Hot August Nights: California's Quest for Resource Adequacy Solutions to Promote Integration of Renewables and Energy Storage in the Midst of Climate Change-Related Challenges to Reliability

NOELLE R. FORMOSA*

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* © 2023 Noelle R. Formosa. Noelle R. Formosa is currently Senior Counsel for strategy and policy at Pacific Gas and Electric Company ("PG&E"). The opinions and analysis presented in this Article are my own and do not represent work product of PG&E. Many thanks to the countless stakeholders in California who worked tirelessly over the past several years to collaboratively develop the "slice of day" framework that is the inspiration for this Article.

I. INTRODUCTION

As night fell over California on August 14, 2020, temperatures soared.[1] Among other contributing factors, millions of air conditioners set at full blast during the period of peak energy demand maxed out the State's power grid.[2] The California Independent System Operator Corporation (CAISO), the non-profit entity responsible for the operation of California's bulk electric power system,[3] ordered utilities to cut power temporarily to hundreds of thousands of customers to help reduce stress on the larger grid for

1. Ivan Penn, *Rolling Blackouts in California Have Power Experts Stumped*, N.Y. TIMES (Aug. 16, 2020; updated June 23, 2021), https://www.nytimes.com/2020/08/16/business/california-blackouts.html [https://perma.cc/9GNX-ENNF].

2. Rob Nikolewski, *Report: A combination of factors caused California's rolling blackouts in August*, THE SAN DIEGO UNION-TRIBUNE (Oct. 7, 2020), https://www.sandiegouniontribune.com/business/story/2020-10-07/report-a-combination-of-factors-led-to-californias-rolling-blackouts-in-august [https://perma.cc/JMA7-XESW]; Catherine Wolfram, *Are There More Blackouts in California's Future?*, ENERGY INSTITUTE AT HAAS (Aug. 31, 2020), https://energyathaas.wordpress.com/2020/08/31/are-there-more-blackouts-in-californias-future/#:~:text=Mid%2DAugust%20Outages%20Exacerbated%20by,enough%20supply%20to%20meet%20deman [https://perma.cc/CKM2-MZRP].

3. The CAISO is the balancing authority that oversees the reliability of approximately 80% of California's electricity demand under a tariff approved by the Federal Energy Regulatory Commission and reliability standards set by the Western Electricity Coordinating Council and the North American Electric Reliability Corporation, CAL. INDEP. SYS. OPERATOR ET AL., ROOT CAUSE ANALYSIS: MID-AUGUST 2020 EXTREME HEAT WAVE 10 (Jan. 13, 2021) [*hereinafter* FINAL ROOT CAUSE ANALYSIS], http://www.caiso.com/Documents/Final-Root-Cause-Analysis-Mid-August-2020-Extreme-Heat-Wave.pdf [https://perma.cc/9FES-C6F9].

periods falling between the hours of 6 and 8 p.m.[4] CAISO-ordered rotating power outages[5] ensued for the first time in California since the devastating California Energy Crisis of 2000-2001.[6]

The next day, the nightmare repeated itself.[7] Thus, in the middle of a global pandemic, California electricity customers experienced the unthinkable: two CAISO-ordered rotating power outages on two consecutive days.[8] The outages affected several hundred thousand households during peak energy demand periods in what has been described as a "West-wide extreme heat wave."[9] Unfortunately, this is just one example of recent severe weather events that have left millions of Americans without power and have put our country's electrical grid to the test.[10]

In response to questions about how this could happen in California, the CAISO, the California Public Utilities Commission (CPUC), and the California Energy Commission (CEC) jointly released a Final Root Cause Analysis in January of 2021, confirming that there was no single root cause

4. Penn, *supra* note 1; FINAL ROOT CAUSE ANALYSIS, *supra* note 3, at 41–42.

5. Rotating power outages (also referred to as controlled load sheds or rolling blackouts) are relatively short power disruptions that alternate throughout communities to reduce demand to match supply and maintain grid reliability. CAL. INDEP. SYS. OPERATOR ET AL., FACT SHEET: ROTATING POWER OUTAGES (2022), http://www.caiso.com/Documents/Rotating-Power-Outages-Fact-Sheet.pdf [https://perma.cc/P3ZQ-NDXV].

6. Ivan Penn, *Poor Planning Left California Short of Energy in a Heatwave*, N.Y. TIMES (Sept. 4, 2020), https://www.nytimes.com/2020/08/20/business/energy-environment/california-blackout-electric-grid.html [https://perma.cc/DZ6Z-6WYS]. The California Energy Crisis of 2000-2001 rotating power outages were preceded by price spikes resulting from a number of factors, including a shortage of generating capacity, bottlenecks in related markets, wholesale generator market power, regulatory missteps, and faulty market design. *Infra* Part II.B.1.

7. Penn, *supra* note 1.

8. FINAL ROOT CAUSE ANALYSIS, *supra* note 3, at 1.

9. FINAL ROOT CAUSE ANALYSIS, *supra* note 3, at 1, 35. The extreme heat wave experienced in August 2020 was a 1-in-30-year weather event in California that extended across the entire western United States. *Id*. at 4.

10. Other recent examples include (1) major wildfires in California over the past five years and (2) the Texas winter storm that occurred in mid-February 2021 and plunged large swaths in Texas into subfreezing temperatures and overwhelmed the state's electricity infrastructure, causing massive power outages. Julia Marnin, *2020 U.S. Wildfires Burned Over 10 Million Acres, Nearly 18,000 Structures: Report*, NEWSWEEK (July 23, 2021), https://www.newsweek.com/2020-us-wildfires-burned-over-10-million-acres-nearly-18000-structures-report-1612637 [https://perma.cc/T9QA-3Z4Z]; Sami Sparber, At least 57 people died in the Texas winter storm, mostly from hypothermia, TEXAS TRIB. (Mar. 15, 2021), https://www.texastribune.org/2021/03/15/texas-winter-storm-deaths/ [https://perma.cc/X29T-JXRB].

of the August 2020 rotating power outages. Rather, the Final Root Cause Analysis finds that the three major causal factors were related to extreme weather conditions, resource adequacy (RA) and planning processes (which are specifically intended to require resource capacity procurement to ensure that enough resources are available to generate electricity when needed to prevent supply shortages), and market practices.[11]

> The climate-change induced extreme heat wave across the western United States resulted in demand for electricity exceeding electricity resource adequacy (RA) and planning targets. . . . Some practices in the day-ahead energy market exacerbated the supply challenges under highly stressed conditions.[12]

With respect to increased renewable penetration on the grid, the CAISO, CPUC, and CEC have been emphatic that "renewable energy did not cause the rotating power outages."[13] However, the Final Root Cause Analysis states: "[i]n transitioning to a reliable, clean, and affordable resource mix, resource planning targets have not kept pace to ensure sufficient resources that can be relied upon to meet demand in the early evening hours. This made balancing demand and supply more challenging during the extreme heat wave."[14] Given California's pledge to procure one

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11. FINAL ROOT CAUSE ANALYSIS, *supra* note 3, at 1; the CAISO, CPUC, and CEC also produced a Preliminary Root Cause Analysis on October 6, 2020. CAL. INDEP. SYS. OPERATOR ET AL., PRELIMINARY ROOT CAUSE ANALYSIS: MID-AUGUST 2020 HEAT STORM (OCT. 6, 2020), http://www.caiso.com/Documents/Preliminary-Root-Cause-Analysis-Rotating-Outages-August-2020.pdf [https://perma.cc/QVJ3-6A65].

12. FINAL ROOT CAUSE ANALYSIS, *supra* note 3, at 1. While this Article does not focus on these market practices, it is important to note their contributions to the August 2020 rotating power outages. Under-scheduling of demand in the day-ahead market, convergence bidding that masked the tight supply conditions, and the configuration of the residual unit commitment market process all exacerbated the untenable conditions. *Id*. at 5, 61. Upon review, it became clear that more exports were scheduled in the day-ahead market than were supportable from internal resources because of the under-scheduled load and convergence bidding issues. *Id*. at 62–63. Moreover, a flaw with the residual unit commitment process in the day-ahead market erroneously signaled that more exports were physically supportable than actually were, further contributing to the problem. *Id*. at 63. Along with pursuing corrections to these issues, the CAISO also modified the real-time scheduling priorities in its system to prevent exports that are not backed by capacity designated to serve external load from receiving higher priority than native load in the CAISO market. 175 FERC ¶ 61,245, Order Accepting Tariff Revisions, Subject to Further Compliance (June 25, 2021).

13. J.D. Morris, *How did California's energy shortage happen? Officials try to explain*, S.F. CHRONICLE (Aug. 19, 2020), https://www.sfchronicle.com/business/article/Californians-urged-to-conserve-power-and-prevent-15495739.php [https://perma.cc/S3ZN-WYFX]. Wind and solar resources generated less energy than their RA values would suggest, but it is normal to see variations between RA amounts and bid-in amounts. FINAL ROOT CAUSE ANALYSIS, *supra* note 3, at 49–50.

14. FINAL ROOT CAUSE ANALYSIS, *supra* note 3, at 1.

hundred percent of its electricity from carbon-free resources by 2045,[15] the increased evening challenges stemming from RA and planning deficiencies are concerning and they show that preferred resources (i.e., renewables and other non-fossil-fuel-fired energy resources) are playing a larger role in meeting reliability and bringing unique reliability challenges.

The Final Root Cause Analysis explains that both of the August 2020 rotating power outages occurred approximately one to two hours after the period of gross peak energy demand,[16] during what is referred to as the "net peak demand," or the peak of energy demand *net* of solar and wind generation resources.[17] As described further herein, in recent years this critical net peak demand period (i.e., when solar generation has dropped to zero) "has increased the challenge of maintaining system reliability, and this challenge is amplified during an extreme heat wave" conditions when temperatures remain high even after sunset.[18] This is, in part, because the reliability value of solar resources, in particular, is over-estimated during the net peak hour under the flawed existing planning framework.[19]

In an effort to avoid a repeat of the hot August nights of 2020, the Final Root Cause Analysis "provides recommendations for immediate, near, and longer-term improvements to resource planning, procurement, and market practices" in California with the intent to "ensure that California's transition to a reliable, clean, and affordable energy system is sustained and accelerated."[20] While a number of actions have been taken to address the issues identified in the Final Root Cause Analysis (including extraordinary

15. FINAL ROOT CAUSE ANALYSIS, *supra* note 3, at 1; CAL. PUB. UTILS. CODE §§ 399.11(a) & 454.53(a).

16. Gross peak demand represents the total energy required by the CAISO to serve demand at its highest level of the day and typically occurs at the hour ending 16:00 to 18:00. CAL. INDEP. SYS. OPERATOR, FACT SHEET: GROSS & NET LOAD PEAKS, http://www.caiso.com/documents/gross-and-net-load-peak-fact-sheet.pdf [https://perma.cc/T6CP-Y98B]; CAL. INDEP. SYS. OPERATOR, 2022 SUMMER LOADS AND RESOURCES ASSESSMENT 23–24, 42 (May 18, 2022) (*hereinafter* 2022 LOADS AND RESOURCES ASSESSMENT), http://www.caiso.com/Documents/2022-Summer-Loads-and-Resources-Assessment.pdf [https://perma.cc/V8YW-GLV3].

17. FINAL ROOT CAUSE ANALYSIS, *supra* note 3, at 4. Net peak demand in California occurs in the hour ending 19:00 to 21:00, when solar generation is close to zero. 2022 SUMMER LOADS AND RESOURCES ASSESSMENT, *supra* note 16, at 42.

18. FINAL ROOT CAUSE ANALYSIS, *supra* note 3, at 4.

19. *Id*. at 6.

20. *Id*. at Letter to Governor Newsom.

measures taken to prevent any additional outages in August 2020),[21] the hot August nights of 2020 also helped inspire longer-term RA policy reform that is only coming to fruition years later. Beginning in 2020, the CPUC began to act formally on the urgent need to reform California's RA paradigm in an effort to secure "the system's ability to meet both net peak and gross peak energy demand,"[22] while preserving the State's commitment to reduce greenhouse gas emissions to 40 percent below 1990 levels by 2030 and achieve 100% zero carbon retail power sales by 2045.[23] The urgency for RA reform was underscored by the Final Root Cause Analysis' finding that it is unlikely that the existing RA planning standards could have avoided additional rotating outages in August 2020 without the extraordinary measures that were taken to mitigate projected supply shortfalls.[24]

This Article focuses on the CPUC RA program's role in helping to keep the lights (and air conditioning) on while advancing California's continued mission to decarbonize the grid, even in the face of extreme climate-change induced weather events. It explains how the existing RA program

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21. For example, the CPUC conducted an Emergency Reliability rulemaking (CPUC Rulemaking 20-11-003) to make more resources available on an expedited basis to prevent a recurrence of blackouts if the western United States experiences extremely high temperature, sustained weather events. FINAL ROOT CAUSE ANALYSIS, *supra* note 3, at 70. Rulemaking 20-11-003 resulted in several additional near-term resource procurement orders through summer 2022. *Decision 21-02-028, Decision Directing Pacific Gas and Electric Company, Southern California Edison Company, and San Diego Gas & Electric Company to Seek Contracts for Additional Power Capacity for Summer 2021*, Cal. Pub. Utilities Comm'n (Feb. 11, 2021), https://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M366/K441/366441341.PDF [https://perma.cc/AFW5-VMBA]; *Decision 21-03-056, Decision Directing Pacific Gas and Electric Company, Southern California Edison company, and San Diego Gas & Electric Company to Take Actions to Prepare for Potential Extreme Weather in the Summers of 2021 and 2022*, Cal. Pub. Utilities Comm'n (Mar. 25, 2021), https://www.cpuc.ca.gov/-/media/cpuc-website/divisions/energy-division/documents/demand-response/emergency-load-reduction-program/decision_elrp_program.pdf [https://perma.cc/CLE5-MESY]; *Decision 21-12-015, Decision Directing Pacific Gas and Electric Company, Southern California Edison company, and San Diego Gas & Electric Company to Take Actions to Prepare for Potential Extreme Weather in the Summers of 2022 and 2023*, Cal. Pub. Utilities Comm'n (Dec. 2, 2021), https://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M428/K821/428821475.PDF [https://perma.cc/7L7T-94G7]. With respect to market practices, the CAISO expedited a stakeholder process to consider market rules and practice changes, including with respect to prioritization of export schedules. FINAL ROOT CAUSE ANALYSIS, *supra* note 3, at 70–71. The CEC also conducted probabilistic studies to evaluate the loss of load expectation on the California system to determine the amount of capacity necessary to meet the desired service reliability targets. *Id.* at 71.

22. *Decision 21-07-014, Decision on Track 3B.2 Issues: Restructure of the Resource Adequacy Program,* Cal. Pub. Utilities Comm'n, at 7 (July 15, 2021), https://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M393/K334/393334426.PDF [https://perma.cc/JXH8-5HRA] [hereinafter *Decision 21-07-014*].

23. S.B. 100, 2018 Leg., 312th Sess. (Cal. 2018); Exec. Order No. B-55-18 (Cal. Sept. 9, 2018).

24. FINAL ROOT CAUSE ANALYSIS, *supra* note 3, at 40.

creates risks of overestimating the availability of some capacity, including solar, wind, and energy storage resources, to meet demand in the increasingly critical evening hours. These risks are attributable to the program's original design, which assumed that all resources will be available to meet load in all hours. This Article outlines the major CPUC regulatory developments since August 2020, aimed at reforming the foundation of RA to better plan and account for the availability limitations inherent in the rapidly shifting electricity resource mix that is necessary to meet California's ambitious clean energy goals. In sum, this Article demonstrates how the pathway to a zero-carbon future in California is inextricably linked to the successful development and implementation of a reformed RA capacity paradigm that properly ensures procurement of resources capable of meeting both gross peak demand *and* energy requirements across all hours.[25] Absent these key features, reliability will suffer, and accelerated decarbonization will almost certainly face major roadblocks.

Part II provides background on RA in California. Part III describes some of the main components of California's existing RA program. Part IV explains the main factors underlying the critical need for RA reform in California, including how integration of renewables and energy storage uniquely affects the existing structure. Part V introduces the future of RA in California: the CPUC's newly reformed "24-hour slice of day" RA framework that will be implemented beginning with a test year in 2024 and will pave the way for a fully decarbonized, reliable grid. Finally, Part VI briefly concludes.

II. BACKGROUND ON RA IN CALIFORNIA

Like the rest of the United States, California relies on the electric power grid as the backbone of its economy.[26] The grid is essential to deliver electricity to businesses, schools, households, and other entities across the State.[27] This "requires coordination, collaboration, and oversight between users, owners, and operators to maintain a system with a high level of

25. While there are some locations in the United States that have energy-only markets to meet customer demand, including the area served by the Electricity Reliability Council of Texas, RA is typically achieved through capacity constructs (either regulatory or market design).

26. NAT'L ASS'N OF REGUL. UTIL. COMM'RS, RES. ADEQUACY PRIMER FOR STATE REGULS. 2 (NARUC Dep't of Commc'ns and Public Affairs ed. 2021), https://pubs.naruc.org/pub/752088A2-1866-DAAC-99FB-6EB5FEA73042 [https://perma.cc/HS94-KWRF].

27. *See id*.

reliability."[28] In order to live their every-day lives, California customers expect and deserve affordable, reliable, safe, and clean electricity service. This need does not diminish in the face of the increasingly intermittent resource portfolio (i.e., wind and solar)[29] that is necessary to meet clean energy goals, nor the heightened uncertainty caused by use-limited resources like battery energy storage, hydro-electric generators, or permit-restricted fossil-fuel resources.[30] To the contrary, consumers continue to require uninterruptible power, regardless of conditions affecting the grid.

To that end, California determined that an effective planning process must be successfully developed and implemented to ensure that (1) adequate supply-side and demand-side resources are constructed (and/or secured via ownership or contract) and (2) the capacity associated with those resources is available to serve consumers' electric needs under all but the most extreme conditions.[31] Rather than focusing on electricity itself, the process of ensuring availability of adequate capacity to meet demand, referred to as "resource adequacy" or RA, is concerned with the ability of a resource to produce when necessary.[32] In California, the availability of resources designated as RA to produce when necessary is secured through a must offer obligation (MOO) to bid into the CAISO's day-ahead and real-time energy markets in hours for which they were procured.[33] RA is,

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28. *Id*.

29. Intermittent resources are resources with output controlled by the natural variability of the energy resource rather than dispatched based on system requirements. *Glossary*, U.S. ENERGY INFO. ADMIN., https://www.eia.gov/tools/glossary/index.php?id=I [https://perma.cc/7N9Z-AE4P] (last visited Feb. 19, 2023).

30. Use-limited resources are resources that have one or more limits that meet all three of the following criteria: (1) the resource has one or more limitations affecting its number of starts, its number of run-hours, or its energy output due to (a) design considerations, (b) environmental restrictions, or (c) qualifying contractual limitations; (2) the CAISO market process used to dispatch the resource cannot recognize the resource's limitation(s); and (3) the resource's ability to select hours of operation is not dependent on an energy source outside of the resource's control being available during such hours, but the resource's usage needs to be rationed. Fifth Replacement Electronic Tariff, CAL. INDEP. SYS. OPERATOR CORP. § 30.4.6.1.1, http://www.caiso.com/Documents/Section30-Bid-and-Self-ScheduleSubmission-in-CaliforniaISOMarkets-asof-Jun1-2022.pdf [https://perma.cc/4XHV-69GE].

31. *See Decision 04-01-050, Interim Opinion*, Cal. Pub. Utilities Comm'n, at 10-17 (Jan. 22, 2004), https://docs.cpuc.ca.gov/PublishedDocs/WORD_PDF/FINAL_DECISION/33625.PDF [https://perma.cc/JU4Z-UVVB].

32. *See* Conn. Dep't of Pub. Util. Control v. FERC, 569 F.3d 477, 479 (D.C. Cir. 2009) ("'Capacity' is not electricity itself but the ability to produce it when necessary.").

33. *Decision 22-06-050, Decision Adopting Local Capacity Obligations for 2023-2025, Flexible Capacity Obligations for 2023, and Reform Track Framework*, Cal. Pub. Utilities Comm'n, at 72 (June 23, 2022), https://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M488/K540/488540633.PDF [https://perma.cc/BSY2-VPRE]; 62 FERC ¶ 61,042, at n.4 (2018).

in essence, "the availability of an adequate supply of generation or demand responsive resources to support safe and reliable operation of the transmission grid."[34] RA works in tandem with multiple other processes in multiple timeframes to meet consumers' expectations and fulfill the reliability mandates born by responsible grid operators.[35] As discussed herein, a decarbonized grid characterized by substantial renewables presents unique challenges when it comes to RA, requiring creative solutions to support both environmental goals and reliability imperatives.

A. Jurisdiction Over RA in California

Numerous governmental authorities and industry stakeholders share the goal of ensuring "a reliable, affordable, safe, and clean electric system that serves all customers."[36] While a thorough review of our nation's energy jurisdictional framework is beyond the scope of this Article,[37] a brief examination of the complexities associated with authority over RA in California is warranted. As with many energy-related matters, one must begin with the Federal Power Act (FPA), originally enacted in 1920.[38] The FPA vests near plenary authority in the federal government over wholesale sales of electricity and transmission lines used to move electricity to consumers.[39] However, the FPA provides several important electric oversight responsibilities to the states exclusively.[40] Most importantly for purposes

34. *See* 116 FERC ¶ 61,274, at n.2 (2006).

35. Foundationally, power system operation involves an intricate web of decision making in various timeframes, ranging from milliseconds (i.e., real time) to months or years ahead (i.e., long term). NAT'L ASS'N OF REGUL. UTIL. COMM'RS, *supra* note 26, at 5. Decisions associated with RA generally fall into the longer-term timeframe and impact the ability of the electricity system to meet consumers' energy needs at all times, taking into account scheduled and unscheduled outages of system components. *Id*. at 6.

36. *Id*. at 9.

37. For an exhaustive review, *see* Amy L. Stein, *Regulating Reliability*, 54 HOUS. L. REV. 1191 (2017); Jess B. Kincaid, *Blackouts and Oversupply or Regulatory Planning and Cooperation*, 43 ENV'T. L. 671 (2013).

38. 16 U.S.C. §§ 791a–828.

39. *See* 16 U.S.C. § 824(b)(1); Joshua C. Macey & Matthew R. Christiansen, *Long Live the Federal Power Act's Bright Line*, 135 HARV. L. REV. 1360, 1363 (2021); the primary exception is for sales of electricity that are not in interstate commerce. *Id*. at n.12.

40. *See* 16 U.S.C. § 824(a). At its inception, the FPA created a "bright line" between state and federal jurisdiction. *See, e.g.*, Miss. Power & Light Co. v. Miss. ex rel. Moore, 487 U.S. 354, 374 (1988) ("Congress has drawn a bright line between state and federal authority in the setting of wholesale rates and in the regulation of agreements that affect wholesale rates"); FPC v. S. Cal. Edison Co., 376 U.S. 205, 215–16 (1964) ("Congress

of this Article, the FPA expressly reserves to states authority over generation facilities, including the authority to determine what kind of generation will be built and what types of resources will be procured by load serving entities (LSEs) in the state.[41]

Congress, the Federal Energy Regulatory Commission (FERC), and the federal courts have long recognized the broad powers that states enjoy in directing the planning and resource decisions of utilities operating within their jurisdictions.[42] FERC has also long recognized the states' historical role in ensuring RA, requiring that such efforts be "workable" in the context of FERC's duty to ensure overall reliability of the bulk power grid.[43] Thus, state commissions, like the CPUC in California, and other local regulatory authorities with jurisdiction within a state, are generally responsible for actively considering and evaluating reliability risks. These risks include the adequacy of supply-side and demand-side resource availability to serve electric needs under all but the most extreme conditions.

At the same time, in fulfilling its "statutory mandate under the FPA to ensure that the rates, terms, and conditions of jurisdictional sales of electric energy and transmission in [the wholesale markets] are just, reasonable, and not unduly discriminatory or preferential," FERC has recognized "the effect of [RA] on [FERC]-jurisdictional prices and . . . on the ability of the operator of the interstate transmission grid to ensure reliable service."[44] As such, FERC-jurisdictional regional transmission organizations (RTOs) or independent system operators, like the CAISO, are jointly responsible with their corresponding state commissions and other local regulatory authorities "for ensuring [RA]" under their approved tariffs.[45] This includes requiring the existence of, and adherence by all LSEs to, a workable RA program.[46] If a state commission or other local regulatory authority establishes a workable RA program, then the RTO or independent system operator will generally defer to the local regulatory authority for the RA

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meant to draw a bright line easily ascertained, between state and federal jurisdiction . . ."). Today, this line is described as more "hazy." Robert R. Nordhaus, *The Hazy "Bright Line": Defining Federal and State Regulation of Today's Electric Grid*, 36 ENERGY L.J. 203, 207 (2015).

41. *See* 16 U.S.C. § 824(b)(1) (providing that FERC "shall not have jurisdiction . . . over facilities used for the generation of electric energy . . . .").

42. *See, e.g.*, Entergy Nuclear Vt. Yankee LLC v. Shumlin, 733 F.3d 393, 417 (2d Cir. 2013) ("States have broad powers under state law to direct the planning and resource decisions of utilities under their jurisdiction.") (quoting S. Cal. Edison San Diego Gas & Elec. Co., 71 FERC ¶ 61,269, at *62080 (1995)).

43. *Cal. Indep. Syst. Operator Corp*., 116 FERC ¶ 61,274, at para. 1117 (2006).

44. *Id*. at para. 1112.

45. 165 FERC ¶ 61,148, para. 2 (2018).

46. 116 FERC ¶ 61,274, para. 1117–18 (2006).

requirements that the local regulatory authority has established.[47] FERC "has held that this bifurcated framework respects the jurisdictional boundaries of the FPA while recognizing the states' historical role in ensuring resource adequacy."[48]

Given the foregoing, local regulatory authorities, like the CPUC and others, in California have traditionally been in charge of planning to ensure that adequate generation is available to meet anticipated future electricity demand.[49] In certain eastern regions, however, RTOs have instituted FERC-jurisdictional centralized, mandatory capacity markets[50] to ensure RA, resulting in removal of state control over RA and, therefore, tensions between RA and state clean energy policies.[51] FERC has "opined on the benefits of specific features of the eastern RTO/ISO centralized capacity markets" but has not found that centralized capacity markets are necessary for a just and reasonable market design.[52]

B. Birth of the CPUC RA Program

As critical as it is to today's reliability paradigm, the CPUC RA program in California did not even exist twenty years ago, and "[u]ntil June 2006, the CAISO market did not require load serving entities to procure sufficient generation capacity to serve their customers."[53] In fact, as described below, RA requirements were developed and implemented in response to the California Energy Crisis of 2000-2001 and have undergone many refinements in the intervening years.[54] Below is a brief history of the origins of the RA program that helps to explain its purpose and the logic behind its existing structure.

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47. *See id.* at para. 1118.
48. 165 FERC ¶ 61,148, para. 70 (2018) (citing 116 FERC ¶ 61,274, para. 1117–18 (2006)).
49. *See* 165 FERC ¶ 61,148, para. 2 (2018).
50. Centralized capacity markets involve periodic capacity auctions run by the RTO in which all load serving entities purchase their capacity requirements at a market clearing price. Shelley Welton, *Rethinking Grid Governance for the Climate Change Era*, 109 CAL. L. REV. 209, 231 (2021). The Commission has not required a centralized capacity market as part of a just and reasonable market design. 165 FERC ¶ 61,148, para. 76 (2018).
51. Shelley Welton, *Rethinking Grid Governance for the Climate Change Era*, 109 CALIF. L. REV. 209, 248 (2021); Alexandra Klass et al., *Grid Reliability Through Clean Energy*, 74 STAN. L. REV. 969, 969 (2022).
52. 165 FERC ¶ 61,148, para. 76 (2018).
53. *See* 116 FERC ¶ 61,274, para. 10 (2006).
54. *Infra* Section II.B.1. and 2.

1. California Energy Crisis of 2000-2001 in a Nutshell

While impossible to fully explore the California Energy Crisis of 2000-2001 in just a few paragraphs, a number of concepts are important to understand in connection with the development of the CPUC's RA program. First, poor regulatory planning in the 1990s contributed to a dysfunctional electricity market in the state by limiting both FERC and CPUC authority to regulate during a time of great volatility in the California energy markets.[55] Between the passage of California Assembly Bill (AB) 1890 (Brulte, 1996), the *Electric Industry Restructuring Act*,[56] in 1996 and the beginning of the California Energy Crisis in 2000, California experienced a great transformation from a traditional, highly State-regulated vertically-integrated utility service structure[57] to a deregulated, competitive structure. Where retail customers were historically served by California's three investor-owned utilities (IOUs), they were now permitted to buy electricity in an open market through direct access from private electric service providers (ESP) and others.[58]

AB 1890 also established two new entities to manage the restructured market: (1) the CAISO, as the FERC-regulated independent, non-profit transmission system operator intended to increase reliability, and (2) the Power Exchange (PX), as the FERC-regulated commodities market through which independent power producers could compete to sell their electricity generation in the spot market in response to bids submitted by buyers.[59]

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55. Kincaid, *supra* note 37, at 672–73; (citing BILL LOCKYER, ATTORNEY GENERAL'S ENERGY WHITE PAPER: A LAW ENFORCEMENT PERSPECTIVE ON THE CALIFORNIA ENERGY CRISIS 6–7 (2004), https://hepg.hks.harvard.edu/files/hepg/files/energywhitepaper.pdf?m=1529615083 [https://perma.cc/4CM3-NJNS]).

56. *See* Assem. Bill 1890, 1996 2nd EX. SESS. CAL. STAT. (codified as amended at CAL. PUB. UTILS. CODE §§ 330–847; §§ 9600–9606).

57. JAMES L. SWEENEY, THE CALIFORNIA ELECTRICITY CRISIS 79 (Hoover Institution Press, 1st ed. 2002). In California's vertically integrated market structure, the three large IOUs owned and operated the generation, distribution, and transmission of the majority of the electrical system. *Id*. at 1.

58. CHRISTOPHER WEARE, THE CALIFORNIA ELECTRICITY CRISIS: CAUSES AND POLICY OPTIONS 12 (2003); In 1995, the CPUC issued a comprehensive decision for electric restructuring, which included the adoption and implementation of a direct access program, Cal. P.U.C, Dec. No. 95-12-063. Under direct access, customers receive distribution and transmission services from the utility, but purchases its electric energy from a private ESP. SWEENY, *supra* note 57, at 72. A utility's bundled customer can choose to become a direct access customer, or vice versa, with the utility currently serving as the provider of last resort, SWEENEY, *supra* note 57, at 72.

59. Kincaid, *supra* note 37, at 683–84. The PX ceased operations in January 2001 and filed for Chapter 11 bankruptcy protections in March 2001 amid the continuing California Energy Crisis. Nancy Rivera Brooks & Nicholas Riccardi, *Power Exchange Marketplace to Close*, L.A. TIMES (Jan. 20, 2001), https://www.latimes.com/archives/la-xpm-2001-jan-20-mn-14822-story.html [https://perma.cc/CGZ4-EQK9]; Nancy Rivera Brooks, *Power Exchange Execs' Pay at Issue*, L.A. TIMES (Oct. 11, 2002), https://www.latimes.com/archives/la-xpm-2002-oct-11-fi-power11-story.html [https://perma.cc/U986-2UUN];

The IOUs were encouraged under AB 1890 to divest of most of their generation assets to these third-party independent power producers, or merchant generators,[60] and forced to rely on the merchant generators for procurement of energy to meet their changing load.[61] While voluntary for all other generators, participation in the PX was mandatory for the IOUs who were required to sell electricity generated by their remaining utility-owned generation into the PX and purchase all electricity to meet demand through the PX.[62]

Essentially, "California restructured its electricity markets in a way that caused almost all electricity to be bought and sold no more than one day ahead of time."[63] Merchant generators were not required to enter into long-term contracts with the selling IOUs to stabilize prices.[64] Instead, generators were permitted to charge anything that the market allowed after receiving FERC certification (contingent on a finding that considered whether a generator controlled 20 percent or less of the market, but not the potential for generators to increase prices during periods of peak demand).[65]

As has been catalogued in many reports and reviews over the intervening years, price spikes in the PX markets ensued as a result of many factors, including "a shortage of generating capacity, bottlenecks in related markets, wholesale generator market power, regulatory missteps, and faulty market design" allowing for market manipulation, ultimately leading to multiple large-scale rolling blackouts.[66]

Voluntary Petition of Debtor, In re California Power Exchange Corp., No. 2:01-BK-16577 (Bankr. C.D. Cal. 2022).

60. Carl Blumstein et al., *The History of Electricity Restructuring in California* 16 (Univ. of Cal. Energy Inst., Working Paper No. 1032002); SWEENEY, *supra* note 57, at 61; WEARE, *supra* note 58, at 10.

61. Kincaid*, supra* note 37, at 683.

62. SWEENEY, *supra* note 57, at 61; Timothy P. Duane, *Regulation's Rationale: Learning from the California Energy Crisis*, 19 YALE J. ON REG. 471, 498–99 (2002).

63. Lee S. Friedman, *The Long and the Short of It: California's Electricity Crisis*, 4 S. CAL. INT. J. PUBLIC POLICY 4, 7 (2009).

64. Blumstein et al*., supra* note 60, at 21.

65. *Id*.

66. *See, e.g.*, James L. Sweeney, *The California Electricity Crisis: Lessons for the Future*, 32 THE BRIDGE 23, 23–31 (2002); WEARE, *supra* note 58, at 15.

2. RA Program to Ensure Reliability

The absence of adequate resources obligated to bid into energy markets via a MOO appeared as a fundamental flaw in the California market design.[67] As part of the solution, the CAISO and the CPUC commenced a market redesign initiative in 2002.[68] As the CPUC worked to create the foundation for an RA program, including procurement of generation by CPUC-jurisdictional LSEs,[69] the CAISO also pursued a market redesign effort at FERC through its regulatory process. This was intended to complement the CPUC's efforts by incorporating new RA provisions applicable to both CPUC-jurisdictional and non-CPUC-jurisdictional LSEs into the CAISO tariff.[70]

California grappled with the creation of RA requirements for years following the California Energy Crisis, ultimately leading to the adoption by the CPUC of an RA program rooted in bilateral procurement and applicable to CPUC-jurisdictional LSEs in a series of decisions beginning in 2004.[71] In D.04-01-050, the CPUC first described the concept of RA and the role of RA procurement obligations as follows:

> Resource procurement traditionally involves the [CPUC] developing appropriate frameworks so that the entities it regulates will provide reliable service at least cost. This involves determining an appropriate demand forecast and then ensuring that the utility either controls, or can reasonably be expected to acquire, the resources necessary to meet that demand, even under stressed conditions such as hot weather [footnote omitted] or unexpected plant outages. 'Resource adequacy' seeks to address these same issues. In developing our policies to guide resource procurement, the Commission is providing a framework to ensure resource adequacy by laying

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67. *Decision 04-01-050, Interim Opinion*, *supra* note 31, at 10–11.

68. *Id*. at 9.

69. 116 FERC ¶ 61,274, at para. 16. "California's three largest investor-owned utilities (IOUs), electric service providers (ESPs) and community choice aggregators (CCAs) are within the CPUC's jurisdiction." *Id.* at n.4.

70. *See id.* at para. 16.

71. The seminal decisions include Decision D.04-01-050, D.04-10-035, and D.05-10-042 as modified by D.06-02-007 and D.06-04-040. *Decision 04-01-050, Interim Opinion*, *supra* note 31; *Decision 04-10-035, Interim Opinion Regarding Resource Adequacy,* Cal. Pub. Utilities Comm'n (Oct. 28, 2004), https://docs.cpuc.ca.gov/PublishedDocs/WORD_PDF/FINAL_DECISION/ 41416.PDF [https://perma.cc/67KE-AXD]; *Decision 05-10-042, Opinion on Resource Adequacy Requirements,* Cal. Pub. Utilities Comm'n (Oct. 27, 2005), https://docs.cpuc.ca.gov/PublishedDocs/WORD_PDF/FINAL_DECISION/50731.PDF [https://perma.cc/NXU2-DUC9]; *Decision 06-02-007, Opinion on Petition of Pacific Gas and Electric Company for Modification of Decision 05-10-042*, Cal. Pub. Utilities Comm'n (Feb. 16, 2006), https://docs.cpuc.ca.gov/PublishedDocs/WORD_PDF/FINAL_DECISION/53749.PDF [https://perma.cc/Z5T5-9NFY]; *Decision 06-04-040, Order Modifying D.04-10-042 and Denying Rehearing of Decision*, As Modified, Cal. Pub. Utilities Comm'n (Apr. 13, 2006), https://docs.cpuc.ca.gov/PublishedDocs/WORD_PDF/FINAL_DECISION/55661.PDF [https://perma.cc/LF5B-DJR3].

> a foundation for the required infrastructure investment and assuring that capacity is available when and where it is needed.[72]

In D.04-10-035, the CPUC adopted requirements for each LSE to acquire "a mix of resources capable of satisfying the number of hours for each month that their loads are within 10% of their maximum contribution to monthly system peak."[73] Thus, the CPUC instituted a peak-load based RA program, requiring that LSEs procure adequate resources to meet their monthly gross peak demands.[74] The logic was presumably that if enough capacity was available during gross peak demand, there would also be enough capacity at all other hours of the day because most resources could run continuously if needed.

In 2005, the California Legislature passed legislation requiring the CPUC, in consultation with the CAISO, to establish RA requirements for all LSEs within the CPUC's jurisdiction to ensure there are enough resources with contractual obligations to provide the CAISO with sufficient resources when needed to prevent the kind of rotating power outages and price spikes that occurred during the unstable period before and during the California Energy Crisis.[75] To accomplish this goal, the Legislature enacted Assembly Bill 380 (codified as Section 380 of the California Public Utilities Code), which requires the CPUC, in cooperation with the CAISO, to adopt a program that requires all CPUC-jurisdictional LSEs, including IOUs, ESPs, and community choice aggregators (CCAs),[76] to "maintain physical generating capacity and electrical demand response adequate to meet its load requirements, including, but not limited to, peak demand and planning and operating reserves."[77] Notably, Section 380 requires the CPUC to "ensure the reliability of electrical service in California while advancing, to the extent possible, the state's goals for clean energy, reducing air pollution, and reducing emissions of greenhouse gases."[78] Thus, a statutory mandate

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72. *Decision 04-01-050, Interim Opinion*, *supra* note 31, at 10.
73. *Decision 04-10-035, Interim Opinion Regarding Resource Adequacy*, *supra* note 71, at 10.
74. *See id*.
75. *See* Assemb. B. 380, 2005 Gen. Assemb., Reg. Sess. (Cal. 2005) (codified as amended at CAL. PUB. UTILS. CODE § 380).
76. "California's three largest investor-owned utilities (IOUs), electric service providers (ESPs) and community choice aggregators (CCAs) are within the CPUC's jurisdiction." 116 FERC ¶ 61,274, at n.14.
77. CAL. PUB. UTIL. CODE § 380.
78. CAL PUB. UTIL. CODE § 380(b).

exists for the RA program to facilitate accelerated decarbonization, if possible.

In D.05-10-042, the Commission reiterated the concept of RA as follows:

> The Commission envisions the resource adequacy program as the means by which the function of reliably matching resources to demand at least cost will be accomplished in the current industry environment. Historically, this function was the responsibility of integrated utilities that provided bundled service to retail customers, and the regulatory compact provided clear standards for utility accountability along with the opportunity for the utility's investors to earn a reasonable return on the investment they devoted to public service. Procurement and reliability responsibilities that were once the IOUs' are now diffused among various industry participants and oversight agencies, and both accountability mechanisms and the opportunities for investment returns are less well defined. Through RAR, the Commission is taking steps to (1) identify and assign these responsibilities in a manner that is effective in achieving reliability, cost-efficient, and fair for all stakeholders; and (2) foster an environment that is more conducive to investment.[79]

For many years now, the CPUC and the CAISO have worked to achieve the RA mandate through the CPUC RA program first implemented by the CPUC in 2006 and refined through the regulatory process.[80] The existing RA program is described in detail below in Part III. The CAISO's market redesign-related RA tariff provisions were also approved by FERC in 2006 and modified over the years to create the existing CAISO RA requirements.[81] These tariff provisions "respect[] the resource adequacy requirements established by the states or Local Regulatory Authorities, with provisions to allow the CAISO to procure additional capacity to meet forecasted needs."[82] Notably, a federally-regulated centralized capacity market was not implemented in California, as "a bilateral procurement framework overseen by state and local authorities is better suited to accommodate" procurement of "resources with specific attributes to maintain reliability in a transforming grid and to comply with state law dictating the generation mix."[83]

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79. *Decision 05-10-042, Opinion on Resource Adequacy Requirements*, *supra* note 71, at 7.

80. *See* CAL. PUB. UTILITIES COMM'N, RESOURCE ADEQUACY HOMEPAGE, https://www.cpuc.ca.gov/industries-and-topics/electrical-energy/electric-power-procurement/resource-adequacy-homepage [https://perma.cc/E4GU-VFKY].

81. *See* 116 FERC ¶ 61,274; *Cal. Indep. Sys. Operator Corp.*, Fifth Replacement Electronic Tariff § 40.6.6.

82. *See* 116 FERC ¶ 61,274, at para. 1.

83. *See* CXA La Paloma, LLC v. Cal. Indep. Sys. Operator Corp., 165 FERC ¶ 61,148, at para. 32 (2018).

III. CALIFORNIA'S EXISTING "PEAK LOAD" RA PROGRAM

As explained above, "the CAISO and local regulatory authorities within its balancing authority area, chiefly the California Public Utilities Commission (CPUC), are jointly responsible for ensuring resource adequacy [in California] through a variety of CPUC-administered programs and under the CAISO tariff."[84] "The primary RA procurement mechanism [in California] is the CPUC Resource Adequacy Program,"[85] which is currently based on meeting the electric system's gross peak demand for a given month of the year, plus a planning reserve margin (PRM).[86] These gross peaks are converted into monthly capacity procurement obligations for individual CPUC-jurisdictional LSEs to meet.[87] The RA program requires LSEs to "procure capacity in three distinct categories:[88] system capacity requirements (effective June 1, 2006),[89] local capacity requirements (effective January 1, 2007),[90] and flexible capacity requirements (effective January 1, 2015)."[91] Below is a brief overview of the main concepts related to the highly complex existing CPUC RA program, which is necessary to understand the need for a reformed structure.

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84. *Id*. at para. 2.
85. *Id*.
86. *See* CPUC 2021 Resource Adequacy Report, March 2023, at 16, https://www.cpuc.ca.gov/-/media/cpuc-website/divisions/energy-division/documents/resource-adequacy-homepage/2021_ra_report.pdf [https://perma.cc/5A2A-3EFU].
87. *See id*.
88. *Id*.
89. *Id*.
90. *Decision 06-06-064, Opinion on Local Resource Adequacy Requirements*, Cal. Pub. Utilities Comm'n (June 29, 2006), https://docs.cpuc.ca.gov/PublishedDocs/WORD_PDF/FINAL_DECISION/57644.PDF [https://perma.cc/6UQ8-G9BH]. As of the 2023 compliance year, all local capacity procurement obligations are reserved to the central procurement entity in PG&E and Southern California Edison Company's distribution service areas. *Decision on Central Procurement of the Resource Adequacy Program*, Cal. P.U.C. Dec. No. 20-06-002, at 3 (June 11, 2020). In SDG&E's service area, local RA requirements are still allocated to Commission-jurisdictional LSEs and each LSE must procure sufficient RA capacity resources in each local area to meet its obligations. *See id*. at 2, 35. For simplicity, this Article does not describe CPE-related local capacity procurement or compliance obligations.
91. *Decision 14-06-050, Decision Adopting Local Procurement and Flexible Capacity Obligations for 2015, and Further Refining the Resource Adequacy Program*, Cal. Pub. Utilities Comm'n, at para. 7 (June 26, 2014), https://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M097/K619/97619935.PDF [https://perma.cc/L7EW-JFRK].

A. System, Local, and Flexible RA Procurement Obligations

Year-ahead system capacity procurement obligations are determined based on each LSE's CEC-adjusted monthly load forecast, plus a PRM.[92] This results in a single procurement obligation for each LSE each month.[93] The PRM "is a critical element of the [CPUC] RA program."[94] It is described in D.04-01-050 as follows: "[p]lanning reserves involve a longer-term perspective of ensuring that in real-time there will be sufficient energy to meet peak demand plus needed operating reserves."[95] The PRM in the existing RA program was finalized in 2004 at 15% to account for 6% contingency reserves needed by the grid operator, with the remaining 9% intended "to account for plant outages and higher-than-average-demand."[96] In 2022, the CPUC recognized that the 15% PRM placed reliability at risk and, therefore, increased the PRM for 2023 to 16% and for 2024 to the minimum of 17% with a larger increase possible.[97]

The CPUC also establishes multi-year local capacity procurement obligations intended to ensure reliable service to load located within import-constrained load pockets based on an annual CAISO study.[98] Local capacity procurement obligations are enforced on a three-year-forward basis (i.e., local capacity must be procured in year 0 for each of year 1, year 2, and year 3).[99]

Annual flexible capacity procurement obligations are based "on an annual CAISO study that assesses the largest three-hour ramp needs for each month needed to run the system reliably to meet the imbalance

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92. 165 F.E.R.C. ¶ 61,148, at para. 2. The forecast used in the RA program is based on the single forecast set developed by the CEC.

93. *See* SASHA COLE ET. AL., 2021 RESOURCE ADEQUACY REPORT, CAL. PUB. UTILITIES COMM'N, 18 (Mar. 2023), https://www.cpuc.ca.gov/-/media/cpuc-website/divisions/energy-division/documents/resource-adequacy-homepage/2021_ra_report.pdf [https://perma.cc/DF8G-CHY8].

94. Elliott J. Nethercutt & Chris Devon, *The Intersection of Decarbonization Policy Goals and Resource Adequacy Needs: A California Case Study*, NRRI INSIGHTS 1, 11 (Mar. 2021).

95. Note that the CPUC uses two different PRM measures for the IRP process and the RA process (this Article focuses only on the RA PRM). *Interim Opinion*, Cal. P.U.C. Dec. No. 04-01-050, at 21 (Jan. 22, 2004).

96. FINAL ROOT CAUSE ANALYSIS, *supra* note 3, at 11, 13; Nethercutt & Devon, *supra* note 94, at n.2.

97. *Decision 22-06-050, Decision Adopting Local Capacity Obligations for 2023-2025, supra* note 33, at 22.

98. *Decision 06-06-064, Opinion on Local Resource Adequacy Requirements,* Cal. Pub. Utilities Comm'n, *supra* note 90, at 2.

99. *Decision 19-02-022, Order Instituting Rulemaking to Oversee the Resource Adequacy Program, Consider Program Refinements, and Establish Annual Local and Flexible Procurement Obligations for the 2019 and 2020 Compliance Years,* Cal. Pub. Utilities Comm'n, at 22, 27 (Feb. 21, 2019), https://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M270/K469/270469481.PDF [https://perma.cc/2875-PMGF].

between CAISO's peak energy demand and renewable energy production."[100] These obligations are intended to ensure that LSEs have "procured enough capacity to meet demand in the crucial early evening hours when solar resources are no longer available."[101]

B. Qualifying Capacity Methodologies

The CPUC's rules for valuing capacity are essential because they determine how much credit an LSE will receive toward its capacity procurement obligations for a given resource.[102] Given the structure of the existing RA program, a resource's current valuation is based upon its contribution to meeting gross peak reliability needs.[103] The process of determining the value of capacity begins with calculating its qualifying capacity (QC) under the CPUC's rules.[104]

As one can imagine, not all resources are valued the same under the CPUC's adopted QC valuation methodologies, which vary by technology type and dispatchability status (i.e., whether they can be turned on and off, or controlled, by operators as needed).[105] Most relevant to this Article, wind and solar facilities receive QC values under the existing RA program based on a methodology known as "effective load carrying capability" (ELCC).[106] While highly technical, ELCC essentially determines the facility's "ability to produce energy when the grid is most likely to experience

100. 165 FERC ¶ 61,148, ¶ 2 (2018).

101. CAISO, *Resource Adequacy: the need for sufficient energy supplies* (2021), https://www.caiso.com/Documents/Resource-Adequacy-Fact-Sheet.pdf [https://perma.cc/6SX5-AFSA].

102. *Decision 04-10-035, Interim Opinion Regarding Resource Adequacy*, *supra* note 71, at 21–22.

103. *See generally* CPUC, 2020 Qualifying Capacity Methodology Manual (Nov. 2020), https://www.cpuc.ca.gov/-/media/cpuc-website/files/legacyfiles/q/6442466773-qc-manual-2020.pdf [https://perma.cc/FF9R-8BY5].

104. *Decision 04-10-035*, *Interim Opinion Regarding Resource Adequacy*, *supra* note 71, at 21–22.

105. *See generally* CPUC, *supra* note 103, at 4–5.

106. *Decision 17-06-027, Decision Adopting Local and Flexible Capacity Obligations for 2018 and Refining the Resource Adequacy Program*, Cal. Pub. Utilities Comm'n (June 29, 2017), https://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M192/K027/192027253.PDF [https://perma.cc/HS83-LYJB], as modified by *Decision 19-06-026, Decision Adopting Local Capacity Obligations for 2020-2022, Adopting Flexible Capacity Obligations for 2020, and Refining the Resource Adequacy Program*, Cal. Pub. Utilities Comm'n (June 27, 2019), https://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M309/K463/309463502.PDF [https://perma.cc/47TU-FXRM].

supply shortfalls" resulting in a potential loss of load event, as compared to a hypothetical "perfect" generator that is able to produce at all times.[107] Valuing wind and solar facilities through the ELCC methodology is meant to represent their ability to help prevent rotating power outages and, therefore, how much they should count toward an LSE's procurement obligations related to RA.[108] Currently, ELCC is expressed as a percentage of the facility's capacity and is calculated based on what is referred to as a loss of load expectation (LOLE) study.[109] Monthly ELCC values are determined for wind and solar using this methodology, resulting in technology factors that are then applied to the resources' nameplate values.[110] There is a single value determined for each solar and wind resource each month based on the ELCC calculation.[111]

Once QC values have been calculated, the CAISO runs a deliverability study on those values to determine the net qualifying capacity (NQC) of the resources.[112] The NQC value is the actual value an LSE can rely on for each resource in meeting its RA capacity procurement obligations for the coming compliance year.[113]

C. Must Offer Obligation

Capacity procured under the resource adequacy program carries an obligation to bid into the CAISO markets (i.e., it has a MOO).[114]

D. Maximum Cumulative Capacity Buckets

In developing the system RA program, the CPUC also adopted a requirement for procurement percentage limits for various resource categories (or "buckets") that indicate the maximum amount of capacity LSEs can rely

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107. Mark Specht, *ELCC Explained: The Critical Renewable Energy Concept You've Never Heard Of*, THE EQUATION (Oct. 12, 2020, 5:25 PM), https://blog.ucsusa.org/mark-specht/elcc-explained-the-critical-renewable-energy-concept-youve-never-heard-of/ [https://perma.cc/X7LE-BYCE].

108. *Id*.

109. *Decision 17-06-027, supra* note 106, at 19; CPUC, *supra* note 103, at 13.

110. *Id*. at 13–14.

111. CPUC, 2020 Qualifying Capacity Methodology Manual, at 13-14 (Nov. 2020), https://www.cpuc.ca.gov/-/media/cpuc-website/files/legacyfiles/q/6442466773-qc-manual-2020.pdf [https://perma.cc/FF9R-8BY5].

112. *Id*. at 4, 7–8.

113. *Id*. at 4.

114. *Decision 22-06-050, Decision Adopting Local Capacity Obligations for 2023-2025*, *supra* note 33, at 13; *Cal. Indep. Sys. Operator Corp.* 162 FERC ¶ 61,042, at ¶ 3 (2018). Resource adequacy resources must offer into the CAISO's markets in hours for which they were procured. Resources that do not offer into the CAISO's markets and are not on outage will have a generated bid submitted on their behalf. *Id*. at n.4.

on from each bucket.[115] In accordance with the CPUC's directive, its energy division staff initially created four resource buckets based on hours of contractual availability, and instituted "procurement caps in the form of maximum percentage limits on resources procured that fall within each bucket."[116] These caps on procurement, known as the maximum cumulative capacity (MCC) buckets, were intended to ensure LSEs would not meet their peak load "RA obligations by procuring a large number of resources that were either contractually or operationally limited" and, therefore, not available to meet load outside of peak demand.[117]

Over the years, the CPUC has settled on five buckets of resources based on the minimum number of hours resources are available during the summer months.[118] Each bucket includes resources that are available during the periods specified in the chart below. "The maximum percentages of an LSE's procurement obligation that can be met with use limited resources or contracts that provide less than 24 X 7 hours of availability per week in each month are currently established utilizing updated 2016-2018 load duration curves."[119] The MCC for each of the buckets was most recently updated in D.22-06-050, as follows:

115. The CPUC initially adopted this construct in D.05-10-042. *Decision 05-10-042*, *Opinion on Resource Adequacy Requirements*, *supra* note 71, at 44 ("Mirant/WCP advocate a maximum cumulative contribution of specified resource categories with physical and contractual availability limitations to alleviate over-reliance on resources that could not be counted on to serve a large portion of a month outside of the peak period"); *id.* at 51 ("We adopt the alternative version of the TD method suggested by Mirant/WCP.").

116. *Decision 12-06-025, Decision Adopting Local Requirement Obligations for 2013 and Further Refining the Resource Adequacy Program*, Cal. Pub. Utilities Comm'n, at 13 (June 21, 2012), https://docs.cpuc.ca.gov/PublishedDocs/WORD_PDF/FINAL_DECISION/169718.PDF [https://perma.cc/Y4VU-2QUQ].

117. *Id*. at 13–14.

118. Decision 11-10-003 added a bucket for demand response that was not included in the original bucket construct. *Decision 11-10-003, Decision Further Refining the Resource Adequacy Program Regarding Demand Response Resources*, Cal. Pub. Utilities Comm'n, at 34 (Oct. 6, 2011), https://docs.cpuc.ca.gov/PublishedDocs/WORD_PDF/FINAL_DECISION/145022.PDF [https://perma.cc/PRQ7-MHAD].

119. *Decision 20-06-031, Decision Adopting Local Capacity Obligations for 2021-2023 Adopting Flexible Capacity Obligations for 2021, and Refining the Resource Adequacy Program*, Cal. Pub. Utilities Comm'n, at 49-50, 86, 88-90, 96 (June 25, 2020), https://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M342/K083/342083913.PDF [https://perma.cc/U4SZ-6TR2].

TABLE 1. REVISED MCC BUCKETS[120]

Category	Availability	Maximum Cumulative Capacity for Bucket and Buckets Above
DR	Varies by contract or tariff provisions, but must be available Monday – Saturday, 4 consecutive hours between 4 PM and 9 PM, and at least 24 hours per month from May – September.	8.3%
1	Monday – Saturday, at least 100 hours per month. For the month of February, total availability is at least 96 hours. January - February, May - December, 4 consecutive hours between 4 PM - 9 PM. March - April, 4 consecutive hours between 5 PM – 10 PM.	17.0%
2	Every Monday – Saturday. January - February, May - December, 8 consecutive hours that include 4 PM – 9 PM. March-April, 8 consecutive hours that include 5 PM – 10 PM.	24.9%
3	Every Monday – Saturday. January-February, May - December, 16 consecutive hours that include 4 PM – 9 PM. March-April, 16 consecutive hours that include 5 PM – 10 PM.	34.8%
4	Every day of the month. Dispatchable resources must be available all 24 hours.	100% (at least 56.1% available all 24 hours)

E. Mechanism for Procurement

"Because there is no centralized capacity market [in California], load serving entities must meet their RA requirements through a combination of owned resources and bilateral contracting."[121]

IV. THE NEED FOR RA REFORM

Even before California's August 2020 rotating outages, the CPUC recognized that a re-examination of California's almost-fifteen-year-old RA capacity structure was necessary.[122] By 2019, it had become clear that

120. *Decision 22-06-050, Decision Adopting Local Capacity Obligations for 2023-2025*, *supra* note 33, at 124–25.

121. 165 FERC ¶ 61,148, at ¶ 2 (2018).

122. *Rulemaking 19-11-009, Order Instituting Rulemaking to Oversee the Resource Adequacy Program, Consider Program Refinements, and Establish Forward Resource Adequacy Procurement Obligations*, Cal. Pub. Utilities Comm'n, at 7 (Nov. 13, 2019), https://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M319/K527/319527428.PDF [https://perma.cc/MX9S-SZS8].

the State was at risk of not having sufficient capacity to meet energy requirements across all hours in the coming years, in part due to the great progress being made in meeting decarbonization goals and the existing RA program's struggle to address resource mix issues.[123] The trends described below provided ample support for an update of California's RA program to incorporate energy sufficiency considerations explicitly.

A. What Changed?

When California's RA program was first developed in 2004 and implemented in 2006, most generation resources were available to operate around-the-clock.[124] Limited renewable resources had come online, and very few resources had physical constraints due to use limitations.[125] In addition, California's three largest IOUs, which served a vast majority of California customers, secured a significant number of long-term tolling arrangements with natural gas-fired generators to mitigate risks.[126] These circumstances supported creation of an RA framework structured to meet system peak load and MCC constraints, since meeting gross energy demand throughout the remainder of the days of a month would be guaranteed if enough continuously-available capacity was secured to meet monthly gross peak demand.

However, in opening a new RA proceeding in November 2019 (R.19-11-009), the CPUC stated that "given the rapid changes occurring in California's energy markets, it may be necessary to re-examine the structure and processes of the Commission's RA program."[127] By then, the CPUC was keenly aware that the RA landscape in California had changed dramatically over the previous fifteen years.[128] For example, the number of LSEs serving load across the state had ballooned well beyond the three

123. In November 2019, the CPUC addressed the potential for electricity system RA shortages beginning in 2021 by issuing D.19-11-016. In this decision, the CPUC recognized the tightening of supply on the system and the need for additional capacity to meet near-term reliability needs. D.19-11-016 ordered 3,300 megawatt (MW) of additional RA capacity to be procured by all LSEs and recommended the extension of operating permission for gas fired generation units that utilize once through cooling technologies to serve as a bridge to meeting the reliability needs from 2021–2023.

124. *See Decision 21-07-014*, *supra* note 22, at 6–7.

125. *Id.* at 6–7.

126. *Id*. at 5–6.

127. *Order Instituting Rulemaking* (Nov. 7, 2019), Cal P.U.C. R. 19-11-009, at 5.

128. *Decision 21-07-014*, *supra* note 22, at 6.

large IOUs, adding a significant management challenge to the RA program.[129] Expanded retail choice led to a decline in IOU customers and an increase in uncertainty about future customer load migration between LSEs. Altogether, this load uncertainty, combined with signals from policymakers of a shift away from reliance on natural gas-fired generation, "green" power competition, and the CEC's power content label requirements,[130] led to a significant decline in the multi-year tolling arrangements that previously ensured electrons would flow at least-cost.[131] Instead, short-term RA-only capacity contracts between LSEs and generators grew prevalent.[132]

In addition, California's implementation of broader greenhouse gas emission and clean energy goals resulted in variable, fuel-limited resources (e.g., renewables like solar and wind) and use-limited resources (e.g., storage and demand response) constituting the grand majority of new resources coming online from the mid-2010s onward.[133] With the increased reliance on preferred and use-limited resources for generating GHG-free electricity, the electric resource mix in California changed dramatically.[134] This change called into question whether the current RA program's expectation that all resources are available to produce in all hours of the month is still reasonable.

In recent years, the variable delivery and non-dispatchability of renewables, coupled with the current focus of RA on the gross peak demand period resulted in increasing levels of energy storage intended to shift excess energy production in a manner not possible at the inception of the existing RA program.[135] Although energy storage resources have significant operational limitations because they are almost universally sized to serve four-hour load,[136] the resources were paradoxically valued in the existing RA paradigm similar to dependable natural gas-fired resources in that their charging needs were not appropriately considered in the paradigm.[137] As energy

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129. By 2021, approximately 38 CPUC-jurisdictional LSEs had committed to serving load, including the 3 IOUs, 25 CCAs, and 10 ESPs. *Id*.

130. The CEC's power content label requirements dictate that LSEs report emissions from tolling agreements on their power content label. *Id*.

131. *Id*.

132. *Id*.

133. *Id*. Between 2015 and 2019, solar generation in California increased by 84% and wind generation increased by 12%. *A Peek at Net Peak*, CAL. ENERGY COMM'N (May 2021), https://www.energy.ca.gov/data-reports/energy-insights/peek-net-peak [https://perma.cc/7CQN-THS6].

134. *Decision 21-07-014*, *supra* note 22, at 6–7.

135. *See id*.

136. *Decision 21-07-014*, *supra* note 22, at 7.

137. *Decision 14-06-050, Decision Adopting Local Procurement and Flexible Capacity Obligations for 2015, and Further Refining the Resource Adequacy Program*, *supra* note 91, at app. B.

storage resources became more prevalent, it became clear that charging would almost certainly present new challenges in previously stable periods without RA program rules in place to ensure energy sufficiency for charging.

While great swaths of new variable and use-limited resources came online beginning in the mid-2010s, another great transition took place throughout the West: older natural gas facilities began retiring.[138] As a result, overall capacity that can be used to meet existing RA procurement obligations during peak hours declined and created an increased opportunity for energy price spikes and risk to grid reliability.[139]

Moreover, in the CPUC's 2019 integrated resource plan (IRP) proceeding, the CAISO presented a stack analysis showing that peak hour would shift from hour ending 17 (i.e., 5pm) to hour ending 18 (i.e., 6pm) in 2022, with significant need extending into hour ending 19 (i.e., 7pm).[140] It quickly became clear that the single most critical period of peak demand was giving way to multiple critical periods during the day, including the "net peak" demand period.[141] As such, the logic that having enough capacity to meet monthly gross peak demand with continuously available resources would ensure sufficient capacity to meet the gross energy demand in any other period was crumbling. The perils of all of these trends became much more apparent during the hot August nights in 2020, underscoring the need for reliability based on the system's ability to meet both net peak and gross peak demand.[142]

Given the challenges of an even more fuel-limited and use-limited resource portfolio, the MCC bucket construct also began to become increasingly important in recent years, even as cracks in the structure surfaced. The CPUC recognized that the MCC buckets did not account for energy storage charging

138. *Id*.
139. *Id*.
140. *See Rulemaking 16-02-007, Reply Comments of the California Independent System Operator Corporation*, Cal. Indep. Sys. Operator Corp., at 10–11 (Aug. 12, 2019), https://docs.cpuc.ca.gov/PublishedDocs/Efile/G000/M311/K582/311582922.PDF [https://perma.cc/H463-YFN3]. The IRP loss of load studies also show that loss of load events could occur as late as hour ending 23 by 2030. Modeling Advisory Group Webinar, Energy Division*, Reliability Filing Requirements for Load Serving Entities' 2022 Integrated Resource Plans – Results of PRM and ELCC Studies*, CAL. PUB. UTILITIES COMM'N. 71 (July 19, 2022), https://www.cpuc.ca.gov/-/media/cpuc-website/divisions/energy-division/documents/integrated-resource-plan-and-long-term-procurement-plan-irp-ltpp/2022-irp-cycle-events-and-materials/20220719-fr-and-reliability-mag-slides.pdf [https://perma.cc/CMH2-9LBU].
141. FINAL ROOT CAUSE ANALYSIS, *supra* note 3, at 47.
142. *Decision 21-07-014*, *supra* note 22, at 7.

needs and that a better framework to manage reliance on use-limited resources to meet reliability needs was necessary.[143] While the peak-load focused construct, coupled with the MCC buckets, was adequate for a system dominated by thermal, nuclear, hydroelectric, and other conventional generation, the increasingly decarbonized, highly renewable-dense electric system characterized by all the changes described above demanded reformation. The RA program had to evolve to address demand in all hours of the day.

B. A Closer Look at the Tension Between Reliability and Decarbonization and Why Increased Renewable and Energy Storage Penetration Contributes to the Need for a Reformed RA Framework in California

For over 150 years, since electricity was first transmitted along the electric grid, power markets have generally operated with the understanding that "electricity cannot be stored," with very few exceptions.[144] This is because electrons travel along the least resistant path and cannot be routed to a particular grid area.[145]As a result, avoidance of widespread blackouts, brownouts, and other grid failures requires that the electric supply must be constantly balanced with demand.[146] This becomes increasingly difficult in the face of natural disasters exacerbated by climate change and increasing load demand.[147] The August 2020 rotating power outages in California are an acutely painful example of supply shortages, partly caused by increasing load demand following unprecedented weather events tied to climate change.[148]

Balancing electric supply and demand has also become more difficult in light of the clean energy transition taking place globally, with California as a leader.[149] For years, renewable generating capacity has been coming online in California in large part due to policies promoting renewable energy.[150]

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143. *Id*. at 27.

144. Thomas Kagerer, *FERC Order 841 & Energy Storage Resources*, 51 TEX. ENVT'L. L.J. 285, 285–86 (2021) (citing Fed. Energy Regulatory Comm'n v. Elec. Power Supply Ass'n, 136 S. Ct. 760, 768 (2016) (describing the functions of interstate energy markets)); David Schmitt & Glenn M. Sanford, *Energy Storage: Can We Get It Right?*, 39 ENERGY L.J. 447, 452 (2018) (explaining the history of energy storage technology).

145. *Id*. at 286.

146. *Id*.

147. *Id*.

148. *Id*.

149. Amy L. Stein, *Reconsidering Regulatory Uncertainty: Making a Case for Energy Storage*, 41 FLA. ST. U.L. REV. 697, 756 (2014).

150. *See generally* CAL. ENERGY COMM'N, *2021 SB 100 Joint Agency Report: Achieving 100 Percent Clean Electricity in California: An Initial Assessment* (Mar. 15, 2021), https://www.energy.ca.gov/news/2021-03/california-releases-report-charting-path-100-percent-clean-electricity [https://perma.cc/S9GJ-CW3U].

Renewable generating facilities are intermittent resources that produce energy only in proportion to the power of the sun or wind, regardless of demand.[151] Generation of renewable energy cannot be manipulated to meet demand, so grid operators must learn to cope with the "variability" that intermittent renewables create.[152]

Due to the limitations associated with renewable generation, the need arises for continued operation of "base-load" generators (i.e., "large and expensive power plants always operating at near 100% capacity") and "peaker plants" (i.e., "generators only operating during peak hours"), many of which are fueled by high-carbon fuels.[153] Reliance on such facilities is discouraged by state initiatives to promote the adoption of clean technologies, such as California's renewables portfolio standard.[154] Thus, a clear tension exists between decarbonization to meet state goals on the one hand and certainty of grid reliability on the other. Therefore, configuring an RA program that supports LSE procurement of capacity from low-carbon and zero-carbon resources is essential.

As noted previously, the existing RA program

> Was developed to meet peak demand, which until recently has been the most challenging and expensive moment to meet demand. The principle was that if enough capacity was available during peak demand, there would be enough capacity at all other hours of the day as well since most resources could run 24/7 if needed. With the increase of fuel-limited resources such as solar generation in recent years, however, this is no longer the case. Today, the single critical period of peak demand is giving way to multiple critical periods during the day, including the net peak demand, which is the peak of load net of solar and wind generation resources.[155]

As behind-the-meter and in-front-of-the-meter solar generation declines, demand fails to decrease at the same rate because air conditioning and other load previously being served by solar returns to the bulk electric power system.[156] Thus, a higher risk of shortages occurs when the net demand

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151. Kagerer, *supra* note 144, at 286.
152. *Id*.
153. *Id*.
154. S.B. 1038 (Sher, ch. 515), 2002 Leg. (Cal. 2002); S.B. 1078 (Sher, ch. 516), 2002 Leg. (Cal. 2002); S.B. 1250 (Perata, ch. 512), 2006 Leg. (Cal. 2006); S.B. 107 (Simitian, ch. 464), 2006 Leg., (Cal. 2006); S.B. X1-2 (Simitian, ch. 1), 2011 Leg., 1st Extraordinary Sess., (Cal. 2011); S.B. 350 (De León, ch. 547), 2015 Leg., (Cal. 2015); S.B. 1393 (De León, ch. 677), 2016 Leg. (Cal. 2016).
155. FINAL ROOT CAUSE ANALYSIS, *supra* note 3, at 43.
156. *Id*. at 43–44.

reaches its peak, and the RA program must address this issue in order to help usher out high-carbon resources while maintaining reliability.

The RA program has tried to adjust for this change in resource mix and timing by simulating each hour of the day, not just peak, and identifying the LOLE, which is affected by the type and quantity of resources on the grid.[157] As explained above, the QC value of wind and solar generation is determined based on the current ELCC methodology, which reflects the ability of "generators to provide value at times when there is risk of loss of firm load."[158] Given that critical risk hours now include later evening times, it would seem that RA value for wind and solar resources should reflect a changing availability; however, the current ELCC values have been established as static NQC values by the CAISO.[159] This means that solar is typically under-valued during the gross peak demand period in the late afternoon but over-valued later in the evening after sunset during the net peak demand period.[160]

The emergence of energy storage resources has begun to help alleviate some of these issues by providing a pathway to convert oversupply of renewables into potential energy for later use.[161] While still in the early stages,[162] energy storage may provide one key to a reliable, sustainable, and efficient electric grid that can better meet demand at all hours of the day and seamlessly integrate renewables.[163] For example, energy storage can address the variable generation problem by "energy shifting," or storing excess renewable energy and then dispatching it during net peak hours.[164] However, growth of energy storage also presents a unique RA planning challenge, as it requires assurance that (i) sufficient energy will be available to charge the increasing energy storage resources and (ii) such energy storage resources will operate in a manner that contributes to meeting reliability requirements.[165]

For these reasons, increased renewable and energy storage penetration on the grid uniquely contributes to the need for a reformed RA framework in California. Recognizing this, the CPUC and stakeholders worked to identify changes that will ensure appropriate low carbon resources are

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157. *Id*. at 44.
158. *Id*.
159. *Id*.
160. *See id*.
161. *Id*.
162. During the mid-August 2020 rotating power outages, there were only approximately 200 MW of RA battery storage resources in the CAISO market. FINAL ROOT CAUSE ANALYSIS, *supra* note 3, at 6.
163. Kagerer, *supra* note 144, at 287.
164. *Id*.
165. *See Decision 21-07-014*, *supra* note 22, at 12.

available to meet loads when availability limits prevent other resources, like solar, from operating.[166]

V. THE FUTURE OF CALIFORNIA RA: SLICE OF DAY

The increase in use-limited resources, the greater reliance on preferred resources, the rolling off of a significant amount of long-term tolling contracts held by utilities, and material increases in energy and capacity prices experienced in California beginning in the mid-2010s certainly caught the CPUC's attention.[167] By January of 2020, the CPUC had scoped into R.19-11-009 an examination of potential modifications to the broader RA structure to address energy attributes or hourly capacity requirements.[168] The goal of this exercise was to ensure that the RA program would be able to meet reliability mandates even as California continues its quest to decarbonize.[169] Subsequently, the August 2020 rotating power outages resulted in near consensus from many parties participating in the regulatory process that the RA program was "barely working" and required serious reformation.[170] A robust stakeholder process ensued, and in July of 2021,[171] the CPUC announced the key principles and concerns guiding its decisions on the future of RA in California, which ultimately resulted in adoption of the new 24-hour slice-of-day framework discussed in detail below.[172]

A. Key Principles and Concerns

In D.21-07-014, the CPUC established five key principles that encompass concerns with the current RA framework and the objectives of the RA program.[173] The principles are as follows:

166. *Infra* Section V (describing the work done by the CPUC and stakeholders to identify changes to the RA program).
167. *See Rulemaking 19-11-009, Assigned Commissioner's Scoping Memo and Ruling*, Cal. Pub. Utilities Comm'n, at 7 (Jan. 22, 2020).
168. *Id*.
169. *See Decision 21-07-014*, *supra* note 22, at 7.
170. GRIDWORKS, RESOURCE ADEQUACY RELIABILITY THROUGH THE CLEAN ENERGY TRANSITION 1 (2021), https://gridworks.org/wp-content/uploads/2021/03/Resource_Adequacy_Reliability_through_Transition.pdf [https://perma.cc/EUE5-C59Z].
171. *Decision 21-07-014*, *supra* note 22, at 25.
172. *Id*. at 12.
173. *Id*. at 25–26.

> **Principle 1**: To balance ensuring a reliable electrical grid with minimizing costs to customers.
>
> **Principle 2**: To balance addressing hourly energy sufficiency for reliable operations with advancing California's environmental goals.
>
> **Principle 3**: To balance granularity and precision in meeting hourly RA needs with a reasonable level of simplicity and transactability.
>
> **Principle 4**: To be implementable in the near-term (e.g., 2024).
>
> **Principle 5**: To be durable and adaptable to a changing electric grid.[174]

In tandem, the CPUC also summarized its five major concerns with the existing RA program.[175] First, the CPUC explained that

> under the existing RA construct, the value of an RA resource does not necessarily align with that resource's energy bidding behavior, which could lead to additional reliability costs to ratepayers . . . . The RA program assumes that the CAISO markets are competitive and that LSEs are incented to hedge competitively for their customer load.[176]

However, retail choice and load uncertainty have resulted in a decline in IOU-held tolling contracts, potentially increasing costs to customers.[177] "In addition, the tightening of supply in the West and the lack of adequate market power mitigation measures in the CAISO market led to instances where energy did not flow, or curtailment of demand did not occur, when needed, which increased costs to customers."[178] Particularly given the August 2020 CAISO-ordered rotating outages and the reliance on import energy to serve California's load, the CPUC found it "critical that a future framework include a component that links RA to a resource's energy bidding behavior so as to increase the cost-effectiveness of RA."[179]

Second, the CPUC recognized that the current RA MCC bucket construct does not account for energy storage charging needs and is non-binding on LSEs.[180] "With the growing penetration of renewable resources, the Commission [determined that] a framework that can better manage reliance on use-limited resources to meet reliability needs" was necessary.[181] The CPUC expressed concern that "the current RA framework considers the monthly gross peak load but may not address other hours of the day when load may still be high. and variable resources provide little or no value."[182] Instead, the CPUC wanted to create a "framework that can ensure grid

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174. *Id*. at 26.
175. *See id*. at 26–28.
176. *Id*. at 26.
177. *Id*.
178. *Id*. at 27.
179. *Id*.
180. *Id*.
181. *Id*.
182. *Id*.

reliability based on the system's ability to meet net peak demand *and* gross peak demand" (emphasis added).[183]

Third, the CPUC stated that the current RA program compliance demonstration was more complex than desirable.[184] It sought a framework that "appropriately balances the granularity of meeting hourly RA needs with a reasonable level of simplicity and transactability to minimize the complexity of the RA program."[185]

Fourth, the CPUC sought to "adopt a new framework in 2022 to begin implementation in 2023 for the 2024 RA compliance year."[186]

Fifth, the Commission sought "a future RA framework that may be durable and adaptable to a changing electric grid."[187]

B. The Original Slice-of-Day Concept

Ultimately, the CPUC determined in 2021 that an overarching framework proposed by PG&E, referred to as "slice-of-day," best addressed the five identified principles and concerns with the current RA framework, as compared to numerous other proposals offered in the RA proceeding.[188] PG&E's "slice-of-day" framework sought "to ensure load would be met in all hours of the day, not just during gross peak demand hours."[189] It established "RA requirements for multiple slices-of-day across seasons and . . . a counting methodology to reflect an individual resource's ability to produce energy during each respective slice."[190] The CPUC opined that PG&E's proposal "best address[ed] the increased penetration of renewable resources by raising reliability needs on a more granular level than the other restructuring proposals."[191] The proposal also sought "to ensure there is sufficient energy on the system to charge energy storage resources."[192] D.21-07-014 stated that, with further development, PG&E's slice-of-day proposal was best positioned to be implemented for the 2024 RA compliance

183. *Id*.
184. *See id*. at 28.
185. *Id*.
186. *Id*.
187. *Id*.
188. *Id*. at 38.
189. *Id*. at 12.
190. *Id*.
191. *Id*. at 37.
192. *Id*. at 12.

year.[193] Parties were directed to undertake a minimum of five workshops to develop implementation details for a final restructuring proposal based on PG&E's slice-of-day proposal.[194] The CPUC also stated that a final proposal should "consider compatibility with existing [CPUC] planning goals and programs, such as the Integrated Resource Plan and Renewable Portfolio Standard proceedings."[195]

Many parties representing a broad and diverse set of interests supported further development of PG&E's overarching proposal.[196] Proponents generally concurred that, "if implementation details could be developed, [PG&E's] proposal better ensures that LSEs contract resources that meet energy requirements during all hours of the day and that energy storage resources are available when needed for discharging."[197]

C. 24-Hour Slice of Day

Stakeholders spent the second half of 2021 and the beginning of 2022 undertaking a series of ten well-attended, robust virtual workshops to flesh out PG&E's slice of day framework.[198] This effort resulted in a working group report submitted on February 28, 2022, that outlined several proposals on the structural slice-of-day framework, specific elements of the framework, and other topics.[199] Numerous parties representing diverse interests supported the structural proposal that was ultimately adopted, with modifications, by the CPUC in D.22-06-050.[200] This proposal, referred to as the "24-hour slice proposal" introduced by Southern California Edison Company, will be implemented with modifications beginning with a test compliance year of 2024 and full compliance starting for the 2025 compliance year.[201]

A comprehensive description of the technical aspects of the 24-hour slice of day framework can be found in Decision 22-06-050,[202] as modified

193. *Id*. at 38–40.
194. *Id*. at 38–40.
195. *Id*. at 52.
196. *Id*. at 15.
197. *Id*.
198. *Future of Resource Adequacy Working Group Report*, at 1–2 (Mar. 1, 2022), https://docs.cpuc.ca.gov/PublishedDocs/Efile/G000/M456/K578/456578904.PDF [https://perma.cc/5FVC-VYGG] (attachment to *Rulemaking 21-10-002*, *Motion of the Independent Energy Producers Association to Late-File the Working Group Report on the Future of Resource Adequacy*, Cal. Pub. Utilities Comm'n (Mar. 1, 2022), https://docs.cpuc.ca.gov/PublishedDocs/Efile/G000/M456/K512/456512946.PDF [https://perma.cc/NT5V-EERK].
199. *Decision 22-06-050, Decision Adopting Local Capacity Obligations for 2023-2025*, *supra* note 33, at 56–57.
200. *Id*. at 65.
201. *Id*. at 106.
202. *Decision 22-06-050, Decision Adopting Local Capacity Obligations for 2023-2025*, *supra* note 33, app. A.

by Decision 23-04-010.[203] Below is a brief, high-level overview of the reformed RA program that will take root in California in the coming years to help accelerate the path to a fully decarbonized grid.[204] Overall, the CPUC found that SCE's 24-hour slice proposal (which built upon the original slice of day framework introduced by PG&E) best satisfied the principles and objectives described above from D.21-07-014, as compared to the other main proposal included in the working group report (i.e., a proposal for a two slice of day framework).[205] "With the growing penetration of variable energy and use-limited resources, [the CPUC] observe[d] that the 24-hour slice framework can better address reliability than the current . . . structure," in part because the existing RA program does not account for energy storage charging needs.[206]

The 24-hour framework directly addresses energy sufficiency at an individual LSE level by requiring each LSE to provide sufficient excess energy to charge any storage it shows across the 24-hour slices. The 24-hour framework also restricts the extent to which use-limited resources can count across the 24-hour compliance period by linking a resource's value to its physical limitations, confirmed by a public RA Resource Master Database . . . . Inclusion of a resource on database would render the values binding, and allows for RA compliance to be based on the database.[207]

1. System, Local, and Flexible RA Procurement Obligations

The 24-hour slice of day framework requires each LSE to demonstrate that it has procured enough capacity to satisfy its specific gross load profile, including PRM, in all 24 hours on the CAISO's "worst day" in each month.[208] The "worst day" is defined as the day of the month that contains the hour with the highest coincident peak load forecast.[209] This means that instead of a single capacity procurement obligation for each month (as in the

203. *Decision 23-04-010, Decision on Phase 2 of the Resource Adequacy Reform Track*, Cal. Pub. Utilities Comm'n, app. A (Apr. 6, 2023), https://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M505/K753/505753716.PDF [https://perma.cc/U9YU-YNNQ].
204. *Id.*
205. *Decision 22-06-050, Decision Adopting Local Capacity Obligations for 2023-2025*, *supra* note 33.
206. *Id*.
207. *Id*. at 74–75.
208. *Decision 23-04-010, Decision on Phase 2 of the Resource Adequacy Reform Track*, *supra* note 203, at 1.
209. *Id*.

existing framework), LSEs will now have 24 hourly capacity procurement obligations for each month based on the representative "worst day," plus the PRM.[210]

For initial implementation, one PRM will apply to all hours of the year.[211] For an LSE that uses energy storage to meet requirements, the LSE must procure excess capacity (i.e., capacity that exceeds the LSE's hourly RA procurement obligation) that offsets the storage usage plus efficiency losses.[212] In other words, LSEs must procure enough extra capacity to serve their own batteries.[213]

In addition to the system requirements, the existing local RA program procurement requirements will be retained.[214] Elimination of flexible RA procurement obligations will be coordinated with the CAISO in the future.[215] Given that the 24-hour framework considers all hours, the need for flexible RA procurement obligations to meet the imbalance between the CAISO's peak energy demand and renewable energy production appears superfluous.

In terms of need determination and allocation, the CEC load forecast will be used to establish individual LSE hourly load forecasts.[216] System procurement obligations and allocation of those obligations to LSEs will flow from the CEC's approach.

2. Qualifying Capacity Methodologies

The shift from a single capacity procurement obligation to hourly procurement obligations means that some of the CPUC's QC valuation methodologies will be modified to reflect the reliability contribution of a resource under the new framework.[217] D.22-06-050 established initial rules for QC counting, including that solar and wind QCs will now be calculated based on an ELCC derived from an exceedance methodology that utilizes hourly production profiles based on historical data.[218] D.23-04-010 provided more detail regarding specific QC counting methodologies, including

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210. *See id*.
211. *Id*. app. A, at 2.
212. *Id*.
213. *Id*.
214. *Decision 22-06-050, Decision Adopting Local Capacity Obligations for 2023-2025*, *supra* note 33, at 58.
215. *Decision 23-04-010, Decision on Phase 2 of the Resource Adequacy Reform Track*, *supra* note 203, at 79.
216. *Id*. app. A, at 1.
217. *Id*. app. A, at 4–6.
218. *Decision 22-06-050, Decision Adopting Local Capacity Obligations for 2023-2025*, *supra* note 33, app. A, at 3.

adoption of PG&E's "Top 5 Day exceedance methodology" as the basis for assignment of monthly 24-hour profiles.[219]

In a positive step forward, resource capacity counting under the new framework must be consistent with the expected capacity contribution in the slice.[220] The expected capacity contribution in a slice will depend on resource size, general type, special operational characteristics or limitations, deliverability status, and potentially location.[221] These limitations will be identified through the development of the RA Resource Master Database.[222] The database will also include tables reflecting solar and wind profiles.[223]

Energy storage resources will be assigned value based on their maximum power output, restricted to daily resource capabilities (e.g., maximum daily run hours, maximum continuous energy, and storage efficiency).[224] As noted above, excess capacity must be procured to cover battery capacity charging, accounting for efficiency losses.[225]

3. Must Offer Obligation

Under the new framework, an RA resource must offer all its capability to the CAISO market for the quantity of RA shown by the LSE.[226]

4. Maximum Cumulative Capacity

Beginning with the 2024 test year, MCC buckets 1 through 4 will be eliminated, while the MCC demand response bucket will be retained.[227]

5. Mechanism for Procurement

LSEs will continue to meet their RA requirements through a combination of owned resources and bilateral contracting.

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219. *Decision 23-04-010, Decision on Phase 2 of the Resource Adequacy Reform Track*, *supra* note 203, at 4.
220. *Id*.
221. *Id*.
222. *Id*.
223. *Id*.
224. *Id*. app. A, at 5.
225. *Id*.
226. *Id*. app. A, at 3.
227. *Id*. app. A, at 6.

6. Demonstration of Compliance with RA Requirements; Penalties

The CPUC will maintain an official database of resources eligible to sell RA that includes their key attributes (RA Resource Master Database).[228] Resources must be fully represented in the RA Resource Master Database to be eligible for use in the CPUC's 24-hour slice RA showing.[229] The RA Resource Master Database will include, among other things: Resource ID, available MW of RA capacity, hours available for production (i.e., the hours of its MOO, which will set the parameters on how the resource can be shown in the CPUC's RA showing), other use-limitations (e.g., peaker permit limits), maximum continuous energy and maximum daily energy megawatt hour (MWh), charging efficiency for storage, daily storage cycles (contractual and physical ability), configurations (for hybrid and co-located resources), and applicable hourly profile for solar and wind.[230]

A single system monthly RA showing will cover all 24 slices of the day.[231] The existing penalty framework will be retained.[232]

VI. CONCLUSION

While much work remains to implement the new 24-hour slice of day framework prior to full implementation in 2025, there is renewed hope that the CPUC and stakeholders in California are headed in the right direction. LSEs will be required to secure the resources they need to meet their customers' energy needs for all 24 hours of the day, not just the peak period. The RA program should start to "work" again to keep the lights (and air conditioning) on even in the increasingly critical evening hours, helping to clear the pathway to a zero-carbon future in California.

228. *Id*. app. A, at 7.
229. *Id*.
230. *Id*.
231. *Id*. app. A, at 8.
232. *Id*.

VII. APPENDIX A

TABLE OF ACRONYMS	
CAISO	California Independent System Operator Corporation
CCA	Community Choice Aggregator
CEC	California Energy Commission
CPUC	California Public Utilities Commission
ELCC	Effective load carrying capacity
ESP	Energy service provider
FERC	Federal Energy Regulatory Commission
FPA	Federal Power Act
IOU	Investor-owned utility
IRP	Integrated resource plan
LOLE	Loss of load expectation
LSE	Load serving entity
MCC	Maximum cumulative capacity
MOO	Must-offer obligation
MW	Megawatt
MWh	Megawatt hour
NQC	Net qualifying capacity
PG&E	Pacific Gas and Electric Company
PRM	Planning reserve margin
PX	Power Exchange
QC	Qualifying capacity
RA	Resource adequacy
RTO	Regional transmission organization