to 25% on January 1, 2026, and then the first IEEPA tariffs of February and March 2025 [65, 66, 67, 68]. The response that worked was to buy ahead — safe-harboring cells and modules into bonded inventory in late 2024 — to diversify suppliers across Korea, Japan and the emerging U.S. cell base, and to map domestic-content adder eligibility at the bill-of-materials level. Sponsors who assumed the 2022–2024 tariff regime was stable were the first to be repriced in 2025.

Pillar 7 — Disciplined exit timing

The period rewarded developers who sold at the right point in the lifecycle. Development pipelines with interconnection agreements and RA contracts commanded premiums from independent power producers and infrastructure funds; operating standalone storage in SP15 attracted strategic and financial buyers; platforms with repeatable origination in CAISO traded on multiples that the Constellation–Calpine agreement (7.9× 2026 EBITDA for a dispatchable fleet) anchored in January 2025 [7]. For a mid-market developer the practical implication was to run a sell-side process at ready-to-build or shortly after commercial operation rather than to hold to terminal value — a decision made easier by the visible narrowing of the federal window in the first quarter of 2025.

6.2 Three archetypes

Table 9. Three archetypes of value creation in CAISO, Q3 2022 – Q1 2025

Archetype	How it made money in the period	What it needed	Representative exit
Greenfield developer (develop-to-RTB)	Originated sites, queue positions, permits and RA contracts; sold at ready-to-build to IPPs and funds.	Early-cluster queue positions; LSE relationships; county and CEC permitting capability; modest balance sheet.	Portfolio or project sale at RTB; often with development-fee earn-outs tied to COD.
Independent power producer (own and operate)	Built and held contracted storage and solar-plus-storage; layered merchant upside; recycled capital through tax-credit transfers and project-level debt.	Tax-credit monetization capacity; construction management; RA compliance and market bidding capability; scale purchasing.	Platform recapitalization or sale to a strategic (utility, oil major, infrastructure fund).
Financial investor (platform or portfolio)	Backed developers or acquired operating portfolios; underwrote to contracted RA cash flows with merchant optionality.	Sector diligence capability; tax-credit transfer counterparties; tolerance for California regulatory process.	Sale to a strategic at a capacity-driven multiple; the Calpine transaction was the period's marker.

6.3 Approaches that did not succeed

- **Solar without storage in SP15.** Rising curtailment (3.4 TWh in 2024), negative midday prices and Slice-of-Day counting rules concentrated solar-only RA value in the daytime slices where the system was already long; the solar-only projects that were financeable had generally been contracted before 2022.
- **Queue speculation.** Filing many Cluster 15 positions without site control or LSE interest, expecting to trade them; the IPE reforms and the December 2024 resubmission window eliminated the strategy.
- **Offshore-dependent strategies.** Any plan whose critical path ran through a federal wind approval was exposed to a single executive action, which arrived on January 20, 2025 [11].
- **Indoor, high-density battery buildings on constrained sites.** The design lineage of Moss Landing Phase 1 became difficult to insure or to permit within weeks of the fire.
- **Treating tariffs and tax rules as static.** Sponsors who did not safe-harbor equipment or document prevailing wage and apprenticeship compliance found their 2025 economics repriced.
- **Corporate PPA as the anchor.** In CAISO a corporate offtake agreement delivered no RA revenue; projects underwritten on it alone could not be financed as storage.

6.4 Offtake channels and stakeholder communications, as practiced

Several offtake channels were available to a utility-scale developer in the period. In order of importance: (1) IOU and CCA resource-adequacy and hybrid PPA solicitations driven by the CPUC's orders; (2) the CPUC's central procurement entities for local RA; (3) DWR central procurement under AB 1373 for long-lead resources (still in design at the close); (4) corporate and public-agency PPAs as energy and REC complements; and (5) merchant participation in CAISO's energy and ancillary-service markets and, prospectively, EDAM. Advisory support was most valuable at the point of monetization — the packaging of queue position, contract and permit into an asset that a strategic buyer would pay for.

Stakeholder communication in the period converged on four messages that regulators, counties and communities responded to: reliability (the project keeps the lights on in the evening ramp), safety (a named fire authority sign-off and an NFPA 855 design), local benefit (jobs, community benefit agreements, tax base) and alignment with the state’s targets (SB 100, the CPUC’s orders). Messages about corporate sustainability or “innovation” carried little weight with the audiences that actually decided permits and contracts.

Chapter 7: Risk Management — What the Period Taught

Table 10. Principal risks and the mitigations that proved effective, Q3 2022 – Q1 2025

Risk	How it showed up, Q3 2022 – Q1 2025	Mitigation that worked
Federal policy	Disbursement pause and offshore-wind memorandum (Jan 20, 2025) [10, 11]; rising probability of tax-credit legislation through Q1 2025.	Safe-harbor construction starts and equipment purchases; transfer agreements executed early; diversification away from federally-permitted resources.
State regulatory	IPE 2023 queue reset; Slice-of-Day implementation; evolving local RA rules; wildfire cost allocation for IOUs.	Portfolio-zone siting; early LSE engagement; RA counting expertise in-house; regulatory counsel on retainer.
Interconnection	500+ GW queue; Cluster 15 resubmission; deliverability allocation uncertainty.	Earlier-cluster positions; surplus interconnection at existing POIs; co-location; readiness documentation.
Financing and rates	Ten-year Treasury from under 2% (early 2022) to above 4.5% (2023–24); tax-equity scarcity.	Transferability; contracted RA as the sizing case; rate hedges at financial close.
Technology and safety	Moss Landing (Jan 16, 2025) [8]; ten CPUC-listed storage incidents since 2021; GO 167-C adopted Mar 13, 2025 [76].	Outdoor containerized LFP designs; NFPA 855 compliance; performance and availability guarantees; augmentation reserves.
Market price	\$2,000/MWh cap reached in Sept 2022; negative midday prices; curtailment +29% in 2024 [21]; ancillary-service saturation.	RA contract as anchor; hybrid contracts with merchant share; storage sized to Slice-of-Day value.
Environmental and community	DRECP exclusions; Williamson Act; local moratoria after Moss Landing; commercial fishing litigation offshore.	Community benefit agreements; CEC opt-in where counties stalled; early wildlife and visual mitigation.
Legal	Contractor disputes on schedule; NIMBY litigation; post-fire tort claims (Moss Landing suits filed March 2025).	Clear EPC risk allocation; insurance reviewed for battery fire; transparent community communication.
Trade and supply chain	Section 201; Southeast Asia AD/CVD (2024); Section 301 escalation scheduled for 2026; IEEPA tariffs from Feb 2025 [65, 66, 67, 68].	Forward purchasing; supplier diversification; domestic-content mapping.
Offtaker credit	IOU wildfire exposure; CCA thin credit; contract renegotiation requests as PPA prices rose.	Security packages calibrated to counterparty; IOU/CCA mix in the portfolio.
Execution	Labor and transformer shortages; interconnection upgrade delays; prevailing wage and apprenticeship compliance.	Long-lead procurement; schedule float; compliance staffing.

Chapter 8: The Interregnum, April 1 – July 4, 2025

The IRA era ended in practice in the first quarter of 2025 and in law on July 4. This chapter covers the ninety-five days in between, so that the reader knows what the market was waiting for and what it did while it waited. Nothing here changes the strategic conclusions of Chapters 1 through 7; it explains why they stop where they do.

8.1 What stopped

New commitments. E2's Clean Economy Works tracker recorded \$7.9 billion of announced clean-energy factories and projects cancelled, closed or downsized in the first quarter of 2025 across 16 projects — more than three times the total for the previous thirty months [1] — rising to \$14 billion and 10,000 jobs by the end of April, \$22 billion and 16,500 jobs by the end of June, and \$34.8 billion for the full year [77, 78, 79]. Developers stopped filing, buyers stopped signing platform and pipeline transactions, and tax-credit buyers began asking how the pending bill would change their own tax liabilities. LevelTen described the North American PPA market in the first and second quarters as operating under immense policy uncertainty, with tariff and tax-credit risk being priced through contract terms rather than headline prices [80]. In CAISO specifically, the operating battery fleet kept growing through 2025 — those projects had been financed in 2023 and 2024 — but new origination, new financings and portfolio M&A were suspended.

8.2 What accelerated

Locking in what already existed. Crux reports that 2025 capital deployment was front-loaded, peaking in the first quarter as developers rushed to establish begin-construction status; it estimates that roughly 170 GW of wind and solar was safe-harbored during 2025 [2]. The transferable tax credit market exceeded \$20 billion in the first half of 2025 — nearly double the first half of 2024 [81] — before demand and pricing softened in the second half as the new law cut corporate tax liabilities by an estimated 20–30% and introduced foreign-entity disqualification risk. Investment-grade ITC pricing slipped from 94.0 cents in the first half to 93.1 cents in the second; PTCs from 95.0 to 94.0 cents [2, 82]. The pattern is characteristic of an interregnum: new undertakings cease while existing ones are protected.

8.3 The sequence of events

Table 11. Sequence of events, April 1 – July 4, 2025

Date	Event	Significance for CAISO participants
Apr 2, 2025	“Liberation Day” reciprocal tariffs; tariffs on Chinese goods escalated to 145% by April 9; Geneva truce May 12 reduced the IEEPA rate on China to 30% for 90 days.	Battery cell and module costs could not be reliably quoted for approximately six weeks [68]; safe-harbored inventory purchased in late 2024 became the most valuable asset on many balance sheets.
Apr 21, 2025	Commerce final antidumping and countervailing duty determinations on solar cells and modules from Cambodia, Malaysia, Thailand and Vietnam (combined rates from the tens of percent to over 3,000% for some Cambodian producers) [66].	Closed the Southeast Asian route that had supplied most U.S. utility-scale modules; accelerated domestic-content and Indian/Laotian sourcing.
May 12–22, 2025	House Ways and Means markup; House passed H.R. 1 on May 22 (215–214) with wind and solar credits terminated for projects not under construction within 60 days of enactment and placed in service after 2028 [83].	The version that would have ended the CAISO solar pipeline outright; storage retained in all drafts.

Date	Event	Significance for CAISO participants
May 22, 2025	CAISO board approved the 2024-2025 Transmission Plan (31 projects, \$4.8 billion; peak growth assumption 1.53%) [25].	Planning continued on the state track regardless of federal action.
Jun 12, 2025	CAISO published Cluster 15 intake scoring: 145 projects, ~68 GW advanced to study out of 541 requests / ~354 GW [84].	Confirmed that readiness, not volume, now determined queue position.
Jun 16, 2025	Senate Finance Committee draft restored the technology-neutral credits for non-wind/solar technologies on the 2032–2036 schedule while keeping the wind and solar cutoff [85].	Storage’s survival became likely; the wind/solar begin-construction window became the negotiation.
Jun 27, 2025	CPUC D.25-06-048 raised the planning reserve margin to 18% for 2026–2027 [86].	RA demand continued to rise on the state track.
Jul 1–4, 2025	Senate passed the bill July 1 (51–50, Vice President breaking the tie); House concurred July 3 (218–214); signed July 4 [83, 87].	End of the IRA era in law. Wind and solar: placed in service by Dec 31, 2027 unless construction begins by Jul 4, 2026. Storage: original schedule retained. FEOC restrictions from 2026.

8.4 Why the period closes at March 31, 2025

Three reasons. First, behavior: the freeze in new commitments and the rush to lock in existing ones were both fully visible in the first quarter; the second quarter added tariffs and legislative text but no new information about how the market would act. Second, data: CAISO’s February 2025 statistics and the Department of Market Monitoring’s December 2024 battery report give a clean, reconcilable snapshot; every figure in this paper ties to them. Third, accuracy of description: a paper that claimed to describe the IRA era “through July 2025” would be describing a market that had already stopped behaving like the IRA era three months earlier. For a developer or investor reading this as a record of how the CAISO market worked when the incentives were intact, the first quarter of 2025 is the last quarter for which that description holds.

Epilogue: After July 4, 2025

Everything below post-dates the signing of the One Big Beautiful Bill Act on July 4, 2025 (the interregnum between the close of the period and the signing is Chapter 8). Each item is dated; sources are listed in Appendix C.

Federal tax credits

The One Big Beautiful Bill Act, signed July 4, 2025, ended the technology-neutral §45Y and §48E credits for wind and solar facilities placed in service after December 31, 2027, with an exception for facilities that began construction by July 4, 2026 (which then have the usual four-year continuity window). Energy storage kept the original IRA schedule — full credit for projects beginning construction before 2033, phasing down thereafter — which is the single most important fact of the epilogue for a CAISO investor: the asset class that defined the period survived, and the asset classes around it did not. The act also imposed “foreign entity of concern” restrictions, including material-assistance cost-ratio tests, on projects beginning construction after December 31, 2025; removed five-year MACRS for post-2024 starts (while making 100% bonus depreciation permanent); terminated the §25D residential solar credit after December 31, 2025; and, for wind, ended the §45X credit for components sold after 2027 [87, 88]. A July 7, 2025 executive order directed Treasury to tighten begin-construction rules, which it did on August 15, 2025, eliminating the 5% safe harbor for larger wind and solar projects in favor of a physical-work test [89, 90]. The result was a concentrated national effort to begin construction of wind and solar projects before July 4, 2026, and a repricing of those that could not [2].

Offshore wind

On December 8, 2025 a federal district court vacated the agencies’ pause on wind approvals as a violation of the Administrative Procedure Act; on December 22, 2025 the administration suspended the leases of five large East Coast projects on national-security grounds [91]. In California the outcome was settlement rather than litigation. In April 2026 Golden State Wind surrendered its Morro Bay lease in exchange for the return of roughly \$120 million, with the proceeds redirected to conventional energy projects; in June 2026 Invenergy surrendered Even Keel Wind at Morro Bay together with three Atlantic leases, redirecting \$765 million to gas-fired and geothermal projects. Equinor is the sole remaining Morro Bay leaseholder [92, 74]. On June 23, 2026 the California Energy Commission and the Attorney General issued notices of intent to sue the Department of the Interior over the settlements [93]. The Morro Bay archetype described in Chapter 5 has, for practical purposes, ended.

Storage, safety and the market

The CAISO battery fleet reached 15.7 GW at December 31, 2025, adding a record 4.7 GW during the year with standalone systems now 59% of the fleet and 93% of fourth-quarter additions [17]; on April 21, 2025 batteries met 36.6% of CAISO load between 5 and 9 p.m., discharging 42.6 GWh [18]. The CEC counted 15,763 MW statewide by April 2025 [94]. ERCOT overtook CAISO in installed capacity in the second quarter of 2025 and stood at 15,981 MW in December 2025 [52, 16] — but still without a contracted capacity framework. SB 283 and AB 303 carried the Moss Landing response through the legislature, and EPA-supervised battery removal at Moss Landing continued through 2025 and 2026 under the General Order 167-C regime adopted in March 2025 [76, 50].

Interconnection and transmission

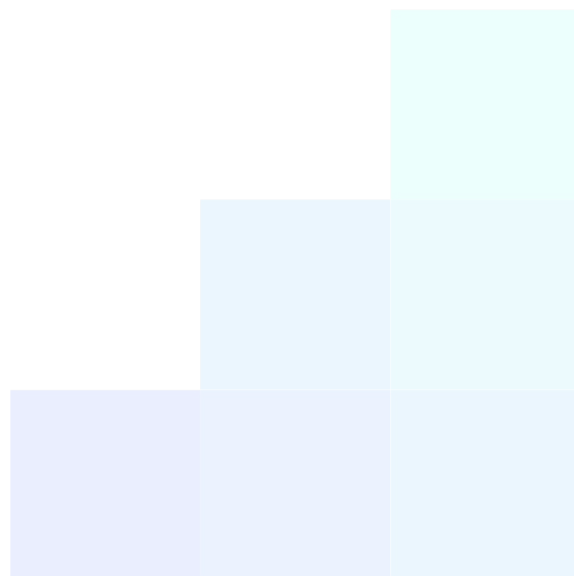
Following the Cluster 15 scoring (Chapter 8), CAISO issued the IPE 5.0 draft final proposal in October 2025; the Cluster 16 window is scheduled to open in October 2026 [95]. The 2024-2025 Transmission Plan approved in May 2025 (31 projects, \$4.8 billion) is now in execution, with load-growth-driven reliability projects and advanced-conductor reconductoring displacing the policy-driven offshore-wind lines that dominated the 2023-24 plan [25].

Western markets

EDAM went live on May 1, 2026 with PacifiCorp; Portland General Electric is scheduled for October 2026, LADWP, BANC, PNM and Turlock Irrigation District for 2027, and Imperial Irrigation District for 2028, at which point EDAM is expected to serve about 42% of Western demand [30]. Bonneville adopted a policy to pursue SPP Markets+ in May 2025 [96], and Markets+ — FERC-approved in early 2025 [31] — is targeting an October 2027 launch with APS, SRP, TEP, Powerex and Bonneville. The two-market West is now a fact.

Other markers

- The NRC approved Diablo Canyon’s 20-year license renewal on April 2, 2026; operation beyond 2029/2030 still requires state action [44].
- LevelTen’s North American solar P25 index reached \$61.67/MWh in the fourth quarter of 2025, up 9% year-on-year, with wind at \$73.77/MWh — policy and tariff costs continuing to flow into contract prices [97].
- California extended its cap-and-trade program beyond 2030 in September 2025 legislation, renaming it cap-and-invest [98].
- Constellation completed the Calpine acquisition on January 7, 2026, following FERC approval on July 24, 2025 and a December 4, 2025 settlement with the Department of Justice requiring the divestiture of generating assets in PJM and ERCOT; no California assets were divested [99, 100, 49].



Conclusion: Lessons Carried Forward

The IRA era in CAISO lasted roughly thirty-one months in practice and thirty-four in law. In that time the market built the world's largest contracted battery fleet, reset its interconnection process, launched a Western day-ahead market, and discovered that a decade of flat load was ending. The strategies that succeeded were not novel. They were storage-first siting in the zone with the deepest need, a capacity contract as the first dollar of revenue, a capital stack that used the federal credits as designed, a queue strategy built on readiness rather than volume, permitting and safety treated as commercial imperatives, procurement that assumed the tariff regime would move, and a willingness to sell when the buyer was paying for what the developer had actually created.

Five lessons carry forward into whatever the next period is called:

1. **Capacity is the product.** CAISO paid for evening capability, not for energy. That is more true, not less, as load growth returns.
2. **Contract beats cost curve.** Prices rose through a period in which technology costs fell, because the binding constraints were interconnection, capital and policy. Underwrite to the contract.
3. **Federal dependence is a discount rate.** Every strategy that required a federal approval a future administration could withdraw was repriced or eliminated. Storage survived the OBBBA; offshore wind did not survive a memorandum.
4. **Readiness is the new queue position.** Site control, an LSE letter and a portfolio zone are now the entry ticket; volume is not.
5. **Safety is a licence.** After Moss Landing, a battery project without a fire authority sign-off has no community, no insurer and no counterparty.

Odette Capital advised on sell-side and capital-formation mandates in this market during the period; this paper reflects that experience. It is published as a record of the period and as a reference for the one that follows.

Appendix A: Q1 2025 Data Snapshot

Table A-1. Principal statistics for the period, with sources

Item	Value	As of / period	Source
CAISO service	~80% of California demand; 32 million consumers; ~26,000 circuit-miles; 22 PTOs; 331 market participants; ~33% of WECC demand	Feb 2025	CAISO Key Statistics
Installed renewables	32,572 MW (solar 20,739; wind 8,346; geothermal 1,610; small hydro 1,147; biofuels 730)	Feb 11, 2025	CAISO Key Statistics
Battery capacity	11,454 MW commercial (Jan 31, 2025); ~13,000 MW active (Dec 2024); statewide 13,391 MW (fall 2024)	—	CAISO; DMM; CEC
Battery mix	5,800 MW standalone; 5,700 MW co-located; ~1,500 MW hybrid storage; 2024 additions ~4.0 GW	Dec 2024	CAISO DMM; Modo
Battery charging share of load, HE10–13	14.7% (2024); 8.3% (2023)	—	CAISO DMM
RA net qualifying capacity	50,852 MW	Jan 31, 2025	CAISO
Peak demand	48,323 MW (Sept 5, 2024); record 52,061 MW (Sept 6, 2022)	—	CAISO
Records	Solar 19,650 MW (Aug 23, 2024); wind 6,465 MW (May 28, 2022); 3-hour ramp 23,228 MWh (Jan 20, 2025)	—	CAISO
Curtailment	2022: 2.4 TWh; 2024: 3.4 TWh (+29%; 93% solar); WEIM avoided 274 GWh (2024)	—	EIA / CAISO
WEIM	22 active, 2 future participants; 11 states; \$6.62B gross benefits since 2014; \$374M in Q4 2024	Q4 2024	CAISO
EDAM signatories	PacifiCorp, Portland General, BANC, LADWP; leaning: NV Energy, Idaho Power, BHE Montana, PNM	Jan 2025	Western Energy Markets
Interconnection	Cluster 14: 151 GW; Cluster 15: 541 requests, ~354 GW; earlier active ~188 GW; resubmission Oct 1 – Dec 2, 2024	—	CAISO
Transmission plans	20-Year Outlook \$30.5B (2022); 2022-23 TPP 45 projects / \$7.3B; 2023-24 TPP 26 projects / \$6.1B (\$4.59B Humboldt OSW)	—	CAISO
CPUC procurement	3,300 MW (D.19-11-016); 11,500 MW NQC (D.21-06-035); 4,000 MW NQC (D.23-02-040)	—	CPUC
Planning reserve margin	17% (2024–25); effective ~22.5%; Slice-of-Day from 2025	—	CPUC
Tax credit transfers	2024 ~\$30B; ITC 92.5¢; PTC 95.0¢; 2023 \$7–9B	2024	Crux
PPA index	NA solar P25 \$56.76/MWh; wind \$67.81; CAISO solar +8.2% q/q, +24.7% y/y	Q4 2024	LevelTen
State RPS progress	42.9% RPS-eligible; 67% zero-carbon	2023	CEC
Load forecast	CAISO 1-in-2 peak 46,094 MW (2025) → 52,940 MW (2030); energy 217.7 → 272.0 TWh	2025	CEC via CAISO
Diablo Canyon	2,240 MW; ~10% of state electricity (2024); extended to 2029/2030 under SB 846	—	PG&E; Governor
Constellation–Calpine	\$16.4B equity + \$12.7B net debt; \$26.6B net; 7.9× 2026 EV/EBITDA; ~27 GW; completed Jan 7, 2026	Jan 10, 2025	Company releases; Form 8-K
Moss Landing fire	Jan 16, 2025; Moss 300 (300 MW / 1,200 MWh); ~100,000 cells, ~55% damaged; reignition Feb 18; GO 167-C Mar 13, 2025	Q1 2025	EPA; CPUC

Item	Value	As of / period	Source
Project cancellations (national)	\$7.9B / 16 projects in Q1 2025 (>3× the prior 30 months); \$14B by April; \$22B / 16,500 jobs by June; \$34.8B / 38,000 jobs full-year 2025	2025	E2 Clean Economy Works
Safe-harbor and transfer activity	2025 deployment peaked in Q1; ~170 GW wind and solar safe-harbored in 2025; H1 2025 transfers >\$20B (~2× H1 2024); full-year 2025 transfers ~\$42B	2025	Crux 2025 mid-year and annual reports

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About Odette Capital

Odette Capital LLC is a boutique clean energy M&A and project finance advisory firm based in New York. Founded in 2024, the firm provides sell-side advisory and capital-formation advisory services to mid-market battery storage, solar and wind developers across the United States. Odette Capital is a New York State Certified Service-Disabled Veteran-Owned Business.

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