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California Energy Commission

STAFF PAPER

Summer Stack Analysis for 2022-2026

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ABSTRACT

The Summer 2022 Stack Analysis Report Update (stack analysis update) examines the potential impacts of a west-wide extreme weather event and prolonged drought in the critical months of July through September between 2022 and 2026. The analysis provides a reference point for consideration in energy reliability-related actions that the state may take.

The California Energy Commission's Stack Analysis Tool is used to identify the potential for a shortfall in planned resources and the amounts and duration of contingency resources that may be needed. This final version of the stack for summer 2022 indicates a need for significant contingency resources. Years beyond 2022 should fare better under current assumptions for new resources and retirements.

Keywords: Stack analysis, system reliability, short-term reliability, summer 2022, supply resources, extreme weather, electricity system planning

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EXECUTIVE SUMMARY

Extreme heat events in 2020 impacted the western United States, straining the electric system in the California Independent System Operator (California ISO) territory and resulting in rotating outages on two days in August. The California ISO, California Energy Commission (CEC), and California Public Utilities Commission (CPUC) conducted a Root Cause Analysis of the events and identified the need for the three entities to assess potential impacts of climate change-induced heat events and improve resource planning to better prepare for summer reliability.

In response, the CEC developed an hourly stack analysis to assess supply conditions against average and extreme weather conditions for the key months of July through September. An hourly stack analysis compares the supply of resources to demand on an hourly basis. The hourly stack analysis tool supplements traditional planning methods and is intended to provide a high-level assessment of the potential for resource shortfalls under an extreme weather event and the contingency resources that might be needed to make up the shortfall.

The CEC first published a Summer 2022 Stack Analysis on July 30, 2021. That analysis provided a preliminary assessment of summer 2022 and showed a need for contingency resources in the early evening hours if an extreme heat event occurred in July, August, or September.

The Summer 2022 Stack Analysis Update includes current information on resources, including new electricity procurements required of load-serving entities by the CPUC and projections for how severe drought will affect hydroelectric generation and pumping demand from the State Water Project. This analysis projects potential need for contingency energy resources in August of up to 1,000 megawatts (MW) and in September of up to 3,500 MW. In 2023, current projections for new resources should reduce the need for contingency resources to 600 MW at net peak and eliminate the need in September. There could be a need for between 900 MW and 3,300 MW of contingency resources between 2024 and 2026.

Background

In 2020, heat waves impacted the western United States and strained electric system operations in California, resulting in rotating outages August 14 and 15, 2020. The Final Root Cause Analysis (RCA) — prepared for Governor Gavin Newsom by the CEC, CPUC, and California ISO and published January 13, 2021 — detailed three root causes behind the outages and identified actions to be taken by the three entities to reduce the potential for grid outages, like those that occurred in August 2020. The RCA required the CEC to develop and publish a multiyear, statewide summer assessment to provide information to support reliability planning and maintain situational awareness of potential impacts to grid reliability under extreme conditions.

In response, the CEC began developing two reliability assessment products: 1) hourly stack analyses to help support contingency planning and 2) probabilistic loss-of-load-expectation (LOLE) analyses to help support long-term policy studies and midterm procurement planning. The hourly stack analysis assesses supply conditions against average and extreme weather conditions as individual scenarios using two planning reserve margins to capture demand and supply conditions. The hourly stack analysis supplements traditional planning methods and is intended to provide only a snapshot of a worst-case scenario on the California ISO system to inform the need to prepare for contingencies. While some energy shortfalls may be best addressed by additional procurement, the intent of this hourly stack analysis is not to determine whether procurement of new resources is needed. Traditional planning tools, such as LOLE analysis combined with hourly stack analyses, can provide a more robust picture to determine the balance between traditional procurement of new resources and contingency resources.

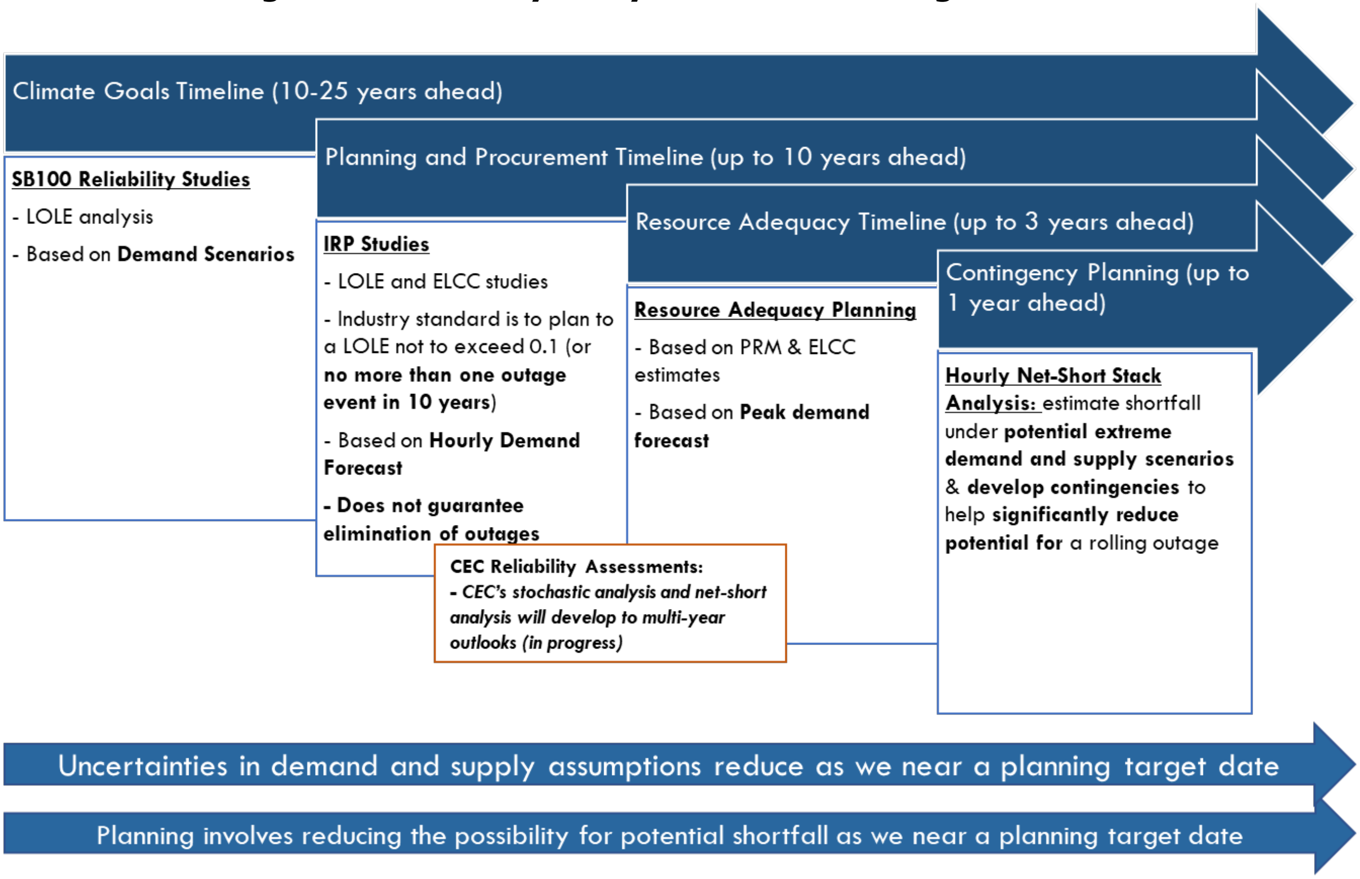
In this document, the CEC has updated the outlook for summer 2022 and provides the preliminary outlook for 2023 under extreme supply-and-demand conditions. This outlook includes an update of the existing supply, proposed new supply, low hydroelectric generation due to drought and demand projections for 2022 and 2023. This staff paper will be the final version of the 2022 stack analysis.

This document also contains potential outlooks for 2024 through 2026. The numbers in these years assume that utilities will procure new resources as scheduled in the most recent IRP order rather than aggregated contract data. Therefore, these years should be considered preliminary.

Reliability Analysis Across Planning Horizons

While reliability analysis has always been a core component of electric sector planning, the challenges on the electric grid in recent years brings into focus the need for a complete picture of reliability risks across all time horizons. The specific purpose, type of analysis, and details change as the target year approaches. The more near-term the analysis, the less uncertainty there is in supply and demand and the greater the focus is on reducing the probability of realized supply shortfalls.

Figure 1: Reliability Analysis Across Planning Horizons



Source: California Energy Commission

Long-term studies, such as the 2021 Joint Agency SB 100 Report (De León, Chapter 312, Statutes of 2018), are focused on developing directional portfolios to meet long-term climate goals. There is significant uncertainty in demand and potential supply, so reliability studies seek to determine whether the magnitude and type of resources in the portfolio are reasonable to maintain reliability.

In the planning studies, which typically have a 10-year planning horizon, portfolios are developed to provide guidance to procurements and inform critical planning processes. The reliability studies seek to determine the resources needed to avoid significant risk of supply shortfalls while balancing the cost of absolute reliability. Reliability is typically assessed through a Loss of Load Expectation (LOLE) analysis, a probabilistic analysis incorporating a distribution of demand profiles, wind and solar profiles, and randomized forced outages to determine the probability of a supply shortfall. The typical standard for the analysis to target an LOLE is referred to as 1-in-10, or roughly less than one outage every 10 sample years.

A portfolio meeting the LOLE standard by itself does not eliminate the probability of realized outages for several reasons. First, by definition, the 1-in-10-year standard does not eliminate the probability of outages. Second, the actualized probability of outages may be different than the model suggests if the inputs do not reflect actual conditions in the given year. For example, if the model assumes an average hydroelectric (hydro) year across all years, but drought conditions are present, the probability of a loss of load event may be higher. Another example is if the distribution of demand profiles is wider or more extreme due to climate change but is not captured in the dataset that relies on historical data, the probability of a loss of load event may also be higher.

In the contingency planning time frame, a year to days ahead, the reliability analysis develops a situational awareness of available supply and demand to prepare contingency resources should conditions be tight. Contingency resources are resources beyond the current resource adequacy requirements. With changing resource supply conditions in California and the West and with increasingly extreme weather conditions due to climate change, this time frame has come into greater focus. In response to the 2020 rotating outages, the CEC developed an hourly stack analysis to evaluate potential shortfalls that could occur during an extreme heat event, particularly as the state experiences drought and wildfires.

CHAPTER 1: Summer 2022 and 2023 Hourly Stack Analysis Update

This outlook is an hourly evaluation of anticipated supply, which is then compared to projected hourly demand for the peak day of each month, July through September. The comparison is depicted in a bar chart that stacks the resources expected to be available in each hour and compares the total against the projected demand under average weather conditions and an extreme weather event.

The 2021 Summer Stack Analysis was published in July 2021 and based on information available at the time about resources anticipated to be on-line in 2021 and 2022. The foundational data on resources comes from California ISO's Net Qualifying Capacity[1] (NQC) data. Table 1 gives the nameplate capacity that has come on-line and the qualifying capacity value for August based on the CPUC's technology factors, which are used to estimate the qualifying capacity for various technologies given their nameplate capacity.

Table 1: New Resources Online November 2020–September 2021

Resource Type	MW NQC Online by 10/2021 August Tech Factors	Nameplate Capacity
Energy Storage	1,230	1,230
Solar	364	1,376
Wind	69	340
Geothermal	9	12
Small Hydro	2	15
Total	1,674	3,019

Source: CPUC staff

The Summer Stack Analysis for 2022 Update was published in January 2022 and indicated a maximum need for contingencies of 2,400 MW in September. Since then, several inputs have been updated, including the demand forecast, new resource projections, and drought impact to hydroelectric generation and pumping. In addition, some emergency procurement resources that contributed to the January update have now been reclassified as contingencies.

1 The NQC value of a resource is a determination of how it is able to contribute to reliability. More information on how NQC is calculated for different kinds of resources can be found in the Qualifying Capacity Methodology Manual. https://www.cpuc.ca.gov/-/media/cpuc-website/files/legacyfiles/q/6442466773-qc-manual-2020.pdf

CHAPTER 2:
Summer 2022 and 2023 Input Assumption Updates

Assumptions about demand and available resources in 2022 and 2023 are based on the best available data. Demand is based on the *Adopted 2021 Integrated Energy Policy Report California Energy Demand (2021 CED)*[2] hourly projections for 2022 and 2023. Available supply projections are based on the California ISO NQC list for 2022, with modifications based on anticipated new resources, planned retirements, and likely drought impacts. Supply assumptions are intended to reflect physical resource availability and may not necessarily reflect resource adequacy or other contracts. This section provides an overview of the inputs and assumptions followed by Table 2 and 3, which have more detailed information on inputs and assumptions.

Analysis Inputs and Assumptions

The following summarizes the key input assumptions and updates made to the adopted analysis.

- **Demand**: Generally, the stack uses the most recently adopted demand projections. For this update, the analysis uses the Adopted CED Hourly Demand projections for summer 2022 and 2023 monthly peak days. These projections are outlined in Table 2.
- **Planning Reserve Margin (PRM)[3]**: The traditional industry standard 15 percent PRM is considered, as well as a 22.5 percent PRM. The higher PRM considers the potential increase from climate change and extreme weather events that impact demand and the forced outage rates for supply-side resources. While the CED projections include the impact of climate change, they do not include projections for extreme weather events, such as those experienced during the summer of 2020.
- **California ISO October 2021 NQC list**: Existing resource projections for 2022 and 2023 are based on this list including resources on-line by August 2021. These additional resources are outlined in Table 3.
- **Resource Updates**: CPUC staff provided updates on new resources and procurement expected from September 2021 to summer 2023 (incremental to the October 2021 NQC list) by each summer month. These are outlined in Table 3.
- **Demand Response (DR):** The investor-owned utility (IOU) DR monthly projections are published by the CPUC in its Load Impact Protocol Reports. The RCA identified that these projections were not fully realized, and, as a result, this resource was derated by 40 percent in previous versions of the summer stack analysis. However, the CPUC

2 Adopted CED 2021 Hourly California ISO Forecast, https://efiling.energy.ca.gov/GetDocument.aspx?tn=240987.

3 The PRM is a standard for how many additional resources should be available compared to expected peak load.

directed the IOUs to update DR projections; therefore, a derate is no longer necessary. The publicly owned utility (POU) DR projections included in the analysis are based on actual summer 2021 monthly showings. These are outlined in Table 3.

- **Resource Adequacy (RA) Imports and POU Liquidated Damage Firm Imports**: Updated to include 2021 RA showings. A six-year rolling average was used consistent with the approach used in the California ISO summer 2021 stack analysis. This rolling average covers 2016–2021. These years are outlined in Table 3.
- **Hydro Capacity**: Hydro capacity is sourced from the October 2021 NQC list. CDWR provided estimates of the impact to their hydroelectric capacity due to the ongoing drought for each month, based on April 1 conditions. CDWR accounts for about 1,700 MW of California's 6,500 MW of hydroelectric capacity.
- **Use of Hourly Profiles for Wind and Solar**: The CEC developed solar and wind profiles corresponding to a high-load day, to take into account any relationship between high-load days and low wind (or atypical solar) generation. See the Hourly Wind and Solar Shapes Section for more details. This method is an improvement over previous stack analyses, which used effective load carrying capacity (ELCC) values or technology factors, as opposed to hourly profiles.
- **Battery Storage**: New to this version of the stack, battery storage is limited to discharging for four hours only. Storage is optimized so that the shortfall in any given hour is equal to or less than the capacity shortfall at net peak.

Table 2: Demand-Side Assumptions

Demand Category	Assumptions
Base Demand	Hourly projections for summer 2022 and summer 2023 monthly peak days from the Adopted 2021 CED.
Drought Adjustment to Demand relative to CED	-338 MW at 7-8PM in July -338 MW at 7-8PM in August -179 MW at 7-8PM in September

Source: California Energy Commission

Table 3: Supply-Side Assumptions

Supply Category	Assumptions
Baseline Resources	2022 projected monthly NQC values from California ISO October 2021 NQC List. Solar and wind resources are converted to an hourly shape based on method described in the next section.
Hydro Drought Derate	Data sourced from CDWR, relative to the 2022 NQC list. -240 MW in July -350 MW in August -327 MW in September
Imports	Average 2016–2021 California ISO RA showings plus POU 2021 firm liquidated damage contracts 6,005 MW July 6,439 MW August 6,560 MW September
Demand Response	IOU and POU totals include line losses. IOU is derated according to the CPUC Load Impact Protocol[4] and POU DR is not derated. 1,419 MW July 2022 1,460 MW August 2022 1,467 MW September 2022
Retirements	No new retirements beyond those accounted for in the October 2021 NQC list
CPUC Procurement Between September 2021 and 2022	Data sourced from CPUC, based on LSE procurement status filings. 1,651 MW NQC (September Tech Factors) by July 1,699 MW NQC (September Tech Factors) by August 2,581 MW NQC (September Tech Factors) by September
CPUC Procurement Between September 2021 and 2023	Data sourced from CPUC, based on LSE procurement status filings. 5,350 MW NQC (September Tech Factors) by July 5,436 MW NQC (September Tech Factors) by August 5,996 MW NQC (September Tech Factors) by September

Source: California Energy Commission

4 Pacific Gas and Electric DR Allocations. https://www.cpuc.ca.gov/-/media/cpuc-website/files/legacyfiles/p/6442465531-public-version-revised-pge-completed-fy2020-dr-lip-allocations-for-py2021-2023-v2.xlsx

San Diego Gas & Electric DR Allocations. https://www.cpuc.ca.gov/-/media/cpuc-website/divisions/energy-division/documents/resource-adequacy-homepage/resource-adequacy-compliance-materials/for-sdge-to-complete----fy2021-dr-lip-allocations-for-py2022-2024_jun152021_sdge-response.xlsx

Southern California Edison DR Allocations. https://www.cpuc.ca.gov/-/media/cpuc-website/divisions/energy-division/documents/resource-adequacy-homepage/resource-adequacy-compliance-materials/for-sce-to-complete----fy2021-dr-lip-allocations-for-py2022-2024---final---redacted.xlsx

Table 4: PRM Assumptions

Demand Curve	PRM Assumptions
Extreme Weather	22.5% PRM: 6% for Operating Reserves 7.5% for Outages 9% for demand variability
Average Weather	15% PRM: 6% for Operating Reserves 5% for Outages 4% for demand variability

Source: California Energy Commission

Hourly Wind, Solar, and Battery Shapes

Hourly wind 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 Oasis website[5], the median generation value for each hour of the day was calculated based on the five highest-load days of each month for each year between 2014 and 2021. The twentieth percentile 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 hydro capacity. This approach is used for both wind and solar.

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

Table 5: Wind and Solar Profiles

Time	Wind			Solar		
(PDT)	Jul	Aug	Sep	Jul	Aug	Sep
4PM-5PM	0.31	0.23	0.11	0.67	0.64	0.57
5PM-6PM	0.37	0.27	0.14	0.53	0.46	0.31
6PM-7PM	0.39	0.33	0.17	0.28	0.17	0.06
7PM-8PM	0.41	0.36	0.21	0.05	0.01	0.00
8PM-9PM	0.44	0.39	0.23	0.00	0.00	0.00
9PM-10PM	0.46	0.43	0.25	0.00	0.00	0.00

Source: California Energy Commission

5 The California ISO Oasis website is where data such as historical loads, prices, transmission flows, etc is made available.

Battery storage is optimized so that the energy shortfall does not result in numbers higher than the capacity shortfall. The profile is created in four steps:

1. Identify the capacity shortfall. This is the highest shortfall in any hour with the batteries discharging at full capacity. For 2022, this is 3,500 MW at 7–8 p.m.
2. 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. This step is repeated until the battery discharge reaches 4 total hours.
4. 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 p.m. hours that have not reached maximum hourly discharge.

Below is the battery storage profile for 2022 provided as an example.

Table 6: Battery Profile for 2022

Time (PDT)	Jul	Aug	Sep
4PM–5PM	0.40	0.31	0.08
5PM–6PM	0.40	0.38	0.58
6PM–7PM	0.80	1.00	1.00
7PM–8PM	1.00	1.00	1.00
8PM–9PM	1.00	1.00	1.00
9PM–10PM	0.40	0.31	0.33

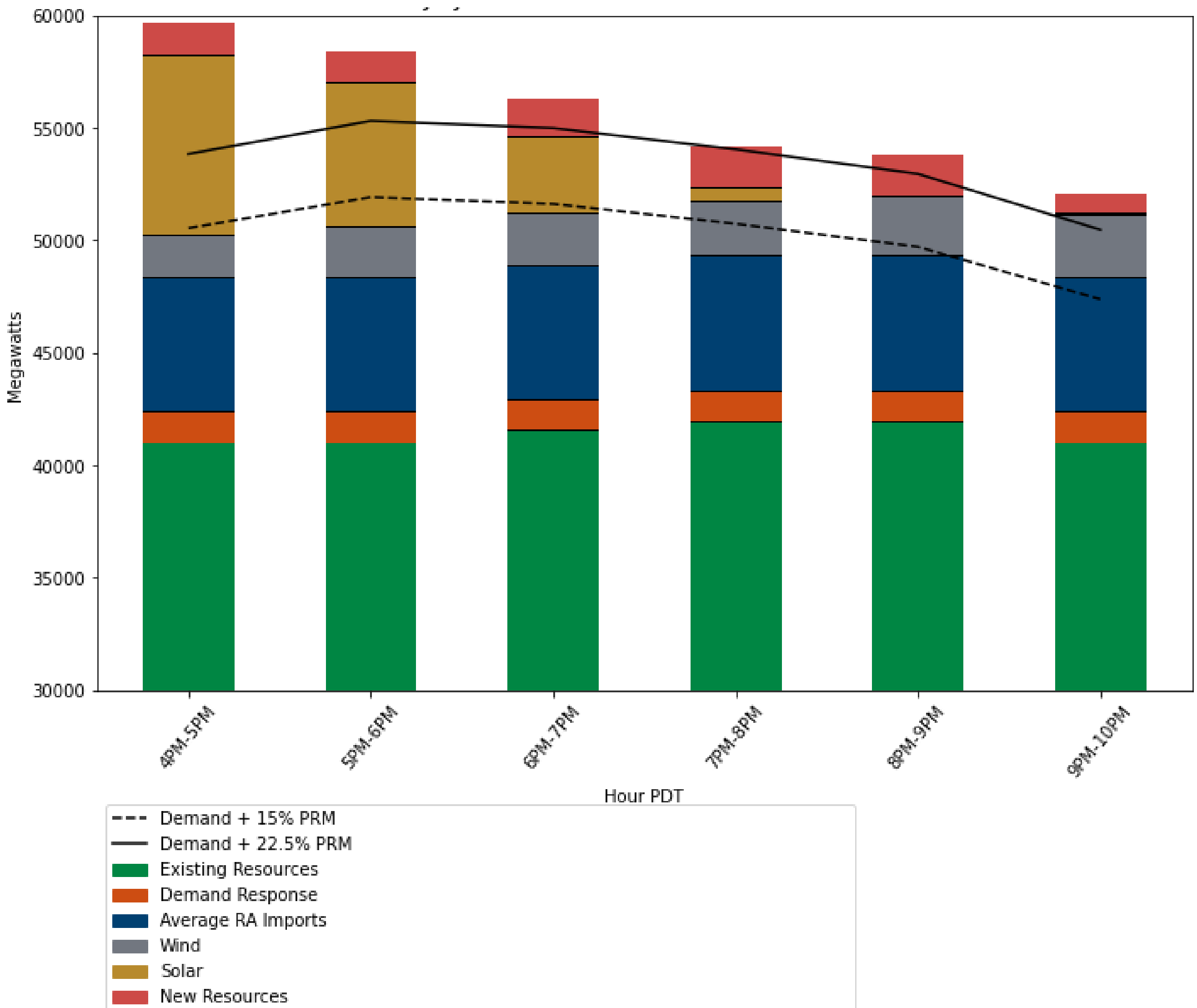
Source: California Energy Commission

CHAPTER 3: Final 2022 Stack Results

With the updates outlined above, the 2022 Summer Stack Analysis tool projects a need for significant contingency resources in August and September 2022. Figures 2–5 display July, August, and September 2022 hourly results, respectively. The maximum need is 1,000 MW in August and 3,500 MW in September.

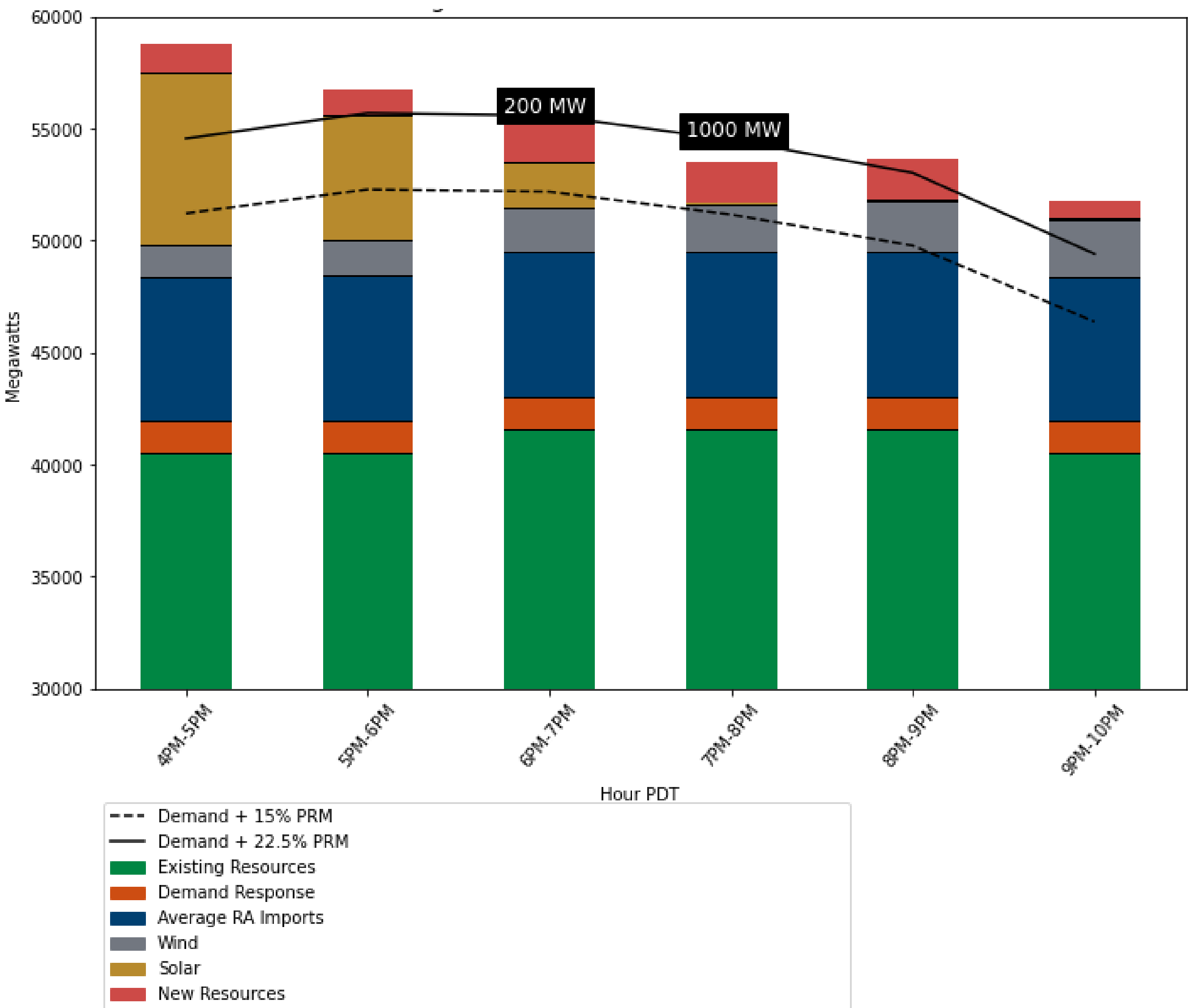
The maximum shortfalls are 1,100 MW higher in September compared to the preliminary version released in January, and August went from being around 900 MW above 22.5% PRM at net peak to a 1,000 MW shortfall. This is primarily due to lower projections of new resources, particularly in July and August.

Figure 2: Final July 2022 Stack



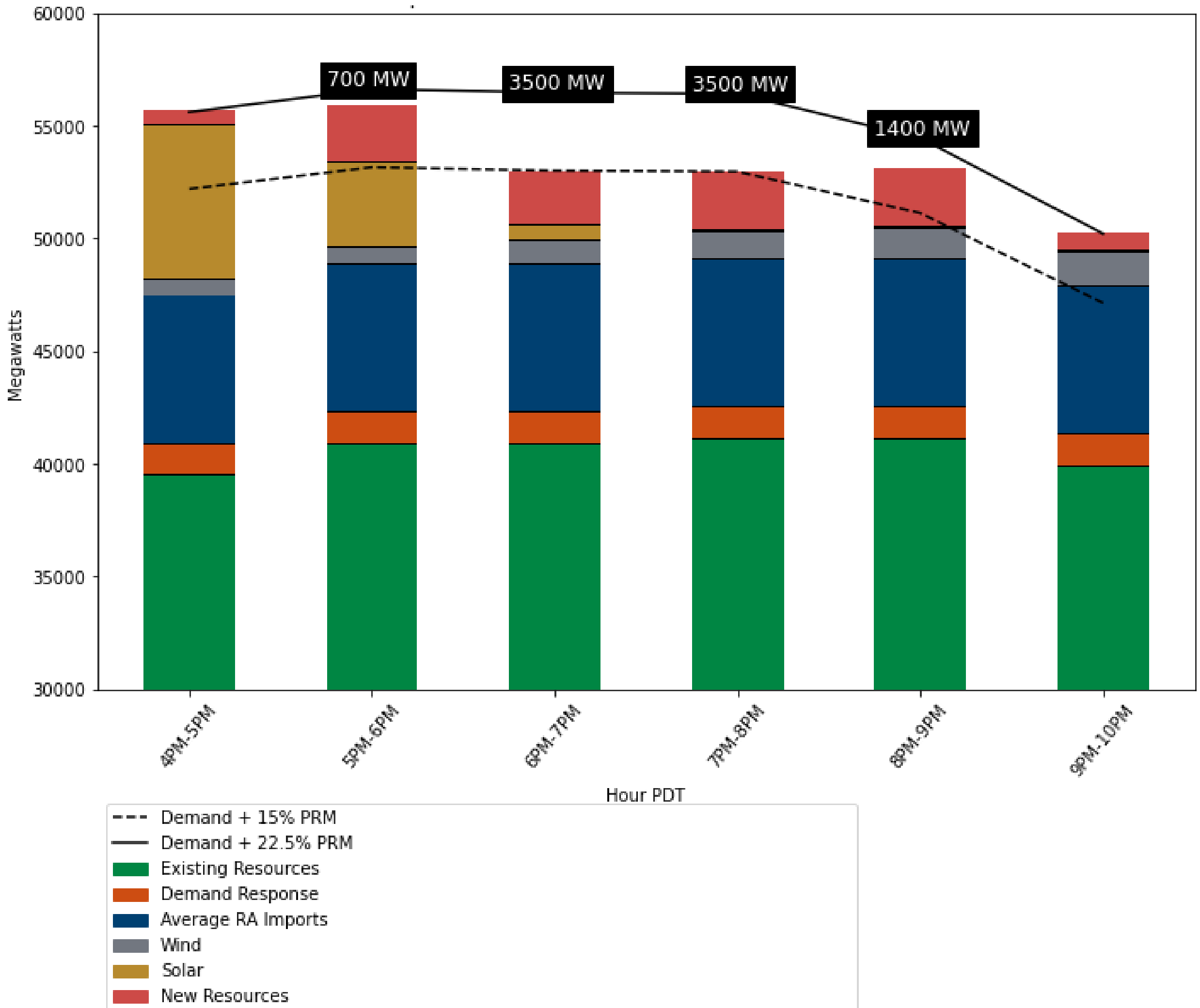
Source: California Energy Commission

Figure 3: Final August 2022 Stack



Source: California Energy Commission

Figure 4: Final September 2022 Stack

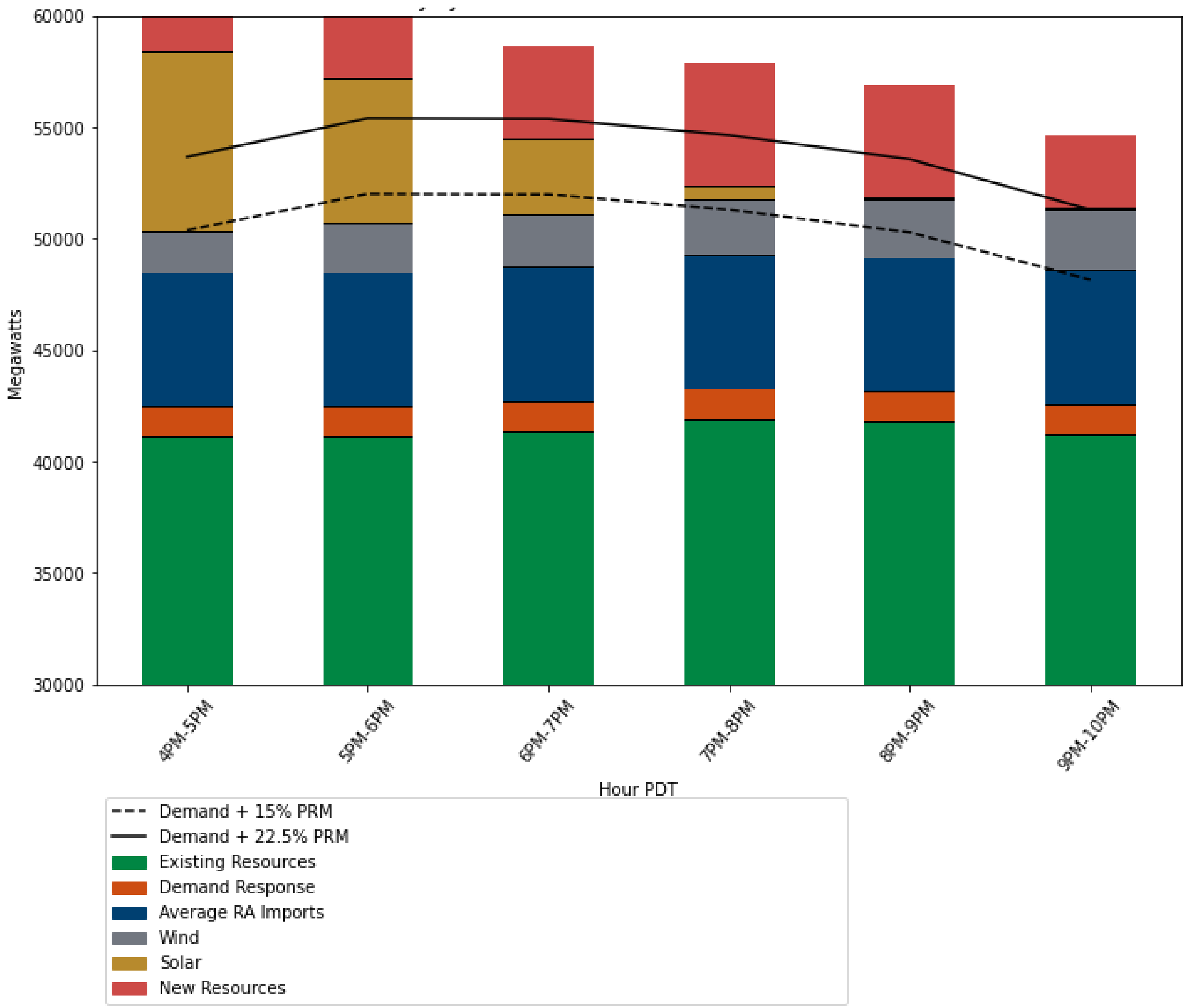


Source: California Energy Commission

CHAPTER 4:
Preliminary 2023 Stack Results

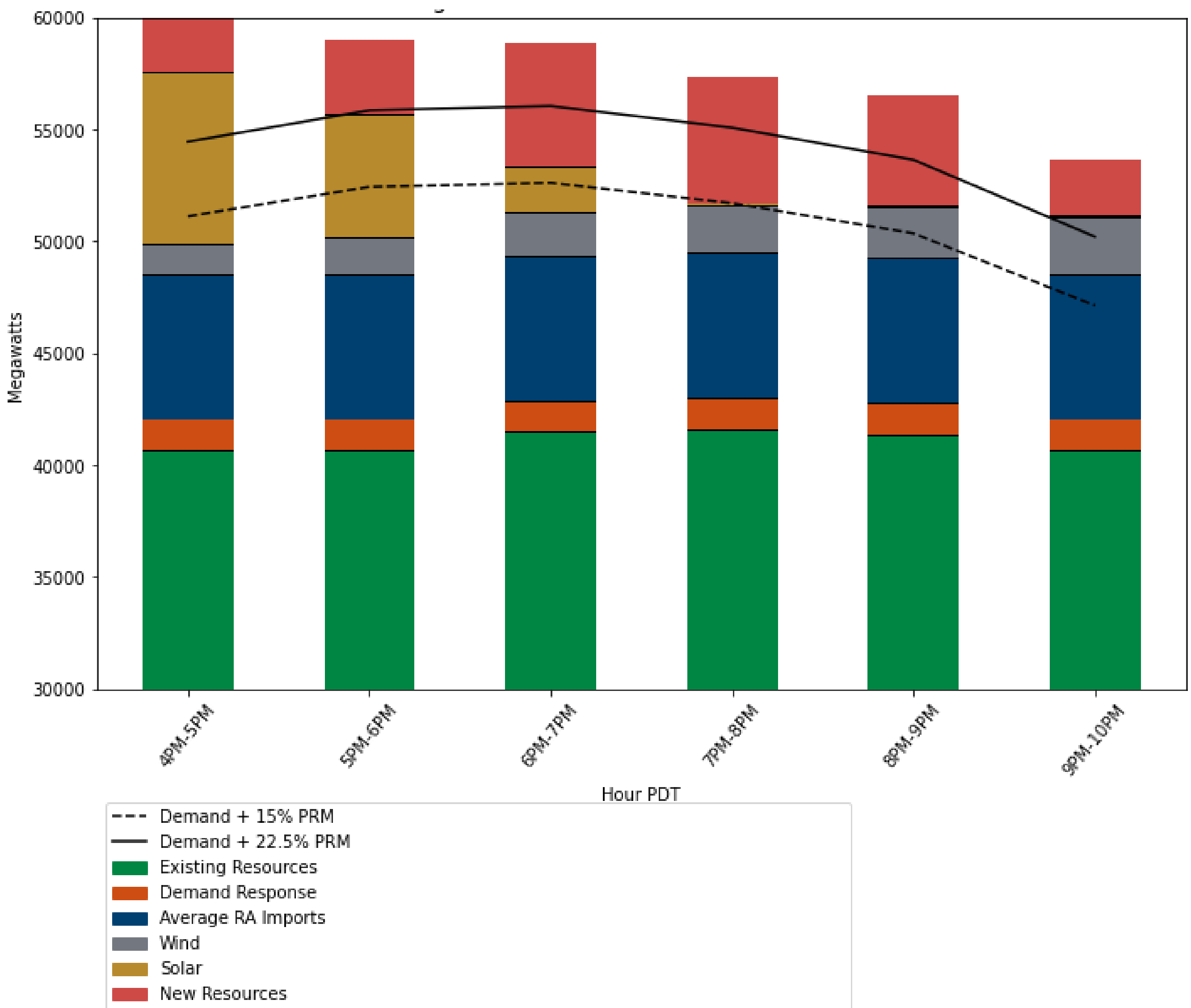
Because of significant planned new resources anticipated to come online, the stack projects a reduced need for contingencies in 2023 compared to 2022. Both July and August resources are at least 2,000 MW above the 22.5 percent PRM margin. In September, there is a maximum need of 600 MW at net peak in the 7–8 p.m. hour.

Figure 5: Preliminary July 2023 Stack



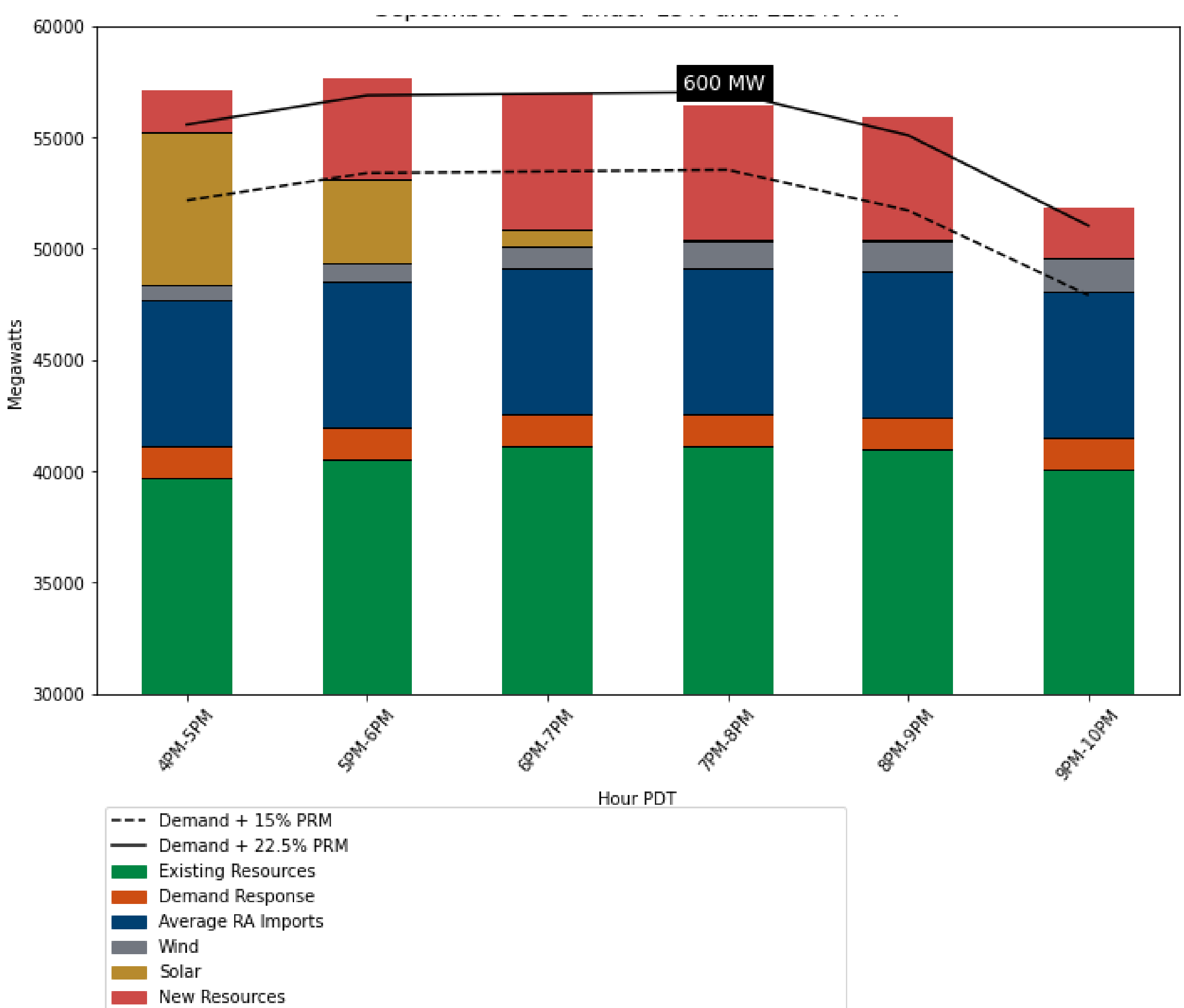
Source: California Energy Commission

Figure 6: Preliminary August 2023 Stack



Source: California Energy Commission

Figure 7: Preliminary September 2023 Stack



Source: California Energy Commission

CHAPTER 5: Contingency Resources

The CEC, CPUC, California ISO and California Department of Water Resources (DWR) have collectively identified potential contingency resources that can be called on in the event of an electricity supply shortfall. These contingency resources are beyond those routinely available and are generally called on only in the extreme case of potential system outages:

- **Voluntary Customer Conservation** — Californians have shown a willingness to voluntarily reduce energy use during critical periods. This willingness can be a low-cost and low-greenhouse-gas-emission option to support the grid. To initiate voluntary conservation, the California ISO issues Flex Alerts in advance of a potential shortage. The alerts provide advice for customers to make the most impactful reductions and can include increasing thermostat temperatures, avoiding the use of major appliances, and turning off unnecessary lights. California ISO initiates the alerts, which are further broadcast by the CEC and CPUC. While a statewide Flex Alert program has been unfunded in recent years, the CPUC funded a two-year, $24 million campaign in 2021 to educate customers about the positive impacts of electricity conservation and inform them of when electricity demand is high and conservation is needed.
- **Additional Generation and Load Reductions** — In addition to voluntary conservation from customers, there are other potential generation sources and load reductions that the state can draw on, typically from larger customers who are not already participating in demand-response programs[6]. An example partner is the DWR, operator of the State Water Project (SWP), a system of water storage facilities, pumping and generating plants, and pipeline and canal infrastructure that delivers water throughout the state. Through DWR operational controls, the SWP can offer California ISO additional electric generation and load reduction during peak periods with sufficient notice. California ISO and CEC coordinate with DWR to make additional generation and load reduction available, as needed. However, for summer 2022, DWR has identified that drought conditions have severely limited its ability to provide additional support during an emergency

  The CEC, in coordination with the Governor's Office, has developed a network to reach other major end users to identify potential load reduction. This network includes large state government users (for example, the Department of General Services, the University of California system) and large commercial, retail, and industrial customers. In the event of an energy emergency, the CEC coordinates with the Governor's Office to identify and request reductions available from this network.
- **Emergency Load Reduction Program (ELRP)** — The CPUC's ELRP provides compensation for certain customers that provide additional load reduction during an

6 A demand response program is a coordinated effort of electricity users to reduce demand when called upon in times of tight supply.

energy emergency.[7] This program is being piloted for five years starting in 2021, after which the CPUC will determine whether the program should continue. The California ISO and CEC coordinate with the IOUs to track potentially available load reductions under this program before and during an emergency.

- **Imports From Other California Balancing Authorities** — Non-California ISO balancing authorities in the state can potentially provide additional available generation as imports to the California ISO territory, as they did during the 2020 heat wave. Before an emergency, the California ISO coordinates with partner balancing authorities to alert them of a need and tracks available generation that they can provide during an emergency.
- **Additional Thermal Generation** — Some thermal power plants may have the ability to generate additional capacity beyond permit limits/restrictions in an emergency. Realizing additional generation is not a certainty and depends on a variety of factors and conditions at each individual facility. Some generators may also be able to generate additional capacity beyond their interconnection limitations. In emergencies, temporary permit relief can be achieved through a Governor's emergency order or through an emergency order from the U.S. Department of Energy. The CEC and California ISO coordinate on identifying where actions such as an emergency order would enable additional generation.

The California ISO may be able to use its backstop authority either before or during the operational time frame. The California ISO tariff provides for a capacity procurement mechanism (CPM)[8] pursuant to manually identifying additional resources or due to a "significant event," or a combination of events, that is determined by the California ISO to either result in a material difference from what was assumed in the resource adequacy program or produce a material change in system conditions that causes, or threatens to cause, a failure to meet reliability criteria.

7 CPUC Decision 21-03-056, March 25, 2021. Decision Directing Pacific Gas and Electric Company, Southern California Edison Company, and San Diego Gas & Electric Company to Take Actions to Prepare for Potential Extreme Weather in the Summers of 2021 and 2022.

8 More information on the CPM can be found on the California ISO website. http://www.caiso.com/Pages/DocumentsByGroup.aspx?GroupID=33EB5656-7056-4B8E-87B2-3EA3D816DA62

CHAPTER 6: 2024–2026 Stack Analysis

CEC staff prepared potential stack analyses for the midterm time frame, 2024 through 2026. Data are not yet available on resources procured for summer 2024 and beyond, so these projections assume utilities procure resources as ordered in CPUC D.21-06-035. Actual procurement may end up higher or lower than these numbers in individual years. Hydro resources are derated as in 2022, so these numbers are assuming a severe drought.

2024–2026 Inputs

Many of the inputs for the 2024–2026 stack analysis are the same as for 2022 and 2023.

- **Demand**: The Adopted 2021 IEPR Forecast provides peak demand for each year.
- **Existing Resources**: The October 2021 NQC list is used as a base.
- **Imports**: The average 2016–2021 RA import numbers are used.
- **Demand Response:** The FY 2021 CPUC filings provide expected demand response totals for 2024. These are used for all three years.
- **Hydro Capacity:** The 2022 derate is used for 2024–2026.

Retirements

The Diablo Canyon Power Plant and the once-through-cooling facilities are assumed to retire on schedule to comply with the State Water Resource Control Board's policy to comply with the federal Clean Water Act. There are no other power plants requesting to be retired on the anticipated retirements and mothball list published by the California ISO as of April 2022.[9] Below is the MW of capacity removed from the existing resource stack for each month and year.

Table 7: Total Retirements 2024–2026

Year	July	August	September
2024	-3,693 MW	-3,693 MW	-3,693 MW
2025	-4,833 MW	-4,833 MW	-5,973 MW
2026	-5,973 MW	-5,973 MW	-5,973 MW

Source: CEC Staff

9 California ISO Announced Retirements and Mothball List. http://www.caiso.com/Documents/AnnouncedRetirementAndMothballList.xlsx.

New Resources

The amount of new resources is estimated based on the procurement ordered in D.21-06-035 and D.19-11-016.[10] Resources that came on-line in 2021 are assumed to count toward the 1,505 MW remaining from D.19-11-016. Some of the resources in 2022 also count toward D.19-11-016 and the remainder toward D.21-06-035. Resources counting toward D.21-06-035 are weighted by the associated incremental ELCCs; the incremental ELCCs here were published in August 2021.[11]

Table 8: Cumulative Procurement Ordered and Fulfilled (MW NQC) 2024–2026

Amount	2024	2025	2026
D.19-11-016	1,505	1,505	1,505
D.21-06-035	8,000	9,500	11,500
Total Ordered	9,505	11,005	13,005
Resources Added Through 2023	7,042	7,042	7,042
Remaining	2,463	3,963	5,963

Source: California Energy Commission staff

The MW of outstanding procurements are converted into resources using the ratios outlined in the 2021 Preferred System Plan.[12] Below are the resources added to the stack in this process, without the additions of resources under contract for 2022 and 2023.

Table 9: Nameplate Resources Added (MW) 2024-2026

Resource Type	2024	2025	2026
Biomass	16	33	34
Geothermal	23	36	1,000
Wind	1,024	1,763	1,839
Solar	3,687	5,710	5,813
Energy Storage 4 h	8,251	10,222	10,346

10 D.21-06-035 Order Instituting Rulemaking to Continue Electric Integrated Resource Planning and Related Procurement Processes. https://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M389/K603/389603637.PDF

D.19-11-019 Order Instituting Rulemaking to Develop an Electricity Integrated Resource Planning Framework and to Coordinate and Refine Long-Term Procurement Planning Requirements. https://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M319/K825/319825388.PDF

11 Incremental ELCC Study for Mid-Term Reliability Procurement. https://www.cpuc.ca.gov/-/media/cpuc-website/divisions/energy-division/documents/integrated-resource-plan-and-long-term-procurement-plan-irp-ltpp/20210831_irp_e3_astrape_incremental_elcc_study.pdf.

12 2021 Preferred System Plan. https://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M451/K412/451412947.PDF.

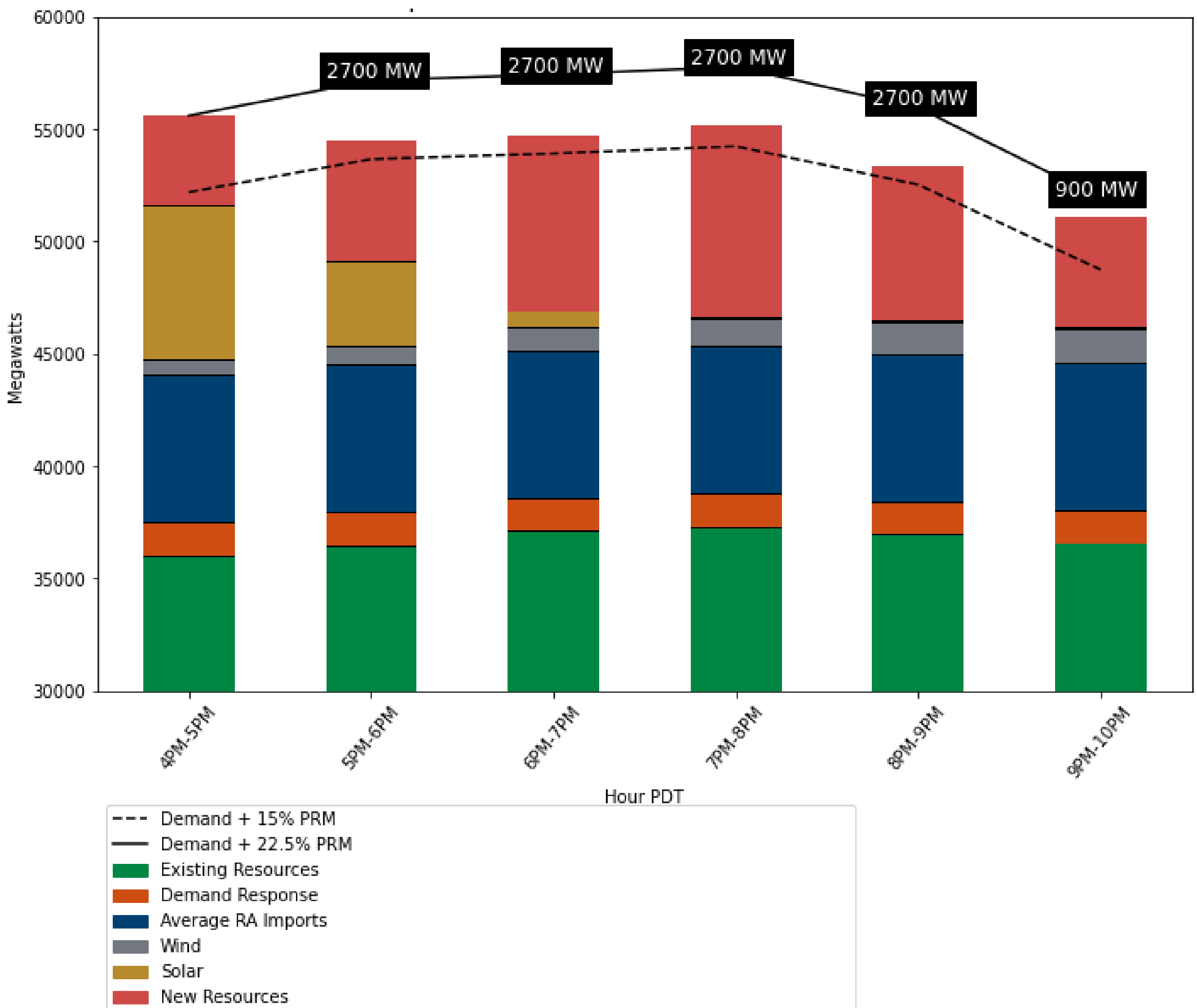
Energy Storage 8 h	0	0	1,000

Source: California Energy Commission

Results

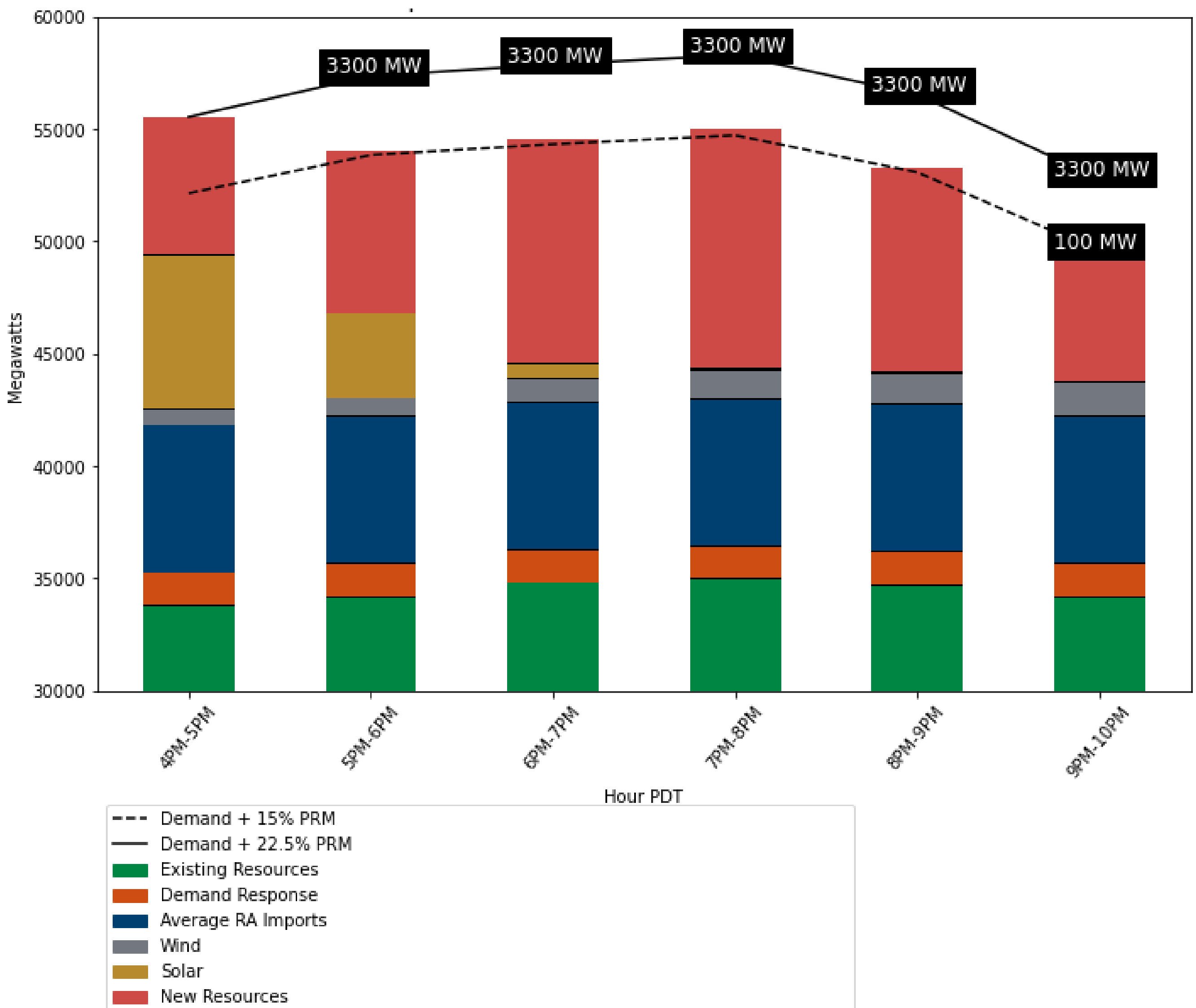
The analysis does not show shortfalls in any hour for July and August 2024-2026. However, the analysis shows maximum shortfalls of 2,700 MW for 2024, 3,300 MW for 2025, and 1,700 MW above the 22.5 percent PRM. Shortfalls above the 22.5 percent PRM are shown for all hours except the 4-5 PM hour in each month. There is a 100 MW shortfall for the 9-10 PM hour in September 2025.

Figure 8: Potential September 2024 Stack



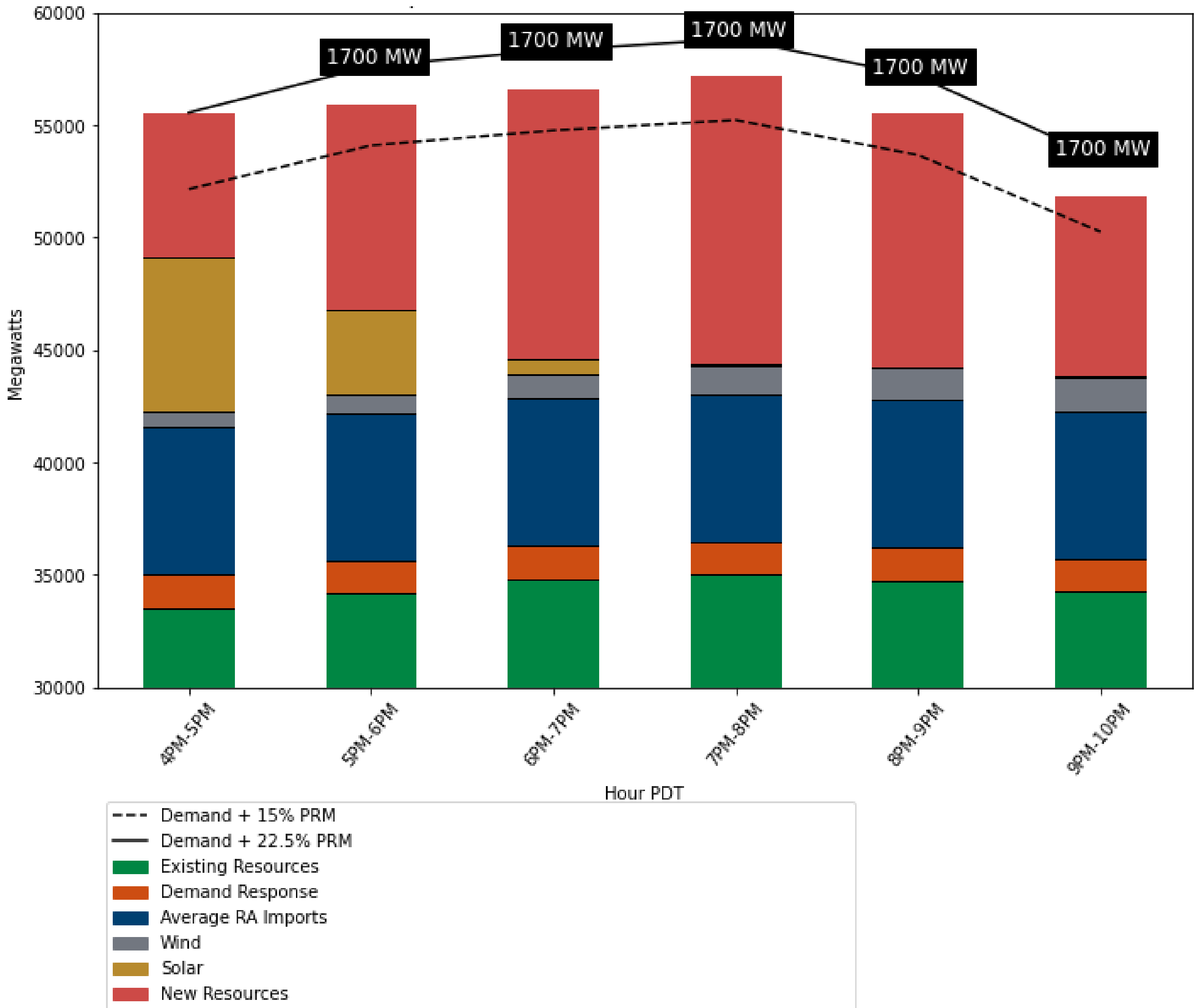
Source: California Energy Commission

Figure 9: Potential September 2025 Stack



Source: California Energy Commission

Figure 10: Potential September 2026 Stack



Source: California Energy Commission

CHAPTER 7: Conclusions

The Summer 2022 Stack Analysis Update identifies a need for significant contingency resources of up to 3,500 MW in summer 2022 in case of an extended heat wave. However, if new resources come online as currently contracted, summer 2023 will meet a 22.5 percent PRM in nearly every hour. There is also likely to be a continued need for some contingency resources between 2024 and 2026 ranging between 1,700 MW and 3,300 MW during September if utilities meet and do not exceed their obligations under D.21-06-035.

GLOSSARY

CAPACITY PROCUREMENT MECHANISM – Capacity procured by the California ISO to address a deficiency in Resource Adequacy capacity.

CONTINGENCY RESOURCE – A resource called on during tight supply conditions above those in existing resource adequacy programs. Many of these resources are additional load reduction or additional generation capabilities.

DEMAND RESPONSE – 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, 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.

EFFECTIVE LOAD CARRYING CAPABILITY – A metric used to assess the capacity value or reliability contribution of electricity resources.

END USER – The entity that uses a product or service.

FINAL ROOT CAUSE ANALYSIS – A joint agency report issued in 2021 detailing the conditions and causes of the rotating blackouts experienced on the California ISO system in August 2020.

FLEX ALERT – An alert issued by the California ISO calling on consumers to voluntarily conserve energy due to tight supply conditions.

INTEGRATED ENERGY POLICY REPORT – A California Energy Commission report that 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.

INVESTOR-OWNED UTILITY – A private company that provides a utility, such as water, natural gas, or electricity, to a specific service area. The investor-owned utility is regulated by the California Public Utilities Commission (CPUC).

LOAD SERVING ENTITY – Any entity that has been granted authority or has an obligation pursuant to state or local law, regulation, or franchise to sell electric energy to end-use consumers of electric power.

LOSS OF LOAD EXPECTATION - The expected number of hours per year that available generation capacity will be inadequate to supply customer demand.

NET QUALIFYING CAPACITY – A determination of how a resource contributes to reliability.

RESOURCE ADEQUACY – The ability of electricity resources (supply) to meet the customers' energy or system loads (demands) at all hours within a study period.

LIST OF ACRONYMS

Acronym	Term
California ISO	California Independent System Operator
CEC	California Energy Commission
CPM	Capacity Procurement Method
CPUC	California Public Utility Commission
ELCC	Effective Load Carrying Capability
ELRP	Emergency Load Reduction Program
DR	Demand Response
DWR	California Department of Water Resources
IEPR	Integrated Energy Policy Report
IOU	Investor-Owned Utility
LOLE	Loss of Load Expectation
LSE	Load Serving Entity
NQC	Net Qualifying Capacity
POU	Public Owned Utility
PRM	Planning Reserve Margin
SWP	State Water Project
RA	Resource Adequacy
RCA	Root Cause Analysis