DOCKETED	
Docket Number:	21-ESR-01
Project Title:	Energy System Reliability
TN #:	248971
Document Title:	Commission Report - Diablo Canyon Power Plant Extension - Final Draft CEC Analysis of Need to Support Reliability
Description:	N/A
Filer:	Jann Mitchell
Organization:	California Energy Commission
Submitter Role:	Commission Staff
Submission Date:	2/24/2023 4:43:55 PM
Docketed Date:	2/24/2023

CALIFORNIA ENERGY COMMISSION

CALIFORNIA NATURAL RESOURCES AGENCY

California Energy Commission

COMMISSION REPORT

Diablo Canyon Power Plant Extension

Final Draft CEC Analysis of Need to Support Reliability

Gavin Newsom, Governor
March 2023 | CEC-200-2023-004

California Energy Commission

David Erne
Mark Kootstra
Primary Authors

David Erne
Project Manager

David Erne
Branch Manager
SUPPLY ANALYSIS BRANCH

Aleecia Gutierrez
Director
ENERGY ASSESSMENTS DIVISION

Drew Bohan
Executive Director

ACKNOWLEDGEMENTS

The California Energy Commission appreciates the contributions from the following staff:

Chie Hong Yee Yang

Liz Gill

Ben Finkelor

Kristen Widdifield

ABSTRACT

The *Diablo Canyon Power Plant Extension – CEC Analysis of Need to Support Reliability* addresses a requirement in Senate Bill 846 (Dodd, Chapter 239, Statutes of 2022) for the California Energy Commission (CEC) to determine the need to extend the operation of the Diablo Canyon Power Plant (DCPP) for 2024–2030. The analysis is based on a CEC assessment of the state's electricity reliability based on forecasted demand and supply for that period. Based on CEC's analysis, the CEC staff recommends that CEC determine that it is prudent for the state to pursue extension of DCPP. This determination is driven by the risk that sufficient electricity resources may not be built in time to reach the ordered procurement and to address potential grid demands in extreme heat events associated with climate change.

Keywords: Diablo Canyon, reliability, demand side resources, supply side resources, reliability assessment, extreme events, climate change

Please use the following citation for this report:

Erne, David, Mark Kootstra. 2023. *Final Draft Diablo Canyon Nuclear Power Plant Extension – CEC Analysis of Need to Support Reliability.* California Energy Commission. Publication Number: CEC-200-2023-004.

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EXECUTIVE SUMMARY

Introduction

The Diablo Canyon Power Plant near San Luis Obispo is owned and operated by Pacific Gas and Electric. The Diablo Canyon Power Plant produces about 18,000 gigawatt-hours of electricity annually, which is about 9 percent of California's in-state generation. The two reactor units are licensed by the U.S. Nuclear Regulatory Commission to operate until November 2, 2024 (Unit 1), and August 26, 2025 (Unit 2). In 2016, Pacific Gas and Electric Company announced a joint proposal to increase investment in energy efficiency, renewable energy, and storage while phasing out nuclear power. Pacific Gas and Electric's application to close Diablo Canyon was approved by the California Public Utilities Commission (CPUC) in January 2018 with Pacific Gas and Electric's withdrawing its application for a licensing extension in February 2018.

Recent extreme heat events and wildfires have highlighted the need to plan for additional risk to California's energy reliability. Senate Bill 846 (Dodd, Chapter 239, Statutes of 2022) provides a path to extend Diablo Canyon Power Plant operations beyond 2025 if it is needed to support grid reliability. The bill also directs the CEC to determine whether the state's electricity forecasts for 2024 through 2030 show potential for reliability deficiencies if Diablo Canyon Power Plant operations are not extended beyond 2025 and whether extending operations to at least 2030 is prudent to ensure reliability and consistency with the state's emission reduction goals.

California's Reliability Situation

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 shift in conditions is creating challenges for its residents, especially those in disadvantaged communities and low-income communities. Senate Bill 100 (De León, Chapter 312, Statutes of 2018) 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 the goals of Senate Bill 100 are resulting in the addition of unprecedented quantities of clean energy resources, primarily solar and energy storage at utility scale.

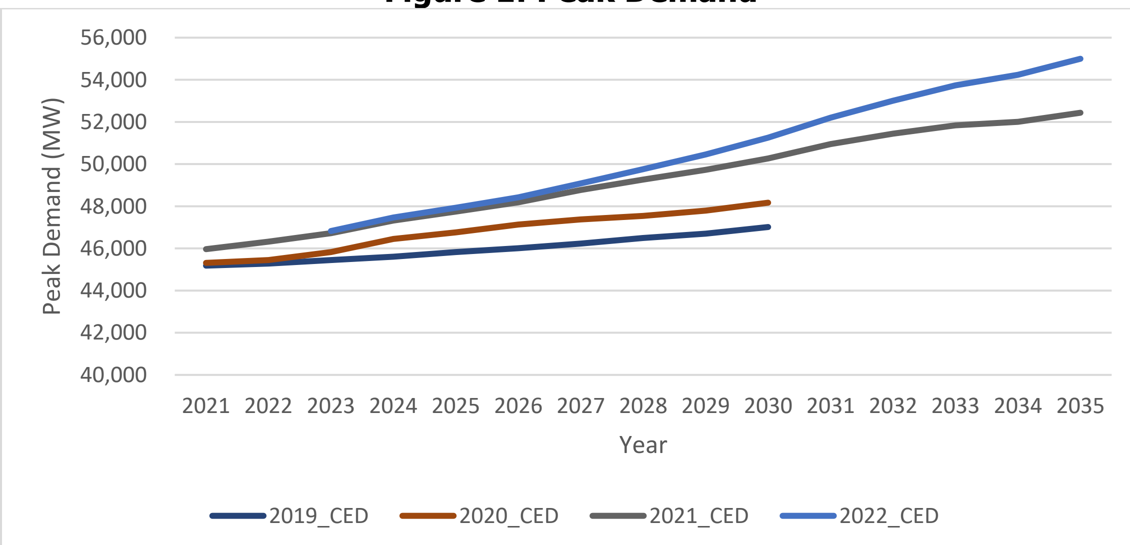
At the same time, climate change is causing substantial variability in weather patterns and an increase in climate-driven natural disasters, resulting in more challenges to grid reliability. In 2020, a westwide heat event resulted in rotating outages August 14 and 15. In 2021, dry conditions resulted in a wildfire in Oregon that impacted transmission lines that California depends on for reliability. The fire resulted in a loss of 3,000 megawatts of imported electricity to the California Independent System Operator territory and 4,000 megawatts 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 megawatts, nearly 2,000 megawatts higher than the previous record, despite significant efforts to reduce load during this peak period.

Reliability Assessment

Demand

Electricity demand in California is increasing. Record-breaking high temperatures are being experienced more frequently, causing higher peaks in demand. With each iteration of the CEC's annual California Energy Demand (CED) forecast, the projected peak demand increases. This increase is due in part to the growing electrification of buildings and transportation that change electricity consumption. It is also attributable to the sensitivity of peak electricity demand forecasts to temperatures, which continue to rise (Figure 1.)

Figure 1: Peak Demand



Source: CEC staff

Recognizing that climate change is affecting extreme peak temperature conditions and that recent temperature patterns do not resemble patterns from 30 years ago, the CEC compared peak temperatures over the past 20 years to those over the past 30 years. When the historical period is truncated, there is a small increase to the normal (or median) peak temperature event, but there is a much greater increase in the frequency of extreme conditions. The CEC found the September 6, 2022, heat event to have an occurrence of once every 14 years (or 1-in-14 event) based on a 20-year weather history, compared to a 1-in-27 event based on 30 years. Traditional system planning is designed to address 1-in-10 events.

Supply

Increased electricity demand requires unprecedented development of new clean energy resources, that is, high build rates. The CPUC has recently ordered an unprecedented level of procurement. Between 2020 and late 2022, the CPUC's Integrated Resource Plan, which is a process to ensure that California's electric sector meets its GHG reduction goals while maintaining reliability at the lowest possible costs, procurement orders and prior load-serving entity procurement resulted in more than 11,000 MW of new nameplate energy resources, equivalent to more than 6,000 MW of new net qualifying capacity, a part or all of a resource's available capacity that can count toward current resource adequacy capacity obligations under CPUC's Resource Adequacy Program. The state has witnessed an extraordinary pace of new development in the past three years, as exemplified by the fact that more than 130 new clean energy projects have come on-line to serve load in the California ISO footprint. Comparing recent build rates to those required for CPUC's current procurement order and CPUC's Preferred System Plan, which is an optimal portfolio of projects that meets statewide climate targets and greenhouse gas emission targets for 2030 and 2032, shows that new projects will have to come on-line even faster than recent unprecedented builds.

The pace of new, clean-energy resource development is impacted by three issues: supply chain disruptions, interconnection delays, and permitting delays. These issues are posing risks to getting new resources on-line, particularly when current build rates are unprecedented and must increase to meet authorized procurement.

Reliability

The reliability assessment approach used for this report looks at forecasted demand and supply for 2023–2032. Although SB 846 only requires consideration of 2024 through 2030, the CEC included the analysis developed for the Joint Agency Reliability Planning Assessment, which covered 2023 through 2032. The analysis shows that under the current resource adequacy planning standard, the CPUC's procurement orders, Decision (D) 19-11-016 and D.21-06-035, are sufficient to eliminate shortfalls through 2030. However, significant grid reliability risks persist through 2030 under increased demand conditions, such as those experienced in August 2020 and September 2022, compared to the forecasted demands. These risks are compounded by the risk of coincident wildfires that could affect transmission lines that import electricity to California.

Need for DCPP to Support Reliability

While CEC staff has concluded that current authorized procurement will meet current resource adequacy planning standards from 2024 through 2030, risks remain to grid reliability. The rate of development needed to meet the procurement levels ordered is greater than the recent record-setting development that has been occurring in the state. Development is being impacted by supply chain issues, particularly for solar and storage, and interconnection and permitting delays resulting from the large number of projects coming on-line that require safety and environmental reviews. Climate change is impacting grid reliability by causing more frequent extreme events beyond what current planning standards account for, such as record-setting heat, droughts, and wildfires that can impact transmission.

CEC staff has determined that it is prudent for the state to pursue the extension of the Diablo Canyon Power Plant through 2030 to mitigate the risks imposed by the dependence on an unprecedented speed and scale of development and of increased frequency and intensity of climate-driven extreme events. CEC staff has determined that this is consistent with the state's emission reduction goals. Additional analysis to be conducted this year will further inform the process. The CEC will conduct a cost comparison of extending Diablo Canyon Power Plant to developing alternative resources. The CPUC will conduct a reliability analysis and make its determination on the extension by December 31, 2023.

CHAPTER 1: Introduction

The Diablo Canyon Power Plant (DCPP) near San Luis Obispo (San Luis Obispo County) is owned and operated by Pacific Gas and Electric Company (PG&E). The DCPP facility has two Westinghouse-designed four-loop pressurized-water nuclear reactors. The twin 1,100 megawatt (MW) reactors produce about 18,000 gigawatt-hours (GWh) of electricity annually. The once-through cooling (OTC) system of the facility draws water from the Pacific Ocean to condense into steam that is then used to drive the turbine systems. The two reactor units are licensed by the United States Nuclear Regulatory Commission (NRC) to operate until November 2, 2024 (Unit 1), and August 26, 2025 (Unit 2). PG&E's decision to retire Diablo Canyon was based on a combination of California's energy and climate policy, power generation requirements and sources, the cost associated with meeting the state's OTC requirements, and market considerations around the costs of natural gas and increasing penetration of renewables and storage.

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 wildfire — the state's energy system could be strained beyond reliability contingencies historically planned for.

In 2020, a westwide 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 electrical supply and demand in California. 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)

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

Task Force with the Governor's Office of Business and Economic Development (GO-Biz) to track new clean energy projects under development to help overcome barriers to 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 was established in 2022 to provide additional support for grid reliability during extreme events. Though in development during summer 2022, The SRR was able to provide about 1,500 MW of support during the extreme heat event the state experienced between August 31 and September 9, 2022, including supporting the procurement of additional imported electricity, securing additional backup generation, and providing load reduction that helped avert outages on September 6, when the California ISO recorded the highest demand ever in its territory. Even with these significant resource additions and SRR resources, uncertainty remains in the supply-and-demand balance between 2024 and 2030.

CHAPTER 2: California's Reliability Situation

California's Reliability Challenges

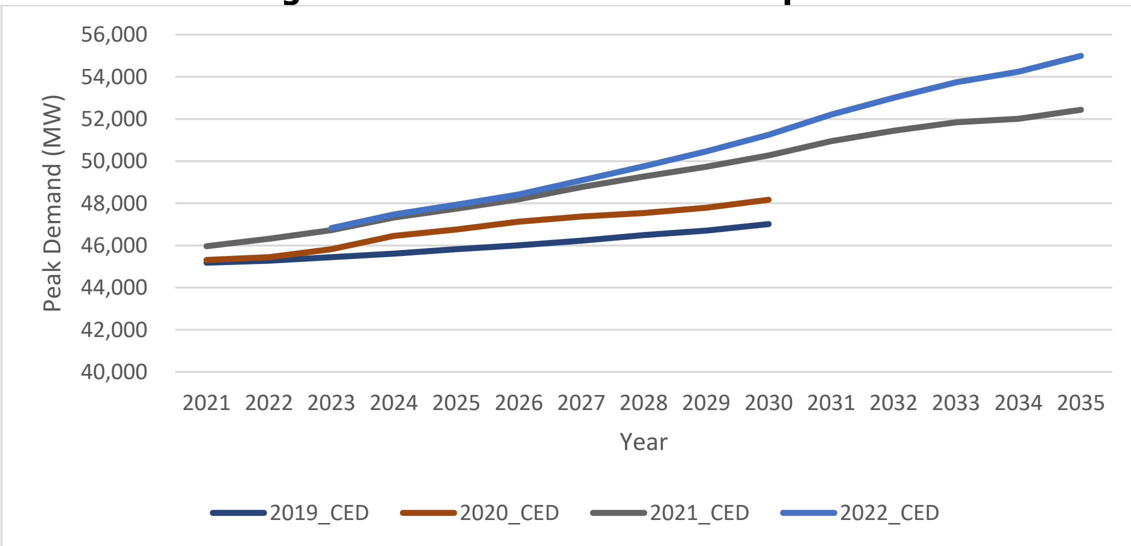
Extreme weather events driven by climate change are contributing to increased energy reliability impacts in California and nationally. At the same time, the state has seen an unprecedented expansion in clean energy development, particularly solar and storage. However, it needs an even greater buildout 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 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.
- Extreme Events: Extreme heat events and wildfires remain a threat to grid reliability. The state can look to existing programs such as the SRR to expand the resources capable of managing or reducing net-peak demand during extreme events.

Demand Is Increasing and Extreme Peaks Are Becoming More Frequent

CEC publishes an update of the California Energy Demand (CED) forecast annually. Figure 2 shows peak demand for the California ISO region from the last four vintages of the CED Forecast, including the draft 2022 CED Planning Forecast. With each iteration of the CED Forecast, the peak demand continues to increase. This increase is due in part to growing electrification of buildings and transportation that change electricity consumption. It is also attributable to the sensitivity of the peak electricity demand forecasts to actual temperatures, which continue to rise.

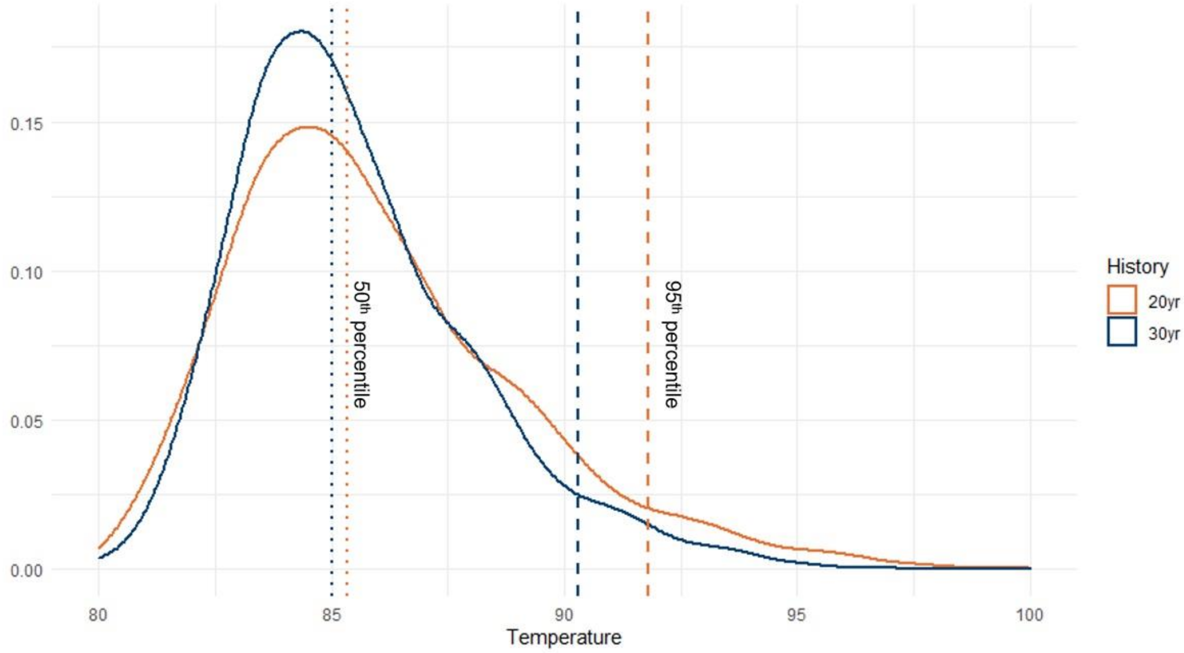
Figure 2: CED Peak Demand Comparison



Source: [CEC staff]

The CED has traditionally examined a 30-year historical weather record in establishing normal peak temperature conditions that serve as the basis for the peak demand forecasts. Over the last decade, however, the state has seen extreme temperatures occur more frequently and with greater magnitude. Recognizing that climate change is affecting extreme peak temperature conditions and the temperature patterns of the recent past do not resemble patterns from 30 years ago, the CEC compared peak temperature events over just the past 20 years to those over the past 30 years (Figure 2). When the historical period is truncated, there is only a small increase to the normal (or median) peak temperature event, but there is a much greater increase to the frequency of extreme conditions, as demonstrated by the fiftieth and ninety-fifth percentiles in Figure 2. The CEC found the recent September 6, 2022, heat event to be a 1-in-14 event based on a 20-year weather history, compared to a 1-in-27 event based on 30 years. Traditional procurement authorization supports a 1-in-10 planning standard. This is not to suggest that ordered procurement be changed to meet these extreme events, but it does mean that there may be a greater likelihood of these events. Having resources like the SRR is important to maintaining grid reliability in extreme events.

Figure 3: Distribution of Peak Temperature (California ISO)



Source: CEC staff

Supply Is Growing, but the Needed Build Rate Is Unprecedented

California is at the beginning of an unprecedented transition to renewable and zero-carbon technologies to support the state's clean energy goals, including increased electrification and the retirement of old once-through-cooling (OTC) units. This transition is requiring unprecedented clean energy resource build rates. The state has witnessed an extraordinary pace of new development in the past three years, exemplified by the fact that more than 130 new clean energy projects have come on-line to serve load in the California ISO footprint. Between 2020 and late 2022, the CPUC's Integrated Resource Plan (IRP) procurement order and prior load-serving entity (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 current resource adequacy (RA) capacity obligations.[2] Comparing these recent build rates to those required for CPUC's 2021 procurement order and CPUC's Preferred System Plan (PSP),[3] new projects will have to come on-line faster than recent unprecedented builds (

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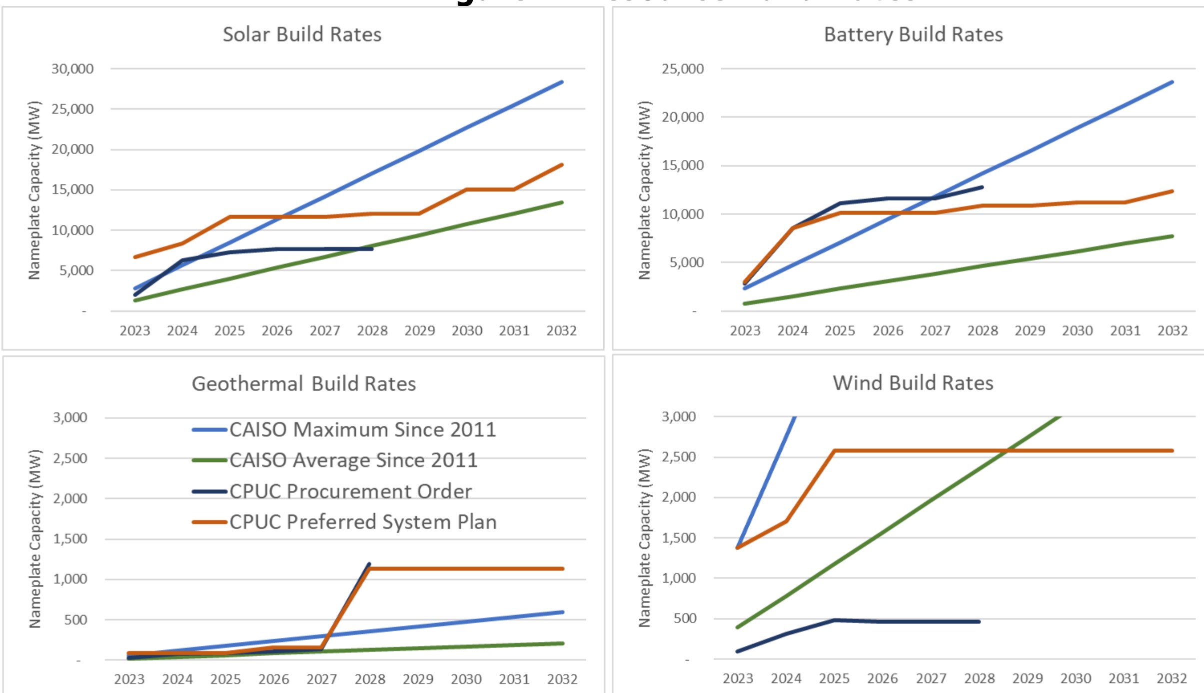
[2] Information on what resources have come on-line are based on information taken from the California ISO and from LSEs' data request submission to the CPUC.

[3] The CPUC's Integrated Resource Plan "planning track" operates on a two-year cycle that concludes with the CPUC adopting a preferred system plan (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.

Figure 4).

Figure 4: Resource Build Rates



Source: CEC staff

The sustained level of resource additions necessary to realize the resource builds envisioned in the PSP and through the CPUC procurement orders represent a significant increase over average resource builds. For example, the average solar additions since 2011 was 1,341 MW/year. Assuming the same build rate continues through 2032, the solar build will be at least 2,500 MW lower than the PSP in all years through 2032.

While the high battery resource additions in the PSP and the CPUC procurement orders appear equally concerning, battery resources are relatively new additions to the grid. Thus, the builds may not follow the average since 2011, and the resource build may increase as the industry continues to increase production capacity.

While historic resource build rates are not alone indicative of the state's ability to deploy resources or meet its clean energy goals, it raises the question of whether the current processes can handle the scale of resources. Developers have identified the timelines for interconnection and permitting as currently impacting build rates. While the state agencies are evaluating and recommending changes to adapt the processes to meet the urgency of challenge at hand, staff believes there is a risk of not meeting resource build needs as described in the next section.

New Supply Projects Have Development Hurdles

A risk to meeting these buildout rates is the potential for delays in new resources under development. There are a variety of issues facing the clean energy projects in development in California. Each project is like any major complex construction project and can have unique challenges. Some challenges are consistent and persistent across many projects. There are three issues that are frequently raised by developers as leading to delays: supply chain disruptions, interconnection and transmission challenges, and permitting delays.

Supply Chain

There are several supply chain issues affecting clean energy development, including the availability and cost of critical materials of construction and disruptions in products being delivered (for example, tariff, labor, and shipping issues). The COVID-19 pandemic exasperated supply chain disruptions and although those are easing to some extent, there remain issues with disruptions. There is uncertainty about whether significant delays from disruptions will persist for tariff issues, such as the U.S. Department of Commerce's recent findings that the largest solar manufacturers were circumventing U.S. tariffs.[4] However, delays are expected to continue impacting procurement. Moreover, utilities and developers have described supply chain delays for other equipment, including batteries, inverters, transformers, and switches.

Like the rest of the economy, all parts of the supply chain have experienced 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. 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.

Interconnection

This rapid acceleration in resource development needed to meet California's clean energy goals 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. With the significant acceleration in procurement targets, these processes must continue to evolve to align with the new dynamics driving resource development. One of the objectives of the recently executed memorandum of understanding among 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. The California ISO also initiated its Interconnection Process Enhancements initiative to address the complexity of managing high volumes of projects in the queue.

In response to a March 2022 letter from CPUC President Alice Reynolds, CEOs of the investor-owned utilities (IOUs) noted 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, ranging

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

from design and engineering acumen to construction and procurement specializations, to complete the work necessary to get these projects interconnected. Furthermore, 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.

Further, the transmission system is being called upon over the next 10 years to support more than six 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 succeed 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. There are projects under development in at least 40 counties and more than 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. AB 205 provided an alternative process allowing eligible energy generation and storage facilities to optionally seek a permit from the CEC. As part of that process, the CEC must find that the project will comply with all applicable laws, ordinances, regulations, and standards. If such a finding cannot be made, the CEC must find that facility is required for public convenience and necessity and there are not more prudent and feasible means of achieving public convenience and necessity.[5]

Tracking Energy Development Task Force

These three challenges spurred the development of the Tracking Energy Development (TED) Task Force in late 2021. The TED Task Force tracks energy development and delays.[6] The TED Task Force is composed of representatives from CPUC, CEC, California ISO, and the GO-Biz. The Task Force was developed to track new energy projects critical for near-term reliability and help ensure that they are brought on-line as quickly as possible. The TED Task Force 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 1-3 years.

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[5] Public Resources Code, Section 25545.8(b) (referencing Public Resources Code Section 25525).

[6] 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.

Resources Developed for Extreme Events

In response to the concerns for summer 2022 reliability, 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 CEC and the DWR to secure conventional generation,[7] efficiency upgrades at existing natural gas plants, demand response, distributed clean energy resources (for example, fuel cells), 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 Emergency Load Reduction Program, which includes customers in (IOU) territories but instead supports customers in 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 to provide additional generation capacity to support grid reliability. Actions include extending the operating life of existing generation facilities planned for retirement, procuring new temporary power generators, or procuring energy storage. On January 31, 2023, the State Water Resources Control Board issued its draft policy to extend the compliance dates for OTC plants[8] to support the ESSRRP. This extension would allow the power plants to be available for contract to DWR as resources for 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 ESRRF programs were initiated to provide resources during summer 2022. The SRR is expected to remain in operation through 2027 but may be extended if circumstances warrant continuation.

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

8 The draft water quality control policy recommends, among other things, extending the operation of Alamitos Generating Station Units 3, 4, and 5; Huntington Beach Generating Station Unit 2; and Ormond Beach Generating Station Units 1 and 2 for three years from December 31, 2023, though December 31, 2026, to support system reliability. It also recommends extending the same policy for DCPP.

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.

Conclusion

While load-serving entities have been successful to date in procuring the resources they need to meet planning targets, the CEC notes risks associated with bringing new clean energy resources on-line to support reliability over the next five years, at a minimum. First, clean energy project development will need to occur at rates never seen before, even compared with recent record build years. Second, projects under development are experiencing delays from supply chain disruptions, an overwhelmed interconnection queue, and permitting delays. CEC staff sees these combined challenges as posing substantial risks to clean energy development at a rate necessary to replace DCPP and, as explained further in the following chapters, concludes that keeping DCPP is valuable until the replacement resources are on-line.

CHAPTER 3: 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.[9] 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). The analysis also considers extreme events and compares total resources against the equivalent resource need associated with the extreme events in 2020 and 2022, and a transmission outage from wildfire equivalent to what happened in Oregon's Bootleg fire in 2021. This assessment identifies the maximum hourly shortfall by year for each scenario using 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 into the future.

The following summarizes the key input assumptions used in this analysis.

- **Demand**: The hourly demand scenario used for this analysis is the draft 2022 CED Planning Forecast.[10]
- **Conditions Relative to the 1-in-2 Forecast**: This analysis explores three system conditions (Table 1). The first is the current RA planning standard of 16 percent for 2023 and 17 percent beginning in 2024. The second is 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. The last is the 2022 equivalent event that 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. These conditions were also evaluated under a coincidental wildfire risk reducing the total import capacity by 4,000 MW.

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

[10] "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 1: System Conditions Defined

Condition Relative to 1-in-2 Forecast	Operating Reserves	Outages	Demand Variability	Coincidental Wildfire 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:**[11] Existing resources located within the California ISO are based on this list, including resources on-line through October 2022. These additional resources are outlined in Table 3.
- **Resource Updates**: The resource build used in this analysis is based on LSE compliance with the CPUC-ordered reliability procurement in D.19-11-016 and D.21-06-035. Details on how the CPUC's procurement orders are translated into specific capacity numbers used in this analysis are described below, in Supply Input. This analysis does not consider the additional 4,000 MW of NQC order adopted by the CPUC on February 23, 2023.[12]

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[11] 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.

[12] On February 23, 2023, the CPUC ordered load-serving entities to procure an additional 4,000 MW of net qualifying capacity, 2,000 MW in 2026 and an additional 2,000 in 2027. This additional procurement was not included in this analysis. https://www.cpuc.ca.gov/news-and-updates/all-news/cpuc-augments-historic-clean-energy-procurement-goals-to-ensure-electric-reliability-2023.

- **Demand Response (DR):** The IOU DR monthly projections are published by the CPUC in its Load Impact Protocol Reports.[13] These numbers are used in addition to the CPUC's November 2022 NQC list for the baseline demand response. The DR numbers, in Table 2: 2023 Aggregated DR Numbers Reported by IOUs, are assumed fixed to 2032 because the IOUs do not forecast or report DR numbers out to a 10-year horizon.

Table 2: 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.
- **Wind and Solar:** The CEC uses hourly shapes to estimate generation from onshore wind and solar within the California ISO balancing authority footprint. These are based on historical generation on high-load days between 2014 and 2021.
- **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 is included in the stack, rather than the effective load-carrying capacity (ELCC) values because discharge limits are directly incorporated. See Hourly Wind, Solar, and Battery Shapes, below, for additional information.
- **Retirements**: The stack analysis assumes OTC plants and Diablo Canyon Power Plant (DCPP) retire as currently scheduled. This retirement date 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 Input

The CPUC's procurement orders are the basis of the resource build beyond the CPUC's November NQC list — specifically, the remaining procurement associated with D.19-11-016 and D.21-06-035. Table 3 shows the NQC order 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.

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[13] 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.

Table 3: 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 the CEC with 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 overprocurement 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 4.

Table 4: 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[14]	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

[14] 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.

The resource needs established by the CPUC's procurement orders were developed using the 2020 CED mid demand update[15] and include only 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.

Resource Delays

Given that there are uncertainties in new clean energy resources coming on-line (for example, supply chain, interconnection, and permitting), the analysis looks at different scenarios that might affect timely on-line dates. The delay scenarios assume that all resources come on-line, but some will be delayed by one year. Scenarios were run for a 0 percent delay, a 20 percent delay, and a 40 percent delay. The delayed capacity is assumed to come on-line in the following year without any additional, or compounding, delay.

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 to 2021. Using historical 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 from 2014 through 2021. The twentieth percentile for the wind generation value is calculated similarly. The profiles are a weighted average of the median and the twentieth percentile, with 80 percent of the weight going to the median and 20 percent to the twentieth percentile. This weighting method is similar to the NQC approach for projecting nondispatchable hydroelectric (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 allow.

[15] 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.

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 p.m. and 10 p.m. hours that have not reached maximum hourly discharge.

Table 5 shows the hourly profile used for solar, wind, and battery resources. While the solar and wind profiles remain unchanged throughout the analysis, the battery profile changes to reduce the shortfalls. Therefore, the battery profile in Table 5 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 5: Wind, Solar, and Battery Hourly Profile

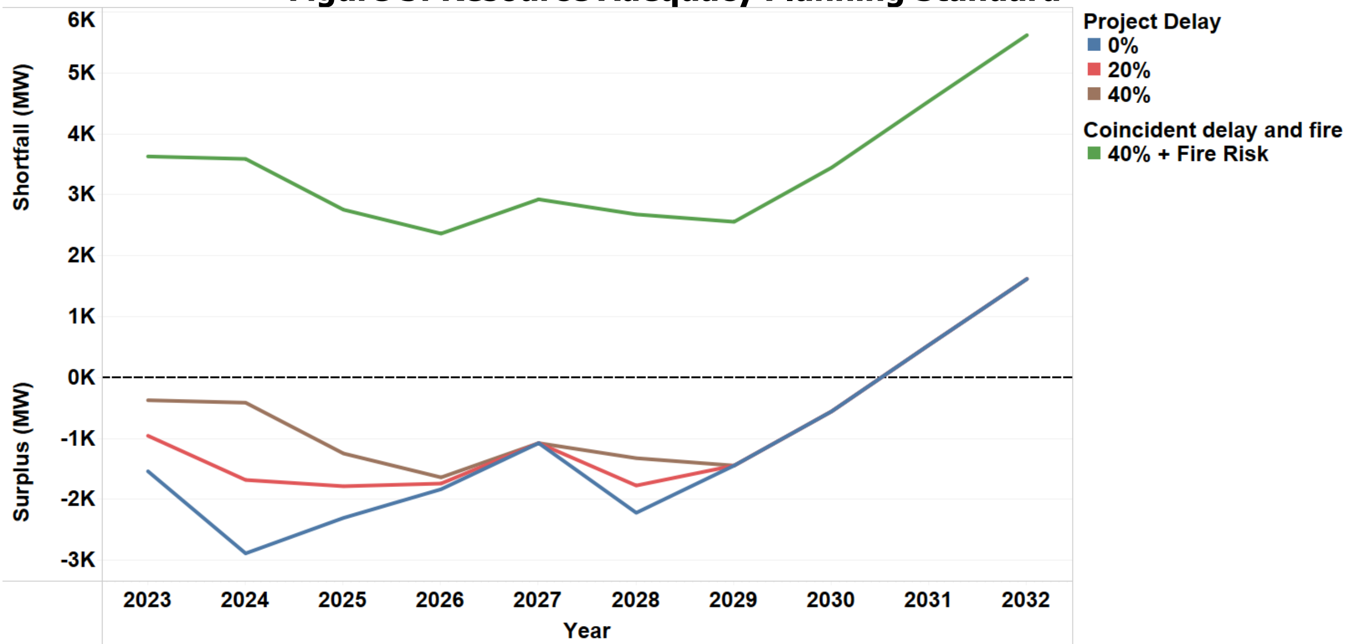
Wind				**Solar**				**Battery**			
Time PDT	Jul	Aug	Sep	Time PDT	Jul	Aug	Sep	Time PDT	Jul	Aug	Sep
4PM-5PM	0.38	0.28	0.17	4PM-5PM	0.71	0.72	0.64	4PM-5PM	0.39	0.31	0.00
5PM-6PM	0.45	0.34	0.21	5PM-6PM	0.57	0.55	0.41	5PM-6PM	0.39	0.31	0.64
6PM-7PM	0.48	0.40	0.24	6PM-7PM	0.33	0.26	0.10	6PM-7PM	0.60	0.95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

Results

The stack results for the current RA planning standard of 17 percent (16 percent for 2023) show that the CPUC's procurement orders are sufficient to meet the planning standard through 2030 despite the procurement order authorizing procurement only through 2028. This is true with the scenario of 40 percent annual capacity delays (Figure 5). While not included in this analysis, the CPUC will consider ordering additional procurement of 4,000 MW NQC total split equally across 2026 and 2027. This procurement could eliminate any shortfall through 2032 under the current planning standard.

Figure 5: Resource Adequacy Planning Standard

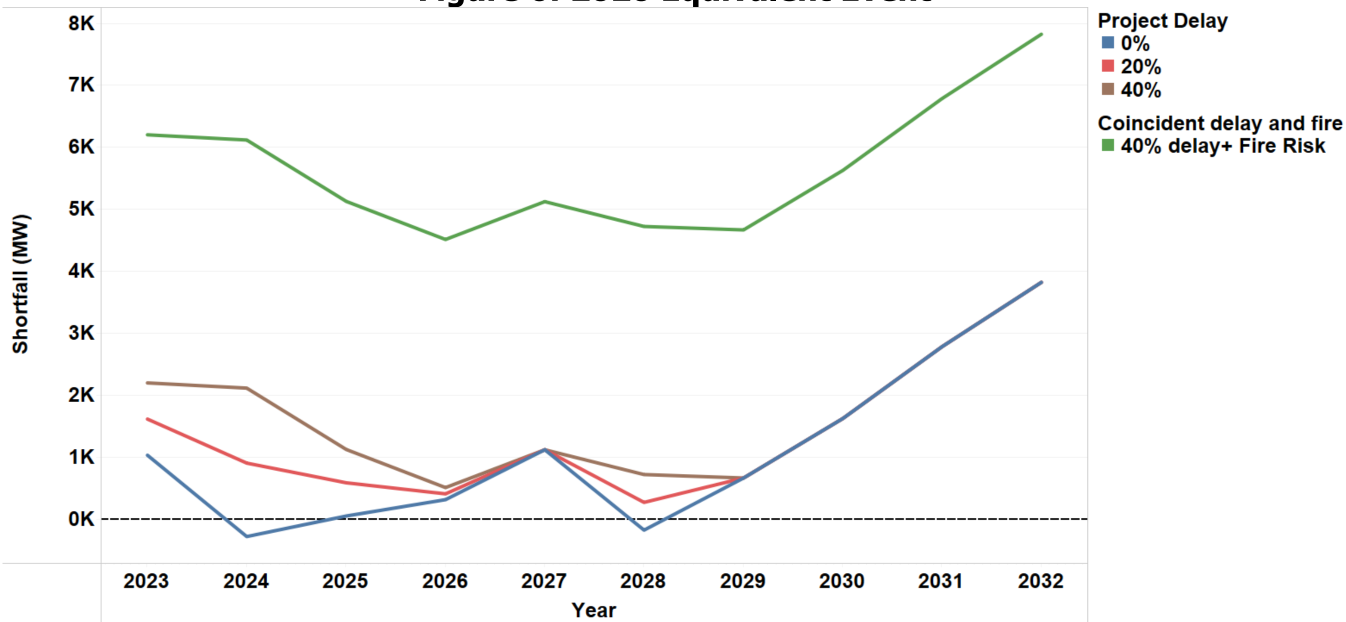


Source: CEC

However, the current RA planning standard may be insufficient to protect against a coincident wildfire risk during the peak period. CEC used the equivalent of a loss of 4,000 MW of transmission capacity, which is equivalent to the amount of transmission capacity lost to the state as a result of the Bootleg wildfire in Oregon in 2021.

Expanding staff's assessment to a 2020 equivalent event, the procurement order capacity is at risk of being insufficient in most years (Figure 6). This risk is greatly increased if a portion of the procurement is delayed by a single year. While greater, the shortfalls are generally near or below 1,000 MW, which could be covered by extreme-event resources that are available to the state. Again, the additional procurement the CPUC is considering would lower the risk beginning in 2026, but there is meaningful risk in 2023 through 2025. This risk increases greatly in the event of a coincident wildfire risk situation. The newly considered procurement would not be expected to reduce this risk to the accepted level of uncertainty, as a shortfall would still be expected beyond 2026. However, the level of shortfalls after the additional procurement may be within reach of the contingency resources.

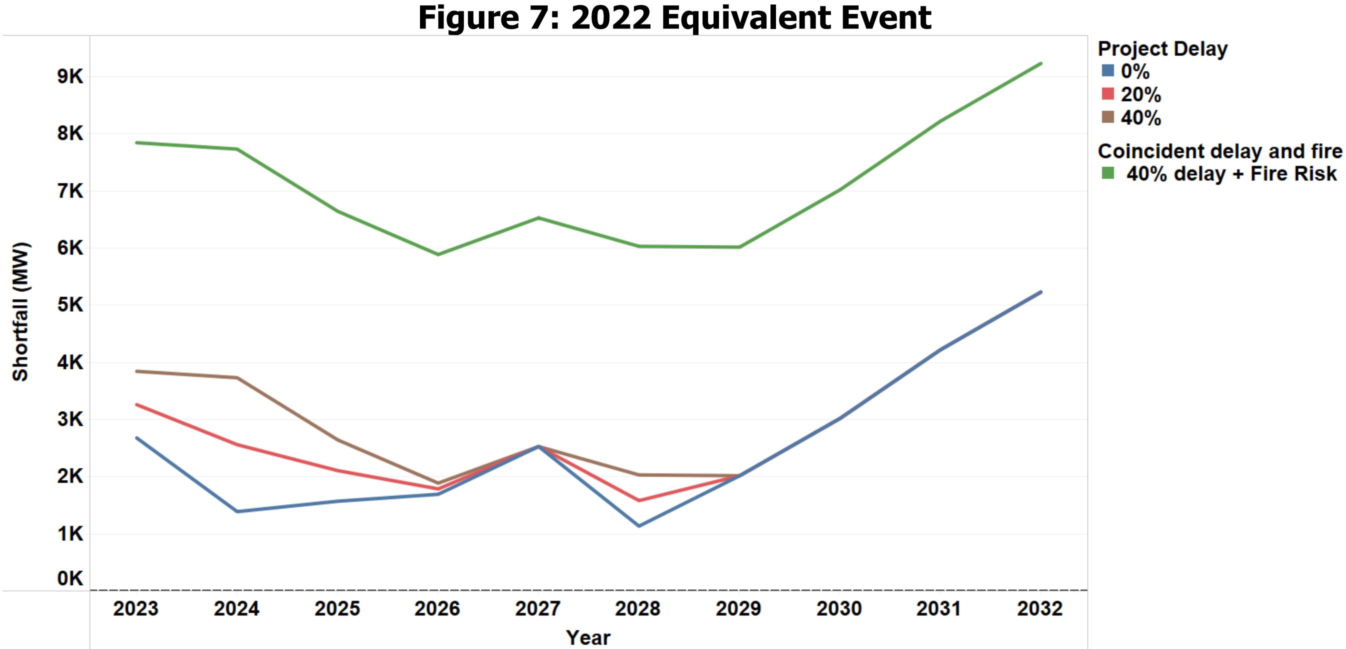
Figure 6: 2020 Equivalent Event



Source: CEC

The reliability risks increase if a 2022 equivalent event were to repeat itself (Figure 7). In this case, the total shortfall exceeds 1,000 MW in all cases and grows to nearly 4,000 MW in 2023 and 2024 under a 40 percent annual capacity delay. Layering a coincident wildfire risk greatly increases the reliability risk.

Figure 7: 2022 Equivalent Event



Source: CEC

The CEC explored additional cases, including resource builds based on the CPUC's 2021 Preferred System Plan (D.22-02-004) and reductions in total capacity additions by 20 and 40 percent. These scenarios, including additional results, can be found in the February 2023 *Joint Agency Reliability Planning Assessment*.[16]

California ISO Reliability Study

The California ISO has been conducting analyses on the reliability of their system, including probabilistic production cost modeling analysis.[17] This analysis type is different from the analysis presented in this report, which does not directly incorporate the interactive effects between the uncertainty of each input that is captured by a probabilistic production cost model. Additional differences between the ISO analysis and the stack analysis used in this report include the demand forecast used, the resource additions, and years analyzed. Specifically, the ISO study uses demands based on the CEC's 2021 CED to create a set of demand distributions, uses resource builds based on the CPUC's preferred system plan, and looked at only 2023 through 2026 and 2032. The analysis in this report used the draft 2022 CED, resource builds based on the CPUC's procurement orders, and studied all years from 2023 through 2032. Similar to the study presented in this report, the California ISO study did not include the February 23, 2023, CPUC procurement order for an additional 4,000 MW of NQC.

Despite these differences, the results for both the Resource Adequacy Planning Standard scenario and the California ISO study show the California ISO system meets planning reliability criteria in 2023 and 2024. In 2025 and 2026, the California ISO analysis shows shortfalls, rather than continued surpluses shown in the Resource Adequacy Planning Standard scenario. The shortfalls identified by the California ISO are between those found in the 2020 Equivalent Event and 2022 Equivalent Event scenarios from this study.

Conclusion

Under the current RA planning standard, the CPUC's procurement orders result in no expected shortfalls well beyond the end of the current procurement orders, despite significant retirements between now and 2026. However, significant grid reliability risks persist through 2030 under extreme heat events, such as those experienced in 2020 and 2022. These risks are compounded by the risk of coincident wildfires impacting imports to California.

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16 Kootstra, Mark and Nathan Barcic (CPUC). 2023. *Joint Agency Reliability Planning Assessment*. California Energy Commission. Publication Number: CEC-200-2023-002

17 Millar, Neil. (California Independent System Operator). "February 2, 2023, Letter to CEC Vice Chair Siva Gunda," http://www.caiso.com/Documents/Jan2-2023-Letter-CaliforniaEnergyCommissionViceChair-CAISOReliabilityModeling.pdf.

CHAPTER 4: Determination of Need to Extend Diablo Canyon

Introduction

California is confronted with several challenges to grid reliability, including extreme events, variability from climate change, and new project development delays. Preparing for greater weather variability and ensuring sufficient grid resources are developed in adequate time are essential to maintaining statewide energy reliability. Staff assessments show that current ordered procurement can meet current resource adequacy planning standards through 2030. However, there are uncertainties both in the ability of California LSEs procuring sufficient resources to meet the current ordered procurement and the determination that procurement would be sufficient to ensure reliability in extreme events. These uncertainties should be considered relative to extending DCPP.

Uncertainties Impacting Reliability

The state is seeing more variable and higher net peak demand as a result of unprecedented climate change-induced heat events. Planning for these events requires improvements to the state's planning approaches, including analytical models, to better assess the likelihood of these events. The CEC, CPUC, and California ISO continue to work on improving the ability to assess demand variability in extreme events. At the same time, the state is seeing greater demand year over year from growing electrification.

The state is creating a set of resources to support grid reliability in extreme events through the SRR. However, the SRR may not have sufficient capacity to maintain grid reliability in a coincident event, such as a westwide heat event resulting in unprecedented load and greater competition throughout the West for available resources, extreme drought impacting hydroelectric output, and one or more wildfires impacting transmission. The required pace of clean energy development also is a challenge to grid reliability. Although the state has experienced a historic rate of building new clean energy resources in the recent past, the state will need an even greater pace of resource development to meet the needs of the ordered procurement and meeting a 1-in-10 planning standard. Availability and timely delivery of key equipment, as well as interconnection and permitting delays, present risk to the ability to get projects on-line and associated generation secured for the resource RA market. Ordering additional procurement does not mean that additional development will be able to meet demand.

These dynamics are not just impacting California. The western states as a whole are seeing tighter availability of resources, causing increased competition for existing resources, as well as related costs, making resources such as imports harder to come by. Given California's historical dependency on imports to meet resource adequacy, the dynamics of the western states' resource adequacy market issues pose additional risk to maintaining reliability.

Recommendation

Given the potential delays in resource build out to meet ordered procurement and increasing risks of climate-related threats to grid reliability, CEC staff recommends that the CEC determine that it is prudent to pursue extension of DCPP until the state can confirm that the necessary resources are on-line or CEC's assessment of alternatives (due September 30, 2023) shows viable alternative resources are available to meet the needs that DCPP would have provided otherwise.

While analysis of the state's electric system reliability indicates that the state can meet the current resource adequacy planning standards over the next 10 years, the analysis projects shortfalls if the state experiences extreme heat events such as it experienced in 2020 and 2022. The analysis is also predicated on the ability to build new clean energy resources at a pace not seen before and in the face of supply chain, interconnection, and permitting delays. It is also predicated on the ability of LSEs to be able to secure imports in an increasingly competitive western market.

Extending DCPP has a decided advantage in the sense that it is a firm, low-carbon resource. This extension allows the state to rely less on natural gas and more on clean resources for the grid. CEC staff notes that additional analysis will be conducted by the CEC to compare the costs to extend DCPP to alternative resources (due to the Legislature by September 30, 2023) and by CPUC in its DCPP proceeding (decision anticipated by December 2023). These analyses will further inform the decision to extend DCPP.

APPENDIX A: Acronyms and Abbreviations

AB – Assembly Bill

BA – balancing authority

BANC – Balancing Authority of Northern California

California ISO – California Independent System Operator

CEC – California Energy Commission

CPUC – California Public Utilities Commission

DR – demand response

ELCC – effective load-carrying capacity

GW – gigawatt

GWh – gigawatt-hours

IEPR – Integrated Energy Policy Report

IOU – investor-owned utility

IRP – integrated resource plan

LADWP – Los Angeles Department of Water and Power

LSE – load-serving entity

MW – megawatt

MWh - megawatt-hour

OOS – out-of-state

PG&E – Pacific Gas and Electric

POU – publicly owned utility

RA – resource adequacy

RPS – Renewables Portfolio Standard

SB – Senate bill

SCE – Southern California Edison

SDG&E – San Diego Gas & Electric

TID – Turlock Irrigation 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/glossary
- California 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.

Building electrification

When the end-user consumption of fuel, not limited to fossil gas, is switched from that fuel to the consumption of electricity to provide the same service to the consumer. Example: Replacing a fossil gas fired water heater with an electric air source heat pump.

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 or the variability or both of the associated properties and that persists for an extended period, typically decades or longer. Climate change may be due to natural internal processes or external forcings 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 is 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.

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"). This is particularly important 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 several 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 tenth or ninetieth 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 (for example, 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 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 economywide 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 (IOU) 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. 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.

Net qualifying capacity (NQC)

The amount of capacity that can be counted toward meeting resource adequacy requirements in the CPUC's RA program. It is a combination of the CPUC's qualifying capacity counting rules, the methods for implementing them for each resource type, and the deliverability of power from that resource to the California ISO 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.

Preferred System Plan

The CPUC's Integrated Resource Plan "planning track" operates on a two-year cycle that concludes with the CPUC adopting a preferred system plan (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.

Publicly owned utility (POU)

Publicly owned utilities (POUs), or municipal utilities, are controlled by a citizen-elected governing board and uses 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 or digester or both, 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. Scenarios are neither predictions nor forecasts but are used to provide a view of the implications of developments and actions.

Strategic Reliability Reserve (SRR)

A collection of programs established by AB 205, as amended by AB 209, administered by the CEC and DWR to provide both supply- and demand-side support to the electrical grid during extreme events.