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Joint Agency Reliability Planning Assessment

SB 846 Quarterly Report and AB 205 Report

Gavin Newsom, Governor
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ABSTRACT

The *Joint Agency Reliability Planning Assessment* (Reliability Planning Assessment) addresses requirements for electricity reliability reporting in Senate Bill 846 (Dodd, Chapter 239, Statutes of 2022) and Assembly Bill 205 (Committee on Budget, Chapter 61, Statutes of 2022). The report provides the first quarterly review of the demand forecast, the supply forecast, and potential high, medium, and low risks to reliability in the California Independent System Operator territory from 2023 to 2032, as required by SB 846. The analysis for 2023 is preliminary and will be updated in May to capture relevant pre-summer conditions (e.g., hydroelectric updates). The report also provides an evaluation of summer 2022 reliability and the magnitude of reliability problems for 2023–2026, as required by AB 205.

Keywords: Reliability, Reliability Planning Assessment, Diablo Canyon, SB 846, AB 205, CAISO, CEC, CPUC, California, Electricity, Supply and Demand, extreme weather, electricity system planning, stack analysis, summer reliability, resource procurement

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Introduction

California is experiencing a substantial shift in conditions affecting the electric grid, which is transitioning to the state's clean energy future, while confronting the impacts of climate change. This is creating challenges for its residents, especially disadvantaged communities and low-income communities. Senate Bill 100 (De León, Chapter 312, Statutes of 2018) (SB 100) sets an ambitious target of powering all retail electricity sold in California and state agency electricity needs with renewable and zero-carbon resources by 2045 to reduce greenhouse gas emissions and help improve air quality and public health. The actions to achieve SB 100 are resulting in the addition of unprecedented quantities of clean energy resources, primarily solar and storage at utility scale.

At the same time, climate change is causing substantial variability in weather patterns and an increase in climate-driven natural disasters, which is resulting in more challenges to maintaining grid reliability. In 2020, a west-wide heat event resulted in rotating outages August 14 and 15. In 2021, dry conditions resulted in a wildfire in Oregon that impacted transmission lines that California depends on for reliability, resulting in a loss of 3,000 megawatts (MW) of imports to the California Independent System Operator (California ISO) territory and 4,000 MW of overall import capacity to the state. In 2022, California experienced record high temperatures between August 31 and September 9. On September 6, 2022, the California ISO recorded a new record peak load at 52,061 MW, nearly 2,000 MW higher than the previous record, despite significant efforts to reduce load during this peak period.

Recognizing these challenges, Senate Bill 846 (Dodd, Chapter 239, Statutes of 2022) mandated the California Energy Commission (CEC) and California Public Utilities Commission (CPUC) to develop a quarterly joint agency reliability planning assessment. The assessment is required to include estimates of supply and demand for the next 10 years under different risk scenarios, information on existing and new resources and delays, and a description of barriers to timely deployment of resources.

Assembly Bill (AB) 205 (Committee on Budget, Chapter 61, Statutes of 2022) required the CEC to develop a similar, one-time assessment including a reliability assessment with an outlook of 2023 to 2026 and an overview of summer 2022 reliability. The CEC is incorporating the request from AB 205 into this joint agency assessment to fulfill the requirements for the first quarterly SB 846 report and the one-time AB 205 report.

California's Reliability Situation

Climate change, which is resulting in greater weather variability and natural disasters, is creating real challenges for the expansion of clean energy resources in California, most of which are weather-variable themselves. This interaction results in three challenges for the state:

- Planning: Timely and effective planning is the essential first step in guiding electric system reliability. Climate change is affecting the ability of existing models to assess reliability into the future, as each progressive year sees more and more divergent weather patterns from historical norms. Planning models and approaches need to be enhanced to account for greater weather variability. The state will benefit from updated planning strategies for bringing on new resources faster and at a larger scale while engaging more closely with communities on solutions that meet their needs.

- Resource Scale: Although the state is experiencing a boom in new project development, challenges remain to achieving the scale and diversity of resources necessary to accomplish the transition. New strategies are needed to increase demand flexibility. Moreover, as supply chain disruptions for solar and storage have the potential to continue, the state needs a more diverse portfolio of new resources to reduce the risk from unexpected project delays. However, alternative technologies are generally more expensive until they reach scale, which would benefit from incentives or cost-sharing strategies to achieve greater diversity in the near term.
- Extreme Events: Extreme heat events and wildfires remain a threat to grid reliability, and the state could look to existing programs such as the Strategic Reliability Reserve (SRR) to expand the resources capable of managing or reducing net-peak demand reduction during extreme events. The SRR was established in 2022 to provide additional generation and demand resources to be used in extreme events.

September 2022 Reliability

Last September, California experienced some of the hottest temperatures on record, and California ISO and the Balancing Authority of Northern California (BANC) set records for peak electricity demand. The extended heat event from August 31 to September 9 created an historic challenge for grid operators, but they averted rotating outages because of actions taken by the Governor, Legislature, state agencies, load-serving entities (LSEs), balancing authorities, and other partners. Planning before the summer by each of the balancing authority areas (BAA) and a high degree of communication and coordination were instrumental to preserve reliability. All BAAs are in support of even greater levels of communication and coordination moving forward and recommend that the state retain existing resources until new firm, clean resources can be brought on-line economically.

Reliability Assessment 2023–2032

The reliability assessment approach used for this report looks at forecasted demand and supply for 2023–2032. Although SB 846 requires only considering the 5- and 10-year points, the CEC and CPUC included annual results. The analysis also includes the detailed analysis for 2023–2026 to meet AB 205 requirements. The analysis for 2023 is preliminary and will be updated in May to capture relevant pre-summer conditions (e.g., hydroelectric updates). The analysis provides an overview of projects coming on-line in the near term (next 1–3 years) and describes barriers to new project development.

Demand Forecast

As directed in SB 846, this reliability analysis uses the most recently available Integrated Energy Policy Report (IEPR) forecast. For the analysis, staff used the draft 2022 California Energy Demand Update (draft CEDU 2022) Planning Forecast from the *2022 Integrated*

Energy Policy Report Update (2022 IEPR Update). The planning forecast is the forecast scenario that will be used by the CPUC for its 2023 Integrated Resource Planning (IRP) efforts. In the planning forecast, the annual managed net load for the California ISO region increases from 217,000 GWh in 2023 to 249,000 GWh in 2032. The 1-in-2 summer peak increases from 47,000 MW in 2023 to 53,000 MW in 2032.

Supply Forecast

California has an Integrated Resource Planning (IRP) process that was established by Senate Bill 350 (De León, 2015) to plan for mid- and long-term procurement of energy resources. Meeting increased load from economic and demographic growth and more extreme weather, replacing aging, retiring generation, and achieving greenhouse gas (GHG) reductions translates into an enormous level of procurement in the mid- and long term. LSEs are procuring new energy resources to meet reliability and GHG reduction targets, but they are facing a variety of barriers, including permitting, financing, and supply chain issues. This report contains information on new supply resources for CPUC-jurisdictional entities and publicly owned utilities (POU), but the analysis is primarily on CPUC-jurisdictional entities. Future versions of the quarterly report will include more information about new supply resources being planned by POU to develop a full understanding of the state's electric supply resource outlook.

As part of the CPUC IRP process, the CPUC adopts a Preferred System Plan (PSP) in the "planning track," which is an optimal portfolio of resources for meeting state electric sector policy objectives at least cost to ratepayers and then sets requirements for LSEs to plan toward that portfolio. The IRP "procurement track" was initiated in 2019 to explore possible actions the CPUC could take to address potential reliability or other procurement needs. The 2021 PSP includes about 25,500 MW of nameplate capacity of new supply-side resources and 15,000 MW of new storage and demand resources by 2032, with a GHG target of 38 million metric tons (MMT) by 2030 and 35 MMT by 2032. In November 2019 and June 2021, respectively, the CPUC approved two decisions within its IRP rulemaking — D.19-11-016 covering the near term (ending in 2023) and D.21-06-035 covering the midterm reliability (MTR), ending in 2028 — ordering CPUC-jurisdictional LSEs to procure a combined amount of 14,800 megawatts (MWs) of net qualifying capacity (NQC) of new electricity resources to come on-line between 2020 and 2026. This amount is equivalent to about 25,000 MW nameplate capacity, depending on the resource types ultimately procured, enough to power roughly 3.2 million homes. The amount of new nameplate capacity identified in Preferred System Plans has also increased significantly year over year.

On January 13, 2023, the CPUC also issued a proposed decision Ordering Supplemental MTR Procurement that would require 2,000 MW net qualifying capacity in 2026 and 2,000 MW in 2027, in addition to the 11,500 MW net qualifying capacity ordered in D.21-06-035. The PD recognizes the difficulties in procuring long-lead-time resources, such as long duration storage and geothermal resources, by 2026 as required by D.21-06-035 and proposes extending that deadline to 2028. The PD is set to be voted on during the CPUC's February 23, 2023, voting meeting.

Even before the new PD, the CPUC procurement orders have resulted in an extraordinary pace of new development in the past three years. Between 2020 and 2022, the CPUC's IRP procurement orders and prior LSE procurement resulted in more than 11,000 MW of new nameplate energy resources, equivalent to 6,000 MW of NQC. Most of the new resources are solar photovoltaic (PV), battery energy storage, and wind.

The POUs in the California ISO BAA have procured nearly 1,200 MW of new nameplate capacity under contract, equivalent to about 300 MW of NQC. The reliability analysis in this report does not include these resources to avoid double-counting and because they are not specific contract commitments, though the CPUC IRP modeling considers these resources indirectly.

Tracking Project Development

The state has witnessed an extraordinary pace of new development in the past three years, with over 130 new clean energy projects coming on-line to serve load in the California ISO footprint during this time. Between 2020 and late 2022, the CPUC's IRP procurement orders and prior LSE procurement resulted in more than 11,000 MW of new nameplate energy resources, equivalent to more than 6,000 MW of new NQC that can count toward resource adequacy capacity obligations.

There is a collaborative effort to track projects coming on-line to support reliability through the Tracking Energy Development (TED) Task Force. The task force is composed of the CEC, CPUC, California ISO, and the Governor's Office of Business and Economic Development (GO-Biz). The TED Task Force reviews new energy projects critical for near-term reliability and provides support, as appropriate, for individual projects, identifies barriers, and coordinates actions across agencies to support all projects. The priority focus for the TED Task Force has been near-term projects, defined as those that can come on-line in the next one to three years. The TED Task Force meets with developers to review projects under development and primarily works on interconnection and permitting delays. Through these coordination meetings with developers, the TED Task Force has identified three key reasons for project delays: supply chain issues, interconnection delays, and permitting delays.

Reliability Planning Assessment

The approach used for the reliability assessment in this report is consistent with the Summer Stack Analysis for 2022–2026 published by the CEC in July 2022. The analysis compares an hourly evaluation of anticipated supply against the projected hourly demand for the peak day of each month, July through September. Under a 17 percent reserve margin scenario, the CPUC's procurement orders and Preferred System Plan avoid reliability shortfalls well beyond the period covered by the current procurement orders. However, grid reliability risks will persist through 2030 under the increased demand conditions experienced in 2020 and 2022 because of continued higher growth in electricity demand. These risks are compounded by the risk of coincident fires impacting generation and electricity imports to California.

Recommendations

The recommendations are organized into the categories addressing the key reliability challenges of ensuring planning, scaling resources and protecting the grid during extreme events:

- Continue to Improve Situational Awareness: The agencies should continue to track project development, as well as increase the transparency of transmission network upgrades and interconnection processes.
- Improve Planning Assumptions: The agencies should develop a common approach to better incorporate climate change into planning and evaluate whether changes to the PRM or other reliability metrics are warranted.
- Realize Procurement: The California ISO should continue to consider interconnection enhancements and the agencies should refine a structure that better integrates statewide planning and local land use planning and permitting.
- Scale Demand-Side Resources: The CEC and CPUC should continue to collaborate to restructure the state's demand response programs and maximize opportunities for demand response and demand flexibility.
- Timely Deployment of Long Lead-Time Resources: The state should consider statutory and regulatory changes to a central procurement mechanism to secure a development path for large, long-lead time clean energy resources.
- Continue to Invest in Research, Development, and Demonstration: The CEC should continue to invest in applied research to support integrating climate considerations into planning and in increasing customer load flexibility. The state should also consider monies other than ratepayer funds, such as the Clean Energy Reliability Investment Plan.
- Continue to Develop Resources for Extreme Events: The CEC and CPUC should continue to coordinate with DWR, California ISO, other BAAs, and stakeholders to develop and expand extreme event resources to support the grid during extreme conditions.

CHAPTER 1: Introduction

Energy reliability in California and nationally is increasingly impacted by highly variable and unusual weather events driven by climate change. California's energy system runs reliably without issue the vast majority of the time, and the state has backup assets in place to provide energy during extreme events and avoid outages. The state's greatest energy reliability concerns are driven by a small number of hours during increasingly historic heat events when demand for electricity skyrockets to unprecedented levels and available supply is constrained. If these moments of extreme weather events coincide with other climate-driven extreme events — like drought or fire — the state's energy system could be strained beyond reliability contingencies historically planned for.

In 2020, a west-wide heat event resulted in rotating outages August 14 and 15, because of systemwide electricity shortages of about 500 megawatts (MW). In 2021, dry conditions resulted in a wildfire in Oregon that impacted transmission lines that California depends on for reliability, resulting in loss of 3,000 MW of imports to the California Independent System Operator (California ISO) territory. In 2022, the state experienced record high temperatures between August 31 and September 9. On September 6, 2022, the California ISO recorded a new record peak load at 52,061 MW,[1] nearly 2,000 MW higher than the previous record, despite significant efforts to reduce load during this peak period.

Since 2020 California energy entities have taken steps to address the potential imbalances between the electrical supply and demand in California, in particular as the electric grid transforms to rely on a high penetration of renewables and low-carbon resources. The California Energy Commission (CEC), California Public Utilities Commission (CPUC), California ISO, and Governor's Office (GO) substantially increased coordination and developed the Tracking Energy Development (TED) Task Force with the Governor's Office of Business and Economic Development (GO-Biz) to track new clean energy projects under development in order to help overcome barriers to their completion. The CEC revised the demand forecast to better account for climate change.

Between November 2019 and June 2021, the CPUC mandated an unprecedented amount of procurement, which will bring 14,800 MW of net qualifying capacity (NQC) by 2026. In response to Assembly Bill (AB) 205 (Committee on Budget, Chapter 61, Statutes of 2022), the CEC and Department of Water Resources (DWR) have begun building out the Strategic Reliability Reserve (SRR). The SRR, though in development during that summer, was able to provide support during the extreme heat event the state experienced between August 31 and September 9, including securing imports, additional backup generation, and load reduction that helped avert outages on September 6, when the California ISO recorded the highest

1 "California ISO Peak Load History 1998 Through 2022," accessed on December 8, 2022, https://www.caiso.com/documents/californiaisopeakloadhistory.pdf

demand ever in its territory. Even with these significant resource additions and strategic reserve resources, there exists uncertainty in the supply-and-demand balance in the 5- and 10-year horizons.

Overview of Reliability Challenges

Extreme weather events driven by climate change are contributing to increased energy reliability impacts in California and nationally. At the same time, the state has seen an unprecedented expansion in clean energy development, particularly solar and storage. However, it needs an even greater buildout of clean energy resources to meet near-term reliability and the long-term clean energy policy goals, embedded in Senate Bill 100 (De León, Chapter 312, Statutes of 2018). The interaction results in three fundamental challenges for the state:

- Planning: Timely and effective planning is the essential first step in guiding electric system reliability. Climate change is affecting the ability of existing models to assess reliability into the future, as each progressive year sees more and more divergent weather patterns from historical norms. Planning models and approaches need to be enhanced to account for greater weather variability. The state will benefit from updated planning strategies for bringing on new resources faster and at a larger scale while engaging more closely with communities on solutions that meet their needs.
- Resource Scale: Although the state is experiencing a boom in new project development, challenges remain to achieving the scale and diversity of resources necessary to accomplish the transition. New strategies are needed to increase demand flexibility. Moreover, as supply chain disruptions for solar and storage have the potential to continue, the state needs a more diverse portfolio of new resources to reduce the risk from unexpected project delays. However, alternative technologies are generally more expensive until they reach scale, which would benefit from supportive financing or cost-sharing strategies to achieve greater diversity in the near term.
- Extreme Events: Extreme heat events and wildfires remain a threat to grid reliability, and the state could look to existing programs such as the Strategic Reliability Reserve (SRR) to expand the resources capable of managing or reducing net-peak demand during extreme events. The SRR was established in 2022 to provide additional generation and demand resources to be used in extreme events.

Senate Bill 846

Senate Bill 846 (SB 846, Dodd, Chapter 239, Statutes of 2022) put in place actions necessary to enable the extension of the Diablo Canyon Power Plant beyond 2025 if it is needed to support grid reliability. A requirement in the bill directs the CEC and the CPUC to submit a Joint Reliability Planning Assessment to the Legislature quarterly. The Joint Reliability Planning Assessment focuses on the California ISO's balancing area, specifically looking at the supply and demand balance for the forward 5- and 10-year periods under different levels of risk. This report is the first of the quarterly reports and provides information on the California Energy Demand (CED) forecast, the supply forecast, a reliability assessment, and joint agency recommendations.

Assembly Bill 205

AB 205 requires the CEC to provide a reliability report to the Legislative Budget Committee by January 31, 2023, in consultation with CPUC, DWR, and the balancing authorities. The report is focused on an evaluation of how the state managed summer reliability, the projected reliability situation for 2023 through 2026, and potential solutions to address any foreseen reliability challenges. Because of the overlap in content of the two reports, CEC is including the additional relevant information for the AB 205 requirement in this first volume of the SB 846 quarterly report. The additional AB 205 content will not be included in future SB 846 reports.

CHAPTER 2: Summer 2022 Reliability Summary

AB 205 requires the CEC to provide a reliability report to the Legislative Budget Committee by January 31, 2023, in consultation with the CPUC, the DWR, and balancing authorities. This first version of the SB 846 quarterly report provides an overview of the reliability situation for the state. This chapter specifically focuses on electric reliability for summer 2022 and efforts taken by balancing authorities and utilities to address the effects of high demand from high temperatures and other extreme events.

Outlook for Summer 2022

Coming into 2022, California had two consecutive summers of reliability challenges, including in 2020, when a heat event resulted in rotating outages August 14 and 15; and in 2021, when the Bootleg Fire in July resulted in the loss of 4,000 MW of imports into California, 3,000 MW of which was lost for California ISO territory. In response to these events, the state energy entities (CEC, CPUC, and California ISO) took actions to be prepared for future events of similar magnitude. This included enhancing coordination before each summer, updating demand forecasts to account for climate change, ordering unprecedented amounts of procurement (described later in Chapter 4), and identifying additional contingency resources — both generation and demand reduction — that could come online in the event of another extreme event. More specifically, the actions taken included:

- Enhancing communication and coordination among the California ISO, state and federal agencies, and industry over the past two years.
- Coordinating state actions around the California ISO's Operations Playbook.
- Adding more than 4,000 MW of new capacity in the California ISO capable of generating during net-peak-demand periods since the summer of 2020, including about 3,500 MW of battery storage projects.
- Creating the Emergency Load Reduction Program (ELRP) in CPUC-jurisdictional territory in response to the 2020 outages, which provides incentive payments for customer-side load reductions when triggered by grid events. Enrollment in this program reached 874 MW by the end of summer 2022.

At the beginning of 2022, the CEC evaluated the upcoming summer reliability situation.[2] Through its stack analysis, which follows the method outlined in Chapter 6, the CEC concluded that the summer reliability situation, though still impacted by drought conditions, had improved with additional resources coming online compared to analyses conducted in 2021. CEC's stack analysis found that shortfalls of 200 MW to 2400 MW could occur in September if

2 TN#241145, Staff Paper – *Updated 2022 Summer Supply Stack Analysis*, https://efiling.energy.ca.gov/GetDocument.aspx?tn=241145.

the state experienced a heat event like in 2020. However, the state had access to sufficient contingency resources to address this need.

Subsequent to the CEC's January 2022 analysis, energy developers noted that ongoing supply chain issues associated with the COVID-19 pandemic would be compounded by a U.S. Department of Commerce tariff investigation that could impact delivery of clean energy products and components from China. (See footnote 36 below.) These issues could impact when projects would be available to come on-line. The CEC and California ISO staff prepared an updated reliability analysis for summer 2022 to include the most current hydrological data from DWR that CEC staff presented at a CEC workshop May 20, 2022. The analysis considered the impacts from extreme weather events, wildfires, potential project delays from several sources (for example, supply chain constraints and interconnection and permitting delays) and improved how it accounted for climate impacts in the electricity demand forecast.[3] It also considered the potential for coincidental events, such as a simultaneously occurring extreme heat wave, drought, and wildfire affecting transmission capacity that could further impact systemwide reliability.

Table 1 presents the results of the CEC and California ISO analysis, which identified a need of up to 7,000 additional MW in 2022 and 10,000 additional MW in 2025 based on coincidental events. The energy agencies had identified 2,000 MW of additional contingency resources — including voluntary and compensated customer load reductions, imports from other balancing authorities, and additional thermal generation — that could be employed in an extreme event above the 1-in-10 Loss of Load Expectation (LOLE).

Table 1: Estimated Impact on Energy Reliability

Issue	2022	2025
Lag in incorporation of updated demand forecasts and policy goals in procurement targeting 1-in-10 LOLE traditional planning metric	1,700 MW	1,800 MW
Extreme weather and fire risks to energy assets not completely captured in a 1-in-10 traditional planning efforts	4,000 – 5,000 MW	4,000-5,000 MW
Project development delay scenarios (estimated)	600 MW	1,600 – 3,800 MW
Total risk in a coincidental situation	~7,000 MW	~10,000 MW

Source: Erne, David, CEC Staff Workshop on Summer and Midterm Reliability, Docket 21-ESR-01, May 20, 2022, "Reliability Workshop Overview," slide 8.

3 TN#243171, "May 20, 2022, Presentation – May 2.0 Reliability Workshop Overview," https://efiling.energy.ca.gov/GetDocument.aspx?tn=243171.

Despite the identified contingency resources, a large shortfall of 5,000 MW remained as of 2022 in the event of coincident events.

Similar to the California ISO, the other balancing authority areas (BAAs) in California performed a reliability assessment for their respective service territories for summer 2022. For example, the Balancing Authority of Northern California (BANC) demonstrated sufficient generation and transmission capacity to meet the forecasted 1-in-2 load and 1-in-10 load with sufficient operating margin in their base case, wildfire scenario, and California ISO in an energy emergency alert (EEA) 3 scenario.[4]

Preparations for Summer 2022

In response to the concerns for summer 2022 reliability, the Governor proposed a strategic reserve of resources to be used in extreme events. The Legislature and Governor created the SRR through AB 205. The SRR is a transitional tool for addressing reliability risks from extreme events. It provides funding to secure conventional generation,[5] efficiency upgrades at existing natural gas plants, demand response, distributed generation, and long-duration storage. The SRR consists of three programs:

- **Demand-Side Grid Support (DSGS) Program** creates incentives for utility customers to reduce load and dispatch backup generation on an on-call basis. It is similar to the CPUC's ELRP, which includes customers in investor-owned utility (IOU) territories but supports customers in both IOU and non-IOU territories. The CEC adopted program guidelines August 10, 2022, and immediately opened the program to publicly owned utilities (POUs) to register and enroll customers.
- **Distributed Electricity Backup Assets (DEBA) Program** provides incentives for the construction of clean and efficient distributed energy resources. The CEC is developing the program, and it will fund the deployment of new zero- or low-emission technologies such as fuel cells and energy storage at existing or new facilities.
- **The Electricity Supply Strategic Reliability Reserve Program (ESSRRP)** is being implemented by the DWR via the Electricity Supply Reliability Reserve Fund to provide additional generation capacity to support grid reliability. Actions include extending the operating life of existing generation facilities planned for retirement, procuring temporary power generators, or procuring energy storage. At its September 30, 2022, meeting, the Statewide Advisory Committee on Cooling Water Intake Structures recommended that the State Water Board extend the compliance dates for three once-

4 California ISO describes an EEA3 as a situation in which the California ISO is unable to meet minimum contingency reserve requirements, and controlled power curtailments are imminent or in progress.

5 Conventional generation refers to generation from coal, oil, or natural gas.

through-cooling plants[6] to support the ESSRRP. This extension would allow the power plants to be available for contract to DWR as resources available in extreme events.

Additional resources were allocated to these programs in subsequent legislation, resulting in $295 million for DSGS, $700 million for DEBA, and $2.37 billion for ESSRRP, for a cumulative SRR of $3.365 billion.

When fully operational, the SRR is anticipated to provide up to 5,000 MW of additional extreme event support to the state. Both DSGS and ESSRRF programs were initiated during the summer to provide resources during summer 2022 and the program can expend funds up to June 2030.

Maintaining Reliability During Summer 2022

The state was again fortunate not to have a substantial overlap of reliability risks throughout the summer. Wildfires were fewer and of lesser extent than previous years. Though several wildfires threatened generation and transmission resources, the California Department of Forestry and Fire Protection (CAL FIRE) and other fire-fighting agencies were able to respond and prevent any substantive impact to electric infrastructure. The only noted curtailment was associated with the Route Fire near Castaic (Los Angeles County), which burned across a Los Angeles Department of Water and Power (LADWP) transmission corridor, resulting in a loss of 1,150 MW of needed transmission August 3. LADWP was able to purchase replacement energy in a timely manner. The transmission lines were restored within 24 hours.

The extreme heat event from August 31 to September 9 posed the most substantial impact to summer grid reliability. California and the West more broadly experienced record high temperatures. Across California from September 1 to 10, 41 locations tied or broke records for all-time hottest temperatures. There were 174 tied or broken records for hottest temperatures for September.[7]

As it became clear that the state would have a severe heat event, Governor Newsom proclaimed a state of emergency August 31, 2022, that expedited emergency interventions to prevent and reduce the effects of the extreme heat. In addition to setting temperature records, the event lasted 10 days. Prolonged heat events take a greater toll on the grid by reducing the efficiency of generation and transmission resources of all types and on customers' willingness to curtail energy use each day.

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6 The advisory committee recommended extending the operation of Alamitos Generating Station Units 3, 4, and 5; Huntington Beach Generating Station Unit 2; and Ormand Beach Generating Station Units 1 and 2 for three years from December 31, 2023, though December 31, 2026, to support system reliability.

Draft 2022 Special Report of the Statewide Advisory Committee on Cooling Water Intake Structures. September 20, 2022. https://www.waterboards.ca.gov/water_issues/programs/ocean/cwa316/docs/2022/saccwis_report.pdf.

7 *California ISO's Summer Market Performance Report, September 2022*, page 23, https://www.caiso.com/Documents/SummerMarketPerformanceReportforSeptember2022.pdf.

The following summarizes the efforts by BAAs and associated utilities to prepare for and respond to grid reliability over the summer.

California Independent System Operator

The numerous actions the Legislature, Administration, and stakeholders took to prepare for summer proved timely and significant in supporting the California ISO grid during the record-setting September 2022 heat event. During August 31–September 9, 2022, the California ISO system experienced an unprecedented, sustained period of high peak loads, averaging 47,000 MW and reaching a new record 52,061 MW on September 6. California ISO was on track to achieve a peak of 53,000 MW before demand-side load reductions were called that day. The heat event of September 2022 was more intense and of longer duration than any previously recorded heat events. Load has topped 50,000 MW only twice before in the California ISO history in 2006 and 2017. California ISO issued a record 10 consecutive days of Flex Alerts[8] during this 2022 period.

Planning and a high degree of coordination and communication factored into the success of the response to this energy emergency:

- The state coordinated activities around the California ISO Operations Playbook ahead of the heat event. Operationalizing the playbook fostered collaboration, communication, and coordinated response with entities such as the Governor's Office, state agencies, load-serving entities, other balancing authorities, and other partners.
- Daily California ISO media events provided regular public updates.
- Frequent (twice daily) calls convened by the Governor's Office and attended by the California ISO, energy and water utilities, state and local agency representatives, and the private sector allowed clear and regular communication throughout the event. The calls also provided a venue for answering questions about participation in emergency programs and disseminating information to a broader audience.
- IOUs and POUs, as well as community choice aggregators (CCAs) and other service providers, communicated the need for customer load flexibility and the extraordinary demands on the grid to their customers. On the worst day, September 6, the California Governor's Office of Emergency Services issued a wireless emergency alert that went out to 27 million Californians in counties with high electric use during the net peak, which supported a near immediate drop in load across the California ISO territory. This was the first time the Wireless Emergency Alert system had been used for an energy extreme event, and it proved highly effective.

The SRR provided critical resources between 554 MW to 1,416 MW during the heat event. The daily contribution of the different elements of the SRR to the grid were as follows:

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8 Flex Alerts are voluntary calls for consumers to conserve electricity. A Flex alert is typically issues in the summer when extremely hot weather drives up electricity use, making the available power supply scarce. This usually happens in the evening hours when solar generation is going offline and consumers are returning home and switching on air conditioners, lights, and appliances.

- The diesel fuel generator sets ranged from 49 MW to 54 MW.
- The gas turbine units ranged from 68 MW to 105 MW.
- Energy imports ranged from 550 MW to 1,444 MW.

Additional contributions to the grid during the September heat event came from management of state assets to support reliability, described below:

- DWR maximized hydroelectric generation and minimized pumping demands from the State Water Project (SWP) during peak demand hours.
    - From August 31 to September 9, SWP generated 469 MW to 911 MW of electrical energy from 4:00 to 9:00 pm. This generation required intense daily temperature modeling to increase generation from the Oroville plant from a typical 150 MW up to 550 MW while meeting critical downstream environmental temperature needs.
    - SWP shifted an additional 30 MW of pump load starting September 5 from 4:00 to 9:00 pm, in addition to the 120 MW of pump load that was shifted away from these hours in late August. This required increasing the surveillance and monitoring of California Aqueduct Pools.
- The state also implemented a warm shutdown of 25 Department of General Services-managed buildings and four California Department of Transportation (Caltrans) district offices between 4:00 pm and 3:00 am, setting building temperature to 85 degrees and turning off all unnecessary lights. Several state facilities preemptively switched to backup generators between 4:00 pm and 9:00 pm, saving about 200 MW.

While the above factors provided a critical margin for reliability that did not exist in August 2020 and helped California weather the more challenging heat event in September 2022, these other important factors supported reliable operations:

- Relatively low outage rates from existing generation during the worst days of the event.
- Low wildfire impacts to electrical infrastructure, even though there were several wildfires in the vicinity of electricity infrastructure in California and the Pacific Northwest during the heat event. CAL FIRE and other firefighting agencies were successful in monitoring and protecting critical infrastructure.
- Coordination and collaboration within California and across the West, resulting in strong imports and emergency assistance going to and from the California ISO during this event. While the heat event affected the entire West, it was not extreme at the same time throughout the region. For example, the Pacific Northwest experienced high temperatures early on but was able to provide additional exports when California most needed them.
- California regulatory policies and investments have driven energy storage on the California ISO footprint from 400MW up to 4,400 in just two years moving solar energy from the afternoon to the evening net peak when California ISO’s reliability concerns are at their highest. Adding new energy storage resources – and expanding the energy storage fleet to include storage greater than 4 hours, and seasonal storage, is a critical

step to flexing the state’s existing energy investments to meet electricity needs on the hottest days.

During the heat event, California ISO market system and processes largely functioned as intended; however, there were a few lessons learned that allowed the state to optimize grid function during emergencies in the future. California ISO’s *Summer Market Performance Report September 2022* assessed the heat event and highlighted three main areas where California ISO could make improvements. The following changes are underway or already addressed:[9]

- Ensure storage resources are appropriately charged and accounted for in California ISO systems to avoid manual corrective action.
- Ensure exports are awarded based on intended priorities.
- Resolve over- and undercounting of capacity available to the California ISO in the Western Energy Imbalance Market resource sufficiency evaluation.

CMUA

The California Municipal Utilities Association (CMUA) represents the state’s POUs that provide electric service to 25 percent of California. There are four municipal BAAs — BANC, Los Angeles Department of Water and Power (LADWP), Turlock Irrigation District (TID), and Imperial Irrigation District (IID) — that provide service to a dozen POUs, while the remaining POUs provide electric service within the California ISO BAA. CMUA provided information about their members’ efforts during the heat event, covering the following BAAs and POUs:

- BANC serves SMUD, Roseville, Redding, Shasta Lake, Trinity PUD, and Modesto Irrigation District (MID). BANC also provides BA services to the Western Area Power Administration – Sierra Nevada Region and the Transmission Agency of Northern California.
- The LADWP balancing authority area serves LADWP, Glendale Water & Power, and Burbank Water & Power
- The TID BAA includes the Merced Irrigation District.
- The IID BAA includes Imperial County and parts of Riverside and San Diego Counties

CMUA submitted a joint letter on the September heat event to Governor Newsom with the Northern California Power Agency (NCPA), California Association of Sanitation Agencies (CASA), and the Southern California Public Power Authority (SCPPA).[10] The letter provided an overview of the protocols that the four entities believe were valuable before and during the event and recommendations to enhance summer reliability. CMUA separately submitted a letter to the CEC with additional perspective on the preparation of its members for summer

9 Ibid.

10 California Municipal Utilities Association, California Association of Sanitation Agencies, Northern California Power Agency, and Southern California Public Power Authority Letter to the Honorable Gavin Newsom; September Heat Event and Grid Reliability – Feedback and Next Steps; October 7, 2022.

2022 and recommendations for future improvements in preparation and response to the summer reliability. The following summarizes the main points in these two letters.

To prepare for summer 2022, the four BAAs prepared reliability analyses and determined they had sufficient resources to meet demand and at times were able to export power (generally about 1,000 MW during peak hours) to the California ISO.

CMUA and the BAAs highlighted several actions taken by members that helped maintain reliability:

- Performing assessments ahead of summer to ensure they have sufficient resources to meet demand 24 hours a day.
- Understanding the schedules of generators in neighboring balancing authorities.
- Participating in twice-daily Governor's Office calls and consistent customer messaging regarding conservation.
- Ramping up utility-owned generation to assist the California ISO.
- Enrolling customers in the new DSGS, passed by the legislature only months before the summer heat event.
- Working with DWR to establish more than 50 MW of new generation for the SRR.

Many of the POUs have experienced similar challenges highlighted by the California ISO, such as meeting the net peak period when the sun goes down, supply chain disruptions, and tight market conditions for resource adequacy (RA) products and high energy prices. To help address these issues, CMUA recommends that:

- POUs maintain the flexibility and local control to procure diverse generating and storage resources and create customer programs that reflect the needs of their communities and operating systems.
- Ensure that existing firm, dispatchable generating assets are able to stay online until there are cost-effective replacement clean energy resources with similar reliability attributes.
- The state continues to invest in reliability solutions, such as the SRR, that can aid POUs in maintaining reliability and continues to focus on meaningful collaboration and coordination between state energy agencies and POUs.

CMUA, along with CASA, NCPA, and SCPPA, also recommend the following actions:

- Develop a post-event summary to describe the actions and contributions by all stakeholders and identify improvements in planning, including which resources are supporting grid reliability and which are not, to refine state energy procurement policies.
- Develop a playbook for future events that is widely shared and fully transparent. An associated contact list is needed to ensure all key utility contacts receive timely information and notice of planning calls.

- Provide a straightforward summary of executive orders and the actions permitted under the executive orders to reduce confusion. This summary includes permissions on the use of backup generators and allowances on air emissions.
- Provide clear, concise information on air quality issues.
- Review and enhance DSGS program requirements to provide clarity of responsibilities for signing up participants and address the full cost of participation.
- Identify an emergency contact at the CEC to lead planning for the summer, coordinate during the event, and address lessons learned after events.

Other recommendations relate to funding for wastewater agency energy efficiency projects, demand response programs proactively rather than in an emergency, increasing flexibility of state managed generation, and storage assets.

LADWP

LADWP is a municipal utility and one of the four municipal BAAs in California. It is also the third largest electric utility in the state. LADWP updates its 18-month forward resource plan monthly and determined that it had sufficient resources to meet its historic all-time peak of 6,502 MW and maintain full operational obligations throughout summer 2022. LADWP also performs a test run in the second quarter of each year of seldom-run resources to ensure that they are able to start and perform as expected in an event. LADWP often has surplus in the summer to offer to support other entities in bilateral markets.

LADWP was able to meet its obligations during the heat event. The Governor's emergency proclamation enabled LADWP to use additional hydro resources and to leverage demand response to further reduce customer loads at critical times. LADWP coordinated closely with other neighboring BAAs, including California ISO, to provide support. As with California ISO, LADWP noted a substantial drop in demand associated with the California Governor's Office of Emergency Services (Cal OES) phone alert. LADWP remained short of breaking its all-time record load.

LADWP noted that the improved coordination in 2022 across the West helped reduce load shed events; however, LADWP made several recommendations looking forward:

- Encouraging California ISO to be able to access the western bilateral markets, which have proven to provide abundant, procurable energy.
- Increase day-ahead coordination among BAAs to allow sufficient time for those with long-start resources to be better positioned to support other BAAs to respond to emergencies. When assistance is requested in real time, BAAs with potential resources have limited ability to support those in need.
- Continue coordinated use of Cal OES alerts during stressed system conditions.
- Retain existing energy resources until new, equally dependable resources are fully available.

BANC

The BANC is a joint powers agency whose members include the MID, City of Redding (Redding), City of Roseville (Roseville), Sacramento Municipal Utility District (SMUD), City of

Shasta Lake (Shasta Lake), and Trinity Public Utilities District (TPUD).[11] In preparing for summer 2022, BANC performed a reliability analysis, updated its operating procedures, trained its operators, and engaged in joint training exercises with the California ISO and other adjacent BAAs. Similar to analyses conducted by the CEC and California ISO for the California ISO territory, BANC conducted reliability analyses that considered such factors as potential heat events, hydro derates,[12] and potential impacts to imports resulting from wildfires. The BANC assessment determined that BANC had sufficient resources to meet the 1-in-2 and 1-in-10 load for summer 2022 with sufficient operating margins. The assessment also showed sufficient resources for extreme events such as wildfire smoke and California ISO reaching an EEA 3. However, BANC would have risks in the event of a west-wide heat event causing a 1-in-20 load and reduced import availability.

Like California ISO, BANC set a new peak demand record during the August 31 - September 9 heat event. BANC almost had to initiate rotating outages a couple of times during the heat event, but it met loads and avoided impacting customers due to various efforts. For example, SMUD, BANC's largest member, took immediate action to find replacement resources for its 500 MW gas-fired Consumnes River Plant (CPP) that suffered an unplanned outage at the beginning of summer. SMUD also obtained the necessary permits to run CPP in simple cycle mode at about one-half its normal capacity, rather than combined cycle mode. Some of the other efforts to maintain reliability were:

- Increased communications with members and other BAs and participated in state-led calls.
- Appropriate use of EEAs to assist in initiating demand response programs and deploying reserves.
- Increased energy procurement efforts by members as needed.
- Sought and received a waiver from U.S Department of Energy (DOE) to promote use of certain backup generators.

In response to 2022 and in preparation for 2023, BANC will continue to conduct detailed summer assessments of anticipated reliability under different scenarios and is evaluating resource adequacy policies in response to heat events. BANC will continue coordination with other BAs, the state, and DOE to identify resources that may be underused, including backup generators.

Imperial Irrigation District

IID provides electric service in Imperial County and parts of Riverside and San Diego Counties and, because of its location, has power consumption per meter in the summer at one of the

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11 BANC provided information required by AB 205, TN#248409 "Balancing Authority of Northern California Comments – on the Summer Reliability Report Required by AB205," https://efiling.energy.ca.gov/GetDocument.aspx?tn=248409.

12 Hydro derates are a reduction in the power output of a hydroelectric facility due to ambient conditions, such as insufficient water supply to maintain flows or water pressure needed for full output.

highest levels in the nation. IID routinely conducts a summer reliability assessment. In its assessment for summer 2022, IID showed a shortfall of 333 MW to meet 115 percent of capacity needs. Upon this finding, IID took action to procure additional resources by renegotiating an expired contract for biomass and mobile generation and purchasing natural gas to secure the reliability of internal generation.

IID experienced temperatures that were, for the most part, within the region's normal summer range of 105 to 115 degrees Fahrenheit. Despite some challenges, such as unplanned outages to generation and transmission and real-time import curtailments, IID maintained reliability and served all demand. IID's assessment highlighted the challenges of meeting resource adequacy, employee attrition, and the effects of extreme weather on infrastructure. IID also recommended conducting reliability assessments early to ensure the ability to procure resources to meet requirements; attending meetings with California ISO, Southern California Gas Company (SoCalGas), Western Electricity Coordinating Council, and others; procuring natural gas for internal generation; system-hardening projects to upgrade existing infrastructure to make it less susceptible to extreme weather events, especially events accompanied by high winds; and enhanced training and recruitment.

Conclusion

California experienced some of the hottest temperatures on record, and California ISO and BANC also set records for peak demand. The extended heat event from August 31 to September 9 challenged grid operators, but they averted rotating outages because of numerous actions taken by the Governor's Office, state agencies, publicly owned electric utilities, load-serving entities, balancing authorities, customers, and many other partners. As this chapter highlights, planning and a high degree of communication and coordination – both in California and across the West - were instrumental during the September 2022 heat event. All BAAs support even greater levels of communication and coordination moving forward and the need to retain existing resources until new firm, clean resources can be brought on-line economically.

CHAPTER 3: Demand Forecast

Demand Forecast Scenarios

As directed in SB 846, this reliability analysis uses the most recently available Integrated Energy Policy Report (IEPR) forecast. For the analysis, staff used the draft 2022 California Energy Demand Update (draft CEDU 2022) Planning Forecast from the *2022 IEPR*. The planning forecast is the forecast scenario that will be used by the CPUC for its 2023 IRP efforts.[13]

Draft CEDU 2022 Planning Forecast Inputs and Assumptions

The demand forecast relies on several data sources as inputs. The baseline economic projection is from a Moody's Analytics scenario that is described as a "50/50" likelihood. Demographic projections (for example, population and number of households) are derived from California Department of Finance (DOF) analysis. Other drivers in energy consumption forecasts are the retail cost of energy, adoption of behind-the-meter self-generation and energy storage technologies, and vehicle electrification. The electricity rate scenarios incorporate recent and pending utility rates and rate actions; projected costs of electric generation procurement, transmission, and distribution revenue requirements; and other costs. Key drivers of increasing electricity rates for the CEDU 2022 were the costs of wildfire mitigation, risk management, and other investment in the distribution grid to support state policy goals.

For planning areas within the California ISO balancing area, CEDU 2022 peak and hourly demand forecasts were developed using the CEC's top-down hourly load model (HLM). This model is at the system level and driven primarily by growth in annual consumption. The key functionality of the HLM is that it allows specific profiles for PV, electric vehicle (EV) charging, and other load-modifying resources to be layered onto the baseline consumption profile, ensuring that the resulting peak forecast accurately captures the contribution of these resources.

Rising temperatures are an important factor affecting the CEC's demand forecasts, particularly forecasts of peak electricity demand that is highly sensitive to temperature. The CEC's peak forecast must consider demand under normal peak conditions, as well as for the types of extreme temperatures that would be expected only once in 5, 10, or 20 years.

Figure 1 shows the density — a measure of the likelihood that a particular value will occur — of daily minimum temperatures averaged across the California ISO control area. Examining the most recent 30 years of historical temperature data shows that the latest 15-year period

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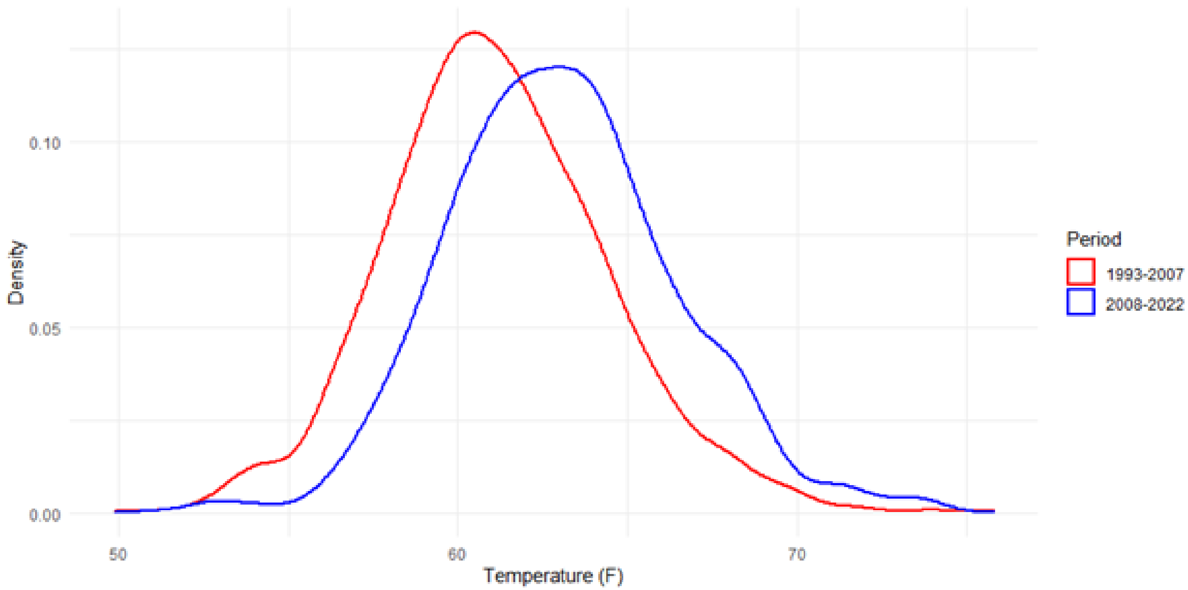
13 Due to the timing of forecast availability, the CPUC uses the prior year forecast to establish Resource Adequacy Requirements applicable to Load Serving Entities (LSEs), for example, 2021 CED Planning forecast determined the RA requirements for calendar year 2023, and the 2022 CEC Planning will determine the RA requirements for calendar year 2024.

exhibits a clear upward shift in the distribution of temperatures relative to the proceeding 15 years. A similar trend can be observed with daily maximum temperatures. These results led to a decision to weight recent years more heavily in forecasting peak loads.

Figure 1: Distribution of Daily Minimum Temperatures Averaged Across California ISO Region



Source: CEC analysis

For more information on the Draft CEDU 2022, see the *Draft 2022 Integrated Energy Policy Report*[14] and the December 7, 2022, and December 16, 2022, IEPR workshop materials.[15]

2022 CED Planning Forecast Results

Figure 2 shows the annual managed net load for the Draft CEDU 2022 Planning Forecast for the California ISO region. The planning forecast shows annual load increasing from 217,000 GWh in 2023 to 224,000 GWh in 2026, 231,000 GWh in 2028, and 249,000 GWh in 2032.

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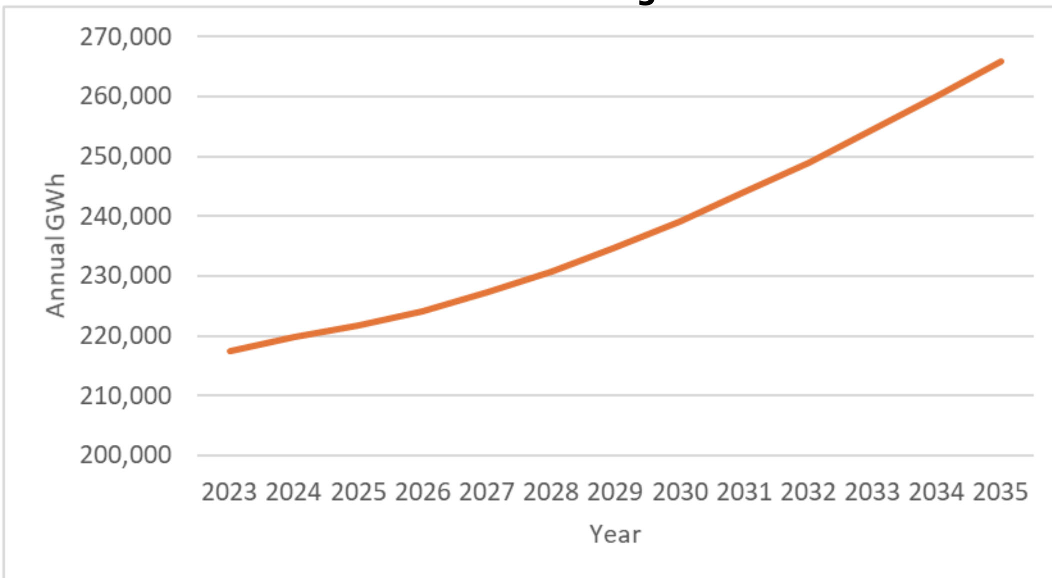
14 Bailey, Stephanie, Jane Berner, David Erne, Noemí Gallardo, Quentin Gee, Akruti Gupta, Heidi Javanbakht, Hilary Poore, John Reid, and Kristen Widdifield. 2022. *Draft 2022 Integrated Energy Policy Report*. California Energy Commission. Publication Number: CEC-100-2022-001-CMD.

15 IEPR Workshop 1 and IEPR Workshop 2 presentations and event recordings are available at https://www.energy.ca.gov/event/workshop/2022-12/iepr-commissioner-workshop-updates-california-energy-demand-2022-2035 and https://www.energy.ca.gov/event/workshop/2022-12/iepr-commissioner-workshop-updates-california-energy-demand-2022-2035-0.

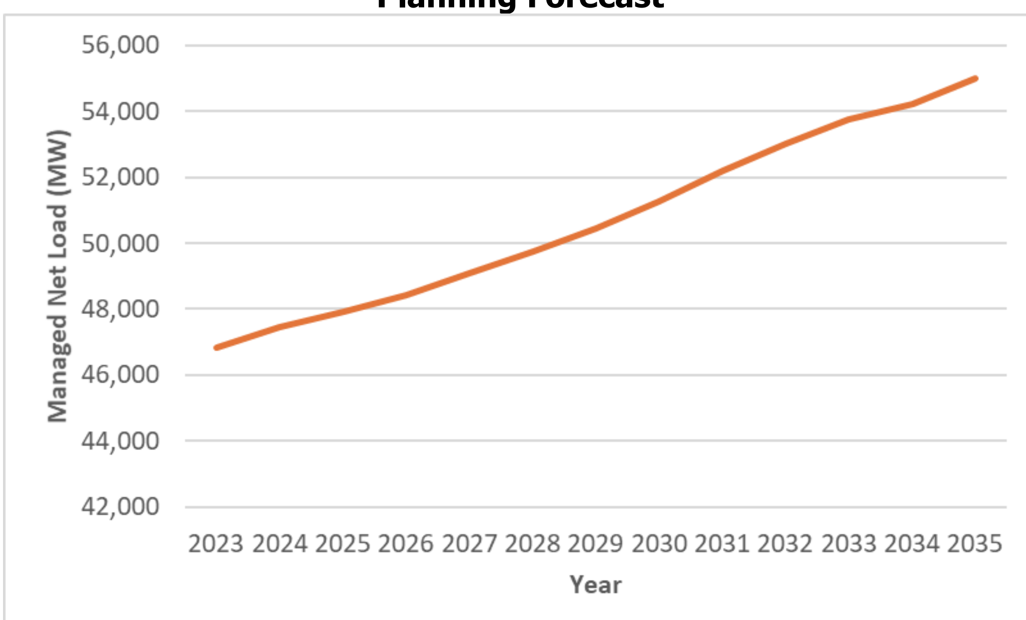
Figure 2: Annual Managed Net Load for the Draft 2022 Planning Forecast for the California ISO Region



Source: [Draft CED 2022 Hourly Forecast CAISO Planning Scenario]

Figure 3 shows the 1-in-2 2022 planning forecast results for peak summer demand in California ISO territory. The 1-in-2 summer peak increases from 47,000 MW in 2023 to 48,000 MW in 2026, 50,000 MW in 2028, and 53,000 MW in 2032.

Figure 3: Peak Summer Demand in the California ISO Region for the Draft 2022 Planning Forecast



Source: [Draft CED 2022 Hourly Forecast CAISO Planning Scenario]

Future Uncertainties

There are many uncertainties in forecasting electricity demand, with the largest uncertainties around climate change impacts and the adoption rates of transportation and building electrification.

Electrification of buildings and transportation will change energy-use patterns. There are numerous uncertainties around this, these uncertainties will need to be considered and monitored as electrification becomes more prevalent. The uncertainties include the rate of adoption of EVs and heat pumps, battery storage and EV charging patterns, and load flexibility and demand response. At the same time, utilities are considering rate strategies, such as real-time pricing, that encourage electrification and load shifting while ensuring grid reliability.

CHAPTER 4: Supply Forecast

Background

California has an IRP process that was established by Senate Bill 350 (SB 350) (De León, Chapter 547, Statutes of 2015) to plan for mid- and long-term procurement of energy resources. The process differs slightly for CPUC-jurisdictional entities (about 70 percent of state energy load) versus non-CPUC-jurisdictional entities (about 30 percent of state energy load). The process for CPUC-jurisdictional load-serving entities (LSEs) succeeded the CPUC's longstanding Long-Term Procurement Planning (LTPP) process, established by Assembly Bill 57 (AB 57)[16] (Wright, 2001). The CPUC IRP process aims to reduce the cost of achieving greenhouse gas (GHG) reductions and other policy goals by looking across LSE boundaries and resource types to identify solutions to reliability, cost, or other concerns that might not otherwise be found.

The IRP process has two parts. First, it identifies an optimal portfolio for meeting state policy objectives and encourages the LSEs to procure toward that future. Second, it aggregates the LSEs collective efforts for planned and contracted resources to compare the expected system to the identified optimal system. The CPUC's IRP process requires jurisdictional LSEs to submit plans every two years to ensure that the LSEs' can meet established GHG reduction targets, at least cost, while maintaining electric system reliability. The CPUC jurisdictional entities subject to this process comprise about 90 percent of the California ISO load.

The POU IRP process is less frequent and primarily requires the POUs to incorporate specific targets and considerations into their own IRPs and processes. Some POU load is part of the California ISO, but the majority of POU load is not part of the California ISO. The CEC reviews the POU IRPs for consistency with statute. In contrast to the CPUC's IRP program, the CEC is only able to provide recommendations to correct any deficiencies noted in the POUs' IRPs. Thus, unlike the CPUC, the CEC is unable to provide specific direction, order procurement, or require changes to utility plans. As a result, the information and accountability for adherence to POU IRPs is limited compared to the CPUC-jurisdictional LSEs.

Over the last six years, the agencies have observed that planning alone cannot ensure that the state's ambitious electric sector GHG emission reduction targets will be met. The procurement of new energy resources to add to the existing fleet of in-state resources and historic levels of energy imports to meet increased load resulting from economic and demographic growth and more extreme weather as well as to replace retiring generation resources, is crucial, but LSEs are faced with a variety of barriers (including permitting, financing, and supply chain issues) that may make it challenging for new resources to come on-line. To explore possible actions the CPUC could take to address potential reliability or other procurement needs, the IRP "Procurement Track" was initiated in 2019, as ordered in Decision (D.)19-04-040. Given the

16 See AB 57.

information available to state agencies on CPUC-jurisdictional LSEs, the discussion of supply will focus on those CPUC-jurisdictional entities in the California ISO balancing authority area, as well as a more limited amount of information on supply resource additions by publicly owned utilities inside the California ISO. However, information on new supply resources being developed by publicly owned utilities is under development by the CEC, and future versions of this report will include information about new supply resources being planned by publicly owned utilities to develop a full understanding of the state's electric supply resource outlook.

CPUC IRP Planning Track

Preferred System Plan (D.22-02-004)

The IRP "planning track" operates on a two-year cycle that concludes with the CPUC adopting a PSP. In the PSP, the CPUC identifies an optimal portfolio of resources for meeting state electric sector policy objectives at least cost and then sets requirements for LSEs to plan toward that future. To the extent that the CPUC orders procurement in the IRP proceeding, it is generally to meet a reliability or GHG reduction need identified in the planning track.[17]

In February 2022, the CPUC adopted its 2021 PSP for use in planning and procurement, as well as to be analyzed by the California ISO in the 2022–2023 Transmission Planning Process (TPP).[18] The PSP portfolio includes about 25,500 MW of nameplate capacity of new supply-side resources and 15,000 MW of new storage and demand response resources by 2032, in addition to existing resources. This is a 565 percent increase in installed capacity over a 10-year period compared to the projected resource need just two years earlier. The PSP adopted a 38-million-metric-ton (MMT) 2030 electric sector GHG planning target, which drops to 35 MMT by 2032. This target adopted in the 2021 PSP is more stringent than the previously adopted 46 MMT GHG target and equates to 73 percent Renewables Portfolio Standard (RPS) resources and 86 percent GHG-free resources by 2032. The order adopting the 2021 PSP also required LSEs to submit plans in their November 1, 2022, IRP detailing how they would meet their share of a 30 MMT electric sector GHG target as well as a 38 MMT GHG target. The CPUC is reviewing these plans. Further, the CPUC IRP proceeding has already transmitted to California ISO a 30-MMT-GHG target portfolio that includes high electrification assumptions for study in 2022–23 TPP[19] as a sensitivity portfolio and issued a proposed decision on January

17 The procurement ordered in D.19-11-016 did not originate with a need identified in the IRP planning track and rather was based on reliability analysis that occurred in a separate IRP procurement track. But in D.21-06-035, the CPUC ordered procurement to meet a mid-decade need for resources that was first identified in the IRP planning track's 2019 Reference System Plan and was based on a projected shortfall of mid-decade system resources that incorporated IRP planning track LSE filings. Moving forward, the CPUC will closely coordinate IRP procurement actions with the need for new resources identified in IRP planning.

18 The TPP is an evaluation of the California ISO transmission grid to identify grid upgrades needed to address reliability, meet state policy goals, and provide economic benefits.

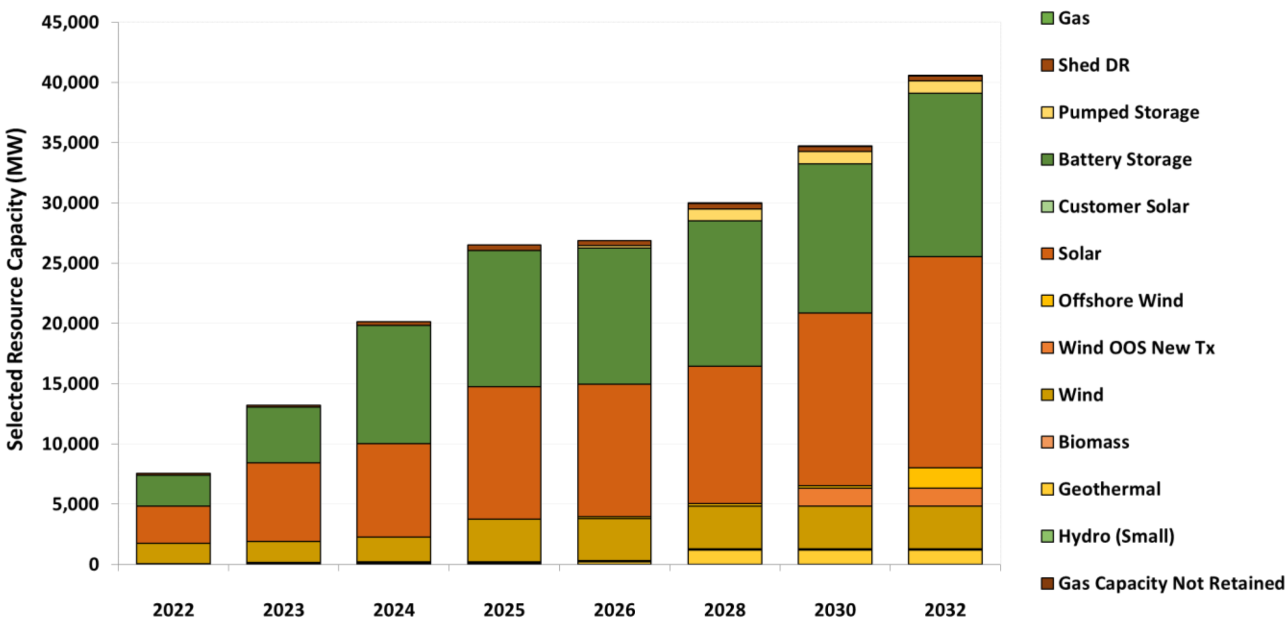
19 See here: https://www.cpuc.ca.gov/-/media/cpuc-website/divisions/energy-division/documents/integrated-resource-plan-and-long-term-procurement-plan-irp-ltpp/2019-2020-irp-events-and-materials/tpp-portfolio-transmittal-letter.pdf.

13, 2023, to transmit a similar portfolio to the ISO for study in its 2023–24 TPP as a base case portfolio.[20] That portfolio, which contains significantly more resources than the PSP, is not covered in this report.

The PSP portfolio includes all resources that LSEs procured or were planning to procure as of June 2020, according to individually filed IRPs, to meet the 38 MMT GHG target. The PSP portfolio also includes additional resources selected through CPUC modeling needed to meet the Mid-term Reliability (MTR) procurement order, described below in more detail, and any remaining GHG and reliability shortfall out to 2032. Figure 4: 2021 PSP Selected Nameplate Capacity (MW)

4 shows the total resource nameplate capacity by megawatt identified in the PSP decision.[21]

Figure 4: 2021 PSP Selected Nameplate Capacity (MW)



Source: 2021 PSP RESOLVE Package Results Viewer

CPUC Identified the California ISO Procurement Need

In November 2019 and June 2021, respectively, CPUC approved two decisions within its IRP rulemaking – D.19-11-0163 and D.21-06-0354. These decisions ordered CPUC-jurisdictional LSEs to procure a combined amount of 14,800 MW of NQC, equivalent to about 25,000 MW nameplate capacity, depending on the resource types ultimately procured, of new electricity resources to come on-line between 2020 and 2026. This amount is enough to power about 3.2 million homes. In addition to the 14,800 MW NQC ordered by the CPUC, there were significant megawatts in development at the time of the 2019 procurement order that were considered

20 See here: https://docs.cpuc.ca.gov/PublishedDocs/Efile/G000/M501/K102/501102663.PDF.

21 Capacity identified in in the 2021 PSP is relative to a June 2020 baseline, which includes resource additions for 2022 through 2024 that were under contract in June 2020.

baseline (that is, they had expected on-line dates after the initial order) that had signed contracts prior to the order being issued.

CPUC 2019 Procurement Order (D.19-11-016) Near Term Reliability

The first procurement directive, D.19-11-016, ordered in 2019, evaluated system need between 2019 and 2023. The focus was on near term reliability needs, primarily resulting from the expected retirement of natural gas units. The analysis was based on the 2018 IEPR 1-in-2 peak California ISO coincident forecast and began with the California ISO NQC list, accounting for near- to -medium-term retirements based on the California ISO's list of mothballed and retired resources. The analysis adjusted the supply stack to account for the effective load carrying capability (ELCC) values that the Commission adopted as a part of the RA Rulemaking R.17-09-020[22] and included expectations for already underway (aka baseline) LSE-contracted resources with online dates before 2024. Other analysis considerations included: an analysis of maximum import capability (MIC), the potential contribution of imports toward system capacity, and estimates for hydroelectric contributions.

Considering all the information available, the Commission adopted a need for 3,300 MW NQC of new incremental resources to serve the CPUC jurisdictional load. Rather than require IOUs to procure all new resources needed for reliability, as had been regular practice in prior CPUC orders, the 2019 order allowed non-IOUs to self-provide their reliability resources (known as "opting-out" of the order). The state's investor-owned utilities (IOUs) are required to procure the resources on behalf of the LSEs choosing not to self-provide the resources, thus ensuring that the total identified need is procured.

CPUC 2021 Procurement Order (D.21-06-035) Mid-term Reliability

The mid-term reliability (MTR) order looked out further in the planning horizon than the D.19-11-016 order and used a higher planning reserve margin (PRM) to address climate impacts and establish the need for new resources. The analysis relied on an updated IEPR forecast, as well as an updated list of baseline generators reflecting information about resources already under contract and expected by various LSEs. The order was designed to be incremental to procurement underway to meet the D.19-11-016 order or any other previously undertaken procurement reported to the CPUC. The CPUC used an updated list of available (existing) baseline resources that aligned with California ISO's Master File. The expected resource additions were based on LSE IRP filings from September 1, 2020. This updated baseline generator list of resources included in-development resources if LSEs had signed contracts either approved by the Commission or by the LSE's highest decision-making authority.

NQC values came from one of three sources. For solar and wind, NQC values were derived using ELCC assumptions developed stochastically by year. For other technologies included in the CPUC's 2021 NQC List, the individual facility NQC values were used. Finally, for the remaining resources a technology specific NQC multiplier was used consistent with the 2019-

22 See D.19-06-026 at 42-49

2020 IRP Inputs and Assumptions.[23] Resources were summed with these NQC values and compared against the reliability need in each year through 2026. The procurement order was based on a "high" need scenario, which effectively increased the PRM to 22.5 percent. The PRM increase reflects both an assumed effect of a one-degree Celsius temperature increase due to climate impacts over the next decade — with the impacts of the changed assumption applied beginning in 2024 — and changes to cover calibration differences between the two major models being used for IRP, RESOLVE and SERVM.[24]

New Additions to Date

The state has witnessed an extraordinary pace of new development in the past three years, as exemplified by the over 130 new clean energy projects have come online to serve load in the California ISO footprint. Between 2020 and late 2022, the CPUC's IRP procurement orders and prior LSE procurement resulted in over 11,000 MW of new nameplate energy resources, equivalent to over 6,000 MW of new Net Qualifying Capacity (NQC) that can count toward RA capacity obligations.[25] As shown in Table 2, a subset of the 11,000 MW new nameplate – or 8,000 MWs were brought online in the California ISO territory and are also considered "SB 100 eligible" resources. The other new resources included some natural gas and specified imports. There were two large natural gas plants that came online in February 2020 as a result of CPUC orders many years prior, as well as a handful of small natural gas plant modifications that made small incremental additions to natural gas capacity. In addition, about 11 new resources were added to the California ISO as pseudo-tied or dynamically scheduled imports, including some New Mexico based wind. These resources outside of the California ISO can count toward an LSE's resource adequacy, IRP, or RPS obligations, depending on whether the resource can be paired with maximum import capability (MIC).

The CPUC also issued a proposed decision (PD) on January 13, 2023, ordering supplemental MTR procurement that would require 2,000 MW NQC in 2026 and 2,000 MW in 2027, in addition to the 11,500 MW NQC ordered in D.21-06-035.[26] The PD recognizes the difficulties in procuring long lead-time (LLT) resources by 2026 as required by D.21-06-035, and proposes to extend that deadline to 2028. The PD is set to be voted on during the CPUC's February 23, 2023, voting meeting. As such, newly proposed quantities are currently omitted from the

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23 CPUC's *Inputs & Assumptions: 2019-2020 Integrated Resource Planning* is available at https://files.cpuc.ca.gov/energy/modeling/Inputs%20%20Assumptions%202019-2020%20CPUC%20IRP%202020-02-27.pdf.

24 This comprised a revision to the operating reserve component of the PRM from 4.5 percent to 6 percent, as well as an additional 2,000 MW of generic capacity that was added in the IRP cycle that preceded issuing the MTR decision.

25 Information on what resources have come online are based on information taken from the California ISO and from LSEs' data request submission to the CPUC.

26 Available at: https://docs.cpuc.ca.gov/PublishedDocs/Efile/G000/M501/K102/501102663.PDF.

procurement order resource build analysis in this report, though the PSP analysis does account for the 2,000 MW of LLT procurement.

As shown in Table 2 below, most of the new energy resources developed between January 2020 and September 2022 are solar PV, battery energy storage, and wind. The pipeline of new energy resources under contract, but not yet online, are similar in terms of technology mix; see Table 2 below.

Table 2: Cumulative New Resource Additions, January 2020 through September 2022

Technology Type	Nameplate Capacity (MW)	Estimated Sept. Net Qualifying Capacity (NQC) MW	Number of Projects
Storage	3,521	3,339	50
Solar	2,901	282	41
Hybrid (storage/solar)	786	395	11
Wind	810	103	19
Geothermal	40	31	1
Biogas, biomass, hydro	34	1	8
Subtotal Total New SB100 Resources, IN-California ISO	**8,092**	**4,151**	**130**
Natural gas, incl. Alamitos & Huntington Beach, California ISO	1477	1476	12
Total New Resources, IN-California ISO	**9,569**	**5,627**	**142**
New Imports, Pseudo-Tie or Dynamically Scheduled	1,523	685	11
Total New Resources, including Imports	**11,092**	**6,312**	**153**

Source: CPUC Staff[27]

Non-CPUC Jurisdictional Supply

POUs are not subject to the CPUC procurement orders, and their activities are not regulated by CPUC orders. However, POUs, and other small utilities, make up about 10 percent of the total energy demand in the California ISO region. The California ISO based resources used by these

27 All data shown derived from California ISO Master Generating Capability List, and CPUC NQC Lists with online dates between Jan 1, 2020 – Sept. 30, 2022. Nameplate Capacity is shown as "Net Dependable Capacity" in the California ISO Master Generating List file. Data shown excludes imports, except where specified. All NQC values are "September NQC" and subject to change based on counting rules. "Project" is defined as a unique California ISO resource ID. "Natural Gas" includes Alamitos Unit 7 (675 MW) and Huntington Beach (674 MW) added in Feb 2020.

entities for reliability are included in the CPUC's NQC[28] list, with adjustments to align with the CPUC Qualifying Capacity accounting rules.[29]

The resources that are expected to be added by the POUs are not tracked directly by the CPUC, though they are considered in CPUC modeling indirectly through information collected by the CEC and eventually in California ISO data when a project comes online. POU IRPs were last reported to the CEC in 2019, consistent with the POU IRP program design that CEC administers. Thus, the quality of data on POU expected additions is not as robust as the data available on CPUC jurisdictional entities. However, the Energy Commission collects expected supply data from these entities through the supply form filings, most recently collected in the Fall of 2022. Although this data is a snapshot of POU supply plans, and not something the POUs will be accountable for meeting, this information provides useful insight into POU plans. The 2022 supply form filings for the POUs in the California ISO balancing authority area include nearly 1,200 MW of new nameplate capacity, see Table 3, which translates to about 300 MW of NQC within the California ISO territory, see Table 4.

Table 3: POU Supply Plan Cumulative Nameplate Capacity Additions (MW)

	2023	2024	2025	2026	2026	2027
Hybrid	19	125	125	125	125	125
Battery Storage	8	8	8	8	8	8
On-Shore Wind	22	22	622	721	820	820
Solar PV	127	127	227	227	227	227
Geothermal	0	0	0	0	0	20
Total	176	282	982	1,081	1,180	1,200

Source: POU Supply Form Filings to the CEC

Table 4: POU Supply Plan Cumulative NQC Capacity Additions Estimates (MW)

	2023	2024	2025	2026	2026	2027
Hybrid	10	57	57	57	57	57
Battery Storage	8	8	8	8	8	8
On-Shore Wind	6	6	6	26	46	46
Solar PV	102	102	202	202	202	202
Geothermal	0	0	0	0	0	10
Total	126	173	273	293	313	323

Source: POU Supply Form Filings to the CEC

The analysis in this report will not include these additional resources for two reasons. First, to avoid the potential for double counting of resources that are contracting with both CPUC and

28 Available at: https://www.cpuc.ca.gov/industries-and-topics/electrical-energy/electric-power-procurement/resource-adequacy-homepage/resource-adequacy-compliance-materials.

29 Available at: https://www.cpuc.ca.gov/-/media/cpuc-website/files/legacyfiles/q/6442466773-qc-manual-2020.pdf.

non-CPUC jurisdictional entities. Second, the information submitted in the CEC supply forms are a snapshot of the utility plans, and not specific contract commitments or required procurement.

CHAPTER 5: Tracking Project Development

The TED Task Force tracks energy development and brings state policymakers information about issues facing energy development in the state.[30] The TED Task Force is composed of representatives from CPUC, CEC, California ISO, and GO-Biz.[31] The Task Force was developed in late 2021, to help ensure that new resources ordered for reliability were brought online as quickly as possible. The objective of the TED Task Force is to track new energy projects critical for near-term reliability that are in development, provide support, as appropriate, for individual projects and identify barriers and coordinate actions across agencies to support all projects. The priority focus for the TED Task Force has been to support near-term projects, defined as those that can come online in the next 1-3 years, on an ad-hoc and as-needed basis.

The CPUC collects information from the LSEs about their various procurement efforts and identifies what capacity is expected to come online, including formal compliance with its IRP procurement orders through biannual LSE compliance filings. As part of the TED Task Force the CPUC provides the relevant information to inform TED Task Force activities and efforts. In these filings, LSEs submit data on the contracts they are using to meet their procurement obligations, as established in the two CPUC procurement orders. Once submitted, the CPUC evaluates LSEs' submitted documentation and assesses progress toward meeting obligations based on requisite milestones that require certain project developments for the various tranches for each procurement order. Generally speaking, the CPUC can assess the need to order backstop procurement based on LSE and project-specific considerations, where a specific LSE plan indicates that it may not be in compliance or that a certain LSE project may be delayed. [32]

The CPUC also receives regular updates on project development and procurement progress from approximately forty CPUC jurisdictional LSEs subject to CPUC IRP procurement orders. The CPUC analyzes the LSE-submitted reports to identify project-specific and/or industry-wide delays hindering project development. This information increases the understanding of resource development but is not used to make determinations about LSE's compliance with the procurement orders and other compliance obligations.

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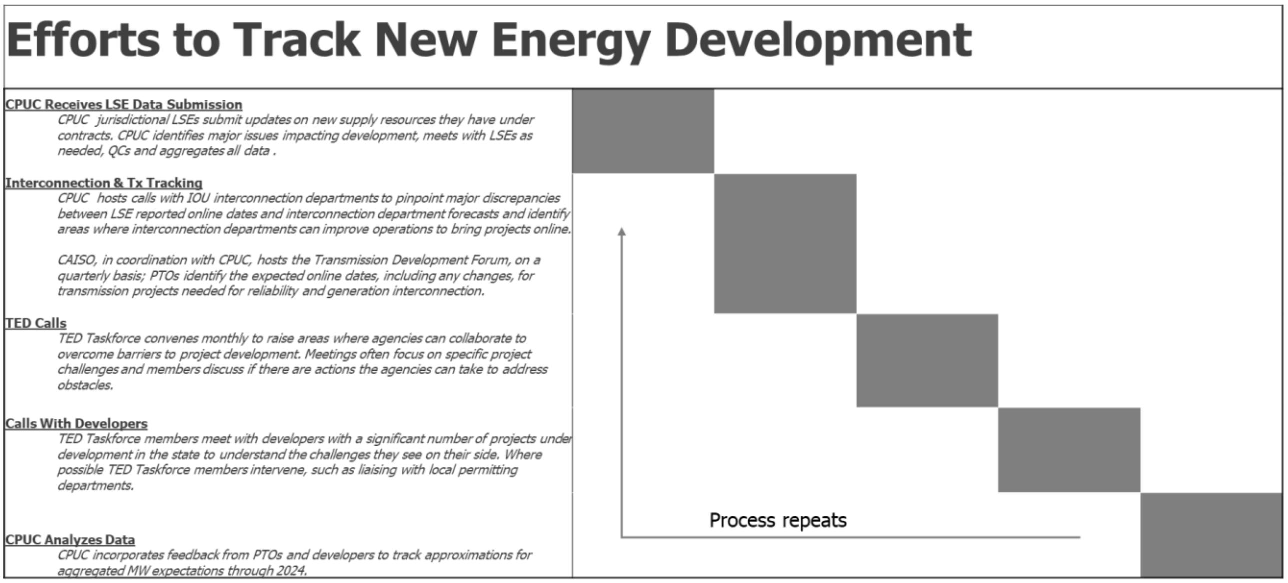
30 For more information on the Tracking Energy Development Task Force see, https://www.cpuc.ca.gov/news-and-updates/newsroom/summer-2021-reliability/tracking-energy-development.

31 AB 137 (2021) established the Energy Unit within GO-Biz to accelerate the planning, financing, and execution of critical energy projects that are necessary for the state to reach its climate, energy and sustainability policy goals through coordination with local, state and federal partners. The Energy Unit is tasked to ensure that private projects both advance the state's energy and climate goals and deliver socioeconomic benefits equitably across the state.

32 See D. 20-12-044 for the CPUC's backstop authority.

The TED Task Force hosts calls with IOU interconnection departments, IOU procurement departments, project developers, and the broader TED Task Force. Figure 5 shows the regular activities that the TED Taskforce members undertake to track project development. This figure is indicative of the CPUC and TED Task Force's efforts to track new energy development but does not include CPUC activities that are part of the IRP proceeding used to determining LSE compliance with procurement orders.

Figure 5: Resource Tracking Efforts



Source: CPUC Staff

The two sections below provide two different snapshots of the total procurement activity, one by TAC area and one by LSE type. The totals provided encompass new supply resources that are expected to come online to meet IRP compliance obligations and will also likely be RA eligible, that CPUC jurisdictional LSEs currently have under contract with online dates throughout 2026. This includes resources being developed for reasons other than compliance with IRP procurement orders. Data in this section are current as of November 2022. LSE procurement activity is still ongoing to meet existing CPUC IRP procurement orders; some of the existing contracts will be delayed and other contracts will be added, which is consistent with the cycle of energy project development.

All totals provided below represent the estimated September NQC under contract to CPUC jurisdictional LSEs (NQCs can vary by month). These totals are subject to change as the CPUC receives new data reports from LSEs field calls with developers and Participating Transmission Owners (PTO) interconnection departments, and as CPUC staff continue to evaluate the data. The underlying projects' expected data can be challenging to track: a single new resource can have multiple expected online date changes, multiple off takers, multiple online dates for different tranches of a project, multiple technologies in various configurations, changes to project sizing, and ultimately projects come online as one or several California ISO resource identification numbers (California ISO Resource IDs).

Procurement by Transmission Access Charge (TAC) Area

This section provides aggregated totals by TAC area based on data from both LSEs and IOU interconnection departments. The "Outside California ISO" projects are those that are either out-of-state or out of California ISO. However, where IOUs have indicated that they are working on interconnection matters, these projects may be included in the respective IOU's TAC area total even if the project is not physically located in the TAC area and merely interconnecting in that area.

Error! Reference source not found. Table 5 shows the estimated September NQC (MW) under development by each TAC area.[30] These data include only projects that have not yet reached commercial online status yet, as of November 2022. Please note that the values listed below are subject to change frequently as additional projects are contracted for by LSEs and as existing contracts experience delays.

Table 5: Estimated September NQC (MW) by TAC Area

TAC Area	2023				2024				2025				2026			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
SCE TAC	371	1,263	1,535	1,757	2,585	4,123	4,173	4,431	4,714	4,729	4,729	4,729	4,744	4,812	4,827	4,827
PG&E TAC	49	766	827	889	1,010	1,094	1,213	1,348	1,623	1,816	1,816	1,891	1,891	1,923	1,923	1,925
SDG&E TAC	131	226	276	356	696	796	796	796	796	842	842	842	842	843	843	843
Outside CAISO	-	71	71	71	246	394	394	408	417	419	421	424	424	480	480	482
Total	551	2,326	2,709	3,072	4,537	6,407	6,576	6,983	7,549	7,806	7,808	7,885	7,901	8,058	8,073	8,077

Source: CPUC Staff

Procurement by LSE Type

Table 6 is the estimated September NQC (MW) under contract broken out by LSE type. Non-IOUs include both CCAs and energy service providers (ESPs).

Table 6: Estimated September NQC (MW) by LSE Type

E Type	2023				2024				2025				2026			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
IOU	339	1,752	1,900	1,922	2,970	4,227	4,319	4,319	4,594	4,721	4,721	4,721	4,721	4,721	4,736	4,736
Non-IOU	212	573	809	1,149	1,566	2,180	2,256	2,663	2,955	3,084	3,086	3,163	3,179	3,336	3,336	3,340
Total	551	2,325	2,708	3,072	4,536	6,406	6,575	6,982	7,549	7,805	7,807	7,885	7,900	8,057	8,072	8,077

Source: CPUC Staff

Tracking Energy Development with Challenges

As described above, the state has experienced a large quantity of new generation coming online in the past three years, and based on LSE contracting, the state expects a large amount of additional procurement to yield high levels of new resources. Nonetheless, delays in new resources are an important area to monitor and understand. There are a variety of issues facing the multitude of generation projects currently under development in California. Some challenges are consistent and persistent across many projects. While expected online date changes are common, it is worth noting that the CPUC's jurisdictional LSEs have not been delayed in meeting CPUC IRP orders for new generation.[33] The CPUC assesses LSE compliance with IRP orders, in addition to working with the TED Task Force to identify, monitor, and mitigate — if possible — issues that face energy development.

In tracking new energy development, the TED Task Force observes there is not one specific issue facing all generation projects currently in development in California, and each project faces its own unique challenges. However, there are three issues that are frequently raised by developers as leading to delays and are the three issues that the TED Task Force was established to help overcome: supply chain disruptions, interconnection approval delays, and permitting delays.

Supply Chain

There are multiple supply chain issues affecting clean energy development, including the availability and cost of critical construction materials and disruptions in products being delivered (for example, tariff, labor, and shipping issues). The TED Task Force maintains awareness of the first types of issues but focuses on the potential disruptions. The COVID-19 pandemic created greater awareness of supply chain disruptions and although those are easing to some extent, unresolved issues remain. Delays are expected to continue to impact procurement in the near-term, but there is uncertainty about whether significant delays from disruptions will persist beyond that.

In March 2022, Auxin Solar filed a petition with the U.S. Department of Commerce that claims that solar cells and modules imported into the U.S. from Cambodia, Malaysia, Thailand, and Vietnam were circumventing U.S. duties on products from the People's Republic of China (China). The Auxin Solar Petition had the potential to prevent importing solar cells and modules – that potentially impacted at least 4,350 MW of solar plus storage projects in California ISO territory with online dates between 2022 and 2024.[34] While the Biden Administration provided temporary relief[35] by declaring a national emergency and providing duty-free treatment of solar cells and modules from Southeast Asia for two years, project

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33 See https://www.cpuc.ca.gov/-/media/cpuc-website/divisions/energy-division/documents/integrated-resource-plan-and-long-term-procurement-plan-irp-ltpp/d1911016-feb-2022-procurement.pdf.

34 See Governor Newsom's letter to Secretary Gina M. Raimondo: https://s3.documentcloud.org/documents/21761581/newsom-letter.pdf.

35 See Declaration of Emergency and Authorization for Temporary and Duty-Free Importation of Solar Cells and Modules from Southeast Asia at https://www.whitehouse.gov/briefing-room/statements-releases/2022/06/06/declaration-of-emergency-and-authorization-for-temporary-extensions-of-time-and-duty-free-importation-of-solar-cells-and-modules-from-southeast-asia/.

delays could persist, especially given the Department of Commerce's recent findings that the largest solar manufacturers were circumventing U.S. tariffs.[36]

Additionally, LSEs and developers have described delays for batteries and other critical components (for example, inverters, transformers, switches). Battery delivery from China was impacted by strict lockdowns that limited manufacturing and shipment. There have been changes in shipping regulations that impact the types of ships that can carry batteries and the number of batteries that can be loaded onto individual ships. There have been delays in port offloading. Congestion among the West Coast's busiest ports, including Oakland, Long Beach, and Los Angeles, exacerbated the supply-focused project delays. Labor strikes also impacted timelines for critical component deliveries, especially for solar inverters. While it is uncommon to have all these issues affecting an individual project, one or more of these supply chain disruptions can impact project delivery dates.

Like the rest of the economy, all parts of the supply chain have experienced limited availability and inflationary pressures, not just panels and batteries, but also cement, transformers, and other balance of plant equipment. Rapidly rising commodity prices, especially for lithium carbonate, are making some previously viable projects less compelling, with Russia's invasion of Ukraine worsening these rising costs even further. Price increases in project components can make projects unviable for developers, making it more costly for them to complete the project at the negotiated price versus defaulting on their contract and losing their deposits. Many developers have sought price renegotiations as a result of the inflationary pressures and have revised online dates as a result of supply chain challenges. Developers and LSEs alike have noted that the recently passed Inflation Reduction Act (H.R. 5736)[37] is helping to curb overall price increases, potentially offsetting otherwise dramatic price increases. To deal with increases in the lithium carbonate market, developers have started to index the component price, and often provide LSE off-takers an "off-ramp" if the price goes above a certain threshold.

Interconnection and Transmission

As the state's principal energy agencies concluded in their 2021 SB 100 Joint Agency Report, California, on average, will need to build 6 GW of new solar, wind and battery storage resources annually from now until 2045. That would represent a near tripling of the annual build rate for wind and solar from recent years and an almost 8-fold increase in the annual build rate for energy storage projects – including long-duration storage – which is an essential component of grid reliability for being able to dispatch stored solar and wind power regardless of their immediate availability. Together, the new resources would result in capacity that is more than double the amount available to the system today. To maintain course with this accelerated transition, the CPUC has authorized historic rates of additional resource

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36 See the Department of Commerce's Preliminary determination: https://www.commerce.gov/news/press-releases/2022/12/department-commerce-issues-preliminary-determination-circumvention.

37 See Inflation Reduction Act of 2022 at https://www.congress.gov/bill/117th-congress/house-bill/5376/text.

procurement the past several years, with more such authorizations anticipated in the near term.

This rapid acceleration in resource development needed in the near and longer term has created challenges in the processes for studying and interconnecting new resources. Over the last 15 years, the California ISO has processed more than 2,000 generation projects that have requested interconnection to the California ISO-managed grid, providing interconnection customers with the information needed to make decisions on how to proceed with their projects and to compete for power purchase agreements with California LSEs. As a result of the high level of competition among resource developers, the California ISO processes multiples of applications, beyond those that ultimately are successful in obtaining a power purchase agreement and move forward into construction. With the significant acceleration in procurement targets, these processes must continue to evolve to align with the new dynamics driving resource development. The dramatic increase in competition among suppliers to meet the rapidly escalating demand for new resources and the compressed timelines for procurement and construction activities has significantly increased the pressure on the California ISO generator study and interconnection process. Accordingly, one of the objectives of the recently executed Memorandum of Understanding between the California ISO, CPUC and the CEC is to focus on project prioritization through alignment of state resource planning, California ISO transmission planning, procurement processes, and the interconnection process.

Once studied, projects enter into interconnection agreements that set out the project-specific interconnection facility or multi-project transmission network upgrades identified in the study process that need to occur prior to interconnection. While the interconnection agreements identify the upgrades required to be built, their actual construction (with associated challenges) can cause generation development timeline uncertainty. The overall volume of projects in the interconnection process is also a challenge; the PTO interconnection departments and the California ISO are faced with the complexity of managing a high volume of interconnection queue projects, both existing and newly proposed. As a project goes through its lifecycle, it is common for interconnection customers to modify their projects for commercial or technical reasons, resulting in the need to consider time-consuming project modification requests to, for example, adding storage from an existing project. The California ISO queue has over 460 projects listed as "in process"; however, only 189 projects with an estimated 42.5 GW of potential generation have signed interconnection agreements (or are identified as "in progress" for an executed interconnection agreement). (See Table XX) In addition to these numbers, the California ISO is studying its Cluster 14, which has a record-setting 373 interconnection requests.[38]

To help promote transparency and ensure that all parties have access to information about project development timelines, the California ISO, in conjunction with the CPUC, initiated quarterly Transmission Development Forums to provide status updates on transmission projects previously approved through the transmission planning process and network upgrades

38 See Decision on Interconnection Process Enhancements – Phase 1 at

http://www.caiso.com/Documents/DecisiononInterconnectionProcessEnhancements-Phase1-Memo-May2022_.pdf identified as dependencies to the generation interconnection process. The California ISO also initiated its Interconnection Process Enhancements initiative to address the complexity of managing high volumes of projects in the queue.

In March 2022, CPUC President Alice Reynolds sent a letter to each of the three largest PTO interconnection departments to emphasize the importance of interconnection issues for new energy development.[37] The CEOs of each PTO IOU responded to President Reynolds' letters, noting that their interconnection departments are challenged by complex processes that require their staff to coordinate among disparate groups within the utility. These teams have specialized roles that require a high level of workforce expertise – that ranges from design and engineering acumen to construction and procurement specializations — to complete the work necessary to get these projects interconnected. Additionally, the CEOs' response letters provided information on what their respective utility was doing to improve interconnection processes, ranging from increasing interconnection staffing to providing more accurate forecasts for when projects will be in-service.

The CPUC has since set up regular meetings with each PTO interconnection department to track their progress toward meeting the goals that they established in their response letters and to track project development milestones.

Table 7: Projects in Interconnection Queue with Signed or In Progress Interconnection Agreements, January 2023

Interconnecting PTO	Sum of Net MWs to Grid	Count of Interconnection Queue Projects
DCRT	3700	2
GLW	1947	8
PGAE	14425.53	88
SCE	17731.42	65
SDGE	4640.28	25
VEA	50	1
Grand Total	**42494.23**	**189**

Source: California ISO Interconnection Queue, available at https://www.caiso.com/PublishedDocuments/PublicQueueReport.xlsx

Further, the transmission system is being called upon to support in 10 years, over 6 times the amount of new installed capacity forecasted only two years ago. The transmission system has been reasonably well-positioned to meet current and near-term needs, but to be successful in meeting emerging needs, the processes for planning, siting, and building new transmission must also be accelerated and enhanced to ensure that the bulk power system in California and the West will have the right transmission in the right locations in a timely manner.

Permitting

Lengthy local permitting requirements can also create delays to project development. Currently, there are projects under development in 40 counties and over 100 cities in

California. Projects are being developed in localities that may have never had to permit energy projects. Some of these localities are faced with a steep learning curve in conducting reviews and issuing permits on technologies new to them. While land use permits have always been a potential construction project delay, the most significant emerging issue is permitting energy storage. Recent energy storage fires are resulting in closer scrutiny of storage projects to ensure they meet fire code.

TED Task Force Strategies to Support Energy Development

The TED Task Force has taken numerous steps to help keep projects on track. These include:

- **Increase General Awareness** to communicate the importance of new energy development to meeting the state's near-term reliability needs and long-term policy goals and to continue communicating broadly that stakeholders understand that high levels of development are the "new normal" and– will persist throughout the decade.
- **Develop Tools to Communicate Key Information** to stakeholders. The CPUC gets project updates from LSEs and augments LSE-provided information with additional details provided by IOU interconnection departments and from developers. Additionally, the CAISO and the CPUC initiated the California ISO's Transmission Development Forum to better share information about transmission network upgrades needed for generator development.
- **Look for Opportunities for Process Improvements** throughout different portions of the generator development lifecycle. As mentioned, the CPUC is collaborating with IOU interconnection departments to work on improving interconnection processes and related transmission development processes. Using various sources of input on project development, the CEC, CAISO, and CPUC are working on identifying areas where existing or new policy efforts can support process improvements. on identifying areas where existing or new policy efforts can support process improvements.[39]
- **Facilitate Timely Communications** to direct state efforts toward bringing near-term projects online. GO-Biz, for example, worked collaboratively with the local governments to ameliorate permitting slowdowns. The CPUC and the California ISO have also worked collaboratively to accelerate timelines for project development.

39 See California ISO User group and recurring meetings at https://www.caiso.com/informed/Pages/MeetingsEvents/UserGroupsRecurringMeetings/Default.aspx.

CHAPTER 6: Reliability Assessment

The reliability assessment approach used for this report is consistent with the Summer Stack Analysis for 2022-2026 published by the CEC in July 2022.[40] The analysis compares an hourly evaluation of anticipated supply against the projected hourly demand for the peak day of each month, July through September. The comparison stacks the resources expected to be available in each hour and compares the total against the projected demand plus a 17 percent reserve margin (referred to as the current RA planning standard, or planning standard), equivalent events to 2020 and 2022 peaks, and those situations under high fire risk situations. This assessment identifies the max hourly shortfall by year for each scenario. Given the condensed timeline to develop this report, the CEC and CPUC relied on a deterministic stack analysis approach. It is difficult to articulate the probability of the outcomes contained in the results from a deterministic stack approach. Thus, the actual probability of the outage risks associated with different supply and demand balances are uncertain, especially when looking far out in the future. Both agencies are working to conduct the analysis using a loss of load expectation (LOLE) analysis. The agencies will attempt to include LOLE analysis in future quarterly reports.

The following is a summary of the key input assumptions used in this analysis.

- **Demand**: The hourly demand scenario used for this analysis is the draft 2022 CED Planning Forecast.[41] Additional information on this can be found in CHAPTER 3: Demand Forecast.
- **Conditions Relative to the 1-in-2 Forecast**: This analysis explores 3 system conditions (*Table 8: System Conditions Defined*). First, the current RA planning standard of 16 percent for 2023 and 17 percent beginning in 2024. Second a 2020 equivalent event that experiences 50 percent higher forced outages and demand variability, equating to the need for 22.5 percent margins above the forecasted peak demand. Finally, the 2022 equivalent event that further increases the demand variability to 12.5 percent to align with the demand variability seen in the September 2022 events, equating to a 26 percent margin above the forecasted peak. All of these conditions were also evaluated under a coincidental fire risk reduces the total import capacity by 4,000 MW.

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40 Craig, Hannah. 2022. *Summer Stack Analysis for 2022-2026*. California Energy Commission. Publication Number: CEC-200-2021-006-REV.

41 Draft - CED 2022 Hourly Forecast California ISO Planning Scenario at https://www.energy.ca.gov/event/workshop/2022-12/iepr-commissioner-workshop-updates-california-energy-demand-2022-2035-0.

Table 8: System Conditions Defined

Condition Relative to 1-in-2 Forecast	Operating Reserves	Outages	Demand Variability	Coincidental Fire Risk	Notes
Current RA Planning Standard – 17%	6%	5%	6%		16% for 2023 & 17% beginning 2024
2020 Equivalent Event: Additional capacity needed to weather heat event like 2020	6%	7.5%	9%	4,000 MW	9% higher demand over median, and 2.5% higher levels of outages
2022 Equivalent Event: Additional capacity needed to weather heat event like 2022	6%	7.5%	12.5%	4,000 MW	12.5% higher demand over median, and 2.5% higher levels of outages

Source: CEC Staff – 1/20/2023 Lead Commissioner Workshop

- **California Public Utilities Commission November 1, 2022, NQC list:**[42] Existing resources located within the California ISO are based on this list, including resources online through October 2022. These additional resources are outlined in Table 3.
- **Resource Updates**: Two resource builds are used in this analysis, the first is based on LSE compliance with the CPUC-ordered reliability procurement from D.19-11-016 and D.21-06-035. The second is based on alignment of LSE procurement activities with the CPUC's 2021 PSP, which assumes full compliance with D.19-11-016 and D.21-06-035, with some delays for long-lead time resources, as well as additional procurement needed for GHG-reduction. Therefore, the PSP includes more resources than the procurement order-based resource build. Details on the 2021 PSP and the CPUC's procurement orders are provided in Chapter 3: Supply Forecast, with specific capacity numbers used in this analysis described below, in Supply Scenario Input. Capacity numbers in the PSP and the procurement orders were adjusted to align with the CPUC's November 2022 NQC list as the baseline resources. This analysis does not consider

42 CPUC Final Net Qualifying Capacity Report for Compliance Year 2023. Published November 1, 2022. https://www.cpuc.ca.gov/-/media/cpuc-website/divisions/energy-division/documents/resource-adequacy-homepage/resource-adequacy-compliance-materials/cpuc-final-net-qualifying-capacity-report-for-compliance-year-2023-1nov22.xls, accessed on December 15, 2022.

additional procurement currently under consideration in the CPUC's January 13, 2023, PD.

- **Demand Response (DR):** The IOU DR monthly projections are published by the CPUC in their Load Impact Protocol Reports.[43] These numbers are used in addition to the CPUC's November 2022 NQC list for the baseline demand response. See Table X. The DR numbers, in *Table 9: 2023 Aggregated DR Numbers Reported by IOUs*, are assumed to be fixed to 2032 because the IOUs do not forecast or report DR numbers out to a 10-year horizon. Future studies will continue to make improvements on the representation of DR and to improvement alignment between the CPUC and CEC characterization of DR in their analysis.

Table 9: 2023 Aggregated DR Numbers Reported by IOUs

	July	August	September
Demand Response (MW)	1,159	1,194	1,202

Source: CEC Staff with Load Impact Protocol Report data

- **RA Imports**: Standard imports are set to 5,500 MW in every hour. The 5,500 MW of fixed RA imports was set in consultation with California ISO and CPUC. The value is consistent with modeling approaches used by both agencies. In addition to the 5,500 MW of RA imports, the stack analysis includes contributions from out-of-state wind resources on new transmission interconnected directly into the California ISO above this total import number, consistent with CPUC modeling for the PSP.
- **Wind and Solar:** The CEC uses hourly shapes to estimate generation from onshore wind and solar located within the California ISO balancing authority footprint. These are based on historic generation on high-load days between 2014 and 2021. Offshore wind and out-of-state wind are included in the stack based on the expected ELCC values for those resources.[44]
- **Battery Storage**: Battery storage is limited to 4 hours of total discharge within a 24-hour stack. Storage is optimized so that the shortfall in any given hour is equal or less than the capacity shortfall at net peak. The full nameplate capacity for battery storage

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43 SCE: https://www.cpuc.ca.gov/-/media/cpuc-website/divisions/energy-division/documents/resource-adequacy-homepage/sce-fy2022-dr-lip-allocations-py2023-2025-public.xlsx
PG&E: https://www.cpuc.ca.gov/-/media/cpuc-website/divisions/energy-division/documents/resource-adequacy-homepage/pge-to-complete----fy2022-dr-lip-allocations-for-py2023-2025-public.xlsx
SDG&E: https://www.cpuc.ca.gov/-/media/cpuc-website/divisions/energy-division/documents/resource-adequacy-homepage/sdge-to-complete----fy2022-dr-lip-allocations-for-py2023-2025-public.xlsx

44 Reliability Filing Requirements for Load Serving Entities' 2022 Integrated Resource Plans - Results of PRM and ELCC Studies, slide 42. 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/20220729-updated-fr-and-reliability-mag-slides.pdf, accessed on December 15, 2022.

is included in the stack, rather than the ELCC values because discharge limits are directly incorporated. See Hourly Wind, Solar, and Battery Shapes, below for additional information.

- **Retirements**: The stack analysis assumes Once-Through-Cooling (OTC) plants and Diablo Canyon Power Plant (DCPP) retire as currently scheduled. This is December 31, 2023, for the 3,700 MW of OTC gas plants. DCPP Units 1 and 2 are assumed to be offline by 2025, resulting in 2,280 MW of capacity reduction to the supply stack.

Supply Scenario Input

Two groups of scenarios were evaluated, each forecasting different supply assumptions from 2023 through 2032. The first group is based on LSE compliance with the CPUC ordered procurement from D.19-11-016 and D.21-06-035. The second group is based on alignment of LSE procurement activities with the CPUC's 2021 PSP, see CHAPTER 4:
Supply Forecast. Both supply assumptions were analyzed with different levels of procurement delays and reductions.

- **Delay Scenarios:** Given that there are uncertainties in new clean energy resources coming online (for example, supply chain, interconnection, and permitting) the analysis looks at different scenarios that might affect timely online dates. The delay scenarios assume that each year a percentage of resources will be delayed by 1 year. Scenarios were run for a 0 percent delay (full order/PSP), 20 percent delay and a 40 percent delay. The delayed capacity is assumed to come online in the following year without any additional delay.
- **Reduction Scenarios:** The reduction scenarios assume that less resources come online than forecasted in the procurement orders and the PSP. Scenarios were run for a 0 percent reduction (full order/PSP), 20 percent reduction and a 40 percent reduction.

The 0 percent delay and reduction scenarios are identical, as they report the full builds as expected. All resource build scenarios were run with the Draft - CED 2022 Hourly Forecast California ISO Planning Scenario.

Procurement Order Resource Build

The procurement order resource build includes the remaining procurement associated with D.19-11-016 and D.21-06-035. Table 10 shows the NQC ordered by each decision, the total contracted NQC for the orders, the remaining contract need, and the total NQC that needs to be added in this scenario beginning in 2022.

Table 10: Ordered NQC Description

MW NQC	2021	2022	2023	2024	2025	2026	2027	2028
D.19-11-016	1,650	2,475	3,300	3,300	3,300	3,300	3,300	3,300
D.21-06-035	-	-	2,000	8,000	9,500	11,500	11,500	11,500
Total Ordered	1,650	2,475	5,300	11,300	12,800	12,800	12,800	14,800
Contracted Procurement	1,536	3,428	6,453	9,061	9,529	9,683	9,619	9,587
Remaining Need	114	(953)	(1,153)	2,239	3,271	3,117	3,181	5,213
Incremental NQC from 2022	-	-	3,025	8,825	10,325	10,325	10,325	12,325

Source: CEC staff analysis of CPUC Procurement Order Data

The CPUC provided information on the capacity under contract with the LSEs to meet these orders and the estimated remaining nameplate capacity necessary to achieve the NQC requirements. The estimates relied on CPUC-provided ELCC values for the resources specified. Actual nameplate capacity required to comply with these orders will depend on the resources selected by each LSE. Due to changing ELCC values, the capacity needed in one year may be less than the previous year. In these cases, the total nameplate capacity additions were not reduced. As a result, the total NQC added in this scenario results in a slight over procurement by the end of 2028. Finally, the contracted capacity is adjusted to account for resources already included in the CPUC November 2022 NQC list, which is the base resource assumption for this analysis. The total nameplate capacity added for this scenario is provided in Table 11.

Table 11: Estimated Ordered Resources in MW Nameplate Capacity

Resource Type (MW)	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**
Solar	1,973	6,278	7,306	7,732	7,732	7,731
Battery[45]	2,820	8,536	11,138	11,601	11,601	12784
Wind	91	311	480	458	458	458
Geothermal	26	80	94	108	134	1,191
Biomass/Biogas	0	0	0	0	0	0
Offshore Wind	0	0	0	0	0	0
Pumped Hydro	0	0	0	0	0	0
Shed DR	42	63	69	68	68	69
Thermal	0	0	7	7	7	7
OOS Wind on New Transmission	0	0	0	0	0	0
Total	**4,952**	**15,268**	**19,094**	**20,001**	**20,001**	**22,241**

Source: CEC staff analysis of CPUC Procurement Order Data

The resource needs established by the CPUC's procurement orders were developed using the 2020 CED mid demand update[46] and only include procurement through 2028. The option to delay procurement of the long lead time resources, which are assumed to be geothermal and 8-hour batteries, from 2026 to 2028 is assumed to be taken. Thus, in this scenario, the long lead time resources that are not already under contract arrive in 2028.

The Preferred System Plan

The nameplate capacity numbers used for the PSP are consistent with the discussion in CHAPTER 4:
Supply Forecast; however, they have been adjusted to account for the actual capacity

45 Battery total nameplate capacity includes standalone batteries, batteries used in hybrid configurations, and 8-hour batteries which are part of the long lead time resources.

46 Bailey, Stephanie, Nicholas Fugate, and Heidi Javanbakht. 2021. *Final 2020 Integrated Energy Policy Report Update, Volume III: California Energy Demand Forecast Update*. California Energy Commission. Publication Number: CEC-100-2020-001-V3-CMF.

additions, contracts that were included in the PSP baseline when the resources are not yet online, and a shift in the baseline resources.

- **Actual Capacity Additions:** The PSP was developed based on a June 2020 baseline, including existing generation, and known contracts for generation not yet online. The analysis for this report relies on the CPUC NQC list from November 2022, which captures actual resource additions. To capture this adjustment, the CEC and CPUC staff adjusted the total nameplate capacity for 2022 in the PSP to account for actual resource additions. After accounting for contracts in the PSP baseline, the cumulative additions toward the 2022 PSP totaled approximately 2,700 MW.
- **Existing Contracts for New Capacity Post 2023:** The PSP baseline includes about 1,700 MW contracted capacity, all wind and solar, that will come online in 2023 and 2024. This capacity was added to the PSP resource build as it was not included in the CPUC's November 2022 NQC list.
- **Baseline Resource Year:** The baseline resource year for the additions was shifted from June 2020 to align with the publication of the CPUC November 2022 NQC list. This was done by reducing the PSP capacity build, including the noted adjustments above, by the cumulative additions for 2022. Thus, all additions are reported as incremental to the resources in the CPUC's November 2022 NQC list.

The resulting resource build can be found in Table 12. Please note that no incremental additions are noted for 2029 and 2031. These years were not included in the PSP analysis, and thus no new incremental additions were assumed for those years. Finally, it should be noted that the PSP was developed using the 2020 Mid CED, and not the draft 2022 CED Planning Scenario. Thus, the reliability of this resource build is expected to be lower than previous studies that used the 2020 Mid CED, this shortfall should grow more meaningful after 2028 as transportation demands grow more rapidly. When the CPUC updates the PSP, appropriate adjustments will be made to align with the selected CED at that time.

Table 12: Adjusted PSP Resource Build

	2023	2024	2025	2026	2027	2028	2030	2032
Solar	6,693	8,404	11,654	11,654	11,654	12,051	14,996	18,160
Battery	3,025	8,598	10,103	10,103	10,103	10,864	11,181	12,357
Wind	1,377	1,707	3,189	3,189	3,189	3,189	3,189	3,189
Geothermal	89	89	94	159	159	1,135	1,135	1,135
Biomass/Biogas	32	50	74	74	74	101	101	101
Offshore Wind	-	-	-	120	120	195	195	1,708
Pumped Hydro	-	-	29	196	196	1,000	1,000	1,000
Shed DR	151	353	441	441	441	441	441	441
OOS Wind on New Transmission	-	-	-	-	-	-	1,500	1,500
Total	11,367	19,201	25,585	25,936	25,936	28,976	33,738	39,591

Source: CEC and CPUC staff analysis of CPUC PSP and the November 2022 CPUC NQC list.

Hourly Wind, Solar, and Battery Shapes

Hourly wind shapes and solar shapes were developed from California ISO-wide aggregated generation profiles, normalized to installed capacity, for each hour from 2014-2021. Using historic hourly demand data from the California ISO Open Access Same-time Information System (OASIS) portal, the median wind generation value for each hour of the day was calculated based on the five highest-load days of each month for each year 2014-2021. The 20th percentile for the wind generation value is calculated similarly. The profiles are a weighted average of the median and the 20th percentile, with 80 percent of the weight going to the median and 20 percent to the 20th percentile. This weighting method is similar to the NQC approach for projecting non-dispatchable hydro capacity.

Hourly Profile = (0.2 x 20th Percentile) + (0.8 x Median)

Battery storage and long duration storage are optimized so that the energy shortfall does not result in numbers higher than the capacity shortfall. The profile is created in five steps:

1. First, find the capacity shortfall. This is the highest shortfall in any hour with the batteries discharging at full capacity.
2. Then, spread the battery discharge out so that in any hour that has a shortfall without battery discharge, the shortfall in that hour is less than or equal to the capacity shortfall.
3. If there is battery capacity remaining after step 2, the battery discharge is used to eliminate the smallest hourly shortfall or reduce it as much as the capacity and power of the batteries allows.
4. Step 3 is repeated until the battery discharge reaches 4 total hours.
5. If every hour has either no shortfall or the maximum hourly battery discharge before total discharge reaches 4 hours, the remaining discharge is split evenly between the 4 and 10 PM hours that have not reached maximum hourly discharge.

Table 13 shows the hourly profile used for solar, wind and battery resources. While the solar and wind profile remains unchanged throughout the analysis, the battery profile changes to reduce the shortfalls. Therefore, the battery profile in Table 13 is for 2023 September peak hours, which was created using the ordered supply case with a 40 percent delay. The ordered supply scenario with a 40 percent delay is the extreme case in 2023 thus, the battery profile is optimized to reduce the shortfalls as much as possible across all critical hours.

Table 13: Wind, Solar, and Battery Hourly Profile

Wind				**Solar**				**Battery**			
Time PDT	Jul	Aug	Sep	Time PDT	Jul	Aug	Sep	Time PDT	Jul	Aug	Sep
4PM-5PM	0.38	0.28	0.17	4PM-5PM	0.71	0.72	0.64	4PM-5PM	0.39	0.31	0.00
5PM-6PM	0.45	0.34	0.21	5PM-6PM	0.57	0.55	0.41	5PM-6PM	0.39	0.31	0.64
6PM-7PM	0.48	0.40	0.24	6PM-7PM	0.33	0.26	0.10	6PM-7PM	0.60	0.95	0.83

Wind				Solar				Battery			
7PM-8PM	0.51	0.44	0.29	7PM-8PM	0.07	0.03	0.00	7PM-8PM	1.00	1.00	1.00
8PM-9PM	0.52	0.49	0.34	8PM-9PM	0.00	0.00	0.00	8PM-9PM	1.00	1.00	1.00
9PM-10PM	0.55	0.51	0.32	9PM-10PM	0.00	0.00	0.00	9PM-10PM	0.61	0.43	0.54

Source: California Energy Commission staff with California ISO data

Annual Results

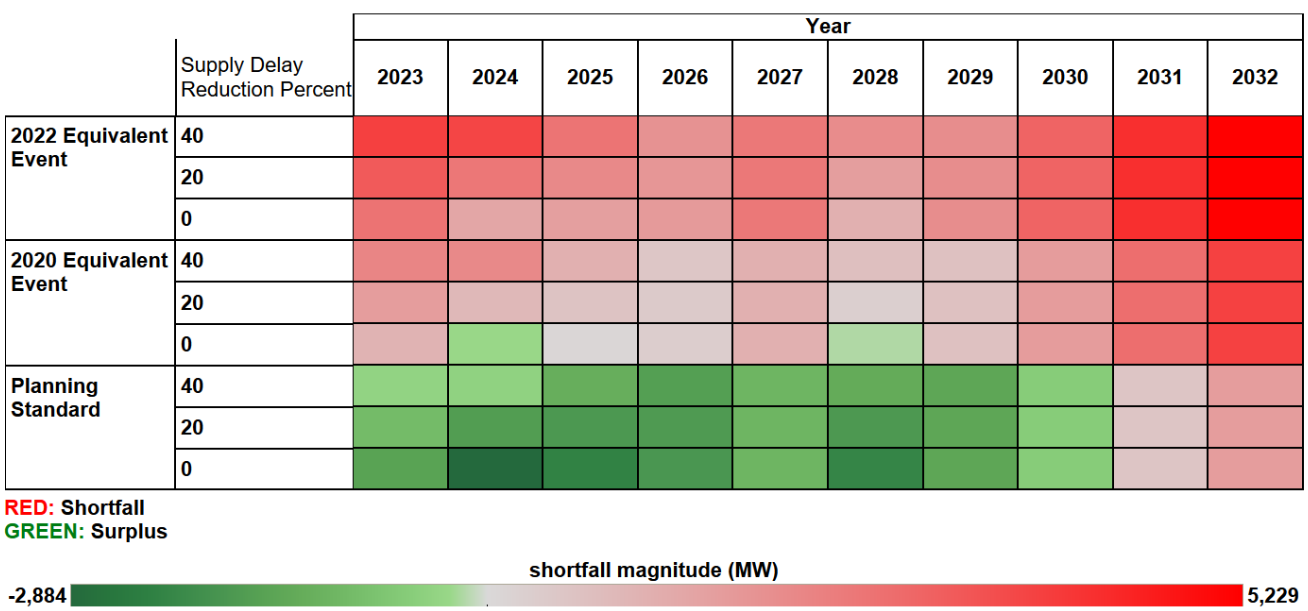
The annual results discussed are the maximum capacity shortfalls found in each of the deterministic scenarios introduced above, within each reliability year (defined as year ending in September 30). It should be noted that the deterministic scenarios are not directly tied to any particular probability, however insights can be drawn from the results relative to one another.

Ordered Procurement

<u>10-Year Overview – Delay Scenario: </u>This section will explore the supply and demand balance in the 10-year horizon using 0, 20, and 40 percent delay adjustments to the ordered procurement supply in each year. The annual supply was compared to a planning standard of a 17 percent reserve margin. Then, the annual supply was compared to more extreme events, which were defined as a 2022 equivalent event and a 2020 equivalent event.

Under the planning standard, the ordered procurement resulted in surplus under all delay scenarios until 2030, which is due to no new supply being ordered after 2028 and the gradual demand increase year to year. The max shortfall observed in the planning standard was 1600 MW in 2032 (*Figure 6: 10-Year Supply Imbalance Outlook – Ordered Procurement*).

Figure 6: 10-Year Supply Imbalance Outlook – Ordered Procurement



Source: California Energy Commission staff with CPUC data

When considering the impacts of extreme events, the supply imbalance outlook becomes worse with 2032 having a 5,200 MW shortfall, in a 2022 equivalent event.

Another element to consider in addition to extreme events, which can worsen an already strained power grid, is loss of transmission. More specifically, this analysis briefly explored the impact of losing 4,000 MW of capacity, as a result fire causing transmission lines to be de-energized. The effects of losing 4,000 MW in the 10-year horizon leads to shortfalls in every year, including shortfalls under traditional planning standard, and greatly increase the shortfalls in the most extreme events, up to 9,200 MW.

<u>5-Year Overview – Delay Scenario:</u>

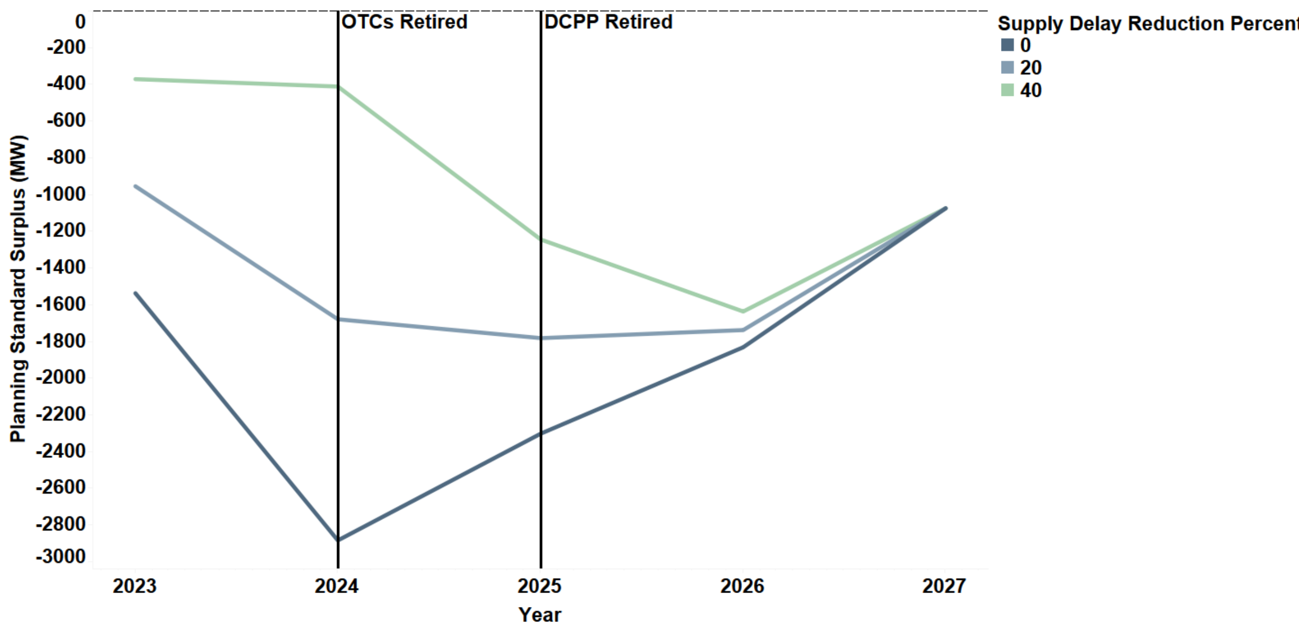
In the 5-year horizon (2023-2027), there are various retirements that may impact the supply and demand balance. By 2023, multiple large once-through cooling plants are anticipated to retire unless their OTC compliance dates are extended by the State Water Resources Control Board. Four fossil gas-fired plants: Alamitos Generating Station; Huntington Beach Generating Station; Ormond Beach Generating Station (Ormond Beach); and Redondo Beach Generating Station are currently scheduled to retire by December 31, 2023.

Their operation may be extended to support the SRR, but they would not be made available to provide contracted resource adequacy. DCPP units will fully retire by 2025, unless the state decides to extend its operation.[47] Therefore, the period of 2023 – 2026 represents a critical period for state grid reliability. This section provides additional detail on this period. The key year, 2025, for reliability was analyzed below.

Within the 5-year horizon, the planning standard resulted in surplus in all delay scenarios and with OTC and DCPP retirements considered (*Figure 7: 5-Year Surplus Trend - Planning Standard*).

Figure 7: 5-Year Surplus Trend - Planning Standard

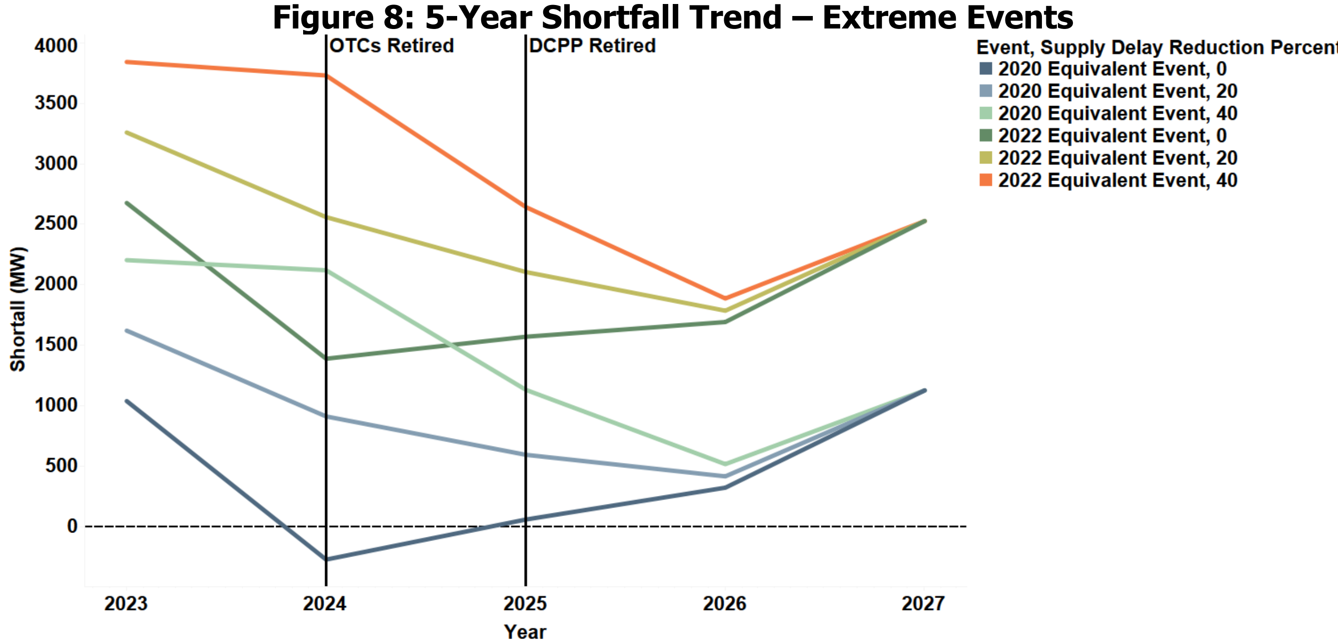
47 See DCPP units at http://www.California ISO.com/Documents/AnnouncedRetirementAndMothballList.xlsx.



Source: California Energy Commission staff with CPUC data

When analyzing the supply and demand balance in extreme events, shortfalls can be observed in the 5-year planning horizon (*Figure 8: 5-Year Shortfall Trend – Extreme Events*). The max shortfall between 2023-2027 is 3,800 MW, observed in 2023 if a 2022 equivalent event were to occur again, and the minimum is 500 MW in 2026. The hourly impacts will be studied later in this chapter. Note that this scenario does not include a coincident event of transmission capacity loss from a wildfire. This scenario also does not include contingencies, such as the Strategic Reliability Reserve, which are intended to support grid reliability in extreme event situations.

Figure 8: 5-Year Shortfall Trend – Extreme Events



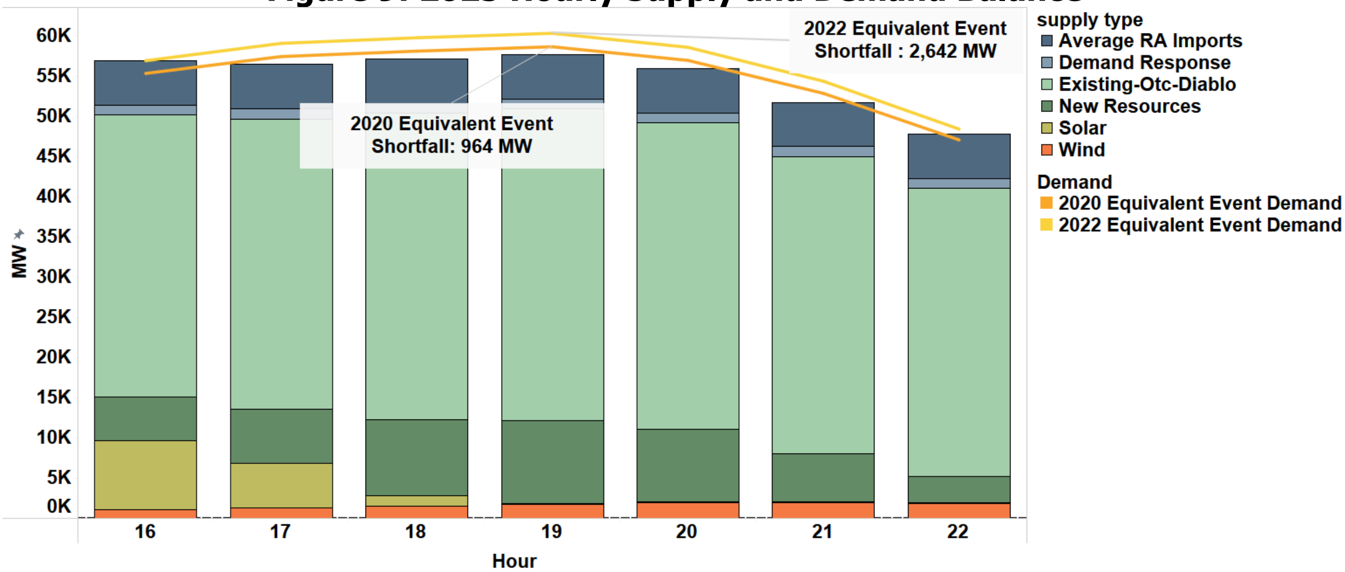
Source: California Energy Commission staff with CPUC data

Since 2025 is a key reliability year within the 5-year horizon, the analysis in this section also studied the hourly impacts of OTC and DCPP retirements (*Figure 9: 2025 Hourly Supply and Demand Balance)*. Two metrics, shortfall magnitude and duration, will be used to describe the most extreme case in 2025. Given the retirements in 2024 and 2025, the most extreme cases are the 2020 and 2022 under a 40 percent new supply delay for both. In a 2020 equivalent event, the max shortfall is about 1,000 MW. However, the shortfall duration is 5 hours.

In a 2022 equivalent event, the max shortfall is 2,650 MW with a 6-hour shortfall duration. While the shortfall duration includes the max shortfall hour, it is important to note that the shortfall duration does not mean the max shortfall magnitude is sustained for that period. Rather, the shortfall magnitudes may be equal to or less throughout the shortfall duration. Note that this scenario does not include a coincident event of transmission capacity loss from a wildfire. This scenario also does not include contingencies, such as the Strategic Reliability Reserve, which are intended to support grid reliability in extreme events.

Because 2025 assumes that both OTC units and DCPP units have been retired, extending one of these sets of units could significantly improve the shortfall magnitudes and duration. For example, extending DCPP units would help the grid stay reliable in a 2020 equivalent event in 2025.

Figure 9: 2025 Hourly Supply and Demand Balance



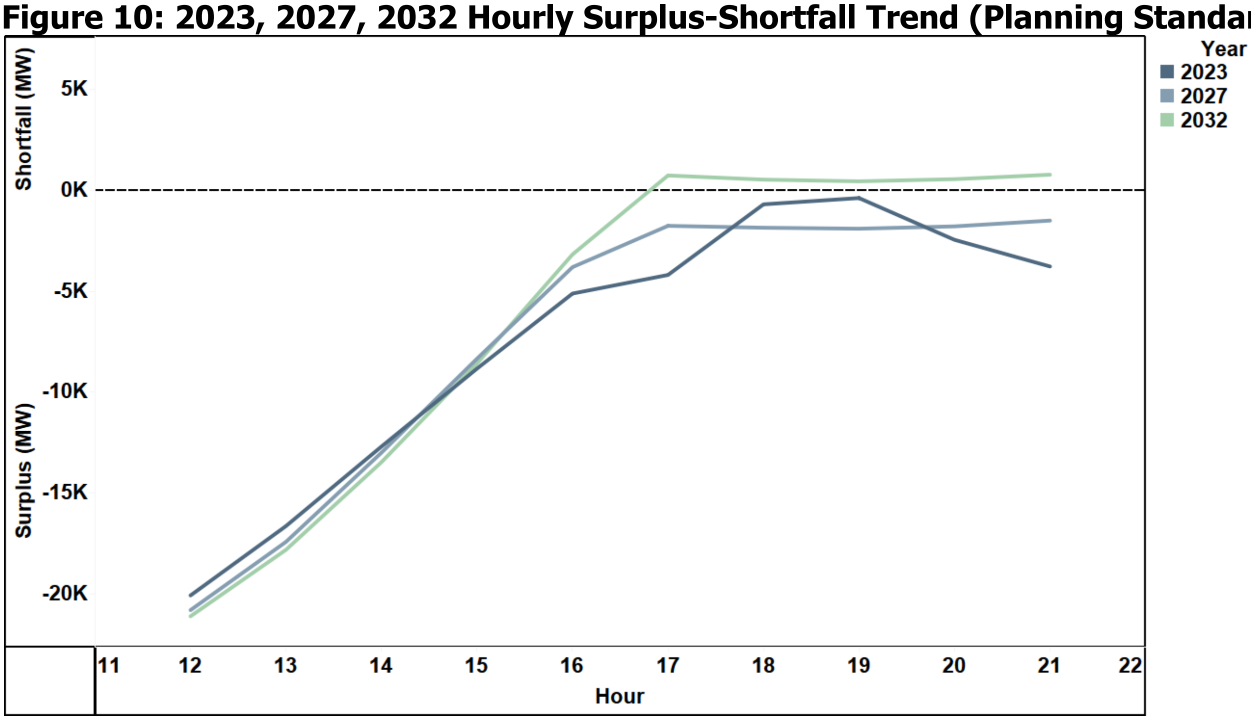
Source: California Energy Commission staff with CPUC data

Hourly analysis – Delay Scenario:

The hourly analysis further studied the impacts of shortfall magnitude and duration in 2023, 2027, and 2032 under planning standards and extreme events.

In the previous *Ordered Procurement* section, it was observed that the planning standard was reliable until 2030. In *Figure 10: 2023, 2027, 2032 Hourly Surplus-Shortfall Trend (Planning Standard)*, 2032 has sustained shortfalls of more than 4 hours with a magnitude of 800 MW in the worst delay scenario (40 percent).

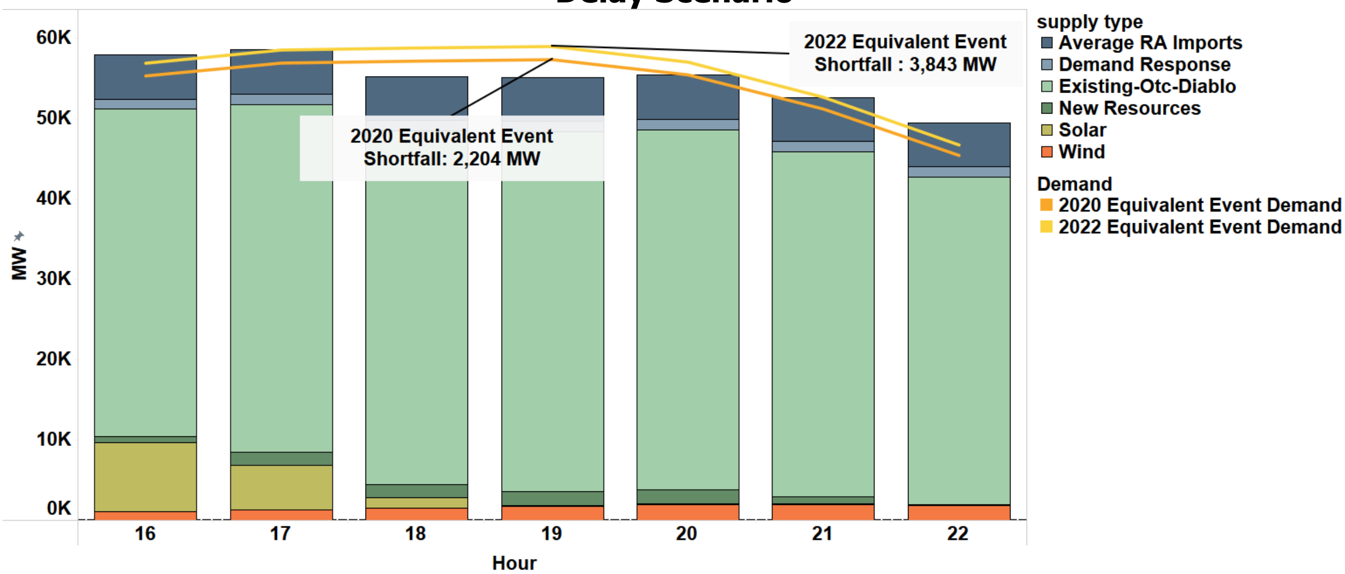
Figure 10: 2023, 2027, 2032 Hourly Surplus-Shortfall Trend (Planning Standard)



Source: California Energy Commission staff with CPUC data

2023: In the extreme events, greater shortfalls are observed starting at the 2020 equivalent event. According to *Figure 11: 2023 September Hourly Supply and Demand Comparison – 40 percent delay*, the largest shortfall of 3,800MW is observed in hours 18 and 19 for a 2022 equivalent event with 40 percent supply delay, which is the worst case in 2023. Note that this scenario does not include a coincident event of transmission capacity loss from a wildfire. This scenario also does not include contingencies, such as the Strategic Reliability Reserve, which are intended to support grid reliability in extreme event situations.

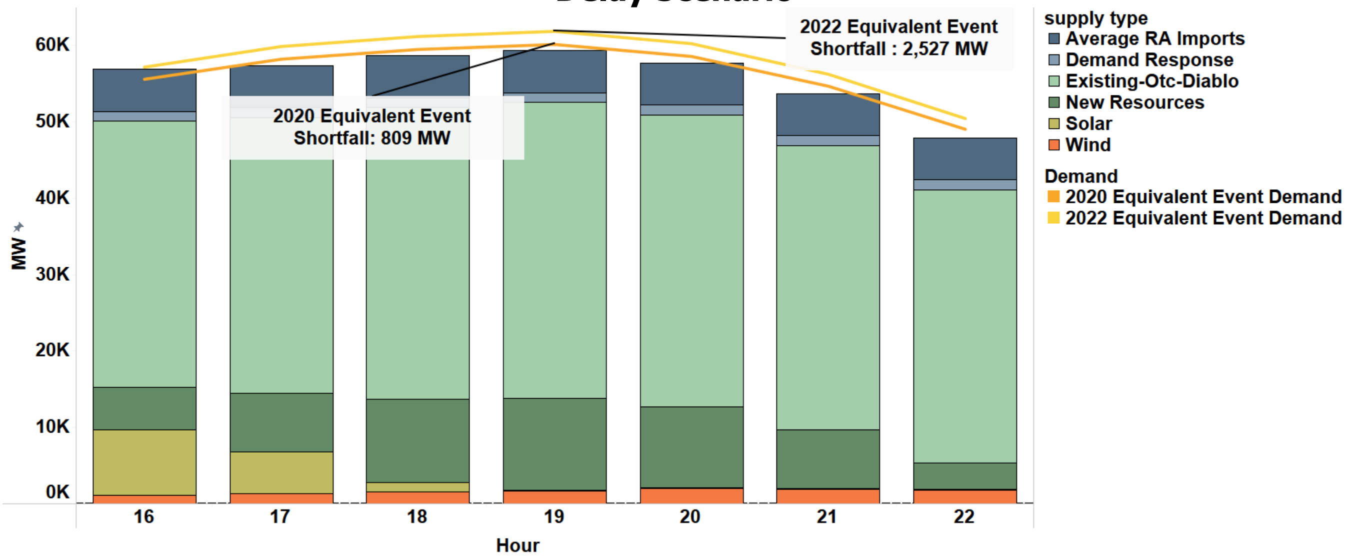
Figure 11: 2023 September Hourly Supply and Demand Comparison – 40 Percent Delay Scenario



Source: California Energy Commission staff with CPUC data

2027: The extreme events, in 2027, resulted in a 2,500 MW max shortfall under the 2022 equivalent event with 40 percent supply delay. The longest shortfall duration in the 2022 equivalent event is more than 5 hours (*Figure 12: 2027 September Hourly Supply and Demand Comparison – 40 percent delay*). Note that this scenario does not include a coincident event of transmission capacity loss from a wildfire. This scenario also does not include contingencies, such as the Strategic Reliability Reserve, which are intended to support grid reliability in extreme event situations.

Figure 12: 2027 September Hourly Supply and Demand Comparison – 40 Percent Delay Scenario

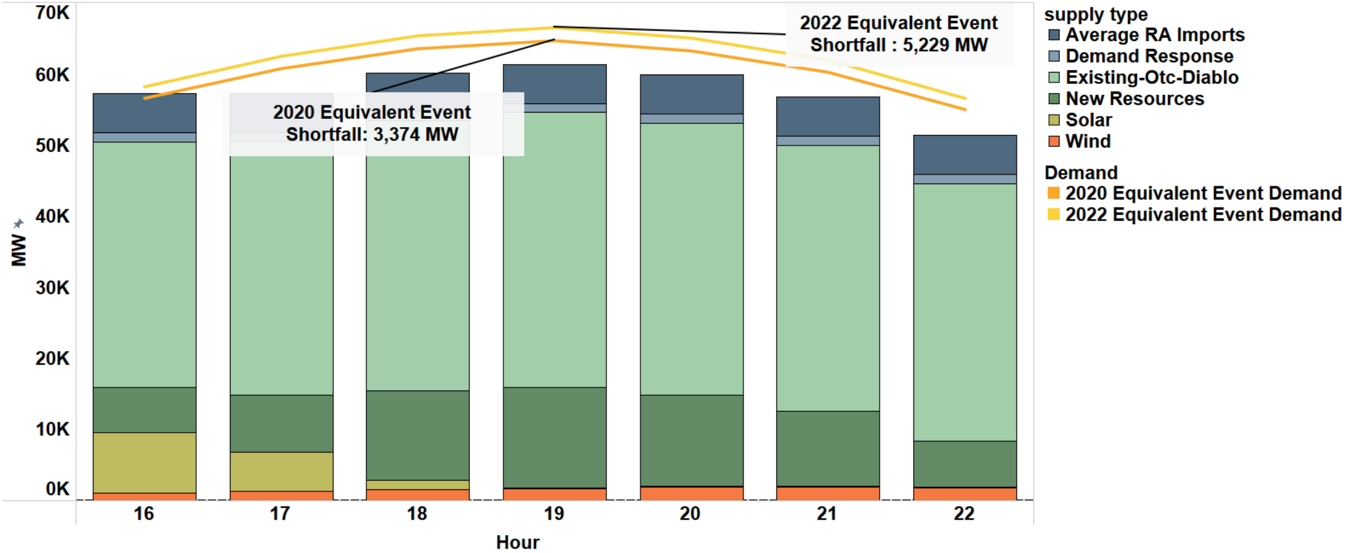


Source: California Energy Commission staff with CPUC data

<u>2032</u>: The driving factors for supply and demand balance in 2032 are no procurement being authorized after 2028 and increasing demand forecast. It is reasonable to expect that these shortfalls will shrink over time as the resource needs are addressed through procurement activities. However, this analysis studied the shortfalls in 2032 to provide a snapshot of the reliability situation given that no new resources would be procured between 2029-2032 (the study assumed that the new supply "flat-lined" after 2028). Therefore, the driving factor for shortfalls is the increasing demand forecast.

In *Figure 13: 2032 September Hourly Supply and Demand Comparison*, the max shortfall in the worst scenario is 5,200 MW, which is a 2022 equivalent event happening in 2032. This extreme event would also result in a more than 6-hour shortfall duration. Note that this scenario does not include a coincident event of transmission capacity loss from a wildfire. This scenario also does not include contingencies, such as the Strategic Reliability Reserve, which are intended to support grid reliability in extreme event situations.

Figure 13: 2032 September Hourly Supply and Demand Comparison

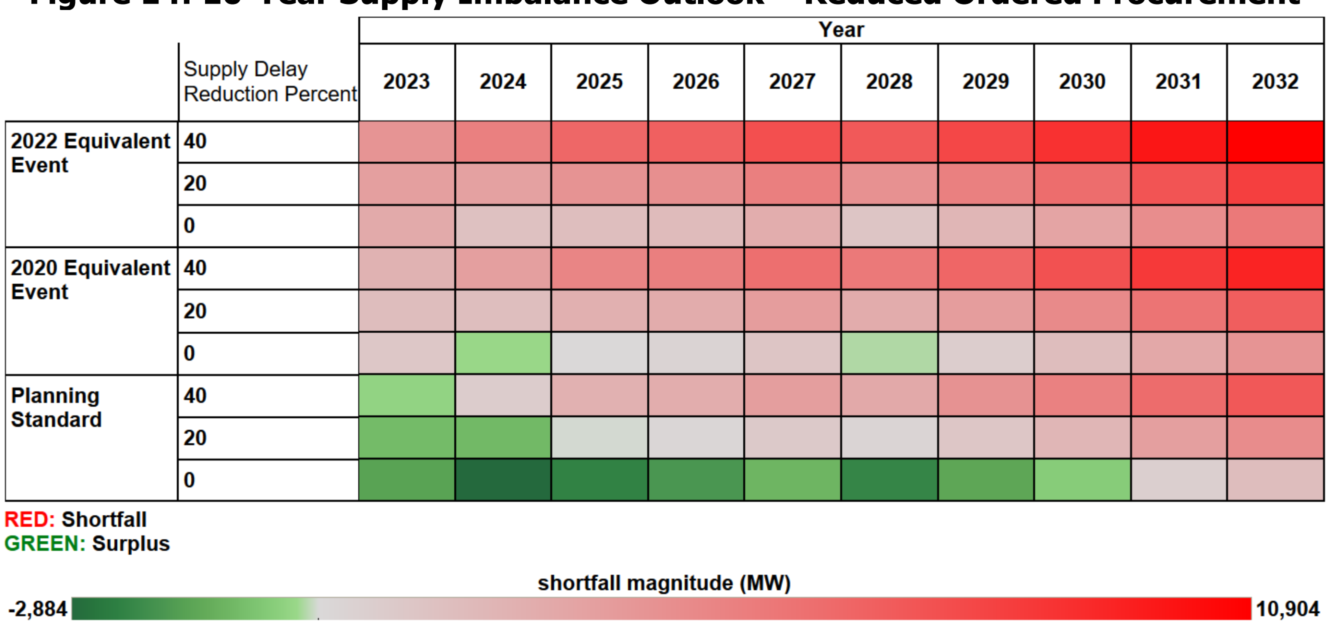


Source: California Energy Commission staff with CPUC data

<u>10-Year Overview – Reduction Scenario:</u>

To provide a different perspective into the 10-year overview, this analysis considered new supply reductions as described in the *Supply Scenario Input* section of this chapter. The shortfall magnitudes are much greater, in the excess of 5,000 MW, when the total capacity available is reduced from the procurement orders due to project failure. For example, *Figure 14: 10-Year Supply Imbalance Outlook – Reduced Ordered Procurement* shows that 2032 would have a 10,900 MW shortfall under a 2022 equivalent event. This section shows that procurement orders should continue to increase.

Figure 14: 10-Year Supply Imbalance Outlook – Reduced Ordered Procurement



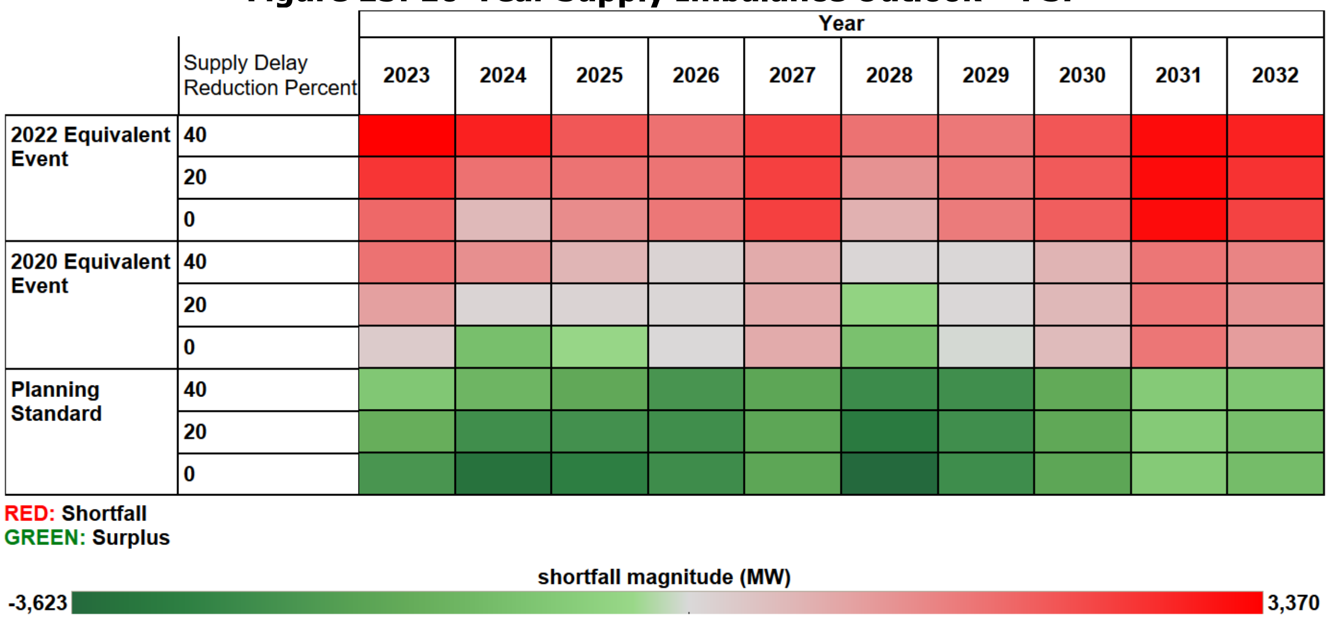
Source: California Energy Commission staff with CPUC data

Preferred System Plan (PSP)

10-Year Overview – Delay Scenario: This section will explore the supply and demand balance in the 10-year horizon using 0, 20, and 40 percent delay adjustments to the PSP. This analysis assumed a very similar set up the Ordered Procurement 10-year overview, with the exception that this section uses the PSP instead of the Ordered Procurement resource build.

Using the planning standard (*Figure 15: 10-Year Supply Imbalance Outlook – PSP*), the analysis showed that PSP is reliable, including OTC/DCPP retirements and delays.

Figure 15: 10-Year Supply Imbalance Outlook – PSP



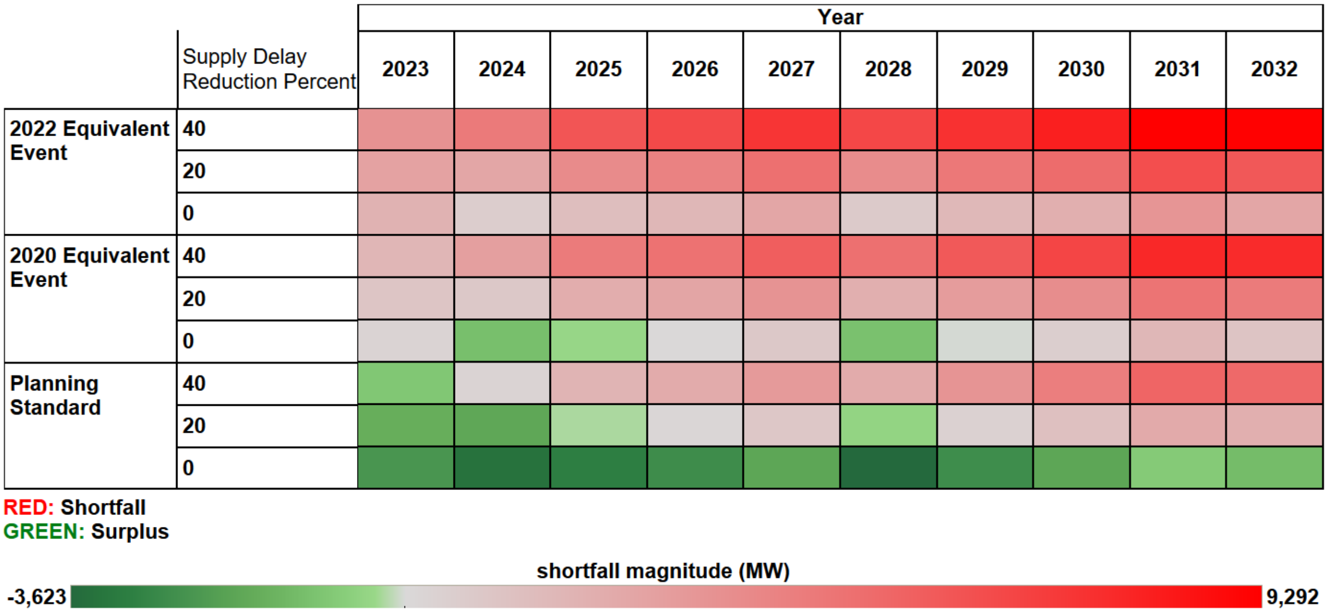
Source: California Energy Commission staff with CPUC data

Under extreme events, such as a 2022 equivalent event, the PSP had a max shortfall of 3,300 MW in 2023 during the 10-year horizon. In a 2020 equivalent event, the PSP had a max shortfall of 1,700 MW in 2023. Assuming that the PSP is fully built, the grid may be able to overcome a 2020 equivalent event with the help of additional contingencies such as DSGS, DEBA, and ELRP.

10-Year Overview – Reduction Scenario:

In this section of the analysis, reductions were applied to the PSP. By reducing the PSP by 20 and 40 percent, this analysis showed the shortfalls increased year to year with the max shortfall of 9,200 MW occurring in 2032 under a 2022 equivalent event (*Figure 16: 10-Year Supply Imbalance Outlook – PSP Reduction*). This section offers a similar takeaway to the *Ordered Procurement 10-Year Overview – Reduction Scenario* section in that the PSP should continue to increase.

Figure 16: 10-Year Supply Imbalance Outlook – PSP Reduction



Source: California Energy Commission staff with CPUC data

Comparison to Past Stack Analyses

The Stack Analysis began in early 2021 in response to the August 2020 blackouts as a way to quickly assess near-term, worst-case reliability scenarios. The first few iterations assessed summer 2021 and 2022 and were focused on the implications of solar dropping off in late evening and hydroelectric resources losing efficacy in a drought.[48] In 2022, the CEC extended the time horizon for the stack analysis to assess planning priorities out to 2026. The analysis was extended in part to assess implications of OTC retirements.[49] Hourly shapes for wind, batteries, and new resources were required, to better represent the limitations of resources the state will be dependent on in the future. Other changes included the use of a generic number for imports rather than recent RA values, the elimination of the drought derate, and a reliance on procurement orders rather than contracts to estimate future resources.

Between the stack release adopted during the September 2021 business meeting and the May 2022 release of the stack, the biggest changes were 1) the retention of Redondo, which raised the baseline resources by 800 MW; 2) the move to the 2021 Adopted CED, which raised the demand at net peak by 1,200 MW; and 3) the use of hourly profiles for wind rather than their NQC value in Existing Resources. The net result of these and other updates reduced the stack shortfall by 800 MW for 2022.

48 Tanghetti, Angela, Liz Gill, and Lana Wong. 2021. *2022 Summer Stack Analysis*. California Energy Commission. Publication Number: CEC-200-2021-006. https://efiling.energy.ca.gov/GetDocument.aspx?tn=239806.

49 Craig, Hannah. 2022. *Summer Stack Analysis for 2022-2026*. California Energy Commission. Publication Number: CEC-200-2021-006-REV. https://efiling.energy.ca.gov/GetDocument.aspx?tn=244116.

Between the stack release in May 2022 and January 2023, the main changes made were 1) delays applied to PSP resources; 2) the change to a flat 5,500 MW import number rather than RA averages, which reduced imports by 900 MW; and 3) higher reserve margin values to match the extent of the 2022 heat event. The net result of these and other updates raised the stack shortfall by 2,100 MW for 2023.

Table 14 below shows the evolution of the stack analysis during 7-8PM September, which is the maximum shortfall hour in each of these analyses. Table 14 includes the average and elevated reserve margins and shortfall numbers at the same hour. Though thousands of megawatts of resources have been brought online and/or retained in the case of Redondo, shortfalls have remained high due to rising demand and PRMs.

Table 14: Stack Releases from September 2021 to January 2023

Publication Date	Summer Assessed	Average Reserve Margin	Average Shortfall (MW)	Elevated Reserve Margin	Extreme Shortfall (MW)
Sep 2021	2021	15%	60	17.5%	1,180
Sep 2021	2022	15%	980	22.5%	4,350
May 2022	2022	15%	40	22.5%	3,500
May 2022	2023	15%	0	22.5%	600
Jan 2023	2023	16%	0	26%	2,700

Source: CEC Staff

CHAPTER 7: Recommendations

The recommendations are organized into the categories addressing the key reliability challenges of ensuring planning, scaling resources and protecting the grid during extreme events.

Continue to Improve of Situational Awareness

- The California ISO, CEC, and CPUC should work to increase the transparency of transmission network upgrades and interconnection processes to assist communities, load-serving entities (LSEs), and developers in their planning. This work will include examining the alignment of the California ISO transmission planning processes, CPUC integrated resource planning, and LSE procurement activities to ensure use of best available information for decision-making.
- The CPUC, CEC, California ISO, and the Governor's Office of Business and Economic Development (GO-Biz) should continue to monitor new clean energy project development to identify potential delays of projects that are critical to reliability and coordinate with stakeholders (for example, developers, local permitting authorities, federal agencies) to support timely deployment.
- The CEC and other relevant state agencies should continue to monitor energy storage performance and safety, continue to improve safe frameworks to ensure both public safety and reliability. Higher outage rates, lengths of outages etc., than assumed in the modeling could have significant impacts on the modeling results and should be carefully considered as more data becomes available. It would be prudent to retain current levels of capacity supporting peak and net peak demands until energy storage performance has been further demonstrated.

Improve Planning Assumptions

- The CEC, CPUC and California ISO should develop a common approach to incorporating climate change into system planning, including a set of climate scenarios to be considered. This approach includes building off Electric Program Investment Charge (EPIC) research that will support incorporating climate change into the demand forecast and anticipated EPIC research to quantify benefits of resilience planning and consider the needs of tribes, disadvantaged, and low-income communities in such planning.
- Evaluate whether changes to the planning reserve margin (PRM) and other reliability planning metrics are warranted for all load serving entities in the state based on climate change impacts and increasing variable generation resources.
- The CEC and CPUC should collaborate to develop alignment of electric demand shapes across historical weather years, including any climate adjustments, to ensure alignment on the weather conditions used in reliability analysis. This would also enable assessing the expected frequency of the extreme load conditions that occurred in Sept 2022. Also create scenarios around hydroelectric vulnerability in the event of drought.

- The CEC and CPUC should coordinate their baseline development efforts to ensure that future studies consistently measure the impacts of ordered procurement against a common baseline such that procurement orders, planning portfolios, and other drivers of procurement can be more easily cross-walked and compared when running different modeling scenarios.

Realization of Procurement

- The California ISO should continue to consider interconnection process enhancements that build on its two-phase stakeholder initiative completed in 2022. The California ISO should continue to assess the positive impacts of the enhancements implemented in 2022, including enhancements that prioritize the award of transmission services to projects based on readiness to proceed to commercial operation, better align interconnection processes with procurement activities, and help move viable projects more effectively though the queue. The California ISO should continue to move forward with the second phase of interconnection process enhancements with targeted implementation in 2023 that will further align the interconnection process with procurement activities, ensuing more viable and ready projects receive priority access to transmission services.
- The CEC, CPUC and CAISO should fully implement the terms of the new MOU signed by the three entities in December 2022.
- Continue to refine a structure that better integrates statewide electricity planning and local land use planning and permitting that recognizes the scale and pace at which clean energy projects and supporting infrastructure must be built.
- Consider policy mechanisms and project viability measures that incentivize LSE selection of projects toward areas where interconnection and transmission network upgrades have a viable and timely path forward.
- Establish a routinized process to provide transparency to the transmission network upgrades and interconnection processes. Propose solutions to address any identified barriers.
- Examine alignment of the California ISO transmission planning processes, CPUC integrated resource planning, and LSE procurement activities to ensure use of best available information for decision making.
- To address the current and growing energy storage deployment, a consistent, statewide approach to permitting and extreme event response capabilities should be adopted to ensure that every jurisdiction is consistent and expert in siting BESS and responding to BESS operational issues.

Scale Demand-Side Resources

- The CEC and CPUC continue to collaborate to restructure the state’s demand response program to shift to an approach that will take advantage of flexible-demand appliances and the market-informed demand automation server (MIDAS).
- Continue coordination efforts between the agencies and proceedings to maximize the opportunities with demand response and demand flexibility.

- The CEC and CPUC should work to expand dynamic rate plans and encourage the rollout of automated devices. The CPUC and CEC will need to coordinate with the smaller non-CPUC-jurisdictional entities and community choice aggregators to encourage these entities to implement similar rate plans and automate access to them.

Long Lead-Time Resources

- Consider statutory and regulatory changes to create a central procurement mechanism or a new cost-recovery mechanism to secure the development path for certain large, long-lead time clean energy resources.

Research, Development, and Demonstration

- The CEC should invest in applied research that supports integration of climate considerations into electric planning, operations, and technology investment. This integration includes improving characterization of the climate conditions under which the grid must reliably operate now and in the future, improving supply and demand forecasting over a range of timescales, and improving situational awareness and forecasting of wildfire-related risks to grid operations. The CEC should coordinate any such research that is funded through EPIC with the LSE EPIC administrators, and encourage their participation in CEC EPIC projects, particularly those related to improving grid operations for reliability and resiliency. This research, in turn, informs technology and policy options that can contribute to grid reliability in the context of decarbonization.
- The CEC should invest in increasing customer load flexibility in the residential, commercial, and industrial sectors to support grid reliability. This work includes overcoming technical, market, and regulatory, barriers that reduce adoption and use of load-flexible technologies. It also includes improving the suite of technology options available to energy users to allow them to better adapt their load to system conditions as flexible power consumers.
- Consider funding sources other than ratepayer monies, such as through the Clean Energy Reliability Investment Plan, for zero-carbon emerging technologies, including long-duration energy storage and renewable hydrogen production, to accelerate the deployment and scale up of these resources.

Continue to Develop Extreme Event Resources

- The CEC and CPUC should continue to coordinate with DWR, California ISO, other BAAs, and stakeholders to develop and expand extreme event resources to support the grid during extreme conditions.

APPENDIX A: Acronyms and Abbreviations

AB – Assembly Bill

BA – balancing authority

BAA – balancing authority area

BANC – Balancing Authority of Northern California

California ISO – California Independent System Operator

Cal OES – California Governor's Office of Emergency Services

CMUA – California Municipal Utilities Association

CCA – community choice aggregators

CEC – California Energy Commission

CPUC – California Public Utilities Commission

DCPP – Diablo Canyon Power Plant

DEBA – Distributed Electricity Backup Assets

DOE – U.S. Department of Energy

DOF – California Department of Finance

DR – demand response

Draft CEDU 2022 – draft 2022 California Energy Demand Update

DSGS – Demand-Side Grid Support

EEA - Energy Emergency Alert

ELCC – effective load-carrying capacity

ELRP – Emergency Load Reduction Program

EPIC – Electric Program Investment Charge

ESSRRF – Electricity Supply Strategic Reliability Reserve Program

ESP – energy service providers

EV – electric vehicle

GHG – greenhouse gas

GO-Biz – Governor's Office of Business and Economic Development

GW – gigawatt

GWh – gigawatt-hours

ID – identification numbers

IEPR – Integrated Energy Policy Report

IID – Imperial Irrigation District

IOU – investor-owned utility

IRP – integrated resource plan

LADWP – Los Angeles Department of Water and Power

LLT – long-lead time

LOLE – Loss of Load Expectation

LSE – load-serving entity

LTTP – Long-Term Procurement Planning

MIC – maximum import capability

MID – Modesto Irrigation District

MIDAS – market-informed demand automation server

MMT – million metric tons

MTR – mid-term reliability

MW – megawatt

MWh - megawatt-hour

NQC – net qualifying capacity

OASIS – Open Access Same-time Information System

OOS – out-of-state

OTC – once-through cooling

PD – proposed decision

PG&E – Pacific Gas and Electric

POU – publicly owned utility

PRM – planning reserve margin

PSP – Preferred System Plan

PTO – participating transmission owner

PV - photovoltaic

RA – resource adequacy

Redding – City of Redding

Reliability Planning Assessment – Joint Agency Reliability Planning Assessment

Roseville – City of Roseville

RPS – Renewables Portfolio Standard

SB – Senate Bill

SCE – Southern California Edison

SDG&E – San Diego Gas & Electric

Shasta Lake – City of Shasta Lake

SMUD – Sacramento Municipal Utility District

SRR – Strategic Reliability Reserve

ESSRRF – Electricity Supply Strategic Reliability Reserve Program

SWP – State Water Project

TAC – Transmission Access Charge

TED – Tracking Energy Development

TID – Turlock Irrigation District

TPP – Transmission Planning Process

TPUD - Trinity Public Utilities District

APPENDIX B: Glossary

For additional information on commonly used energy terminology, see the following industry glossary links:

- California Air Resources Board Glossary, available at https://ww2.arb.ca.gov/about/glossaryCalifornia Energy Commission Energy Glossary, available at https://www.energy.ca.gov/resources/energy-glossary
- California Energy Commission Renewables Portfolio Standard Eligibility Guidebook, Ninth Edition Revised, available at: https://efiling.energy.ca.gov/getdocument.aspx?tn=217317
- California Independent System Operator Glossary of Terms and Acronyms, available at: http://www.caiso.com/Pages/glossary.aspx
- California Public Utilities Commission Glossary of Acronyms and Other Frequently Used Terms, available at https://www.cpuc.ca.gov/glossary/
- Federal Energy Regulatory Commission Glossary, available at https://www.ferc.gov/about/what-ferc/about/glossary
- North American Electric Reliability Corporation Glossary of Terms Used in NERC Reliability Standards, available at: https://www.nerc.com/pa/Stand/Glossary%20of%20Terms/Glossary_of_Terms.pdf
- US Energy Information Administration Glossary, available at: https://www.eia.gov/tools/glossary/

Balancing authority

A balancing authority is the responsible entity that integrates resource plans ahead of time, maintains load-interchange-generation balance within a balancing authority area, and supports interconnection frequency in real time. Balancing authorities in California include the Balancing Authority of Northern California (BANC), California ISO, Imperial Irrigation District (IID), Turlock Irrigation District (TID) and Los Angeles Department of Water and Power (LADWP). The California ISO is the largest of about 38 balancing authorities in the Western Interconnection, handling an estimated 35 percent of the electric load in the West. For more information, see the WECC Overview of System Operations: Balancing Authority and Regulation Overview Web page.

Balancing Authority of Northern California (BANC)

The Balancing Authority of Northern California is a joint powers authority consisting of the Sacramento Municipal Utility District, Modesto Irrigation District, Roseville Electric, Redding Electric Utility, Trinity Public Utility District, and the City of Shasta Lake. The BANC is a partnership between public and government entities and provides an alternative platform to other balancing authorities like the California Independent System Operator.

Climate change

Climate change refers to a change in the state of the climate that can be identified (for example, by using statistical tests) by changes in the mean and/or the variability of its properties and that persists for an extended period, typically decades or longer. Climate change may be due to natural internal processes or external forces such as modulations of the solar cycles, volcanic eruptions, and persistent anthropogenic changes in the composition of the atmosphere or in land use. **Anthropogenic** climate change is defined by the human impact on Earth's climate while **natural** climate change are the natural climate cycles that have been and continue to occur throughout Earth's history. Anthropogenic (human-induced) climate change is directly linked to the amount of fossil fuels burned, aerosol releases, and land alteration from agriculture and deforestation. For more information, see the Energy Education Natural vs Anthropogenic Climate Change Web page.

Community Choice Aggregation (CCA)

Community Choice Aggregation (CCA) is a program that allows cities, counties, and other qualifying governmental entities available within the service areas of investor-owned utilities (IOUs), to purchase and/or generate electricity for their residents and businesses. The IOU continues to deliver the electricity through its transmission and distribution system and provide meter reading, billing, and maintenance services for CCA customers.

Demand response (DR)

Demand response refers to providing wholesale and retail electricity customers with the ability to choose to respond to time-based prices and other incentives by reducing or shifting electricity use ("shift DR"), particularly during peak demand periods, so that changes in customer demand become a viable option for addressing pricing, system operations and reliability, infrastructure planning, operation and deferral, and other issues. It has been used traditionally to shed load in emergencies ("shed DR"). It also has the potential to be used as a low-greenhouse gas, low-cost, price-responsive option to help integrate renewable energy and provide grid-stabilizing services, especially when multiple distributed energy resources are used in combination and opportunities to earn income make the investment worthwhile.

For more information, see the CPUC Demand Response Web page.

Distributed energy resources (DER)

Distributed energy resources are any resource with a first point of interconnection of a utility distribution company or metered subsystem. Distributed energy resources include:

- Demand response, which has the potential to be used as a low-greenhouse gas, low-cost, price-responsive option to help integrate renewable energy and provide grid-stabilizing services, especially when multiple distributed energy resources are used in combination and opportunities to earn income make the investment worthwhile.
- Distributed renewable energy generation, primarily rooftop photovoltaic energy systems.
- Vehicle-Grid Integration, or all the ways plug-in electric vehicles can provide services to the grid, including coordinating the timing of vehicle charging with grid conditions.

- Energy storage in the electric power sector to capture electricity or heat for use later to help manage fluctuations in supply and demand.

Effective load carrying capability (ELCC)

Effective load carrying capability" (ELCC) is the increment of load that could met by the resource while maintaining the same level of reliability. The ELCC of a variable renewable energy resource is based on both the capacity coincident with peak load and the profile and quantity of existing variable renewable energy resources. For a detailed description of ELCC implementation in RESOLVE, see page 87 of the Inputs & Assumptions: CEC SB100 Joint Agency Report.

Extreme weather event

An extreme weather event is an event that is rare at a particular place and time of year. Definitions of rare vary, but an extreme weather event would normally be as rare as or rarer than the 10th or 90th percentile of a probability density function estimated from observations. By definition, the characteristics of what is called extreme weather may vary from place to place in an absolute sense. When a pattern of extreme weather persists for some time, such as a season, it may be classed as an extreme climate event, especially if it yields an average or total that is itself extreme (e.g., drought or heavy rainfall over a season).

Integrated Energy Policy Report (IEPR)

Senate Bill 1389 (Bowen, Chapter 568, Statutes of 2002) requires the California Energy Commission to prepare a biennial integrated energy report. The report, which is crafted in collaboration with a range of stakeholders, contains an integrated assessment of major energy trends and issues facing California's electricity, natural gas, and transportation fuel sectors. The report provides policy recommendations to conserve resources, protect the environment, ensure reliable, secure, and diverse energy supplies, enhance the state's economy, and protect public health and safety. For more information, see the CEC Integrated Energy Policy Report Web page.

Integrated Resource Planning (IRP)

The CPUC's Integrated Resource Planning (IRP) process is an "umbrella" planning proceeding to consider all of its electric procurement policies and programs and ensure California has a safe, reliable, and cost-effective electricity supply. The proceeding is also the Commission's primary venue for implementation of the Senate Bill 350 requirements related to IRP (Public Utilities Code Sections 454.51 and 454.52). The process ensures that load serving entities meet targets that allow the electricity sector to contribute to California's economy-wide greenhouse gas emissions reductions goals. For more information see the CPUC Integrated Resource Plan and Long-Term Procurement Plan (IRP-LTPP) Web page.

Investor-owned utility (IOU)

Investor-owned utilities (IOUs) provide transmission and distribution services to all electric customers in their service territory. The utilities also provide generation service for "bundled" customers, while "unbundled" customers receive electric generation service from an alternate provider, such as a Community Choice Aggregator (CCA). California has three large IOUs offering electricity service: Pacific Gas and Electric, Southern California Edison, and San Diego Gas & Electric.

Load serving entity (LSE)

A load serving entity is defined by the California Independent System Operator as an entity that has been "granted authority by state or local law, regulation or franchise to serve [their] own load directly through wholesale energy purchases." For more information see the California Independent System Operator's Web page.

Loss of load expectation (LOLE)

The expected number of days pe year for which the available generation capacity is insufficient to serve the demand at least once in that day. California has a planning target of expecting no more than one day with an outage every 10 years. Assessments of the LOLE for a system use hundreds or thousands of potential combinations of various system, weather, and resource supply conditions for a single year. The LOLE is then determined by dividing the total number of days with an outage by the total number of simulated years. If the result is not greater than 0.1, the planning target has been met even if all the day with an outage occurred in a single simulated year.

Net qualifying capacity (NQC)

The amount of capacity that can be counted towards meeting Resource Adequacy requirements in the CPUC's RA program. It is a combination of the CPUC's qualifying capacity counting rules and the methodologies for implementing them for each resource type, and the deliverability of power from that resource to the CAISO system

Once-through cooling (OTC)

Once-through cooling technologies intake ocean water to cool the steam that is used to spin turbines for electricity generation. The technologies allow the steam to be reused, and the ocean water that was used for cooling becomes warmer and is then discharged back into the ocean. The intake and discharge have negative impacts on marine and estuarine environments. For more information on the phase-out of power plants in California using once-through cooling, see the Statewide Advisory Committee on Cooling Water Intake Structures Web page and the CEC Once-Through Cooling Phaseout Tracking Progress Report.

Planning reserve margin (PRM)

Planning reserve margin (PRM) is used in resource planning to estimate the generation capacity needed to maintain reliability given uncertainty in demand and unexpected capacity outages. A typical PRM is 15 percent above the forecasted 1-in-2 weather year peak load, although it can vary by planning area. The CPUC's resource adequacy program is increasing the PRM requirement to 16 percent minimum for 2023, and 17 percent minimum for 2024 and beyond.

Publicly owned utility (POU)

Publicly owned utilities (POUs), or Municipal Utilities, are controlled by a citizen-elected governing board and utilizes public financing. These municipal utilities own generation, transmission and distribution assets. In contrast to CCAs, all utility functions are handled by these utilities. Examples include the Los Angeles Department of Water and Power and the Sacramento Municipal Utility District. Municipal utilities serve about 27 percent of California's total electricity demand.

Renewables Portfolio Standard (RPS)

The *Renewables Portfolio Standard*, also referred to as *RPS*, is a program that sets continuously escalating renewable energy procurement requirements for California's load-serving entities. The generation must be procured from RPS-certified facilities (which include solar, wind, geothermal, biomass, biomethane derived from landfill and/or digester, small hydroelectric, and fuel cells using renewable fuel and/or qualifying hydrogen gas). More information can be found at the CEC Renewables Portfolio Standard web page and the CPUC RPS Web page.

Resource adequacy (RA)

The program that ensures that adequate physical generating capacity dedicated to serving all load requirements is available to meet peak demand and planning and operating reserves, at or deliverable to locations and at times as may be necessary to ensure local area reliability and system reliability. For more information, see the CPUC Resource Adequacy Web page.

Scenario

A plausible description of how the future may develop based on a coherent and internally consistent set of assumptions about key driving forces (for example, rate of technological change, prices) and relationships. Note that scenarios are neither predictions nor forecasts but are used to provide a view of the implications of developments and actions.

Time-dependent electricity rates

Also known as time-of-use rates, time-dependent electricity rates vary depending on the time periods in which the energy is consumed. In a time-of-use rate structure, higher prices are charged during utility peak-load times. Such rates can provide an incentive for consumers to curb power use during peak times.

Transmission Planning Process (TPP)

The California Independent System Operator's annual transmission plan, which serves as the formal roadmap for infrastructure requirements. This process includes stakeholder and public input and uses the best analysis possible (including the Energy Commission's annual demand forecast) to assess short- and long-term transmission infrastructure needs. For more information, see the California ISO Transmission Planning Web page.