DOCKETED

Docket Number:	18-IRP-01
Project Title:	Integrated Resource Plan
TN #:	256094
Document Title:	CPAU 2023 Integrated Resource Plan
Description:	N/A
Filer:	James Stack
Organization:	City of Palo Alto Utilities
Submitter Role:	Public Agency
Submission Date:	4/30/2024 4:07:44 PM
Docketed Date:	4/30/2024

City of Palo Alto

2023 Electric Integrated Resource Plan

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I. Executive Summary

The City of Palo Alto's 2023 Electric Integrated Resource Plan (IRP) is a comprehensive plan for developing a portfolio of power supply resources to meet the utility's objective of providing safe, reliable, environmentally sustainable, and cost-effective electricity services while addressing the substantial risks and uncertainties inherent in the electric utility business. The IRP also supports the City's mission to promote and sustain a superior quality of life in Palo Alto. In partnership with our community, our goal is to deliver cost-effective services in a personal, responsive and innovative manner.

The IRP meets the requirements of California Senate Bill (SB) 350 (de León, Chapter 547, Statutes of 2015), which requires publicly owned utilities (POUs) with an average annual energy load greater than 700 gigawatt-hours (GWh) to submit an updated IRP at least every five years to the California Energy Commission (CEC).

The IRP discusses current and anticipated California regulatory and policy changes facing Palo Alto and the electric utility industry. Additionally, the IRP presents the analyses conducted and underlying assumptions, and outlines a resource plan to reliably and affordably meet customers' energy needs through calendar year 2030.

The electric utility industry has undergone significant changes since Palo Alto prepared its last IRP in 2018, with a continuation of the shift towards greater levels of variable, distributed, low-emissions generation, along with significant growth in energy storage capacity, building and transportation electrification load, and an expanding suite of regulatory mandates that the City must satisfy. The region has also recently experienced extreme volatility in natural gas market prices, the emergence of another state's carbon compliance market, and several other states in the region setting aggressive renewable energy and/or carbon targets. And nationally, the effects of the recent passage of the Inflation Reduction Act and the Infrastructure Investment and Jobs Act are just beginning to be felt in the industry. Table 1 provides an overview of some of the key structural changes in California's electricity market that must be addressed in the 2023 IRP, compared to their status at the time of the 2018 IRP.

Table 1: California Energy Market Changes Since 2018

IRP Topic	2018 Status	2023 Status
GHG Emissions Targets	40% below 1990 levels by 2030	40% below 1990 levels by 2030 and 85% by 2045; 100% carbon-free electricity supply by 2045
Renewable Procurement	50% by 2030 and beyond	60% by 2030 and beyond
Energy Storage	Requirement to study adoption of targets; less than 200 MW of capacity installed in CAISO	Requirement to study adoption of targets; more than 5,000 MW of capacity installed in CAISO
Transportation Electrification	Requirement to address procurement of EV infrastructure	All cars sold after 2035 be ZEV; all new public fleet purchases required to be ZEVs starting in 2027; all medium and heavy duty trucks sold to be ZEVs by 2036

Building Electrification	No goals established	Ban on new natural gas-powered space and water heaters by 2030
Structured Markets	Intra-hour market	Intra-hour market, inter-regional real-time balancing through EIM
Resource Adequacy	Local, system, and flexible capacity requirements	Local, system, and flexible capacity requirements; CPUC-jurisdictional entities moving to slice-of-day framework
Transmission Costs	2.1 cents/kWh	3.5 cents/kWh

Similarly, Palo Alto itself has undergone a myriad of changes over the past five years—both in its long-term planning goals and in how it uses electricity currently. Table 2 describes some of the major changes and accomplishments in Palo Alto since 2018, from dramatic changes in the City's power supply and emissions reduction targets, to considerable growth in local solar generation and electric vehicles (EVs).

Table 2: City of Palo Alto Energy-Related Changes Since 2018

Topic	2018 Status	2023 Status
Community-wide GHG Emissions (from electricity, natural gas and transportation)	**Goal:** Reduce GHG emissions to 80% below 1990 levels by 2030. **Achieved:** 43% below 1990 emission levels.	**Goal:** Reduce GHG emissions to 80% below 1990 by 2030. **Achieved:** 54% below 1990 emission levels (2021).
Electric Supply Portfolio	**Goal:** 50% RPS by 2030; 100% Carbon Neutral by 2013 **Achieved:** 58% RPS; 100% Carbon Neutral (annual accounting)	**Goal:** 60% RPS by 2030; 100% Carbon Neutral by 2013 **Achieved:** 65% RPS; 100% Carbon Neutral (hourly accounting)
Local Solar PV Systems	**Achieved:** 2% of load - 1,081 systems	**Achieved:** 3.1% of load - 1,609 systems (2022)
Energy Efficiency	**Goal:** 0.75% avg. annual load savings; 5.7% cumulative savings (2018-2027) **Achieved:** 0.73% of avg. annual load; 4.4% cumulative 6-year savings (2007-2012)	**Goal:** 0.68% avg. annual load savings; 4.4% cumulative savings (2022-2031) **Achieved:** 0.74% of avg. annual load; 4.5%[1] cumulative 6-year savings (2013-2018)
Energy Storage	**Goal:** No explicit goal.	**Goal:** No explicit goal or rebates as not yet cost-effective. Facilitate customer adoption in coordination with Building department. **Achieved:** 34 systems

[1] Includes savings related to Codes and Standards changes, as well as estimated savings for 2023.

Transportation Electrification	**Goal:** No explicit goal. **Achieved:** Approx. 3,000 EVs registered in Palo Alto; 60 City-owned EV chargers; incentives for EV charger installation.	**Goal:** Target 50% EVs by 2030 **Achieved:** Approx. 6,000 EVs registered in Palo Alto; 124 City-owned EV chargers; Incentives for EV charger installation.
Building Electrification	**Goal:** No explicit goal.	**Goal:** Reduce GHG emissions from the direct use of natural gas in the buildings sector by at least 60% below 1990 levels by 2030
Annual Energy Load	925 GWh	860 GWh
Summer Peak Capacity Load	182.5 MW	178.1 MW
Average Retail Rate[2]	13.9 cents/kWh	21.36 cents/kWh

The IRP planning period is from 2023 through 2045. Through 2028, the City of Palo Alto Utilities (CPAU) has sufficient renewable contracts to supply over 60% of the City's needs. The City's one long-term wind contract and all five landfill-gas-to energy contracts expire in the late 2020's or early 2030's, while the six long-term solar contracts all extend beyond 2040. The City's contract with the Western Area Power Administration (WAPA) for hydroelectric resources, which supplies nearly 40% of the City's energy needs in a normal hydro year, expires at the end of 2024, but the City has already executed a renewed 30-year contract with WAPA (although it retains the ability to reduce its allocation or exit the contract until July 2024).

CPAU expects to continue operating within the Northern California Power Agency's (NCPA) Metered Sub-System Aggregation (MSSA) Agreement with the California Independent System Operator (CAISO). Under this agreement, NCPA balances CPAU's loads and resources to comply with CAISO planning and operating protocols. With resources available under the NCPA MSSA Agreement, Palo Alto has access to sufficient system, local, and flexible capacity, as well as resources to provide ancillary services to reliably meet City loads.

Costs are projected to increase through 2045, primarily due to transmission and distribution system upgrade costs, increasing environmental regulations, and renewable integration costs (which are part of the tradeoff between pursuing sustainable electricity supplies and reducing overall supply costs). Retail energy sales are also projected to increase through 2045 due to building and transportation electrification; increases in energy efficiency and local solar installations are expected to offset these load increases to some degree, but the overall trend in load is expected to be upward.

[2] Retail rate and energy efficiency values are for Fiscal Years 2018 and 2023; the rest of the values in Table 2 are for Calendar Years 2018 and 2023.

CPAU staff will provide public updates on the progress, successes, and new challenges over the implementation period of this IRP.

A. *CEC IRP Guidelines & Required Elements*

The schedule and structure of the IRP process is being guided in large part by state law,[3] which requires Council adoption of Palo Alto's IRP by January 1, 2019, submission to the CEC by April 30, 2019, and updates at least once every five years thereafter. Specifically, the City's IRP demonstrates how the City's utility will:

- Meet GHG emissions reduction targets set by the State's Air Resources Board (Sections II.B, II.C.ii, X.B);
- Ensure procurement of at least 60% renewable resources by 2030 (see IRP Sections II.B, II.C.iii, V.A, X.A);
- Minimizes impacts to ratepayers' bills (Section VI);
- Ensure system and local reliability, including in the hour of peak net demand, and ensure the procurement of resource adequacy products to meet its peak demand and planning reserve margin, sufficient to provide reliable electric service to its customers (Sections III.B.vii, IV.E, IV.F, VII)
- Strengthen the diversity, sustainability, and resilience of the bulk transmission and distribution systems, and local communities (Sections II.B, IV.A.ii, IV.E, IV.F, VII, VIII)
- Enhance distribution systems and demand-side energy management (Sections IV.A.i, VII.B)
- Minimize localized air pollutants and other greenhouse gas emissions with early priority to disadvantaged communities (Sections II.B, IV.A.ii, IX)
- Address rate design, existing or planned incentives, and customer education and outreach that support transportation electrification consistent with the state's carbon-neutrality goals in Executive Order B-55-18 (Sections II.C.vi, IV.A.iii, VI)
- Address the following procurement topics:
    - Energy efficiency and demand resources that are cost effective, reliable, and feasible (Sections II.B, II.C.iv, III.B.i, IV.A.i)
    - Energy storage (Section III.B.iv)
    - Transportation electrification (Section II.C.vi, III.D.iii, IV.A.iii)
    - A diversified procurement portfolio of short-term electricity, long-term electricity, and demand response products and strategies or programs (Section III.B.v)
    - Resource adequacy (Sections IV.G, V.A)

The City currently has the resources, plans, and programs in place needed to achieve all of the objectives addressed by the IRP. In addition, and in order to demonstrate compliance with the objectives listed in the IRP Guidelines, CPAU must include the following four Standardized Tables as part of its IRP submission:

[3] *See* Public Utilities Code sections 9621, 9622; Public Utilities Code section 399.11 also established a new Renewable Portfolio Standard (RPS) to meet 60% of the City's load from applicable renewable supplies by 2030, which the City has already achieved. SB 350 also requires the doubling of energy efficiency savings targets by 2030 and establishes a new Renewable Portfolio Standard (RPS) to meet 50% of the City's load from applicable renewable supplies by 2030. The 10-Year Energy Efficiency Potential Plan approved by Council in March 2017 addresses the new energy efficiency savings requirements and the City expects to achieve an RPS of 58% in 2023.

- Capacity Resource Accounting Table (CRAT): Annual peak capacity demand in each year and the contribution of each energy resource (capacity) in the POU's portfolio to meet that demand.
- Energy Balance Table (EBT): Annual total energy demand and annual estimates for energy supply from various resources.
- RPS Procurement Table (RPT): A detailed summary of a POU resource plan to meet the RPS requirements.
- GHG Emissions Accounting Table (GEAT): Annual GHG emissions associated with each resource in the POU's portfolio to demonstrate compliance with the GHG emissions reduction targets established by CARB.

This IRP along with the four aforementioned Standardized Tables and the materials listed in the Supporting Information section satisfy the IRP filing guidelines listed in the CEC guidelines.

B. *Public Process Summary*

Palo Alto staff has provided numerous reports and presentation related to various facets of the IRP to the Utilities Advisory Commission (UAC) over the past 15 months. The current IRP report was reviewed by the UAC on October 11, 2023, before being presented to the Finance Committee and City Council for approval in November and December 2023. Table 3 below lists all public presentations related to the IRP, with links to the associated reports.

Table 3: Public Process Summary for Development of the 2023 IRP

Forum	Date	Topic	Link
UAC	6/8/2022	Overview of CPAU's IRP Development Process	Report
UAC	12/7/2022	Discussion of CPAU's Long-term Electric Load Forecast	Report
UAC	7/5/2023	Presentation of Electric Supply Portfolio Modeling Results	Presentation
Council	9/18/2023	Annual Carbon Neutral Plan and RPS Supply Update	Report
UAC	10/11/2023	Recommendation to Approve CPAU's 2023 IRP	Report
Finance	11/7/2023	Recommendation to Approve CPAU's 2023 IRP	Report
Council	12/4/2023	Approval of CPAU's 2023 IRP	Report

An IRP represents a snapshot of a continuous process that evolves and transforms over time. The conditions and circumstances in which utilities must make decisions about how to meet customers' future electric energy needs are ever-changing. The IRP process utilizes a methodology and framework for assessing a utility's ever-changing business and operating requirements and adapting to factors such as changing technology, regulations, and customer behavior. Assumptions, scenarios, and results are all reviewed and updated as information and events unfold, and the process is continually revisited under formal or informal resource planning efforts.

II. Background & Achievements to Date

A. *CPAU History and Mission Statement*

The City of Palo Alto Utilities' (CPAU) history began over one hundred years ago, in 1896, when the water supply system was first installed. Two years later, the wastewater or sewer collection system came online. In 1900, the municipal electric power system began operation, followed in 1917 by a natural gas distribution system. While CPAU and the utilities industry have evolved dramatically over 123 years, the City has nonetheless maintained a consistent set of core values: Quality, Courtesy, Efficiency, Integrity, and Innovation.

Palo Alto's 2023 IRP is a comprehensive planning document to guide long-term power planning aligned with CPAU's Mission Statement, which is "to provide safe, reliable, environmentally sustainable and cost effective services."[4]

B. *Previous IRPs & Recent Accomplishments*

Palo Alto regularly engages in long-term planning efforts related to its electric supply portfolio – previously under the auspices of the Long-term Electric Acquisition Plan (LEAP) and more recently through the IRP. The last time the City completed a LEAP update was on April 16, 2012 (Staff Report 2710, Resolution 9241). A few years later, in 2015, Senate Bill 350 (SB 350) was signed into law, and it includes a requirement that publicly-owned utilities (POUs) serving loads greater than 700,000 megawatt-hours per year, such as Palo Alto, develop and adopt an IRP by January 1, 2019 and submit it to the CEC by April 30, 2019 and every five years thereafter.[5]

As part of the 2012 LEAP update and the 2018 IRP, the City Council approved a set of electric portfolio decision-making Objectives and Strategies; as part of the current IRP process, staff developed an updated version. The current Objective and Strategies, which aligns with the Utilities 2018 Strategic Plan, is very similar to the ones adopted in 2012 and 2018, with the new version placing greater emphasis on managing uncertainty related to resource availability and costs, regulatory uncertainty, and the increased penetration of DERs, electric vehicles (EVs), and building electrification.

The 2018 IRP included a Work Plan describing a set of ongoing tasks and new initiatives for the City to undertake in order to satisfy the Objectives and Strategies. In carrying out this Implementation Plan and other initiatives, Palo Alto has accomplished the following over the past five years:

- Continued to achieve the goals set in the City's **Carbon Neutral Electric Supply Plan**, as it has every year since 2013, while also changing from an annual accounting methodology to a stricter hourly accounting approach in 2020;

[4] See the City of Palo Alto Utilities 2018 Strategic Plan, which includes the Mission Statement and Strategic Direction, here:https://www.cityofpaloalto.org/files/assets/public/utilities/city-of-palo-alto-utilities-2018-strategic-plan-overview.pdf.

[5] *See* Public Utilities Code sections 9621, 9622. The Clean Energy and Pollution Reduction Act of 2015 also raised the state's renewable portfolio standard (RPS) to 50% by 2030 (a standard that was subsequently raised to 60% through SB 100 (2018)) and required a doubling of energy efficiency savings by 2030. The primary objective of the IRP requirement in SB 350 is to ensure that the state's large POUs are on track to reduce their greenhouse gas emissions, helping the state meet its overall target of reducing GHG emissions to 40% below 1990 levels by 2030.

- Increased the **renewable energy supply** from 57% of total load to 65% of total load, fully complying with all CEC RPS procurement and filing requirements without relying on any optional compliance measures or the use of historic carryover generation;
- **Reduced GHG emissions** related to electricity by 123,000 MT CO2e, helping reduce community-wide emissions by 54% compared to 1990 levels;
- Increased the amount of local solar generation participating in the City's **Feed-in Tariff program** (Palo Alto CLEAN) from 1.6 MW to 2.9 MW;
- Executed a **new geothermal power contract** (10 MW of capacity);
- Executed a 30-year extension of the **Western Area Power Administration hydroelectric contract**;
- Achieved cumulative **energy efficiency savings** of 7.4%[6] since 2012;
- Coordinated with other departments on the installation of dozens of new **public EV charger ports** owned and maintained by the City, more than doubling the overall total (now 124);
- Launched a **heat pump water heater program** that provides installation service and on-bill financing to homeowners;
- Launched rebates and a **building electrification technical assistance** program to support electrification projects in commercial buildings;
- Adopted **aggressive energy efficiency goals** which require new and innovative programs;
- Adopted a **Sustainability and Climate Action Plan (S/CAP) Implementation Work Plan** to help the community achieve its goal of reducing emissions to 80% below 1990 levels by 2030;
- Continued to **balance the City's loads and resources** under the CAISO-NCPA Metered Subsystem Agreement;
- Participated in the **SunShares solar group buy program** with 63 solar installations, 21 of which include a storage system, and 3 standalone storage installations initiated since 2021;
- Adopted **local reach codes** that requires all new construction projects to be all-electric with no natural gas appliances.
- Expanded **EV charging infrastructure requirements** for new construction projects above state's minimum requirements.
- Operated an **appliance recycling program** that recycled 50 freezers and 380 refrigerators over the programs 3-year lifetime.

C. *Changing Planning Environment*

Across the industry, integrated resource planning has undergone significant changes in recent years. Traditionally, an IRP was an opportunity for a utility to evaluate the steady growth of its customer loads over a 10+ year planning horizon, and develop a plan for meeting that load growth through staged additions of new centralized thermal generation resources. Today's IRPs, however, have to consider how to integrate increasing volumes of variable and/or distributed generation in an environment of increasing regulatory mandates, all while maintaining reliability and controlling costs. Accordingly, the objective of this IRP is to evaluate Palo Alto's portfolio of resources against the changing utility landscape and California's environmental requirements, while recommending strategies to ensure Palo Alto continues to meet the Council's goals for affordability and sustainability. The following is a description of some of the primary changes to the utilities planning environment over the past several years.

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[6] Includes savings related to Codes and Standards changes, as well as estimated savings for 2023.

i. Load Profile Uncertainty & Overgeneration

California's resource mix has changed considerably in recent years as a result of its ambitious renewable mandates and the rapidly declining costs of solar and wind resources. The shift to renewables has led to a fundamental change in the grid's daily net load shape, which traditionally had a single peak lasting several hours each day, but which now has a small peak in the morning and a large, sharp peak in the late evening, and a much lower level throughout the middle of the day. During these midday "solar hours," market prices tend to be dramatically lower and at times can even be negative, as the market sends a price signal that there is too much energy on the grid and that generators either need to pay to generate or curtail their generation. The changing load shape means new resources will be needed, and existing resources will need to be used differently, while maintaining affordability for customers.

Solar and wind resources, unless paired with multi-hour energy storage systems, are intermittent sources of generation, where energy output is a function of fuel availability (i.e., sunlight and wind). In order to accommodate large volumes of intermittent resources, the system must include a sufficient supply of highly responsive resources (or load) to follow this new demand profile. Recent capacity additions for RPS compliance have largely been solar resources, which are introducing a surplus of energy supply in the daytime hours, particularly in the spring and fall when renewable resources maintain higher levels of output and customer loads are at seasonal lows.

ii. GHG Emission Reductions

In 2006, California passed Assembly Bill (AB) 32, the California Global Warming Solutions Act. AB 32 is a mandate for several sectors, including the electricity sector, to reduce GHG emissions to 1990 levels by 2020. In 2016, AB 32 was augmented by Senate Bill (SB) 32, which mandated a GHG emissions reduction target of 40% below 1990 levels by 2030. In 2022, CARB raised the 2030 GHG emissions reduction goal to 48% below 1990 levels and added a new target of net zero emissions by 2045. California's aggressive GHG emissions reduction goals will be achieved through a combination of market mechanisms (e.g., Cap and Trade) and prescriptive mandates (e.g., RPS) to retire and replace high emitting resources with cleaner resources.

In order to achieve these targets, many sectors of the economy – including industry, transportation, and electricity – will need to reduce their GHG emissions. The state's electric sector GHG emissions in 1990 were 108 MMT CO2e. Reducing this amount by 48% creates a target of 56 MMT CO2e; however, CARB's 2030 GHG planning target range of 30-53 MMT CO2e for the electricity sector is a 51% to 72% reduction, well in excess of the sector's pro-rata share of the overall reduction target.[7]

The electricity sector is expected to surpass its pro-rata emission reduction share due primarily to the 60% RPS goal and aggressive energy efficiency requirements. SB 350 requires that POU IRPs not only describe how they will meet their 60% RPS target by 2030, but also how they will contribute to the

[7] The two other major sectors in the economy are the industrial and transportation sectors. In the Scoping Plan, CARB estimates the industrial sector can reduce GHG emissions between 8% and 15%, while the transportation sector can reduce GHG emissions between 27% and 32%. Much of the transportation sector's emissions reduction burden is expected to be shifted to the electricity sector via transportation electrification, which was not accounted for in CARB's Scoping Plan. This means the electricity sector's GHG emissions reduction burden will be even greater than it appears.

electricity sector's share of GHG emissions reductions target for that year. For benchmarking in this IRP and for portfolio planning purposes, Palo Alto used the mid-range value of 41.5 MMT CO2e as the 2030 target for the electricity sector (of which Palo Alto's load-based pro rata share is 72,000 MT CO2e). These goals are for planning purposes and not compulsory; however, if changes to the regulations occur, Palo Alto will reflect those updates in its future resource planning efforts.

iii. Renewable Portfolio Standards (RPS)

One of the primary mechanisms for reducing GHG emissions in the electricity sector is the state's RPS. The state's RPS program mandates that an increasing percentage of retail sales be served by qualifying renewable generation. An RPS mandate was first imposed on Palo Alto by SB X1-2 in 2011, and subsequently expanded by SB 350 in 2015 and SB 100 in 2018. Currently, the major targets are 50% by 2026 and 60% by 2030. Through a formal rulemaking process, the CEC adopted multi-year Compliance Periods and procurement targets for each calendar year (CY) through the year 2030, as outlined below:

$$\text{Compliance Period 4 Target} \geq 35.75\% \times \text{CPAU Retail Sales}_{2021} + 38.5\% \times \text{CPAU Retail Sales}_{2022} + 41.25\% \times \text{CPAU Retail Sales}_{2023} + 44\% \times \text{CPAU Retail Sales}_{2024}$$

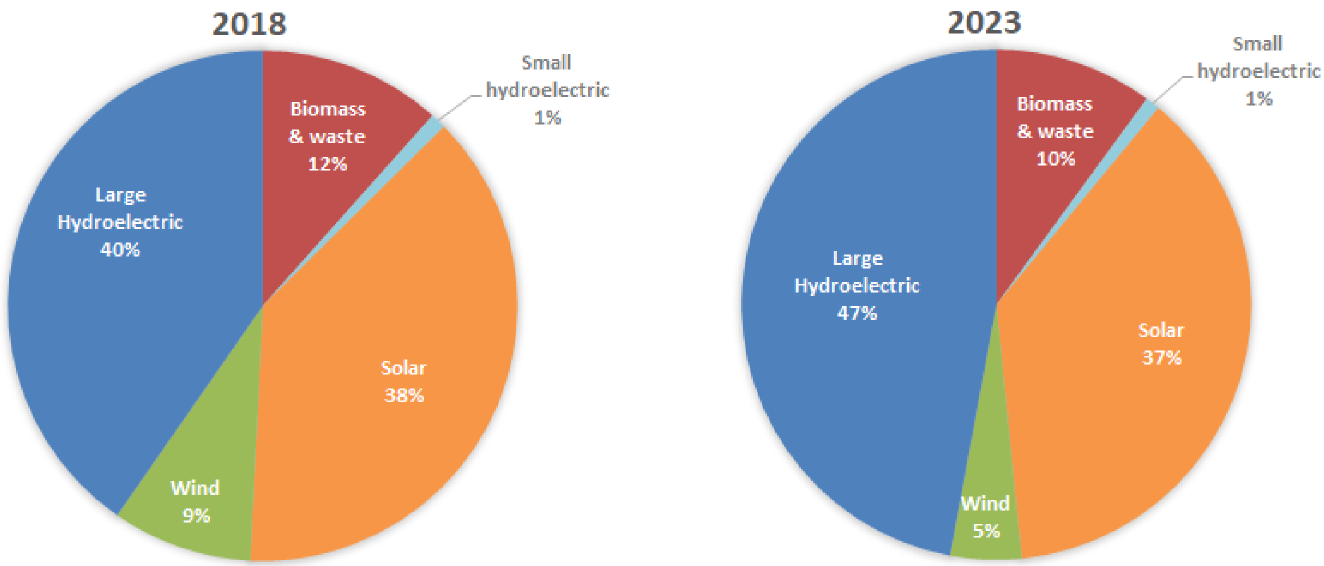
$$\text{Compliance Period 5 Target} \geq 46\% \times \text{CPAU Retail Sales}_{2025} + 50\% \times \text{CPAU Retail Sales}_{2026} + 52\% \times \text{CPAU Retail Sales}_{2027}$$

$$\text{Compliance Period 6 Target} \geq 54.67\% \times \text{CPAU Retail Sales}_{2028} + 57.33\% \times \text{CPAU Retail Sales}_{2029} + 60\% \times \text{CPAU Retail Sales}_{2030}$$

In addition to the minimum renewable generation procurement requirements, the RPS program also includes portfolio balancing requirements and long-term contract requirements, as described in Palo Alto's RPS Procurement Plan (included as Supplementary Information).

Palo Alto satisfies its RPS requirements through a diverse portfolio of qualifying renewable resources – wind, solar, bioenergy (landfill gas), and small hydro. In addition, approximately half of Palo Alto's load is served by large hydro, a carbon-free resource that helps reduce GHG emissions but which cannot be counted for RPS compliance. Figure 1 illustrates Palo Alto's actual and projected power supply mix for 2018 and 2023. If the City maintains its full contract allocation with the Western Area Power Administration after 2024, the 2030 power supply mix is projected to be similar to the 2023 mix, but with less wind and landfill gas; these resources would be replaced with another (as yet undetermined) renewable energy source.

Figure 1: Palo Alto Power Supply Changes Since Previous IRP



iv. Regional Grid Transformation

CPAU is a market participant in CAISO, the non-profit agency that manages 26,000 circuit miles of high-voltage power lines that make up 80% of California's power grid, serving 30 million consumers. CAISO also operates a competitive wholesale energy and ancillary services market, and is responsible for grid reliability and efficiency. While the vast amount of new variable renewable energy resources that have been built in California in recent years have driven down the state's GHG emissions associated with electricity usage, they have also presented CAISO with significant challenges for maintaining grid reliability and energy market stability.

In an effort to promote the reliability of the greater regional electric transmission system, CAISO has recently been pursuing several initiatives aimed at greater integration of the CAISO grid with other balancing authority areas (BAAs) in the region. These efforts – including the Western Energy Imbalance Market (WEIM) and the Extended Day Ahead Market (EDAM) – are attempting to leverage the significant resource diversity and transmission connectivity between major supply and demand regions throughout the western United States, creating additional benefits through strong regional collaboration across a larger geographic footprint. Since its launch in 2014, the WEIM has grown to 22 participating entities representing 79% of the load in the Western Interconnection, and delivering more than $3 billion in benefits, along with reliability and environmental benefits.

v. Energy Efficiency

California has continually increased the energy efficiency of its new buildings and appliances since the Warren Alquist Act of 1974. These efficiency standards (Title 24) were updated to mandate Zero Net Energy (ZNE) residential new construction starting in 2020. ZNE homes require energy efficiency that will be achieved through implementing a high-efficiency envelope (insulation, windows, etc.), and efficient heating, ventilation, and air conditioning units. The remaining energy consumption must be offset by on-site generation, sized so that the annual building electricity consumption is equal to the building's electricity generation.

vi. Building & Transportation Electrification

Since January 2020, Palo Alto's local reach codes require that all low-rise residential new construction projects to be all-electric. Beginning January 2023, Palo Alto has expanded the all-electric new construction requirement to include nonresidential buildings and has also prohibited new gas infrastructure for outdoor equipment such as pools, spas and BBQ grills. Since 2016, Palo Alto has offered rebates to encourage homeowners to replace their gas water heaters with heat pump water heaters (HPWH). Uptake of the rebate program has been low due to high upfront cost and low awareness of heat pump technology. In Spring 2023, Palo Alto launched an innovative program that offers end-to-end HPWH installation service with on-bill financing to lower the upfront cost to homeowners. Within the Bay Area, other community choice aggregators (CCAs) and agencies such as BayREN have begun incentivizing the adoption of HPWHs as a strategy to reduce fossil fuel use and lower GHG emissions. At the state level, the TECH Clean program is a statewide initiative to accelerate the adoption of heat pump water heating and space heating technology across California. The Federal Inflation Reduction Act of 2022 further created tax incentives and rebates to support heat pump technologies. Collectively, these incentives are expected to reduce the cost barrier and advance the market transformation for heat pump technologies. In September 2022, the California Air Resources Board voted to ban the sale of new natural gas-powered space and water heaters in California by 2030. This is an important step to help California meet its carbon-neutral goal by 2045, given that residential and commercial buildings account for around 25% of the state's GHG emissions.

The 2022 California Green Building Standards (CALGreen) specify minimum EV infrastructure requirements for new buildings and existing multifamily buildings. Through its local green building codes, Palo Alto has adopted EV infrastructure requirements that exceed these minimum state requirements. These local efforts, along with EV customer programs described below and the state's Advanced Clean Cars regulations that require 100% sales to be emission free by 2035 and Advanced Clean Trucks/Fleets Regulations requiring fleets and trucks sold to be emission free by 2036 will greatly enhance Palo Alto's ability to meet its GHG reduction goals.

D. *Overview of IRP Methodology*

Integrated resource planning is the process that utilities undertake to determine a long-term plan to ensure generation resources are adequate to meet projected future peak capacity and energy needs, while achieving other utility goals such as maintaining an adequate capacity reserve margin for system reliability. Resource plans must ensure generation reliability is maintained at or above industry-standard levels. IRPs should also forecast long-term costs and potential rate impacts to customers to ensure that the utility can monitor and track trends with sufficient time to implement solutions to ensure reliability, compliance, and affordable electric service. An effective resource plan should also provide a reasonable degree of flexibility for the utility to deal with uncertainty in technological change and future regulations.

IRPs require the use of sophisticated analytical tools capable of evaluating and comparing the costs and benefits of a comprehensive set of alternative supply and demand resources. Supply options typically include the evaluation of new conventional generation resources, renewable energy technologies, and distributed energy resources. Demand options typically include consideration of demand response programs, energy efficiency programs, and other "behind the meter" options which may reduce the overall load that the utility must be prepared to supply.

IRPs utilize various economic analyses and methodologies to assess alternative scenarios (e.g., different combinations of supply and demand resources) and sensitivities to key assumptions to arrive at an economically optimal resource plan (subject to various constraints, such as regulatory mandates and local policies). The key steps in the resource planning process are outlined below.

> *Step 1:* EXAMINE PLANNING FRAMEWORK AND RISKS: Identify and assess challenges the utility faces in the current business and regulatory environment.
>
> *Step 2:* ASSESS NEEDS: Develop forecasts of load changes (incorporating impacts of cost-effective demand-side resources), existing plant conditions, contract terms, and operational constraints to determine resource needs over the planning period.
>
> *Step 3:* CONSIDER RESOURCE OPTIONS: Evaluate available generation resources, including centralized and distributed renewables and long-term market power purchases to identify the role each will play in meeting customer needs and regulatory and policy goals.
>
> *Step 4:* DEVELOP RESOURCE PORTFOLIOS: Develop resource portfolios and evaluate them quantitatively and qualitatively to determine a preferred portfolio. Evaluation relies upon GHG emission requirements, needs assessment, and planning data specified in previous steps.
>
> *Step 5:* PERFORM SCENARIO AND RISK ANALYSIS: Perform detailed evaluations of preferred resource portfolios through scenario and risk analysis, to assess performance under a range of potential market and regulatory conditions.
>
> *Step 6:* IDENTIFY PLAN: Identify a "Preferred Plan" based on the resource portfolio expected to reliably serve demand at a reasonable long-term cost, while achieving regulatory compliance, accounting for inherent risks, and allowing for flexibility to respond to future policy changes.

III. Forecast Methodology for Energy and Peak Demand

Palo Alto's forecasted energy and demand were generated by creating an econometric model for monthly energy and peak demand and then adding the non-linear components of EV load growth, building electrification growth, and additional commercial projects planned. Energy and peak demand profiles for these additional loads were generated they were added to the energy and peak demand forecast.

Equation 1: Methodology Energy and Peak Demand Forecast

$$Forecast = Econometric\ Forecast + EV_{Nonlinear\ Growth} + Building\ Elec. + New\ Com.\ Loads$$

More details on the econometric forecast and additional nonlinear loads that were added to the IRP long-term forecast are shown in the December 2022 Utilities Advisory Commission meeting (ID # 14677).[8]

A. *Description of Econometric Forecast Models*

i. Energy Econometric Model

The econometric model inputs (i.e. independent variables) have been selected based on the availability of data, economic theory, and tests to validate the forecasts with actual energy (or demand) data. The coefficients of the models were obtained via statistical estimation on historical (in-sample) data where the Yule-Walker Generalized Least Squares method was employed to take into account the autocorrelation structure of the residuals to obtain valid standard error estimates. The coefficients were then combined with forecasts of each driver (independent variable) to produce the forecasted energy (or peak demand). Forecasts of the economic driver variable were provided by the Bureau of Economic Analysis and the forecasted values provided by the UCLA Anderson Forecast group. Weather variables were obtained from NOAA, and the forecasted weather conditions were set to reflect normal weather based on average temperatures across the training data set.

ii. Peak Demand Econometric Model

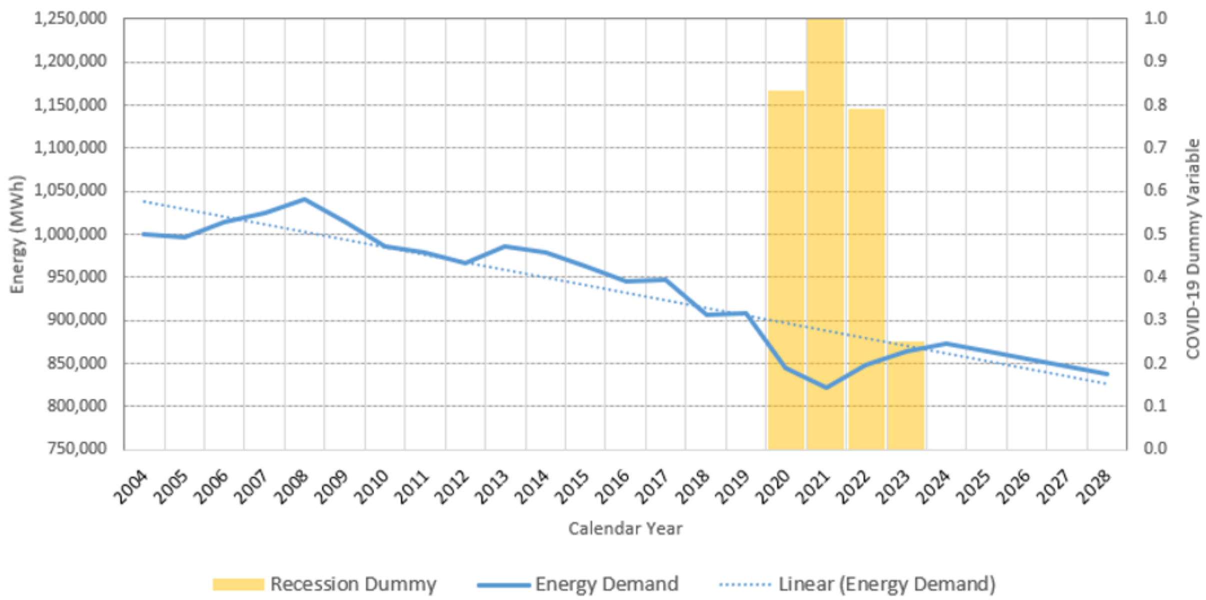
The Peak Demand forecast is also an econometric model that maps a set of calendar variables, weather variables, and the energy forecast onto Palo Alto's monthly peak demand measured at its CAISO meter. Similar to the Energy Forecast, monthly dummy variables are used in the model to capture underlying changes in Palo Alto customers' electric consumption throughout the year. Daily heating and cooling degree days corresponding to the peak day of the month is used as the weather driver. Monthly historical energy usage is added as the final variable explaining peak demand.

[8] https://www.cityofpaloalto.org/files/assets/public/agendas-minutes-reports/agendas-minutes/utilities-advisory-commission/archived-agenda-and-minutes/agendas-and-minutes-2022/12-07-2022/12-07-2022-agenda-and-packet.pdf Page 71 (ID # 14677)

iii. Impact of COVID-19 Recession

The recession due to COVID-19 required an additional 'recession dummy' variable superimposed on top of it, given it is the only time in recent history of stay at home orders and required working from home. The electricity consumption of Palo Alto is rebounding as Palo Alto exits the COVID-19 recession, and electricity consumption expected to largely normalize by 2023.

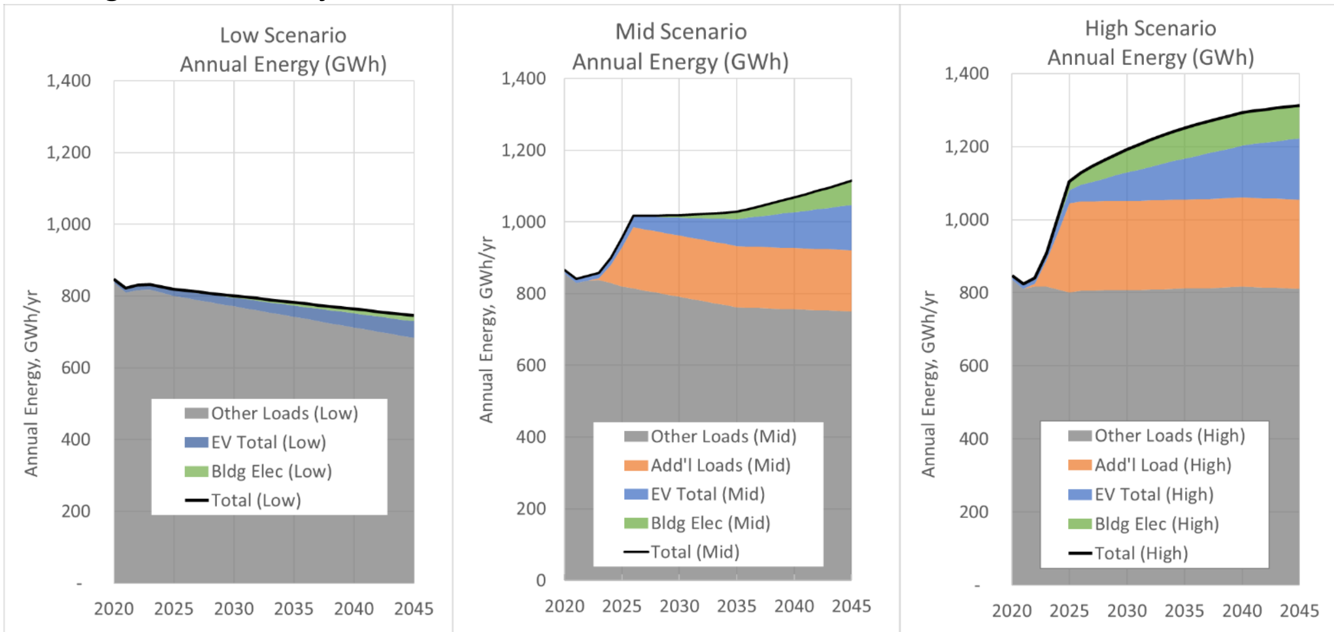
Figure 2. Graph of Long-term Linear Load Loss and COVID-19 Recession



B. *Overall Forecast Including Linear and Nonlinear Trends*

The combined forecast for low, mid, and high projections are shown in Figure 3 total expected additional data center load, total EV load, building electrification load, in order show the relative scale of expected loads.

Figure 3. Load Projections with Total EV loads, New Data Center Loads, and Electrification



For both electric vehicle adoption and building electrification rate, the high case assumes meeting 71% reduction in CO2 emissions from 1990 levels by 2030. The low forecasts for both electric vehicle adoption and building electrification rate assume linear extrapolation of current trends of the last three to five years. The mid forecasts for both electric vehicles and building electrification are aggressive but potentially realistic. The data center additional load growth is for additional data centers which are planned for the next three years, with 70% of customer projected loads assumed for the mid forecast, and 100% for the high case.

Table 4. Additional Loads with Nonlinear Components

	2020	**2045 projection**		
Additional Modeled Load Growth	**Actual**	**Low**	**Mid**	**High**
Additional Data Centers, GWh	-	0 (0%)	161 (19%)	230 (27%)
Electric Vehicles, GWh	10 (1%)	46 (5%)	129 (15%)	165 (19%)
Building Electrification, GWh	1 (0.1%)	16 (2%)	69 (8%)	91 (11%)
Total, GWh	**11** **(1%)**	**62** **(7%)**	**359** **(42%)**	**486** **57%**

Table 5. Assumptions behind Growth Factors for Data Centers, EVs, and Building Electrification

	Low Projection			**Mid Projection**			**High Projection**		
New Load Assumptions	2020	2030	2045	2020	2030	2045	2020	2030	2045

New Data Centers	-	-	-	-	70%	70%	100	100%	100%
Electric Vehicles									
Residents Vehicles	10%	21%	42%	10%	31%	61%	10%	44%	86%
Res. New Vehicles	30%	40%	62%	30%	50%	80%	30%	85%	100%
Building Electrification									
Single-Family All-electric	1%	7%	26%	1%	10%	87%	1%	100%	100%
Gas Packs Converted	0%	0%	0%	0%	0%	75%	0%	75%	100%
School Sqft Converted	0%	0%	0%	0%	0%	25%	0%	25%	50%
Large Com. Converted	0%	0%	0%	0%	5%	20%	0%	20%	40%

C. *Changes in Seasonal and Hourly Usage Patterns*

Staff is also exploring the changing trends of electricity usage and have updated the hourly models to encompass these hourly and seasonal trends (higher winter loads, nighttime loads), behind the meter solar and batteries, and elevated temperatures from climate change (e.g. more air conditioning, less heating overall). Approximately half of the building electrification load is expected to be from heating homes and businesses, which will have more usage in the winter and in the night. Staff has incorporated this into our hourly forecast and will consider running sensitivities around it. Electric vehicles used for commuting are also assumed to charge more in the evenings and at night, which staff have also integrated into the hourly forecast.

D. *Specific Components of Forecast*

i. Energy Efficiency Forecast

a. Committed Energy Efficiency

AB 2021 (2006) required POUs to identify all potentially achievable cost-effective electric efficiency savings and to establish annual targets for energy efficiency savings over ten years, with the first set of EE targets to be reported to the CEC by June 1, 2007, and updated every three years thereafter. AB 2227 (2012) amended this target-setting schedule to every four years. Palo Alto adopted its first Ten-Year Energy Efficiency Portfolio Plan in April 2007, which included annual electric and gas efficiency targets between 2008 and 2017, with a ten-year cumulative savings goal of 3.5% of forecasted energy use. In accordance with California law, the electric efficiency targets were updated in 2010, with the ten-year cumulative savings goal doubling to 7.2% between 2011 and 2020. Since then, increasingly stringent statewide building code and appliance standards have resulted in substantial energy savings. However, these "codes and standards" energy savings cannot be counted toward meeting the utility's EE goals.

The ten-year electric efficiency targets were updated again in 2012, with the ten-year cumulative electric efficiency savings being revised downwards to 4.8% between 2014 and 2023. For fiscal year (FY) 2017, CPAU achieved electric savings of 0.7% of load through its customer efficiency programs. Cumulative electric efficiency savings since 2006 are about 6% of the FY 2017 electric usage. Adoption rates for EE are based on the 10-year Energy Efficiency Goals for 2023-2027 which were updated in 2017. The ten-year cumulative electric efficiency savings target was updated to 5.7% between 2023 and 2027. In 2021, CPAU updated its 10-year Energy Efficiency goals for 2022-2031 with a cumulative EE savings goals of 4.4%. Energy efficiency goals were set lower for this period due to the impacts of Covid-19 on energy efficiency program participation and the growing focus on promoting electrification over efficiency.

b. Additional Achievable Energy Efficiency

There is no additional achievable energy efficiency assumed in this IRP forecast because the additional achievable energy efficiency is already included in the adopted energy efficiency goals for 2022 to 2031.

ii. Solar Photovoltaic Forecast

We have projected approximately linear growth of local solar through 2045. Solar PV projections are based on technical and economic potential; they indicate that adoption will grow steadily, with the growth rate itself plateauing as is typically seen in a maturing market. These projections include only behind-the-meter installations in residential and commercial sectors.

iii. Transportation Electrification Forecast

The EV adoption rate in Palo Alto is around 15% of total vehicles registered in the City at the end of 2022, approximately four times greater than the California statewide average, and this residential adoption rate relative to statewide average projections is assumed to continue at a roughly linear pace until 2045. To estimate the EV adoption rates of commuters *into* Palo Alto, the observed adoption rate from 2017 census data for the entire Bay Area was extended to 2030. In addition to the number of residential EVs there are projected to be approximately 1,900, 3,000, and 11,000 commuter EVs in 2017, 2020 and 2030, respectively. CPAU staff projects roughly linear energy consumption growth from EVs until 2045 given the competing forces of increasing EV adoption, smaller EVs such as electric bikes, and fewer vehicle miles traveled (from increased telecommuting, walking, and cycling). Detailed estimates of load growth are shown above in Table 5.

iv. Building Electrification Forecast

As mentioned above, staff has estimated a substantial amount of conversions of current residential and commercial natural gas appliances to electric. Table 5 shows the underlying assumptions for rate of conversions. The assumed scenario is represented in the 'mid' scenario.

v. Energy Storage Forecast

CPAU, in coordination with the Palo Alto Development Services Department, is facilitating the adoption of energy storage systems by customers by streamlining the process for permitting and interconnecting such systems. Detailed analysis in 2020 showed that batteries are currently not cost effective from a societal perspective within CPAU's service territory and therefore Palo Alto currently does not provide any rebates for energy storage systems.[9] The current net energy metering rate provides some incentive for energy storage systems by incentivizing onsite usage, with a lower buyback rate for power exported to the grid. The current relatively high monthly demand charges for commercial customers incentivizes energy storage systems to lower peak monthly demand. Staff is also currently evaluating proposals for

[9] https://efiling.energy.ca.gov/GetDocument.aspx?tn=236202-1&DocumentContentId=69171
https://www.cityofpaloalto.org/files/assets/public/city-clerk/resolutions/reso-9396.pdf

large utility-scale batteries at our resources or new resources. Some battery storage is included in our recommended electric supply portfolio.

vi. SB 338 Requirements

On September 30, 2017, SB 338 was signed into law by Governor Brown, including additional provisions for the POU IRPs, which were effective January 1, 2018. This included revisions to Public Utilities Code section 9621(c), requiring the POU's governing board to *"consider the role of existing renewable generation, grid operational efficiencies, energy storage, and distributed energy resources, including energy efficiency, in helping to ensure each utility meets energy needs and reliability needs in hours to encompass the hour of peak demand of electricity, excluding demand met by variable renewable generation directly connected to a California balancing authority, as defined in Section 399.12, while reducing the need for new electricity generation resources and new transmission resources in achieving the state's energy goals at the least cost to ratepayers."*

As part of the comprehensive process undertaken to develop this IRP, CPAU staff reviewed and considered resource options that included all of the technologically feasible and cost-effective options available to it, including what options would be best utilized to meet energy needs and reliability requirements during hours of net peak[10] demand for the utility. This includes a review of the best available options considering both new and existing preferred resources, as would necessarily be assessed in order to ensure that Palo Alto provides its customers with the cleanest and most cost-effective generation resources, while also ensuring that the City meets all of the statutory requirements of not only Section 9621, but other procurement and resources mandates, as well.

[10] "Net peak demand" is defined as peak electricity demand, excluding demand met by variable renewable generation directly connected to a California balancing authority.

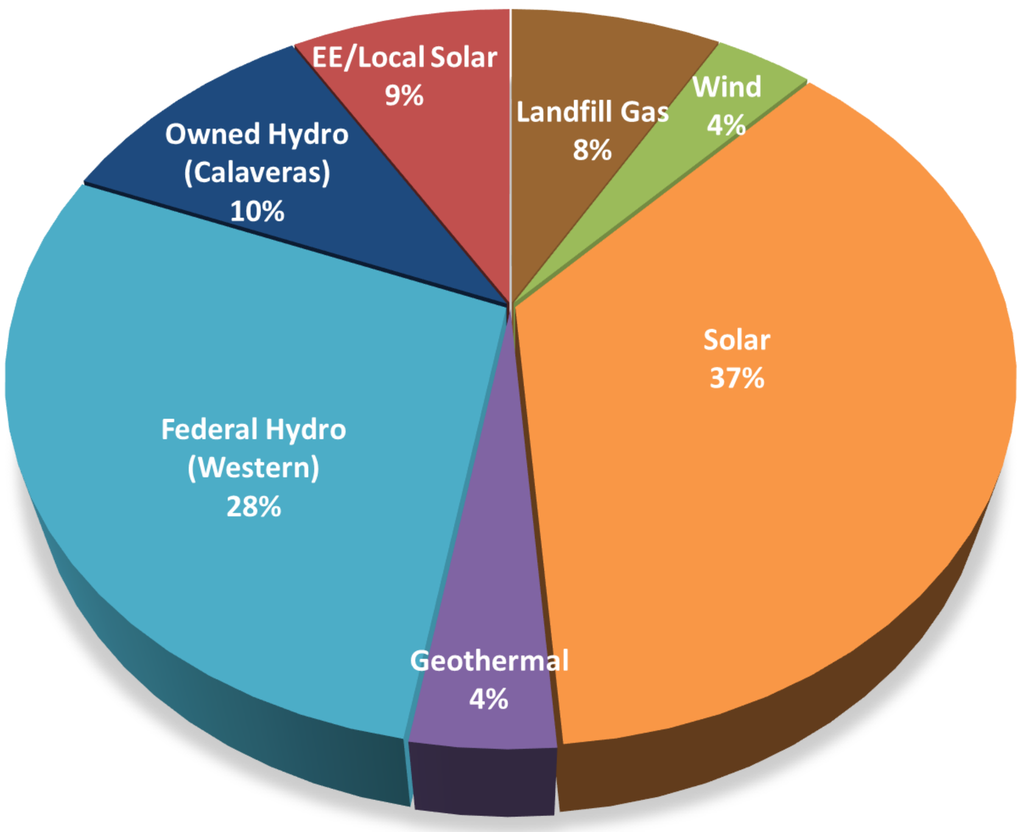
IV. Existing Resource Portfolio

The City's current electric supply portfolio comprises the following major types of resources:

- Energy efficiency and distributed generation;
- Federal hydro (Western contract);
- Owned hydro (Calaveras);
- Long-term, in-state, RPS-eligible power purchase agreements (PPAs), which include solar, wind, and landfill-gas resources; and
- Market power purchases, matched with RECs, for monthly/hourly portfolio balancing.

For calendar year 2025, the projected contribution of each of these five resource types to the City's overall electric supply portfolio is represented in Figure 4 below.

Figure 4: Projected Palo Alto Electric Supply Mix in CY 2025 by Resource Type
*** Estimated Average Annual Unit Cost of 6 ¢/kWh ***



A. *Energy Efficiency, Building Electrification, Transportation Electrification & Local Renewable Generation*

i. Energy Efficiency

Palo Alto has long recognized cost-effective energy efficiency (EE) as the highest priority energy resource, given that EE typically displaces relatively expensive electricity generation and lowers energy bills for customers.

Palo Alto places such emphasis on energy efficiency and demand side management programs that each year we prepare a detailed Demand Side Management Annual Report describing and reporting on efficiency savings from electricity, gas, and water.

Highlights of Current Energy Efficiency Programs

- **Multifamily Residence Plus+ Program -** This CPAU program focuses on multifamily buildings, especially below-market rate apartment complexes, providing free, direct installation of energy efficiency measures to multifamily residences with four or more units including hospices, care centers, and rehabilitation facilities. Efficiency measures covered under this program include efficient lighting, attic insulation, refrigerator replacement, and more recently, high efficiency toilets as well as air source heat pump systems to replace gas furnaces.

- **The Home Efficiency Genie Program -** The Genie was launched in 2015 as a home efficiency assessment program. The program provides phone consultation to customers to review their utility bills and advise on efficiency upgrade projects. For a fee, residents can receive an in-depth home efficiency assessment which includes air leakage testing, duct inspection, and insulation analysis. In 2019, a home electrification readiness assessment was added to help homeowners determine existing home amp loads and electric main panel size, and to provide project guidance on home electrification projects such as adding EV charger or a HPWH.

- **Heat-Pump Water Heater Program –** In Spring 2023, Palo Alto launched a full-service HPWH program that provides end-to-end service to replace a gas water heater with a HPWH in single family homes. The project cost is subsidized by CPAU, and to further lower the upfront cost to residents, CPAU offers a zero interest on-bill financing option. Customers can also opt for a rebate if they prefer to choose their own contractor. The program has a goal of installing 1000 HPWHs in one year.

- **Green Building Ordinance –** The Green Building Ordinance (GBO) is Palo Alto's local building reach code that is more stringent than the state's Title 24 standards. Prior to the 2022 code cycle, the GBO requires that new construction projects exceed the state's energy and water efficiency standards. For the 2022 code cycle, Palo Alto requires that all new construction projects be all-electric with no gas-fired equipment or appliances.

- **Residential Energy Assistance Program (REAP) -** This program provides qualifying low-income residents with free energy and water efficiency measures such as LED lighting, heating system upgrades, weather stripping and shell insulation. More recently, high efficiency toilets, heat pump water heaters, and air source heat pump systems are added to the measure list. This program has equal focus on efficiency and comfort, so there may not be reported energy savings for a customer project.

- **Business Energy Advisor** – Commercial customers can get a free consultation and on-site assessment from the Business Energy Advisor with custom recommendations for to help them lower their utility costs with more efficient equipment. From there, the Business Energy Advisor can help them find qualified contractors, identify rebates available, and explore financing options.

- **Commercial and Industrial Energy Efficiency Program (CIEEP)** – This program provides commercial and industrial (C&I) customers with a free high-level assessment of their facility's energy usage and concrete recommendations for saving energy. The program has been running since 2009, providing cash incentives and no-cost expert engineering support through Enovity.

ii. Building Electrification

CPAU is currently offering a concierge program (the Heat Pump Water Heater program) to help single family residents switch from a gas water heater to a heat pump water heater at a discounted project cost using a City contractor; zero-interest financing is available to lower the upfront project cost. Residents can also choose their own contractor to install a heat pump water heater and receive a $2,300 rebate.

For commercial customers, CPAU is offering free on-site assessment to identify electrification opportunities and free consultation for contractor selection, equipment selection and permitting. Electrification rebates are available for eligible products to offset project costs.

iii. Transportation Electrification

CPAU provides customers with a wealth of information on choosing and comparing vehicles and provides both financial and technical assistance to support the installation of EV charging equipment. CPAU offers qualifying customers (including school, non-profits, and multi-family properties) rebates of up to $80,000 for installing EV charging equipment. If customers installing EV charging infrastructure need to upgrade their electric service capacity, CPAU also offers Transformer Upgrade Rebates (up to $10,000 for single-family homes and up to $100,000 for schools, non-profits organizations, public entities, and multi-family/mixed-use properties).

In terms of technical assistance, CPAU provides customers who want to install an EV charger at their home with a free online estimate for their project and also connects them with a local, vetted professional who will handle the permitting and inspections process for them. CPAU also offers an EV Charging Technical Assistance Program that provides personalized technical assistance, free of charge, to support owners and managers of schools, non-profits, multifamily properties, and small to medium businesses navigate the process of installing EV charging infrastructure. This assistance can include help with site assessments, engineering, design, vetting contractor bids, and project managing the installations.

iv. Local Renewable Generation

Local renewable energy programs are critical to lowering emissions of local air pollutants and CPAU has enacted a number of initiatives and programs to facilitate customer adoption.

The following is a description of Palo Alto's current customer-side renewable generation programs:

- **SunShares -** Every year since 2015 Palo Alto has been an active partner in promoting the Bay Area SunShares PV Group-buy program which pre-screens solar installers and negotiates lower rates for customers. Since 2015, Palo Alto has been the top "Outreach Partner," both in terms of the number of solar contracts signed and the kilowatts of rooftop solar capacity installed annually through the program. In 2021 and 2022 Palo Alto customers completed 63 solar installations totaling 368 kW through the SunShares program, 21 of which include a storage system, and 3 standalone storage installations.
- **Net-Energy Metering Successor Program -** Prior to January 1, 2018 residential and commercial customers in Palo Alto who installed approved PV systems were able to sign up for the CPAU Net Energy Metering (NEM) program. CPAU reached the NEM cap of 10.8 MW in January 2018 and CPAU is now offering a NEM Successor Program instead. The NEM Successor process is integrated with the permitting process, and customers receive a credit for electricity exported to the grid based on CPAU's avoided costs.
- **Palo Alto CLEAN (Clean Local Energy Accessible Now) -** This feed-in tariff program purchases electricity generated by renewable energy resources located in Palo Alto's service territory and interconnected on the utility-side of the electric meter. The electricity is purchased by Palo Alto for the electric renewable portfolio standard. The program was launched in 2012 and has been modified several times since then. In February 2014 the City Council approved a total program capacity of 3 MW at a price of 16.5 cents per kilowatt hour (kWh) fixed for 20 years. In May 2017 the City Council approved additional minor changes to the program, including adding a 15-year contract term option and removing the total participation cap for both solar and non-solar eligible renewable energy resources. CPAU is currently offering to purchase the output of eligible renewable electric generation systems located in Palo Alto at the following prices:
    - For solar energy resources: 16.5 cents per kilowatt hour (¢/kWh) for a 15-, 20- or 25-year contract term until the subscribed capacity reaches 3 MW – after that the price will drop to 8.8 ¢/kWh for a 15-year contract term, 8.9 ¢/kWh for a 20-year contract term, or 9.1 ¢/kWh for a 25-year contract term; and
    - For non-solar eligible renewable energy resources: 8.3 ¢/kWh for a 15-year contract term, 8.4 ¢/kWh for a 20-year contract term, or 8.5 ¢/kWh for a 25-year contract term.

  There is no minimum or maximum project size, but the program is best suited for commercial property owners with available roof-tops or parking lots. In 2016, Palo Alto's Public Works Department solicited proposals to install solar PV systems and electric vehicle chargers at four City-owned parking structures; all four of these parking garage solar PV systems participate in the CLEAN program and are now operational. As of August 2023, there are a total of six solar PV systems participating in the Palo Alto CLEAN program, accounting for 2.915 MW of the capacity available at the 16.5 ¢/kWh contract rate, with contract terms ranging from 15 to 25-years.

B. *Hydroelectric Resources*

i. Sierra Nevada Region Western Area Power Authority (WAPA) Base Resource

Since the 1960s, CPAU's participation as a power customer of the Central Valley Project (CVP) has been an instrumental factor in its ability to deliver low-carbon electricity to Palo Altans at low rates. The U.S. Bureau of Reclamation (BOR) built the CVP in the 1930s and is charged with the operation, maintenance, and stewardship of the project. The CVP was constructed primarily for flood control of the Sacramento Valley area; however, it is also used to provide water for irrigation and municipal use and for navigation and recreational purposes. Hydroelectric generation is a lower priority function of the CVP, relative to the purposes listed previously.

The BOR is legally required to first provide power to "Project Use" for operations and pumping water through the CVP project, and then to "First Preference Customers," those customers whose livelihood and/or property/land was impacted by the construction of the CVP. The remaining hydroelectricity ("Base Resource") is then made available for marketing under long-term contracts with not-for-profit entities such as municipal utilities and special districts. The Western Area Power Administration (WAPA) is the federal Power Marketing Agency charged with marketing and contracting with customers for the electric output associated with the CVP, and collecting funds to meet allocated revenue requirements on behalf of the BOR. WAPA also responsible for transmission of the federal power.

In 2000, the City executed a new 20-year contract with WAPA for CVP power deliveries starting in 2005. Under this contract the City receives 12.3% of all the Base Resource product output and is obligated to pay 12.3% of all the CVP's revenue requirements as allocated to power customers, regardless of the amount of energy received. Under normal precipitation and hydrological conditions, this resource provides over 30% of CPAU's electricity needs. However, since 2005 the amount has varied from a low of 11% to a high of 64%. Given that the overall cost of this contract is essentially fixed while the amount of energy the City receives from it varies significantly with weather conditions, the corresponding cost per MWh has ranged from $22 to $105/MWh.

The current Base Resource contract will expire at the end of 2024. Under WAPA's 2025 Power Marketing Plan, CPAU, as an existing Base Resource power customer, recently executed a contract to renew its Base Resource allocation at 98% of its existing allocation level for a thirty-year term (2025-2054).[11] However, under the terms of the Power Marketing Plan, all Base Resource power customers have the ability to reduce their allocation under the new contract—or exit the agreement entirely—until the end of June 2024. Therefore, a key consideration of the current IRP is whether or not the City should exercise this option to reduce its allocation, and if so, to what degree—and what alternative resources to replace it with.

The analysis necessary to aid Council in its decision will consider the cost and the value of the resource going forward. Generation is highly variable and uncertain due to unpredictable precipitation conditions,

[11] Resolution 9946: https://www.cityofpaloalto.org/files/assets/public/v/1/city-clerk/resolutions/resolutions-1909-to-present/2021/reso-9946.pdf

climate change, and the potential for new environmental policies and/or projects which threaten to erode generation volumes and/or value.

The costs associated with participating in the Base Resource are also highly uncertain. The project has many parts that need to be replaced, as it was first put into service nearly eighty years ago. Additionally, funding requirements under the Central Valley Project Improvement Act (CVPIA)[12] and the appropriateness of the allocation of Restoration Fund collections between water and power customers is of serious concern to CPAU and other power customers, who have been actively encouraging BOR and Congress to adjust this allocation.

NCPA staff and CPAU staff are in the process of assessing the potential impact and likelihood of several issues which threaten to dilute the future value of Base Resource, as well as NCPA's and CPAU's ability to influence these issues. These issues are in addition to highly variable hydrological and precipitation conditions which naturally create substantial year-to-year variations in the value of the resource. Staff and NCPA have begun analyzing each of these risk factors to aid in the decision of whether to reduce CPAU's Base Resource allocation by June 30, 2024 for the 2025-2030 period. One aspect that helps to mitigate the financial risk of this resource is the contractual ability to decrease CPAU's share or exit the contract entirely every five years.

ii. Calaveras

The Calaveras hydroelectric project was bond-funded and built as a joint project between members[13] of the Northern California Power Agency (NCPA) and the Calaveras County Water District (CCWD) in 1983. CCWD holds the Federal Energy Regulatory Commission (FERC) license and NCPA is the project operator. The project resides on the North Fork of the Stanislaus River in Calaveras, Alpine and Tuolumne Counties. Calaveras was built primarily for hydroelectric generation purposes and as such water is stored and managed to optimize generation value and to meet member owners' energy needs. Palo Alto's share in the project is 22.92%, which serves approximately 10% of the City's annual load in an average hydro year.

Calaveras' project capacity is about 253 MW and it can generate approximately 400 gigawatt-hours (GWh) of energy annually under average hydroelectric conditions. Palo Alto's corresponding share of the output is 58 MW of capacity and 92 GWh of annual energy under average conditions.

As of January 2024, the City's outstanding debt on the project is approximately $39 million, of which a large portion will be maturing in 2024 and the remainder will mature in 2032. Through fiscal year 2024, the City's annual debt related to this project is on average about $8.5 million; for the remaining years

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[12] The Central Valley Project Improvement Act was passed by the U.S. Congress in 1992 to establish the Restoration Fund, funding requirements and goals to restore the habitat of the area impacted by the CVP. Water and power customers are obligated to pay into the Restoration Fund. https://www.usbr.gov/mp/cvpia/docs/public-law-102-575.pdf

[13] NCPA members participating in the Calaveras Project via the Calaveras Third Phase Agreement with NCPA include the cities of Alameda, Biggs, Gridley, Healdsburg, Lodi, Lompoc, Palo Alto, Roseville, Santa Clara, and Ukiah, and the Plumas-Sierra Rural Electric Cooperative.

until 2032, the annual debt is about $4.2 million. In addition, efforts are underway to apply for relicensing, given that the current FERC license for the project expires in 2032. The costs associated with this relicensing effort are yet to be finalized, but they will be collected from participants in the coming years. NCPA has also recently initiated efforts to dredge one of the Calaveras system's major reservoirs, to remove trees, soil, sand, gravel and other debris that have been deposited into the reservoir in recent years by high inflows. Like the relicensing effort, the costs associated with this dredging project have yet to be finalized but will be collected by the project's participants in the coming years.

Historically, debt and other costs associated with Calaveras have resulted in the overall value of the project being below market.[14] However, because Calaveras' variable operating and maintenance costs are relatively low, the project is dispatched regularly for the purpose of generating energy. Additionally, Calaveras has the ability to meet several CAISO compliance and operating requirements, including: following variations in the City's load in real-time (load following), ancillary services related to regulation energy and spinning reserves; and meeting some of the City's Resource Adequacy requirements, including flexible capacity and system capacity. Calaveras also serves as an energy storage asset, since water is stored in the main reservoir, New Spicer Meadow, and released at optimal times to meet energy and capacity needs. In the long-term it is expected that the value of Calaveras will increase, assuming average or above average hydroelectric conditions and favorable regulatory requirements.

While there are no imminent decisions associated with Calaveras, a few issues may be worth evaluating in the context of the IRP, including:

1. Assessment of Calaveras' value and operating strategies, given the City's commitment to other large hydroelectric resources, RPS resources, and hydro risk management objectives;
2. How to best optimize Calaveras given its flexible dispatch ability, which enables it to meet intermittent resource integration requirements; and
3. The value of the City's long-term stake in Calaveras, including the post-2032 period, when the current FERC license expires.

C. *Renewable Energy Resources*

i. Wind PPAs

Palo Alto currently has one long-term contract for the output of a wind power project. Under this contract with Avangrid Renewables the City receives a 20 MW share of the output of the High Winds I project located in Solano County. This resource typically supplies about 4% of Palo Alto's total electric supply needs and its contract term ends in 2028. The project is considered fully deliverable, and it is located in the Bay Area local capacity area.

[14] In anticipation of Direct Access and the possibility for load to leave CPAU, in 1996 Council approved a competitive-transition-charge (CTC) to be added as a non-by-passable fee on all CPAU customers electricity bills. This was done to collect the above market cost (stranded cost) associated with Calaveras debt and the funds were held in the Calaveras Reserve, which had been established in 1983 to help defray cost associated with Calaveras. The Calaveras Reserve was repurposed in 2011 and is now the Electric Special Project Reserve (see Staff Report 2160).

ii. Landfill Gas (LFG) PPAs

Palo Alto currently has five long-term contracts with Ameresco for the output of landfill gas electricity projects. The five contracts include a 1.5 MW share of a project located in Watsonville, a 5.1 MW share of a project located in Half Moon Bay, a 1.9 MW share of a project located in Pittsburg, and the entire output of a 1.4 MW project located in Gonzales and a 4.1 MW project located in Linden. The terms of these agreements are all 20 years, with contract expiration dates between 2025 and 2034. Together, the five resources currently supply about 11% of Palo Alto's total electric supply needs. All five projects are also considered fully deliverable, with two of them located in the Bay Area local capacity area.

iii. Solar PPAs

Since the beginning of 2012, Palo Alto has executed six long-term contracts for utility-scale solar PV projects. These six contracts include three with AES (the 26.7 MW Hayworth Solar project located in Bakersfield, the 20 MW Western Antelope Blue Sky Ranch B project and the 40 MW Elevation Solar C project – both of which are located in Lancaster), two with Boralex (the 20 MW EE Kettleman Land project in Kettleman City and the 20 MW Frontier Solar project located in Newman), and one with Clearway Energy (the 26 MW Golden Fields Solar III project in Rosamond). These six projects are all currently operational, and they provide over 40% of Palo Alto's total electricity needs. The terms of these agreements are all at least 25 years, with contract expiration dates starting in 2040. The three projects operated by AES are considered fully deliverable, with the Hayworth project located in the Kern local capacity area, and the other two located in the Big Creek-Ventura local capacity area. Golden Fields Solar III is also considered fully deliverable, providing valuable system capacity to the grid.

D. *Market Purchases & RECs*

Palo Alto has nine active Master Agreements for the purchase and sale of market electric power (with BP Energy, Shell Energy North America, Powerex Corp, Cargill Power Markets, Exelon Generation, Avangrid Renewables, NextEra Energy Marketing, Turlock Irrigation District, and PacifiCorp) to facilitate competitive forward market power purchases and sales to meet Palo Alto's loads in the short- to medium-term. As of June 30, 2023, Palo Alto had outstanding electricity purchase commitments for the period July 2023 to June 2024 totaling 42 GWh, and sales commitments for this period totaling 33 GWh. These market based purchases and sales are made within the parameters of Palo Alto's Energy Risk Management Program, which the City is in the process of revising to align with current market conditions and norms.

In FY 2023, gross market-based purchases (including both forward transactions and spot-market transactions) provided approximately 12% of Palo Alto's electricity needs, while gross market-based sales were equivalent to 13% of Palo Alto's needs (i.e., the City was a net seller of market-based energy). However, the volume of market purchases and sales is highly dependent on hydro conditions and long-term commitments to renewable resource-based supplies. During normal hydro conditions, gross market purchases are expected to meet approximately 15% of energy needs, while gross market sales will amount to approximately 25% of energy needs. NCPA serves as Palo Alto's scheduling and billing agent for all transactions, and acts as the interface with the CAISO under a Metered Subsystem Aggregation Agreement (MSSA).

Since 2013, Palo Alto has operated under a Carbon Neutral Plan for its electric supply portfolio, ensuring that all electrical generation that serves the City's needs produces zero GHG emissions on a net annual basis. In 2020, in recognition of the changing dynamics of California's electric grid and power supply mix, the City updated its Carbon Neutral Plan, switching from the original annual accounting approach to a stricter hourly accounting approach for defining "carbon neutrality." Under the new methodology, the City weights its hourly net surplus or net deficit positions by the grid's average emissions intensity value for that hour, then sums these hourly emissions totals over the course of the year. (In years where this calculation determines that the City has been a net emitter of greenhouse gases, CPAU purchases unbundled RECs to neutralize these residual emissions.) By recognizing the effects that the huge amounts of new solar generation have had on the hourly emissions profile of grid electricity in the state, the City is holding its carbon neutrality claims to the highest possible standard.

E. *COBUG*

In 2002, shortly after experiencing a series of rolling blackouts during the California energy crisis, the City decided to invest in a set of locally-sited natural gas-fired back-up generators in order to stave off such events in the future. These four generators, together known as the Cooperatively Owned Back-Up Generator (COBUG), total 4.5 MW in capacity. These units are close to their end of life, and an evaluation is underway to determine the best use of the space these units are currently occupying in the Municipal Services Center.

F. *California-Oregon Transmission Project (COTP)*

Fourteen Northern California cities and special districts and one rural electric cooperative, including Palo Alto, are members or associate members of a California joint powers agency known as the Transmission Agency of Northern California (TANC). TANC, together with the City of Redding, WAPA, two California water districts, and Pacific Gas and Electric (PG&E) own the California-Oregon Transmission Project (COTP), a 339-mile long, 1,600 MW, 500 kV transmission power project between Southern Oregon and Central California. Palo Alto is entitled to 4.0% of TANC's share of COTP transfer capability (50 MW). As a result of low utilization of the transmission capacity and therefore low value relative to costs (in addition to a focus on acquiring in-state renewable resources), in August 2008 Palo Alto effected a long-term assignment of its full share and obligations in COTP to the Sacramento Municipal Utility District (SMUD), Turlock Irrigation District (TID), and Modesto Irrigation District (MID). The long-term assignment is for 15 years (through the beginning of 2024), with an option to extend the assignment for an additional five years. Staff is currently evaluating executing a new layoff or bringing the resource back to the portfolio.

G. *Resource Adequacy Capacity*

As described above, the majority of Palo Alto's long-term generation contracts (and its one owned thermal generating asset) are deemed fully deliverable and provide the City with Resource Adequacy (RA) capacity to satisfy its CAISO regulatory requirements. The amounts of RA capacity provided to Palo

Alto by each resource are detailed in the CRAT standardized table in the appendices of this report, and a high-level overview is provided in Table 6 below.

Table 6: Palo Alto's Resource Adequacy Capacity Portfolio

Project	Resource Type	Local Area	Flexible RA?	Average NQC (MW)
Western Base Resource	Hydroelectric	CAISO System	No	147.0[15]
Calaveras	Hydroelectric	CAISO System	Yes	58.0
High Winds	Wind	Bay Area	No	5.4
Santa Cruz LFG	Landfill Gas	CAISO System	No	1.5
Ox Mountain LFG	Landfill Gas	Bay Area	No	5.2
Keller Canyon LFG	Landfill Gas	Bay Area	No	1.8
Johnson Canyon LFG	Landfill Gas	CAISO System	No	1.4
San Joaquin LFG	Landfill Gas	CAISO System	No	4.2
Hayworth Solar	Solar PV	Kern	No	12.8
Elevation Solar C	Solar PV	Big Creek-Ventura	No	26.3
Western Antelope	Solar PV	Big Creek-Ventura	No	13.2
Golden Fields Solar III	Solar PV	CAISO System	No	17.1
COBUG	Natural Gas	Bay Area	No	2.25

[15] https://www.wapa.gov/regions/SN/Operations/Documents/FinalGreenbook2004.pdf Palo Alto's share of average Base Resource Capacity from Greenbook values.

V. Future Procurement Needs and Scenario Analysis

A. *Needs Assessment: Energy, RPS, Resource Adequacy Capacity*

To evaluate the need for additional resource procurement during the IRP planning period, CPAU compared its load forecast with its resource supply projections (on both a monthly and an annual basis) in terms of energy, RPS supplies, and capacity. Over the next few years, Palo Alto's resource portfolio has a slight surplus of energy, as well as a surplus of RPS generation (relative to its RPS procurement requirements under SB 100) and capacity, as detailed in the Standardized Tables presented in Appendix D.

Figure 5 below presents the City's projected load and contracted energy supplies through 2045. (Note that all figures in this section are based on the assumptions that the Western Base Resource contract is renewed in 2025, all renewable energy PPAs are allowed to expire at the end of their contract terms, and no additional resources are procured.) Although the City is projected to have an annual energy surplus through 2025, the relatively rapid projected growth in total load over the next few years is expected to result in slight overall energy deficits beginning in 2029, with these deficits growing over time as existing contracts expire.

Figure 5: Palo Alto's Projected Load and Contracted Energy Supplies

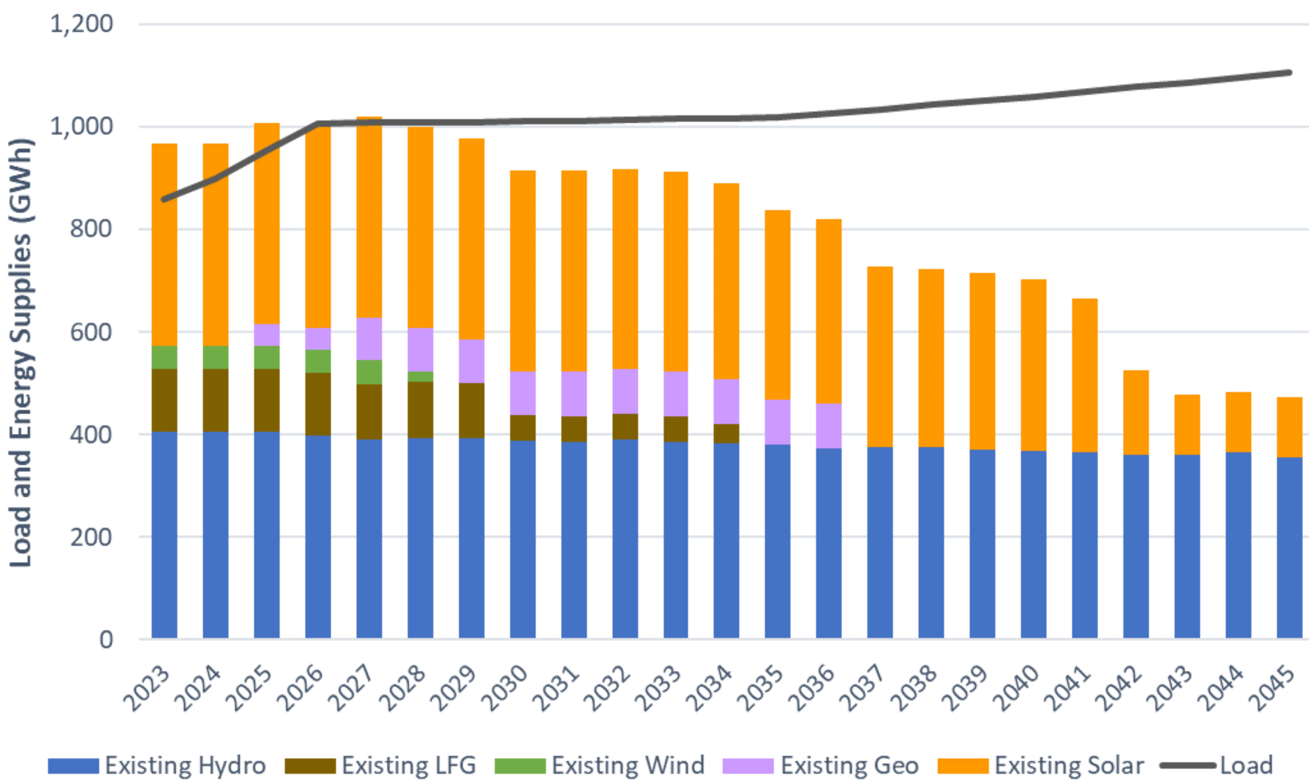
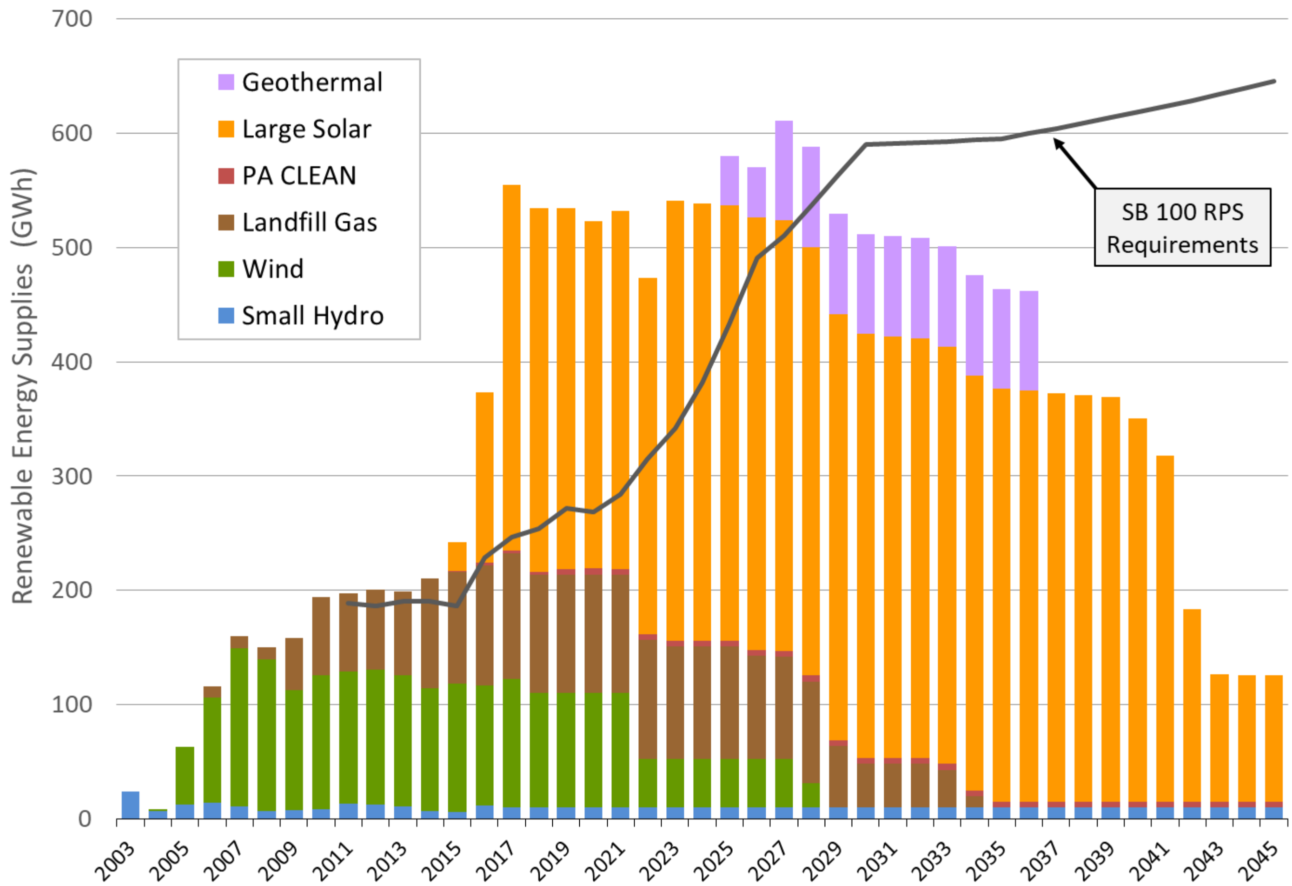


Figure 6 below depicts the City's projected supplies[16] of eligible renewable generation for the period 2003 to 2045, as well as the City's annual RPS generation procurement requirements under SB 100, based on its actual and forecasted retail sales volumes. (Note that this figure assumes no utilization of CPAU's Historic Carryover and Excess Procurement supplies from prior years. Such supplies do exist and could be utilized in the event of an RPS supply shortage, but it is not the City's plan to rely on these supplies for compliance with SB 100's RPS procurement requirements.) Just like with the City's projected long-term energy deficits, Figure 6 indicates that the City's RPS deficits are also projected to begin in 2029.

Figure 6: Palo Alto's RPS Generation Projections and RPS Compliance Requirements



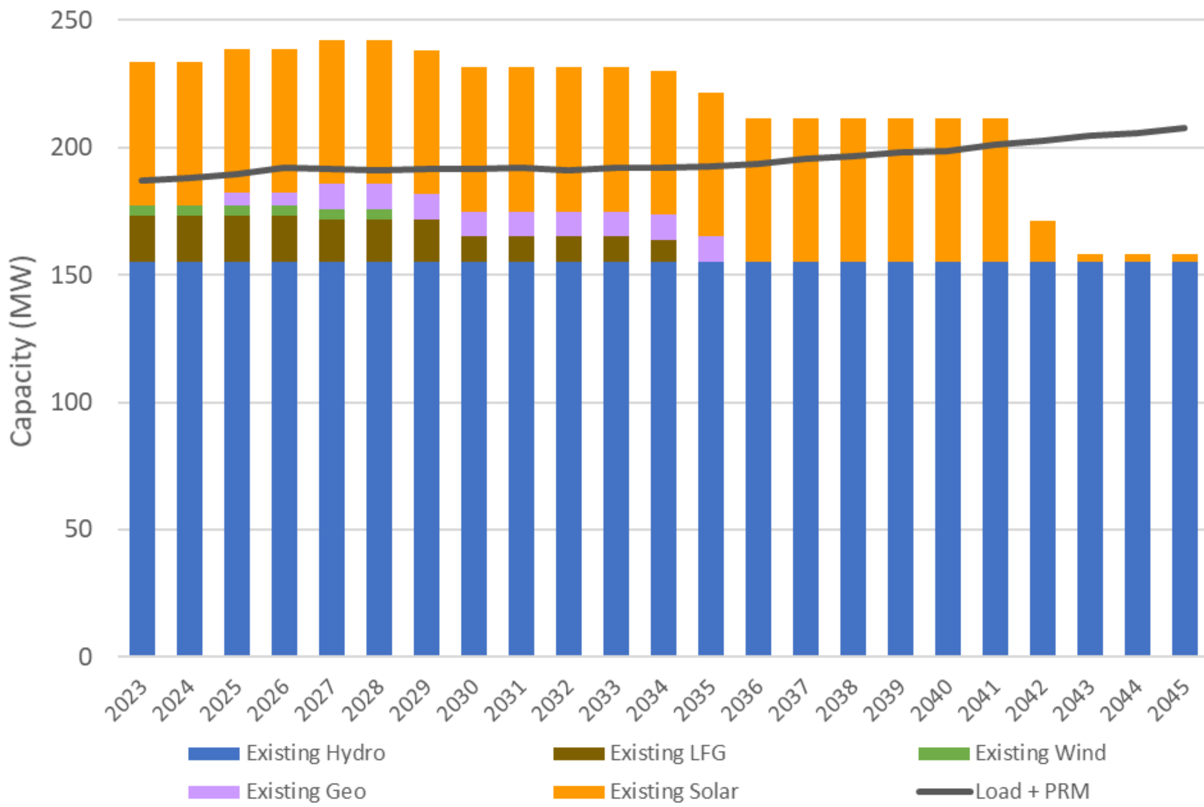
In terms of capacity needs, the City has a projected surplus of system RA capacity until the early 2040s (as Figure 7 illustrates), but deficit positions in local and flexible RA capacity.[17] The City makes up these deficits each year via bilateral RA capacity purchases. One of the challenges that CPAU faces over the IRP

[16] Note that renewable energy supplies shown in Figure 6 which are surplus to the City's RPS procurement requirements may ultimately be sold or banked for use in future compliance periods. A portion of the excess supplies for 2020-2023 were sold and replaced with PCC 3 supplies (unbundled RECs).

[17] For additional details on Palo Alto's projected needs and supplies of electrical generation, RPS generation, and RA capacity, please see the EBT, RPT, and CRAT standardized tables in Appendix D to this report.

planning period is ensuring that it can continue to procure adequate supplies of local and flexible RA capacity – both to satisfy its regulatory compliance obligations, and to ensure the overall reliability of the CAISO bulk transmission system.[18]

Figure 7: Palo Alto's Contracted System Capacity Supplies and Requirements



The remainder of this section will focus on determining the optimal mix of new resource acquisitions that will allow Palo Alto to satisfy its energy, RPS, and capacity needs while minimizing supply costs and cost uncertainty—all while remaining compliant with the City's Carbon Neutral Plan requirements.

B. *Portfolio Optimization Analysis*

As noted in the July 2023 presentation to the Palo Alto UAC, CPAU staff worked with a consultant, Ascend Analytics (Ascend), to evaluate a large number of potential new supply-side and demand-side resources in the portfolio optimization analysis it performed for this IRP. CPAU staff and Ascend worked together to develop assumptions around the long-term generation levels and costs for its existing portfolio of resources, and Ascend provided a forecast of long-term capital and operating costs for various new resource options.

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[18] Also, if Palo Alto opts not to renew its Western Base Resource contract in 2025 – or significantly scales back its share of this resource – then the City will face the additional challenge of ensuring it has adequate *system* RA capacity to meet its planning reserve margin requirements. As Table 6 indicates, the Western Base Resource contract is by far the City's largest source of system RA capacity.

Table 7 below summarizes the various resource types and their relative merits that staff considered most closely in its portfolio analysis. The key indicators used for comparing the different portfolio options are:

- Value: The net value of a resource; the projected revenue from selling the resource's energy into the CAISO market less the resource's bi-lateral contract cost;
- Portfolio Fit: Lower reliance on the grid for hourly load balancing;
- Diversification: Geographic and resource diversity;
- Term Flexibility: Flexibility in length of contract and termination provisions; and
- Cost Certainty: Degree of certainty of future resource costs.

Table 7: Relative Merits of Candidate Resources Considered to Rebalance Supply Portfolio
*** Ratings reflect relative changes from current portfolio of resources ***

	Value	Portfolio Fit	Generation Flexibility	Portfolio Diversification	Term Flexibility	Cost Certainty
Federal Hydro (WAPA)	◕	◑	◕	•	◕	◑
Out-of-State Wind	◕	●	•	●	•	●
In-State Solar	◑	•	•	•	•	●
Baseload Renewable	◔	●	•	◕	•	●
Energy Storage	◔	◕	◕	◕	•	●
Market Power & RECs	◔	●	●	◕	●	•

Legend: **High** ● ◕ **Medium** ◑ ◔ **Low** •

i. Capacity Expansion Modeling Results

For IRP portfolio development, CPAU relied on PowerSIMM, an industry-leading market simulation, capacity expansion, and production cost model developed by Ascend. PowerSIMM captures and quantifies elements of risk through the simulation of meaningful uncertainty with weather as a fundamental driver. PowerSIMM is a "hybrid model," meaning it uses both market data and long-term fundamentals to simulate load, renewables, and CAISO spot market prices against which resources are dispatched and valued. Setting the model up involved gathering historical generation data, resource specifications, cost projections, and other relevant inputs and feeding them into the model. CPAU staff then validated the model by running it under various weather and pricing conditions and confirming that its outputs matched staff's expectations. A set of economic dispatch studies were then run for every resource, and these results were fed into PowerSIMM's Automated Resource Selection (ARS) module, which used the information to select resource additions based on minimizing the cost of procuring and operating new and existing resources while also satisfying all of the IRP objectives.

Once additional resources were selected by the ARS module, they were incorporated into a portfolio including CPAU's existing resources and evaluated using an hourly dispatch model to understand the overall implications of the selections on the portfolio. To capture the uncertainty in future conditions, these hourly dispatch studies used a stochastic framework to simulate 100 different future conditions, in which market prices, weather patterns, renewable generation, water availability, and load were varied according to distributions observed in the historical data. To capture the uncertainty associated with the distribution of portfolio costs across these 100 different simulations, a risk premium metric for the portfolio was developed, which represents the magnitude of the portfolio's financial exposure to market price volatility, variation in generation and load, and changes in weather conditions.

After many modeling iterations were performed to ensure the robustness of the results, CPAU staff and Ascend ultimately arrived at a Recommended Portfolio that is summarized in the following figures. Figure 8 displays the volumes of new resources that the model selects (in terms of their nameplate capacity) in each year of the planning period. Although the model selects new solar capacity starting in 2030, and storage capacity starting in 2041, the actual resources that the City will contract with to meet its planning objectives will depend heavily on the responses received in future RFPs. Changing market conditions, the specific characteristics and quality of individual offers, and changing regulatory requirements all add uncertainty to the selection of future resources.

Figure 8: Nameplate Capacity of New Resource Additions for the Recommended Portfolio

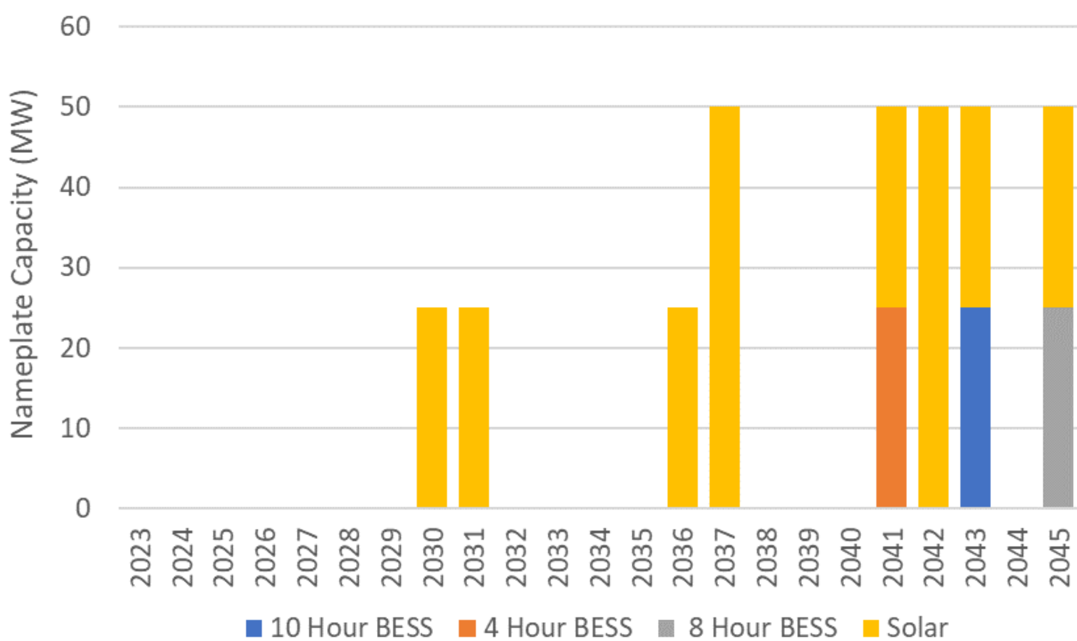
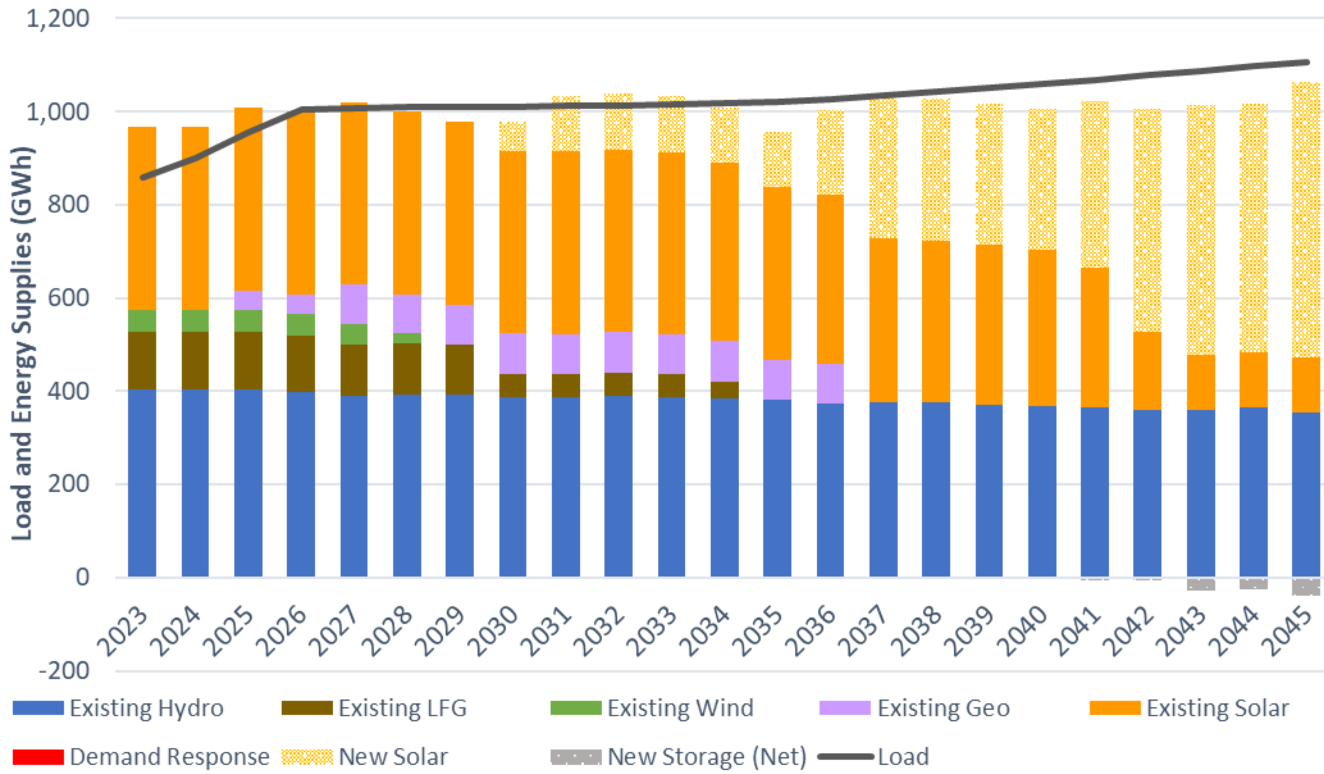


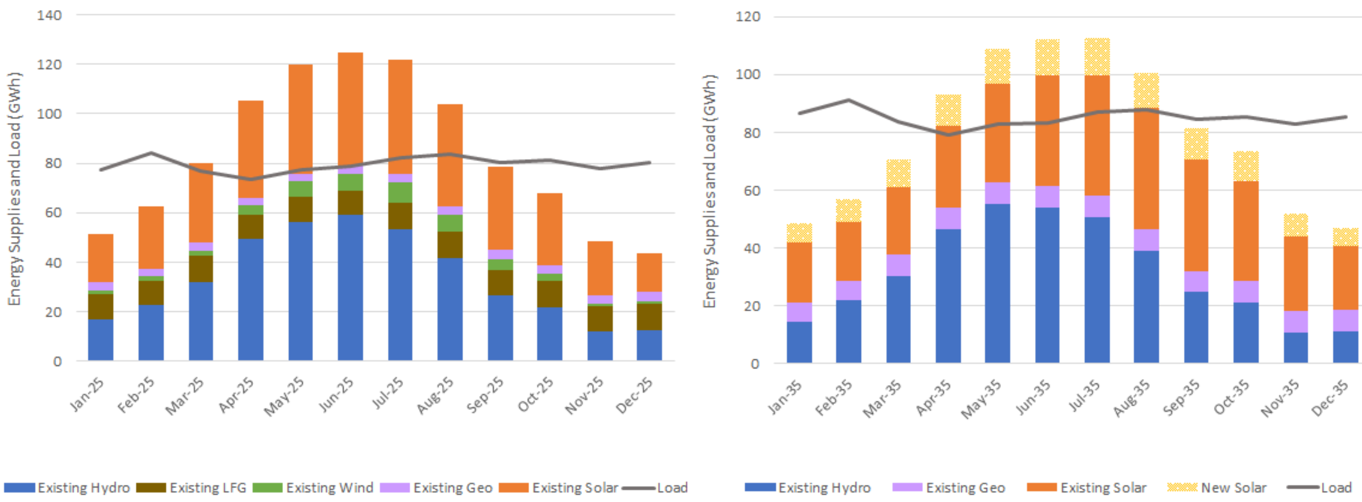
Figure 9 below shows the City's projected load and energy supplies by year under the Recommended Plan. The small deficit positions depicted in a few years in this figure would be covered using short-term market purchases of energy bundled with PCC 3 RECs. Overall, the Recommended Plan results in a portfolio that would be 98% hedged over the IRP planning period.

Figure 9: Projected Load and Energy Supply Balance for Palo Alto's Recommended Plan



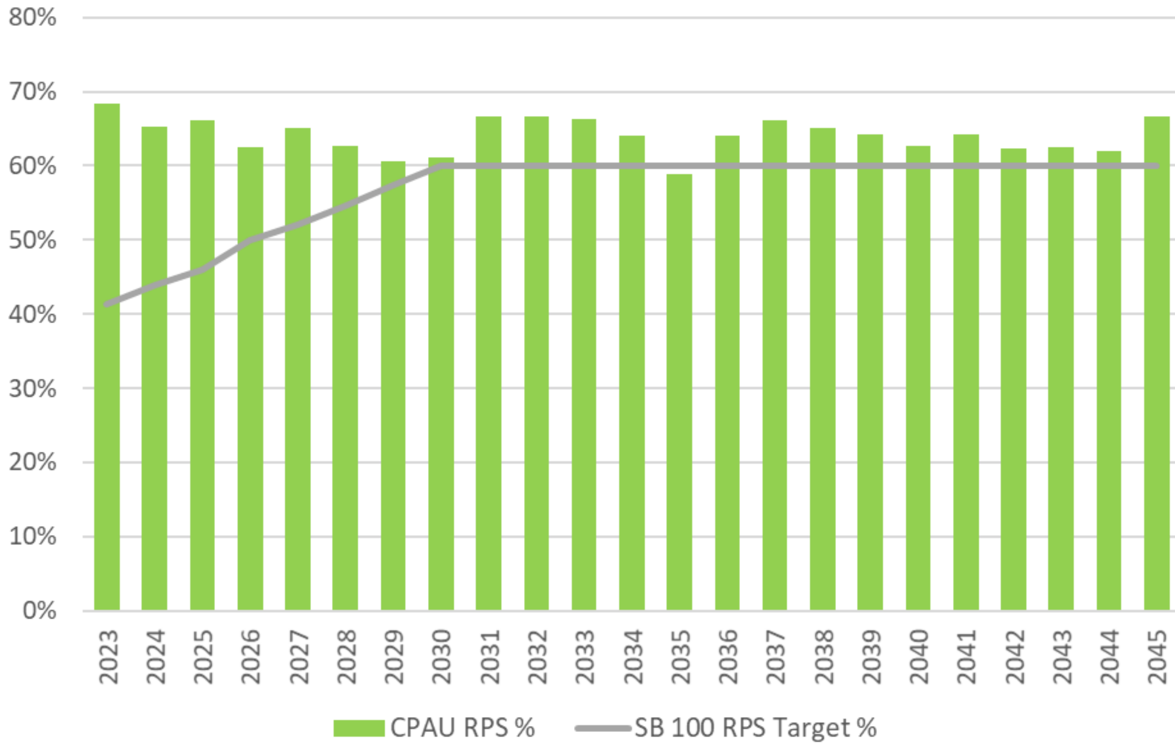
On an intra-year basis, the Recommended Plan would yield significant energy surpluses in the spring and summer months, followed by significant energy deficits in the fall and winter months as shown in Figure 10 below. This pattern, and the resulting market exposure that it would entail, will be another consideration in the process of selecting new resources to add to the City's supply portfolio which could lead to a more diverse mix of new resource selections than is shown here in the Recommended Plan.

Figure 10: Palo Alto's Monthly Load and Energy Supplies in 2025 & 2035



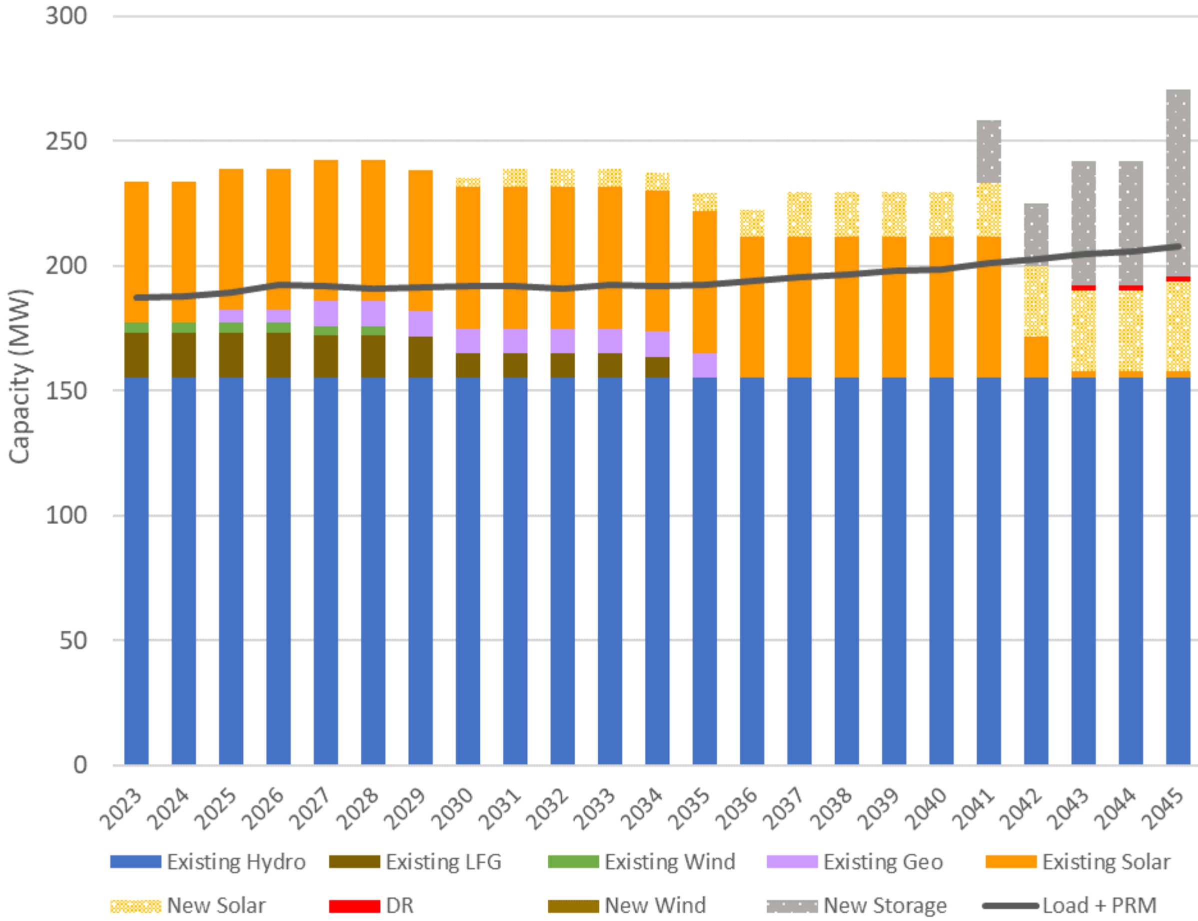
As Figure 11 below illustrates, the Recommended Plan would ensure that Palo Alto exceeds the state's annual RPS procurement targets in all but one year (2035) of the IRP planning period. However, because RPS compliance is evaluated based on aggregate procurement over three-year compliance periods after 2030, the City would still easily achieve full compliance with its RPS requirements under the Recommended Plan. (And in reality, CPAU intends to meet or exceed its annual RPS procurement target in *every* year.)

Figure 11: SB 100 RPS Requirements and RPS Level of the Recommended Plan



As Figure 8 indicated, the capacity expansion model adds a significant amount of battery energy storage systems (BESSs) beginning in the 2040s—25 MW each of 4-hour, 8-hour, and 10-hour BESSs. According to Ascend, the model selected these resources primarily to ensure the Recommended Plan would satisfy Palo Alto's system capacity needs during this period (when almost all of the City's existing renewable energy PPAs have expired). Figure 12 illustrates how these BESS additions—along with a small volume of demand response capacity—ensure that Palo Alto can easily satisfy its system capacity needs throughout the planning period without having to rely on short-term RA purchases.

Figure 12: Projected System Capacity Requirements and Supplies for Palo Alto's Recommended Plan



ii. Scenario Analysis

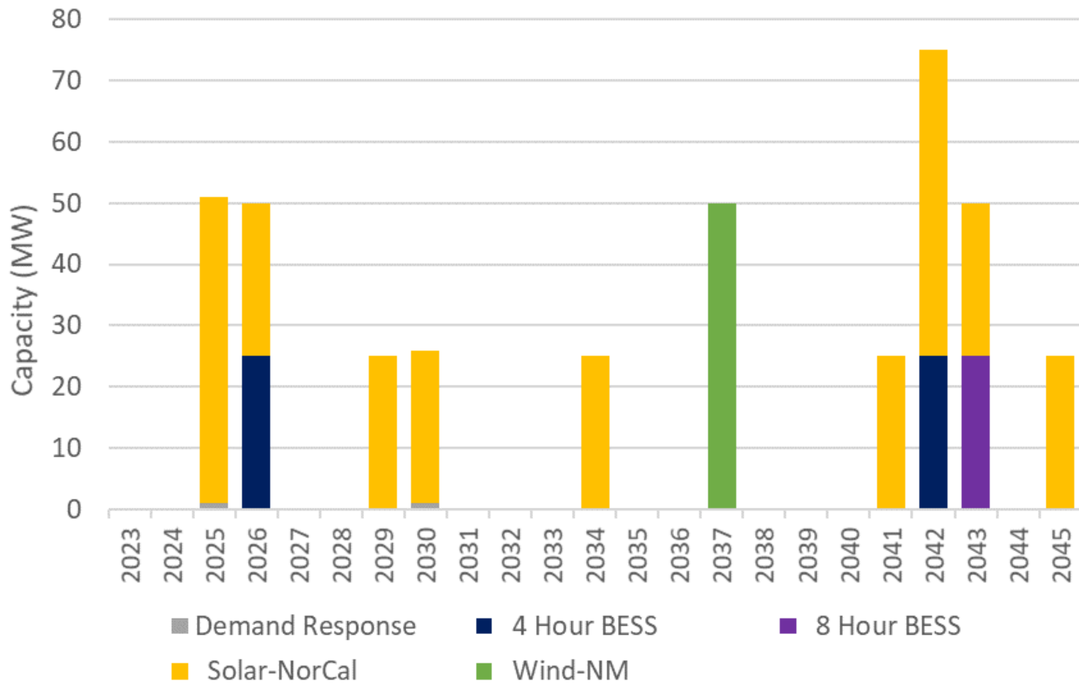
Given the extended length of the IRP planning period, there is obviously a tremendous amount of uncertainty around the performance and characteristics of the City's electric supply portfolio. Changes in hydrological conditions, regulatory requirements, technological advancements, and the City's load, among many other factors, could all have tremendous implications for the results of this portfolio modeling analysis and the ultimate selection of new resources to include in the City's portfolio. To try to understand the magnitude of this uncertainty, CPAU staff and Ascend ran the ARS module under several different future scenarios, and then used PowerSIMM's production cost model function to evaluate the overall cost and cost uncertainty of the supply portfolio selected in each case. The four different scenarios that were evaluated can be summarized as follows:

1. **Base Case** – Expected hydro output and expected market prices (P50)
2. **Reduced Hydro Output** – Hydro energy output is reduced by 30% and capacity is reduced by 60%, while hydro costs increase by 25%
3. **Dry Year, High Prices** – Simulating an extended drought, hydro energy output is reduced by 25%, and market prices are high (P95)
4. **Wet Year, Low Prices** – Based on historical conditions during wet years, hydro energy output is increased by 50%, and market prices are low (P5)

Interestingly, for the wet year and dry year scenarios the model selected the same new capacity additions as in the base case (see Figure 8). Despite Palo Alto's heavy concentration of large hydro resources in its existing portfolio, these long-term changes in hydrological conditions were not enough to cause the model to select a different volume or type of resources to include in the portfolio. Instead, the model indicates that the City should simply buy more or sell more energy and capacity in the short-term market to balance its energy and capacity needs in these situations. (While the Recommended Plan portfolio is 98% hedged on average over the IRP planning period, the Dry Year, High Prices scenario would yield a portfolio that is 87% hedged, while the portfolio would be 121% hedged in the Wet Year, Low Prices scenario.)

In the Reduced Hydro Output case, however, the model made significantly different selections for the City's supply portfolio, as summarized in the figures below.

Figure 13: Nameplate Capacity of New Resource Additions in Reduced Hydro Output Scenario



Because of the new resources added to the portfolio in the Reduced Hydro Output scenario, the overall hedge level was 106% for the planning period, as Figure 14 illustrates.

Figure 14: Projected Load and Energy Supply Balance in the Reduced Hydro Output Scenario

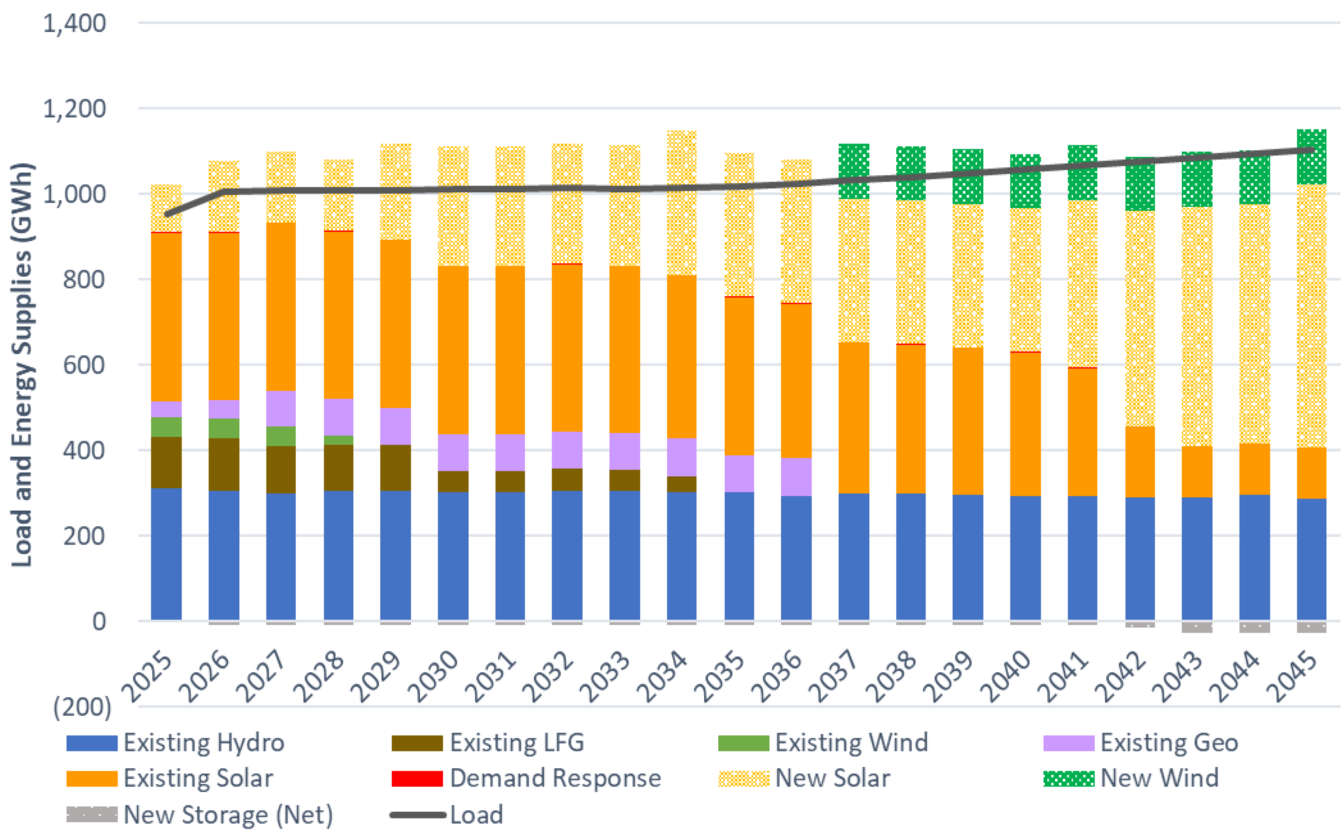
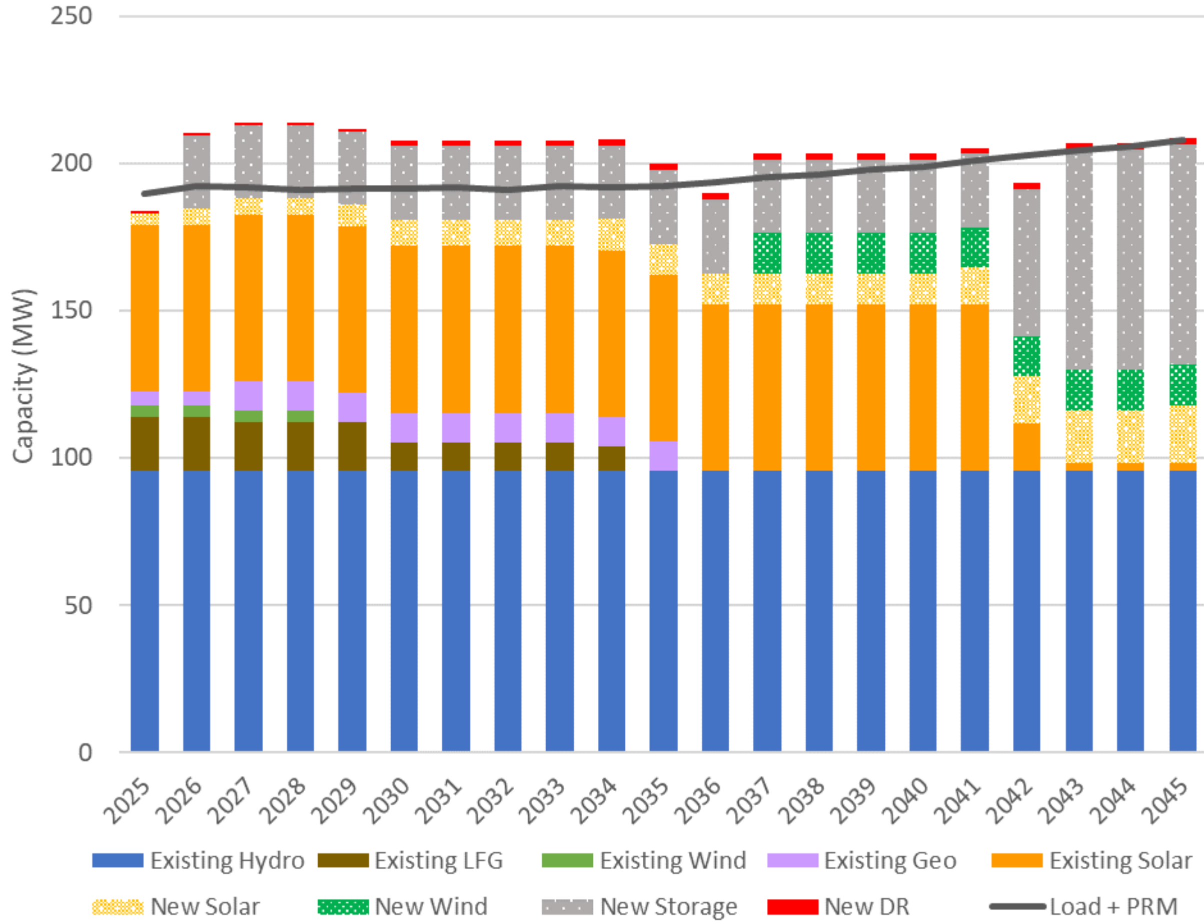


Figure 15: Projected System Capacity Requirements and Supplies in Reduced Hydro Output Scenario



iii. Portfolio Cost Uncertainty and Management

Financial metrics for the four scenarios described above are displayed in Table 8 below, including each scenario's average supply cost, NP15 market price, mark-to-market (MTM)[19], and risk premium[20]. As expected, this information indicates that the total portfolio in the Reduced Hydro Output scenario is significantly more costly than the Base Case portfolio. But, interestingly, the modeling indicates that the

[19] Mark-to-market is a risk assessment tool which measures the current estimated value of a portfolio relative to its original contracted price; a positive value indicates an increase in the value of the purchase, which would be realized only if the transaction was liquidated. It also represents the City's credit exposure with the supplier. Note that the MTM values presented in Table 8 are based on the total cost of each supply resource, but only account for the energy value (as measured by the resource's Locational Marginal Price). The RA capacity value and REC value associated with each resource's output are not considered in this calculation, thus it is not an accurate representation of the true value of each portfolio; nonetheless, the MTM differences between the four scenarios are reflective of the differences in their values.

[20] The expected value of the cost of each portfolio is the probability-weighted average cost of CPAU's supply portfolio across all simulations performed in the analysis. The risk premium, which is calculated in a manner similar to an insurance premium, is the probability-weighted average of costs between the median and 95th percentile of costs in all simulations. It is essentially a measure of the uncertainty or risk in the estimated value of the different portfolios considered, reflecting the possibility that supply costs may be greater than the expected costs.

portfolio becomes significantly more valuable under both the Dry Year, High Prices scenario, as well as the Wet Year, Low Prices scenario, compared to the Base Case scenario.

Table 8: Financial Performance Summary of the Four Scenarios Modeled

	Base Case	Reduced Hydro Output	Dry Year, High Prices	Wet Year, Low Prices
Average Supply Cost ($/MWh)	$63.58	$66.27	$83.05	$40.76
Average Market Price ($/MWh)	$64.17	$64.17	$88.05	$45.52
Total MTM ($/MWh)	$0.65	($3.34)	$4.09	$4.62
Average Annual MTM ($M)	$0.47	($2.00)	$5.31	$4.70
Average Annual Risk Premium ($M)	$6.43	$3.27	$19.91	$4.33

The Risk Premium results indicate that the portfolio's cost uncertainty (or value at risk) related to high market prices/dry hydro conditions is far greater than for low market prices/low hydro conditions. For this reason, CPAU tends to hedge the supply portfolio based on the assumption of slightly drier than average conditions, and also maintains significant hydroelectric reserves.

The cost uncertainty of the electric supply portfolio in the short-term is primarily driven by the water available for hydroelectric production, and is estimated at $15 to $20 million per year at prevailing market prices. Palo Alto is well positioned to manage this cost uncertainty through its hydro rate adjustment mechanism[21] and by maintaining sufficient cash reserves. The cost uncertainty related to seasonally balancing the portfolio[22] is minimal since market price variability between seasons is highly correlated and because staff executes seasonal buy-sell transactions at the same time.

As noted above, in the long-term, there are a number of issues that could dramatically affect the value of the Western resource in the coming years. As such, a large focus of staff efforts in the next five years will be to better understand the long-term economics of the Western Base Resource contract and determine if and when to reduce its allocation of this resource.

There are also proceedings underway to investigate market restructuring to deal with issues related to the integration of variable renewable resources, very steep evening ramp periods, and the appropriate valuation of dispatchable generation capacity. Volatility in market prices, as the CAISO and the CEC determine how to send price signals to ensure a reliable grid, could leave a seasonally unbalanced portfolio such as the City's current portfolio exposed. Increases in transmission charges could also make remote resources compare less favorably to local resources and demand-side management in the future.

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[21] For additional detail on the hydro rate adjustment mechanism, please see Staff Report ID 8962 (March 2023): https://www.cityofpaloalto.org/civicax/filebank/documents/63851.

[22] Revenues received from the sale of surplus energy during the spring and summer periods are utilized to purchase electricity needs for the fall and winter periods.

VI. Supply Costs & Retail Rates

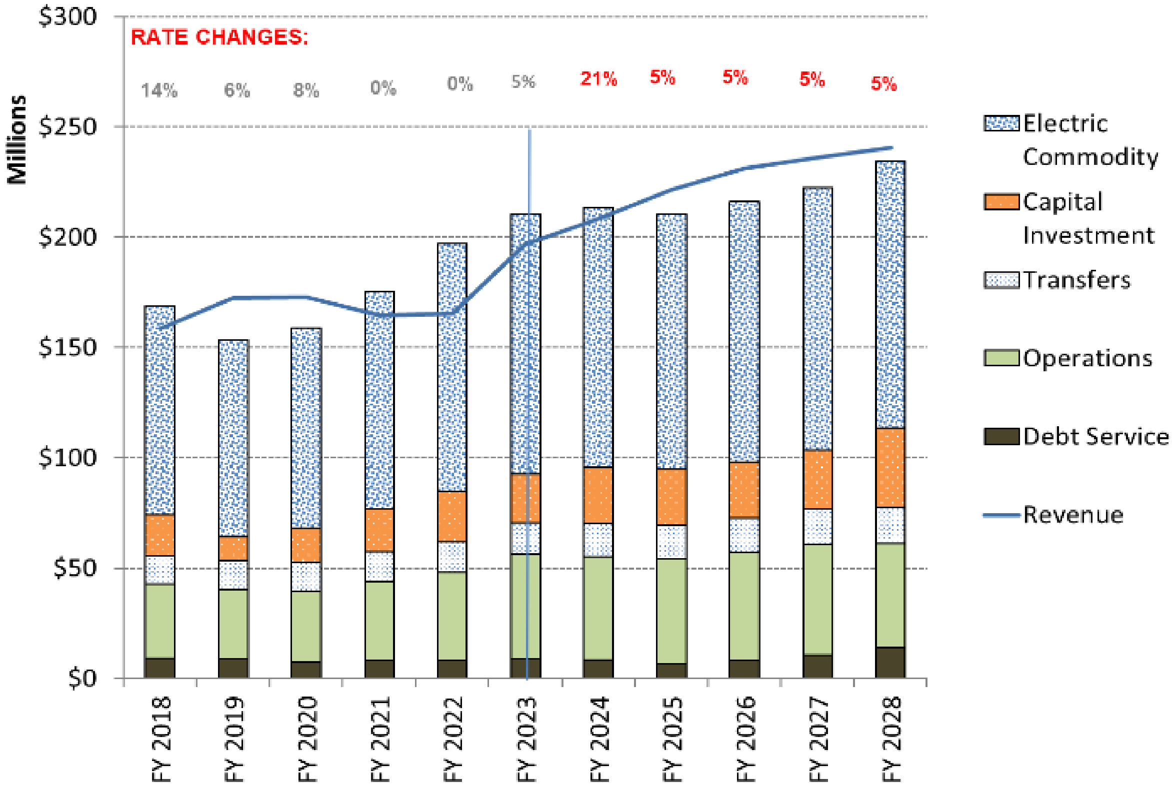
Critical to the success of an IRP, in addition to ensuring that the adopted plan leads to compliance with all regulatory requirements, is ensuring that it also results in supply cost minimization and (ideally) low and stable customer retail rates. As described in the FY 2024 Electric Utility Financial Plan and Rate Proposal to the Palo Alto City Council, CPAU staff projects supply costs to rise substantially for the next several years, largely driven by increases in transmission costs, higher RPS requirements, general capacity shortfalls, and increased natural gas prices.

Retail rates are also projected to rise due to substantial additional capital investment in the electric distribution system (largely driven by modernizing the residential portion of the distribution system to accommodate increased building and transportation electrification), and operational cost increases. CPAU is also in the midst of a capital-intensive project to convert all of its existing metering infrastructure to Advanced Metering Infrastructure (AMI), or "smart meters," with a planned completion date of July 2025. These investments are currently being funded through the City's existing Electric Special Projects (ESP) reserve fund.

CPAU is also currently evaluating the implementation of several new specialized rates, including: a commercial DC Fast Charging EV rate, a residential time of use rate, and a residential All Electric Rate. This effort is intended to see if these rates can be justified under cost of service principles and can better support transportation and building electrification. If we are able to find a way to improve the existing rate structure to better support transportation and building electrification goals, we will likely implement a new rate offering in the near future.

In order to ensure adequate revenue recovery, the Palo Alto City Council recently approved a 21% retail base rate increase for FY 2024 (taking effect July 1, 2023), and adopted a Financial Plan that calls for additional 5% annual rate increases for FY 2025 through FY 2028, as illustrated in Figure 16. However, it should be noted that the City's current electric rates are far lower than the statewide average electric retail rates, and, under the recommended portfolio presented in Section V of this report, staff projects that they will remain so. In fact, even under the worst-case scenarios staff evaluated the City's retail electric rates remain lower than the projected statewide average rates.

Figure 16: CPAU Revenues, Expenses, and Rate Changes through FY 2028



VII. Transmission & Distribution Systems

C. Transmission System

At the transmission level, CPAU staff has two main focuses during the IRP planning period: (1) determining the optimal utilization of the COTP asset when Palo Alto's long-term layoff of this resource ends on February 1, 2024, as discussed above in the Existing Resource Portfolio section; and (2) pursuing an additional interconnection point with PG&E's transmission system. The new interconnection point with PG&E is being sought in order to provide redundancy, and therefore increased local reliability, in the event that an outage affects the three current interconnection lines – as happened in February 2010.[23] To minimize the possibility of a City-wide outage caused by an interconnection line outage, it is in the City's interest to find a physically diverse connection to the PG&E transmission system for power supply to the City. Staff has been investigating options for an alternative connection to the transmission grid for numerous years.[24]

D. Distribution System

Palo Alto's electric distribution system is directly interconnected with the transmission system of Pacific Gas and Electric Company (PG&E) by three 115 kV lines, which have a delivery point at Palo Alto's Colorado substation. Palo Alto's distribution system consists of the 115 kV to 60 kV delivery point, two 60 kV switching stations, nine distribution substations, approximately 12 miles of 60 kV sub transmission lines, and approximately 469 miles of 12 kV and 4kV distribution lines – including 223 miles of overhead lines and 245 miles of underground lines.

In 2018 CPAU staff completed a high-level distribution system assessment report to begin the process of understanding the distribution system upgrades that will be required to integrate increasing penetration levels of distributed energy resources, particularly electric vehicles. A detailed assessment of electric distribution system upgrade needs to accommodate City's ambitious building electrification and transportation electrification goals was undertaken in 2023. The assessment projected the need to plan the CPAU distribution system for an average residential customer capacity demand of 6 kVA, up from the current planning paradigm of 2 kVA per customer, in order to accommodate future electrification efforts. Based on this assessment, efforts are underway to upgrade the following infrastructure elements:

- Distribution transformers and secondary conductors
- 12 kV Circuit Ties
- Substation Transformers

The upgrades are expected to cost $220 to $306 million over the next decade.

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[23] Although three lines would normally provide redundancy and back-up power delivery to the City, all three lines run in a common corridor on the bay side of the City, a corridor that is in close proximity to the Palo Alto Airport. The common corridor and proximity to an airport means that the City's power supply is susceptible to single events that can affect all three lines, as happened in February of 2010 when a small aircraft hit the power lines resulting in a city-wide power outage for over 10 hours.

[24] See this January 2016 staff report for additional background on the efforts to secure an additional transmission interconnection point: https://www.cityofpaloalto.org/civicax/filebank/documents/50608.

VIII. Low-income Assistance Programs

CPAU has three programs to provide financial assistance to low-income customers:

- Residential Energy Assistance Program (REAP): This program provides qualifying low-income residents with free energy and water efficiency measures such as LED lighting, heating system upgrades, weather stripping and shell insulation. More recently, high efficiency toilets, heat pump water heaters, and air source heat pump systems are added to the measure list. This program has equal focus on efficiency and comfort, so there may not be reported energy savings for a customer project.
- Rate Assistance Program (RAP): This program provides a 25% discount for electric and gas charges for income-qualified customers. Applicants can qualify based on medical or financial need.
- ProjectPLEDGE: This program provides a one-time contribution of up to $750 applied to the utilities bill of qualifying residential customers. Eligibility criteria include experiencing recent employment and/or health emergency events. Administered by CPAU, this program is funded by voluntary customer contributions.

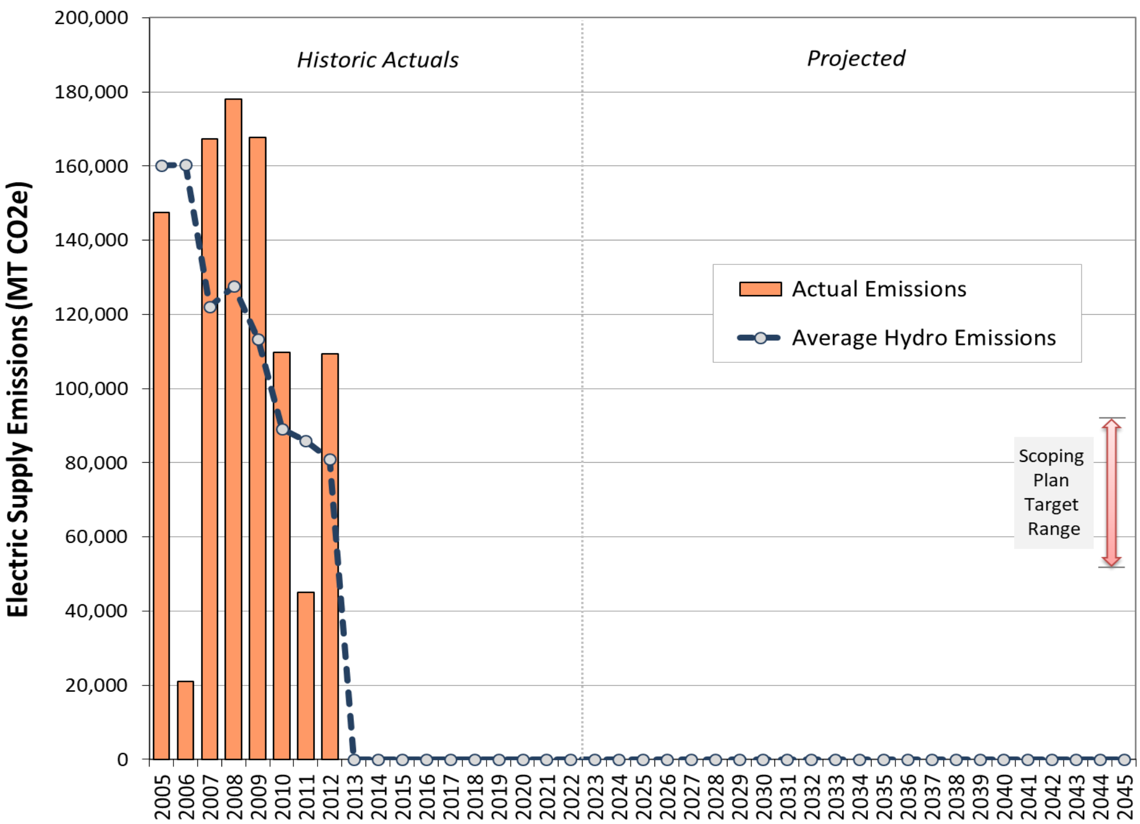
IX. Localized Air Pollutants

The City currently offers various building electrification and transportation electrification program services to both residential and nonresidential customers. By lowering consumption of gasoline and natural gas use in buildings, these programs contribute not only to achieving the City's aggressive GHG emissions reduction goal, but also reducing localized air pollutants including NOx, SOx and other particulate matter. Detailed descriptions of these programs are provided in Section IV.A.

X. GHG Emissions Projections

CARB's 2017 Scoping Plan identified GHG emissions targets for the entire state, as well as individual economic sectors, including the electricity industry. The Scoping Plan established an overall electric sector GHG target for 2030 of 30 to 53 million metric tonnes (MMT) of CO2e, of which Palo Alto's pro rata share (based on load) is 0.174%, or 52,049 to 92,103 MT CO2e. As Figure 17 indicates, given its electric supply portfolio consisting entirely of carbon-free resources (hydroelectric, wind, solar, and biogas), Palo Alto is on track to emit far less than even the most aggressive end of the target range identified in the CARB Scoping Plan.

Figure 17: CPAU Electric Supply Emissions (2005-2045)



XI. Next Steps and Path Forward

E. *Future Analytical Efforts*

The City will have until June 30, 2024 to make a decision to reduce or reject its allocated share of the future Western contract, which would be 98% of the City's current share and provides over 30% of the City's total electric supply under average conditions. The additional analysis regarding this decision should include:

1. An examination of the City's net load forecast and associated uncertainties, with particular emphasis on how it may be affected by customer electrification and adoption of DERs (Demand Response, Energy Efficiency, Solar PV, and storage) in order to avoid stranding assets.
2. An update and extension of CPAU's supply portfolio analysis, including updates to hourly LMP forecasts and the costs, assumptions, and uncertainties associated with all resource options.
3. Analysis of the projected costs, output, and flexibility of the renewed Western contract, to reduce and estimate the amount of uncertainty around this resource.

Aside from the Western contract decision, staff will be actively following state regulators' activities related to electric supply portfolio GHG emissions accounting and allocation of statewide GHG emissions reduction targets, as well as efforts to promote greater regionalization of the bulk transmission system in the western US.

And of course, staff will continue its activities in pursuit of lowering the overall cost to serve customer loads. These include continuing to optimize the use of the City's Calaveras resource, evaluating the benefits of the NCPA pool, and/or the procurement of alternative scheduling services for its renewable resources.

F. *Key Issues to Monitor & Attempt to Influence*

In the course of developing this IRP, CPAU staff has identified a number of important issues and sources of uncertainty to closely monitor and attempt to positively influence over the course of the planning period. Some of the primary issues and uncertainties that staff will be focused on include:

- Cost and operations of Western hydroelectric resource: environmental restoration cost, water delivery timing and priorities, Western transmission upgrade needs, environmental regulations affecting water releases, and long-term climate change
- Frequency and magnitude of economic curtailment of solar PV resources
- Renewing the FERC license of the Calaveras hydroelectric project
- Seasonal and daily variation in CAISO energy market prices, given the overall generation profile of CPAU's resource portfolio
- Changes in overall energy market prices and changes in carbon allowance prices associated with State's cap-and-trade program
- Increased market prices related to load-following capacity and ancillary services
- Customer load profiles changes and potential loss of customer loads available for the City to serve
- New legislative and regulatory mandates

XII. Appendices

G. *Key Supplemental Reports and Documents*

14. NCPA-CAISO Metered Sub-System Agreement
15. FY 2024 Electric Utility Financial Plan
16. Ten-Year Electric Energy Efficiency Goals (May 2021)
17. City of Palo Alto Utilities 2020 Energy Storage Report (AB2514)
18. Distributed Energy Resources Plan (2017)
19. 2021 RPS and Carbon Neutral Plan Update (October 2022)
20. Impact of Electrification on Electric Resiliency (November 2021)
21. S/CAP Goals and Key Actions (2022)
22. S/CAP Work Plan for 2023-2025 (June 2023)
23. EV Programs Status Update (August 2022)
24. FY 2021 Demand Side Management Annual Report (June 2023)
25. Electric Distribution Infrastructure Modernization Update (June 2023)
26. Palo Alto Earth Day Report 2023

H. ***RPS Procurement Plan***

CITY OF PALO ALTO UTILITIES

CITY OF PALO ALTO'S

RENEWABLE PORTFOLIO STANDARD PROCUREMENT PLAN

Version 4
December 2020

REVISION HISTORY

Version	Date	Resolution	Description
4	12/07/20	9929	Updated to reflect Senate Bill 100 (2018) requirements
3	12/03/18	9802	Updated to reflect Senate Bill 350 (2015) requirements
2	11/12/13	9381	Updated to reflect adoption of final CEC regulations, effective 10/1/13, permitting the City to adopt rules for Excess Procurement, Compliance Delay, Cost Limitations, Portfolio Balancing Reductions, and Historic Carryover. Other non-substantive clean up.
1	12/12/11	9215	Original version per Senate Bill X1 2 (2011) requirements

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INTRODUCTION

This document presents the City of Palo Alto Utilities' (CPAU) Renewable Portfolio Standard Procurement Plan (RPS Procurement Plan), as required for compliance with Senate Bill (SB) 100.[25] This legislation, which was signed into law in the 2018 Session of the Legislature, modified the state's renewable portfolio standard (RPS) program and set forth RPS requirements applicable to all load-serving entities in the state. Pursuant to Public Utility Code § 399.30(a) and Section 3205 of the California Energy Commission's (CEC) "Enforcement Procedures for the Renewables Portfolio Standard for Local Publicly Owned Electric Utilities"[26] (RPS Regulations), each POU must adopt and implement a renewable energy resources procurement plan (RPS Procurement Plan). SB X1 2, signed into law in 2011, directed the CEC to adopt regulations specifying procedures for enforcement of the RPS for Publicly Owned Utilities.

This RPS Procurement Plan replaces the RPS Procurement Plan approved by the Palo Alto City Council (City Council) on December 3, 2018 (Resolution No. 9802, Staff Report No. 9761) and is consistent with the provisions set forth in the CEC's RPS Regulations, which have been adopted by the CEC and approved by the Office of Administrative Law, with an effective date of April 12, 2016.[27]

CPAU's RPS Procurement Plan consists of:

A. Purpose of the plan;

B. Plan Elements;

C. Measures that address each of the optional provisions set forth in §399.30(d) and RPS Regulations Section 3206; and

D. Additional provisions.

Where appropriate, this RPS Procurement Plan includes section citations to the Public Utilities Code (PUC) and the CEC's RPS Regulations.

A. PURPOSE OF THE PLAN (PUC § 399.30(A))

In order to fulfill unmet long-term generation resource needs, the City Council adopts and implements this RPS Procurement Plan. This Plan requires the utility to procure a minimum quantity of electricity products from eligible renewable energy resources, including renewable energy credits (RECs), as a

[25] SB 100 (2018) was signed by California's Governor on September 10, 2018, and made significant revisions to Public Utilities Code sections 399.11-399.32, the California Renewable Portfolio Standard Program.

[26] California Code of Regulations, Title 20, Division 2, Chapter 13, Sections 3200 - 3208 and Title 20, Division 2, Chapter 2, Section 1240.

[27] At the time of writing for this edition of CPAU's RPS Procurement Plan, the RPS Regulations had not been updated with SB 350 and subsequent legislative requirements. Where both Public Utility Codes and RPS Regulations are cited but the RPS Regulations are outdated, CPAU's RPS Procurement Plan will reflect the more current Public Utility Codes.

specified percentage of CPAU's total kilowatt-hours of electrical energy sold to its retail end-use customers, during each compliance period, to achieve the targets specified in SB 100 and the RPS Regulations. This RPS Procurement Plan establishes the framework for achieving the minimum requirements under SB 100 and the RPS Regulations, and does not include or preclude actions taken by CPAU to achieve the City Council's goals.

B. PLAN ELEMENTS

CPAU will comply with the requirements for renewables procurement targets set forth in SB 100 and the applicable enforcement procedures codified in the CEC's RPS Regulations, including implementation of the following Plan Elements:

1. Compliance Period Definitions

CPAU has adopted the relevant compliance period definitions identified in PUC § 399.30(b).

2. Procurement Requirements

CPAU shall meet or exceed the following procurement targets of renewable energy resources for each compliance period per PUC §§ 399.30(c)(1) and (2) and the CEC's RPS Regulations:

Compliance Period 1 Target ≥ 20% × (CPAU Retail Sales_{2011}_+ CPAU Retail Sales_{2012} + CPAU Retail Sales_{2013}).

Compliance Period 2 Target ≥ 20% × CPAU Retail Sales_{2014} + 20% × CPAU Retail Sales_{2015} + 25% × CPAU Retail Sales_{2016}

Compliance Period 3 Target ≥ 27% × CPAU Retail Sales_{2017} + 29% × CPAU Retail Sales_{2023} + 31% × CPAU Retail Sales_{2019} + 33% × CPAU Retail Sales_{2020}

Compliance Period 4 Target ≥ 35.75% × CPAU Retail Sales_{2021} + 38.5% × CPAU Retail Sales_{2022} + 41.25% × CPAU Retail Sales_{2023} + 44% × CPAU Retail Sales_{2024}

Compliance Period 5 Target ≥ 46% × CPAU Retail Sales_{2025} + 50% × CPAU Retail Sales_{2026} + 52% × CPAU Retail Sales_{2027}

Compliance Period 6 Target ≥ 54.67% × CPAU Retail Sales_{2028} + 57.33% × CPAU Retail Sales_{2029} + 60% × CPAU Retail Sales_{2030}

For every subsequent three-year Compliance Period (e.g., 2031-2033), CPAU shall procure renewable energy resources equivalent to at least sixty percent (60%) of retail kilowatt-hour sales during that Compliance Period.

The procurement targets listed for each individual year above are soft targets. That is, by the end of each Compliance Period, CPAU's RPS total for the period has to equal the sum of the annual targets, but the targets do not have to be achieved in each individual year.

3. Portfolio Content Categories (PCC)

CPAU adopts the definitions for qualifying electric products and Portfolio Content Categories (PCC) per Sections 3202 and 3203 of the CEC's RPS Regulations.

a. *How CPAU Plans to Achieve its RPS Requirements per Section 3205(a)(1) of the CEC's RPS Regulations*

CPAU's RPS portfolio will include grandfathered contracts (commonly referred to as "PCC 0"), which are executed prior to June 1, 2010, and PCC 1 eligible resources, which are typically directly or dynamically connected to a California balancing authority. CPAU's RPS portfolio may also include PCC 2 eligible resources that are scheduled into a California balancing authority, and PCC 3 eligible resources, which are typically unbundled renewable energy credits (RECs). PCC 0 resources are defined in Section 3202(a)(2) of the CEC's RPS Regulations, while PCC 1, 2, and 3 resources are defined in Section 3203 of the CEC's RPS Regulations. CPAU shall determine the category to which each procured resource belongs.

In its 2011 through 2017 RPS Compliance Reports, CPAU listed a total of five PCC 0 contracts. All five of these contracts extend through the end of Compliance Period 3, and all have achieved commercial operation. On their own, these PCC 0 contracts were sufficient to enable CPAU to meet its Compliance Period 1 and 2 RPS targets.

CPAU has currently executed six contracts for PCC 1 resources, all of which have commenced operation. With these six PCC 1 resources, along with its five PCC 0 contracts, CPAU forecasts that its renewable energy supplies will be well in excess of its procurement requirements through at least Compliance Period 6.

4. Portfolio Balancing Requirements

In satisfying the procurement requirements listed in section B.3 of this RPS Procurement Plan, CPAU shall also satisfy the legally-required portfolio balancing requirements specifying the limits on quantities for PCC 1 and PCC 3 per PUC § 399.30(c)(3), §§ 399.16(c)(1) and (2). CPAU shall apply the formulae specified in Section 3204(c) of the CEC's RPS Regulations to determine these portfolio balance requirements. Renewable energy procured from PCC 0 contracts shall be excluded from these portfolio balancing requirement formulae.

5. Long-Term Contract Requirement

In meeting the RPS procurement requirements identified in section B.3 of this RPS Procurement Plan, CPAU is subject to long-term contract requirements. Consistent with Public Resources Code

§ 399.13(b), CPAU may enter into a combination of long- and short-term contracts for electricity and associated renewable energy credits. Beginning January 1, 2021, at least 65 percent of CPAU's procurement that counts toward the RPS requirement of each compliance period shall be from its contracts of 10 years or longer or in its ownership or ownership agreements for eligible renewable energy resources.

6. Reasonable Progress

CPAU shall demonstrate that it is making reasonable progress towards ensuring that it shall meet its compliance period targets during intervening years per PUC §§ 399.30(c)(2).

C. OPTIONAL COMPLIANCE MEASURES

As permitted by Section 3206(a) of the CEC's RPS Regulations, the City Council hereby adopts rules permitting the use of each of the following five optional compliance measures included in the CEC's RPS Regulations: Excess Procurement, Delay of Timely Compliance, Cost Limitations, Portfolio Balance Requirement Reduction, and Historic Carryover. The City Council also hereby adopts rules permitting the use of the Large Hydro Exemption as described in PUC § 399.30(l).

1. Excess Procurement (PUC §399.13(a)(4)(B))

a. *Adoption of Excess Procurement Rules*

The City Council has elected to adopt rules permitting CPAU to apply excess procurement in one compliance period to a subsequent compliance period, as described in Section 3206(a)(1) of the CEC's RPS Regulations.

b. *Limitations on CPAU's Use of Excess Procurement*

CPAU shall be allowed to apply Excess Procurement from one compliance period to subsequent compliance periods as long as the following conditions are met:

1. Excess Procurement shall only include generation from January 1, 2011 or later.

2. Eligible resources must be from Content Category 1 or Grandfathered Resources to be Excess Procurement. Resources from Content Category 2 or Content Category 3 will not count towards Excess Procurement.

c. *Excess Procurement Calculation*

CPAU shall calculate its Excess Procurement according to formulae in section 3206 (a)(1)(D) of the CEC's RPS Regulations.

d. *City Council Review*

CPAU's use of the Excess Procurement to apply towards CPAU's RPS procurement target in any compliance period will be reviewed by the City Council during its annual review as per section D.3 of this RPS Procurement Plan.

2. Waiver of Timely Compliance (§ 399.30(d)(2), § 399.15(b)(5))

a. *Adoption of Waiver of Timely Compliance Rules*

The City Council has elected to adopt rules permitting it to make a finding that conditions beyond CPAU's control exist to delay timely compliance with RPS procurement requirements, as described in Section 3206(a)(2) of the CEC's RPS Regulations.

b. *Waiver of Timely Compliance Findings*

The City Council may make a finding, based on sufficient evidence presented by CPAU staff, and as described in this Section C.2, that is limited to one or more of the following causes of delay, and shall demonstrate that CPAU would have met its RPS procurement requirements but for the cause of the delay:

(1) *Inadequate Transmission*

i. There is inadequate transmission capacity to allow for sufficient electricity to be delivered from CPAU's proposed eligible renewable energy resource projects using the current operational protocols of the California Independent System Operator's Balancing Authority Area.

ii. If the City Council's delay finding rests on circumstances related to CPAU's transmission resources or transmission rights, the City Council may find that:

a) CPAU has undertaken, in a timely fashion, reasonable measures under its control and consistent with its obligations under local, state, and federal laws and regulations, to develop and construct new transmission lines or upgrades to existing lines intended to transmit electricity generated by eligible renewable energy resources, in light of its expectation for cost recovery.

b) CPAU has taken all reasonable operational measures to maximize cost-effective purchases of electricity from eligible renewable energy resources in advance of transmission availability.

(2) *Permitting, interconnection, or other factors that delayed procurement or insufficient supply*.

i. Permitting, interconnection, or other circumstances have delayed procured eligible renewable energy resource projects, or there is an insufficient supply of eligible renewable energy resources available to CPAU.

ii. In making its findings relative to the existence of this condition, the City Council's deliberations shall include, but not be limited to the following:

a) Whether CPAU prudently managed portfolio risks, including, but not limited to, holding solicitations for RPS-eligible resources with outreach to market participants and relying on a sufficient number of viable projects;

b) Whether CPAU sought to develop its own eligible renewable energy resources, transmission to interconnect to eligible renewable energy resources, or energy storage used to integrate eligible renewable energy resources.

c) Whether CPAU procured an appropriate minimum margin of procurement above the minimum procurement level necessary to comply with the renewables portfolio standard to compensate for foreseeable delays or insufficient supply;

d) Whether CPAU has taken reasonable measures, under its control to procure cost-effective distributed generation and allowable unbundled renewable energy credits;

e) Whether actions or events beyond CPAU's control have adversely impacted timely deliveries of renewable energy resources including, but not limited to, acts of nature, terrorism, war, labor difficulty, civil disturbance, or market manipulation;

(3) *Unanticipated curtailment of eligible renewable energy resources if the delay would not result in an increase in greenhouse gas emissions.*

(4) *Unanticipated increase in retail sales due to transportation electrification.* In making a finding that this condition prevents timely compliance, the City Council shall consider both of the following:

(i) Whether transportation electrification significantly exceeded forecasts in CPAU's service territory based on the best and most recently available information filed with the State Air Resources Board, the Energy Commission, or another state agency.

(ii) Whether CPAU took reasonable measures to procure sufficient resources to account for unanticipated increases in retail sales due to transportation electrification.

c. *Procedures upon Approving Waiver:*

In the event of a Waiver of Timely Compliance due to any of the factors set forth above, CPAU shall implement the following procedures:

(1) Establish additional reporting for intervening years to demonstrate that reasonable actions under the CPAU's control are being taken (§399.15(b)(6)).

(2) Require a demonstration that all reasonable actions within the CPAU's control have been taken to ensure compliance in order to grant the waiver (§ 399.15(b)(7)).

3. Cost Limitations for Expenditures (PUC § 399.30(d), § 399.15(c))

a. *Cost Limitations for Expenditures*

The City Council has elected to adopt rules for cost limitations on the procurement expenditures used to comply with CPAU's procurement requirements, as described in Section 3206(a)(3) of the CEC's RPS Regulations. These cost limitation rules are intended to be consistent with PUC §399.15(c).

b. *Considerations in Development of Cost Limitation Rules*

In adopting cost limitation rules, the City Council has relied on the following:

1) This Procurement Plan;

2) Procurement expenditures that approximate the expected cost of building, owning, and operating eligible renewable energy resources;

3) The potential that some planned resource additions may be delayed or canceled; and

4) Local and regional economic conditions and the ability of CPAU's customers to afford produced or procured energy products. These economic conditions may include but are not limited to unemployment, wages, cost of living expenses, the housing market, and cost burden of other utility rates on the same customers. The City Council may also consider cost disparities between customer classes within Palo Alto, and between Palo Alto customers and other Publicly Owned Utility and Investor Owned Utility customers in the region.

c. *Cost Limitations*

Since 2002, the City of Palo Alto's RPS policy has required that CPAU pursue a target level of renewable purchases while "[e]nsuring that the retail rate impact for renewable purchases does not exceed 0.5 ¢/kWh on average," i.e., the cumulative incremental cost of all renewable resources over and above the estimated cost of an equivalent volume and shape of alternative non-RPS resources shall not cause a retail rate impact in excess of 0.5 ¢/kWh on average. This limit was first established by the City Council in October 2002 based on public input, and the goal of balancing resource reliability and cost considerations in the consideration of investment in renewable and energy efficiency resources.

d. *Actions to be Taken if Costs Exceed Adopted Cost Limitation*

If costs are anticipated to exceed the cost limitations set by the City Council, staff will present proposals to the City of Palo Alto's Utilities Advisory Commission to either reduce the RPS requirements or increase the cost limitation. Staff and the Commission's recommendations will then be taken to the City Council for action.

4. Portfolio Balance Requirement Reduction (PUC § 399.16(e))

a. *Adoption of Portfolio Balance Requirement Reduction Rules*

The City Council has elected to adopt rules that allow for the reduction of the portfolio balance requirement for PCC 1 for a specific compliance period, consistent with PUC §399.16(e), as described in Section 3206(a)(4) of the CEC's RPS Regulations.

b. *Portfolio Balance Requirement Reduction Rules*

CPAU may reduce the portfolio balance requirement for PCC1 for a specific compliance period, consistent with PUC §399.16 (e) and the following:

1. The need to reduce the portfolio balance requirements for PCC 1 must have resulted because of conditions beyond CPAU's control, as provided in Section 3206(a)(2) of the CEC's RPS Regulations.
2. CPAU may not reduce its portfolio balance requirement for PCC 1 below 65 percent for any compliance period after December 31, 2016.
3. Any reduction in portfolio balance requirements for PCC 1 must be adopted at a publicly noticed meeting, providing at least 10 calendar days' notice to the CEC, and include an updated renewable energy resources procurement plan detailing the portfolio balance requirement changes.

5. Historic Carryover

a. *Adoption of Historic Carryover Rules*

The City Council has elected to adopt rules to permit its use of Historic Carryover, as defined in Section 3206(a)(5) of the RPS Regulations, to meet its RPS procurement targets.

Current calculations indicate that CPAU has Historic Carryover due to CPAU's early investment in renewable energy resources.

b. *Historic Carryover Procurement Criteria*

CPAU's use of Historic Carryover is subject to section 3206 (a)(5) of the CEC's RPS Regulations, including the following:

1) Procurement generated before January 1, 2011 may be applied to CPAU's RPS procurement target for the compliance period ending December 31, 2013, or for any subsequent compliance period; and

2) The procurement must also meet the criteria of Section 3202 (a)(2) of the CEC's RPS Regulations; and

3) The procurement must be in excess of the sum of the 2004-2010 annual procurement targets defined in Section 3206(a)(5)(D) of the CEC's RPS Regulations; and

4) The procurement cannot have been applied to the RPS of another state or to a voluntary claim.

5) The Historic Carryover must be procured pursuant to a contract or ownership agreement executed before June 1, 2010.

6) Both the Historic Carryover and the procurement applied to CPAU's annual procurement targets must be from eligible renewable energy resources that were RPS-eligible under the rules in place for retail sellers at the time of execution of the contract or ownership agreement, except that the generation from such resources need not be tracked in the Western Renewable Energy Generation Information System.

c. *Historic Carryover Formula*

CPAU will calculate its Historic Carryover according to formulae in section 3206 (a)(5)C) and (D) of the CEC's RPS Regulations.

d. *Historic Carryover Claims*

The number of RECs qualifying for Historic Carryover is dependent upon the acceptance by the CEC of CPAU's applicable procurement claims for January 1, 2004 – December 31, 2010, which are due to the CEC within 90 calendar days after the effective date of the CEC's RPS Regulations (October 30, 2013). The Historic Carryover submittal shall also include baseline calculations, annual procurement target calculations, and any other pertinent data.

e. *Council Review*

CPAU's use of the Historic Carryover to apply towards CPAU's RPS procurement target in any compliance period will be reviewed by the City Council during its annual review as per section D.3 of this RPS Procurement Plan.

6. Large Hydro Exemption (PUC § 399.30(l))

a. *Adoption of Large Hydro Exemption Rules*

The City Council has elected to adopt rules permitting CPAU to reduce its annual RPS procurement requirements, as described in PUC §399.30(l).

b. *Limitations on CPAU's Use of the Large Hydro Exemption*

CPAU shall be allowed to invoke the Large Hydro Exemption as long as the following conditions are met:

1. During a year within a compliance period, CPAU shall have received greater than 40% of its retail sales from large hydroelectric generation, which is defined as electricity generated from a hydroelectric facility that is not an eligible renewable energy resource.
2. The large hydroelectric generation is produced at a facility owned by the federal government as a part of the federal Central Valley Project or a joint powers agency.
3. Only large hydroelectric generation that is procured under an existing agreement effective as of January 1, 2015, or an extension or renewal of that agreement, shall counted in the determination that CPAU has received more than 40% of its retail sales from large hydroelectric generation in any year.

c. *Large Hydro Exemption Calculation*

CPAU's annual RPS procurement target for a year in which the Large Hydro Exemption is invoked shall equal the lesser of (a) the portion of CPAU's retail sales unsatisfied by its large hydroelectric generation or (b) the annual RPS procurement soft target for that year, as listed in section B.2 of this RPS Procurement Plan. CPAU's RPS procurement requirement for the compliance period that includes said year shall be adjusted to reflect any reduction in CPAU's annual RPS procurement target pursuant to this section.

d. *City Council Review*

CPAU's use of the Large Hydro Exemption to reduce its annual RPS procurement target in any compliance period will be reviewed by the City Council during its annual review as per section D.3 of this RPS Procurement Plan.

D. ADDITIONAL PLAN COMPONENTS

1. Exclusive Control (PUC § 399.30(n))

In all matters regarding compliance with the RPS Procurement Plan, CPAU shall retain exclusive control and discretion over the following:

a. The mix of eligible renewable energy resources procured by CPAU and those additional generation resources procured by CPAU for purposes of ensuring resource adequacy and reliability.

b. The reasonable costs incurred by CPAU for eligible renewable energy resources owned by it.

2. Deliberations & Reporting (PUC § 399.30(e), § 399.30(f))

a. *Deliberations on Procurement Plan* (§399.30(f)):

(1) *Public Notice*: Annually, CPAU shall post notice of meetings if the CPA Council will deliberate in public regarding this RPS Procurement Plan.

(2) *Notice to the California Energy Commission (CEC)*: Contemporaneous with the posting of a notice for such a meeting, CPAU shall notify the CEC of the date, time and location of the meeting in order to enable the CEC to post the information on its Internet website.

(3) *Documents and Materials Related to Procurement Status and Plans:* When CPAU provides information to the CPA Council related to its renewable energy resources procurement status and future plans, for the City Council's consideration at a noticed public meeting, CPAU shall make that information available to the public and shall provide the CEC with an electronic copy of the documents for posting on the CEC's website.

b. *Compliance Reporting* (Section 3207 of the CEC RPS Regulations)

(1) CPAU shall submit an annual report to the CEC by July 1. The annual reports shall include the information specified in Section 3207(c) of the CEC RPS Regulations.

(2) By July 1, 2021; July 1, 2025; July 1, 2028; July 1, 2031; and by July 1 of every third year thereafter, CPAU shall submit to the CEC a compliance report that addresses the annual reporting requirements of the previous section, and information for the preceding compliance period as specified in Section 3207(d) of the CEC RPS Regulations.

3. Annual Review

CPAU's RPS Procurement Plan shall be reviewed annually by the City Council in accordance with CPAU's RPS Enforcement Program.

4. Plan Modifications/Amendments

This RPS Procurement Plan may be modified or amended by an affirmative vote of the City Council during a public meeting. Any City Council action to modify or amend the plan must be publicly noticed in accordance with Section D.2.a.

Effective Date: This plan shall be effective on December 7, 2020.

APPROVED AND ADOPTED this 7th day of December, 2020.

I. *Standardized IRP Tables*

i. Capacity Resource Adequacy Table (CRAT)

State of California
California Energy Commission
Standardized Reporting Tables for Public Owned Utility IRP Filing
Capacity Resource Accounting Table
Form CEC 109 (May 2017)

Scenario Name: Expected

Yellow fill relates to an application for confidentiality.
Data input by User are in dark green font.

Units = MW

	PEAK LOAD CALCULATIONS		2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
1	Forecast Total Peak-Hour 1-in-2 Demand		185	155	166	165	164	163	162	161	160	158	156	155	153	151
2	[Customer-side solar: nameplate capacity]		15	17	19	21	22	24	25	27	29	32	34	37	41	44
2a	[Customer-side solar: peak hour output]		12	14	15	16	17	18	20	21	23	25	27	29	32	34
3	[Peak load reduction due to thermal energy storage]		0	0	0	0	0	0	0	0	0	0	0	0	0	0
4	[Light Duty PEV consumption in peak hour]		1	1	1	2	2	3	4	5	6	7	8	9	10	11
5	Additional Achievable Energy Efficiency Savings on Peak				0	0	0	0	0	0	0	0	0	0	0	0
6	Demand Response / Interruptible Programs on Peak				0	0	0	0	1	2	2	3	4	5	6	7
7	**Managed Peak Demand (1-5-6)**		**185**	**155**	**166**	**165**	**164**	**163**	**161**	**160**	**158**	**155**	**152**	**150**	**147**	**144**
8	Planning Reserve Margin	15%			25	25	25	25	24	24	24	23	23	22	22	22
9	Firm Sales Obligations															
10	**Total Peak Procurement Requirement (7+8+9)**		**185**	**155**	**190**	**190**	**189**	**188**	**186**	**184**	**182**	**179**	**175**	**172**	**169**	**166**

EXISTING AND PLANNED CAPACITY SUPPLY RESOURCES

	Utility-Owned Generation and Storage (not RPS-eligible): [list resource by name]	Fuel	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
11a	Collierville	Hydroelectric			57	57	57	57	57	57	57	57	57	57	57	57
11g																
	Long-Term Contracts (not RPS-eligible): [list contracts by name]	Fuel														
11h	Western Base Resource Generation	Hydroelectric			191	183	175	175	175	175	175	175	175	175	175	175
11	**Total peak dependable capacity of existing and planned supply resources (not RPS-eligible) (sum of 11a...11n)**		**0**	**0**	**247**	**240**	**232**	**232**	**232**	**232**	**232**	**232**	**232**	**232**	**232**	**232**
	Utility-Owned RPS-eligible Resources: [list resource by plant or unit]	Fuel														
12a	New Spicer Hydroelectric	Hydroelectric	1	1	1	1	1	1	1	1	1	1	1	1	1	1
12n																
	Long-Term Contracts (RPS-eligible): [list contracts by name]	Fuel														
12o	PROJECT #1 - HIGHWINDS	Wind			10	10	12	10	10	10	10	10	10	0	0	0
12p	PROJECT #2 - SHILOH #1	Wind			12	12	10	0	0	0	0	0	0	0	0	0
12q	Santa Cruz (Buena Vist Landfill)	Landfill Gas			2	2	2	2	2	2	2	0	0	0	0	0
12r	Ox Mountain (Half Moon Bay)	Landfill Gas			5	5	5	5	5	5	5	5	5	5	0	0
12...	Keller Canyon	Landfill Gas			2	2	2	2	2	2	2	2	2	2	2	0
12...	Johnson Canyon (Ameresco)	Landfill Gas			1	1	1	1	1	1	1	1	1	1	1	1
12...	San Joaquin (Ameresco)	Landfill Gas			4	4	4	4	4	4	4	4	4	4	4	4
12...	EE Kettleman Land	Solar			0	0	0	0	0	0	0	0	0	0	0	0
12...	Elevation Solar C	Solar			34	34	34	34	34	34	0	0	0	0	0	0
12...	Western Antelope Blue Sky Ranch B	Solar			17	17	17	17	17	17	17	17	17	17	17	17
12...	Frontier Solar	Solar			0	0	0	0	0	0	0	0	0	0	0	0
12...	Hayworth Solar	Solar			22	22	22	22	22	22	22	22	22	22	22	22
12...	Wilsona Solar	Solar			0	0	0	0	0	0	0	0	0	0	0	0
12...	Palo Alto CLEAN Projects	Solar			1	1	1	1	1	1	1	1	1	1	1	1
12	**Total peak dependable capacity of existing and planned RPS-eligible resources (sum of 12a...12n)**		**1**	**1**	**29**	**29**	**29**	**17**	**17**	**17**	**17**	**16**	**16**	**6**	**1**	**1**
13	**Total peak dependable capacity of existing and planned supply resources (11+12)**		**1**	**1**	**277**	**269**	**261**	**249**	**249**	**249**	**249**	**248**	**248**	**238**	**233**	**233**

GENERIC ADDITIONS

	NON-RPS ELIGIBLE RESOURCES: [list resource by name or description]	Fuel			2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
14a	None															
14	**Total peak dependable capacity of generic supply resources (not RPS-eligible)**				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
	RPS-ELIGIBLE RESOURCES: [list resource by name or description]	Fuel														
15a																
15	**Total peak dependable capacity of generic RPS-eligible resources**				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
16	**Total peak dependable capacity of generic supply resources (14+15)**				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

CAPACITY BALANCE SUMMARY

		2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
17	**Total peak procurement requirement (from line 10)**	185	155	190	190	189	188	186	184	182	179	175	172	169	166
18	**Total peak dependable capacity of existing and planned supply resources (from line 13)**	1	1	277	269	261	249	249	249	249	248	248	238	233	233
19	**Current capacity surplus (shortfall) (18-17)**	(184)	(154)	86	79	72	61	64	66	68	69	73	66	64	67
20	**Total peak dependable capacity of generic supply resources (from line 16)**			0	0	0	0	0	0	0	0	0	0	0	0
21	**Planned capacity surplus/shortfall (shortfalls assumed to be met with short-term capacity purchases) (19+20)**	(184)	(154)	86	79	72	61	64	66	68	69	73	66	64	67

ii. Energy Balance Table (EBT)

State of California
California Energy Commission
Standardized Reporting Tables for Public Owned Utility IRP Filing
Energy Balance Table
Form CEC 110 (May 2017)

Scenario Name: Expected

Units = MWh

Yellow fill relates to an application for confidentiality.

NET ENERGY FOR LOAD CALCULATIONS

				Historical Data 2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
1	Retail sales to end-use customers		3%			913,986	911,077	907,555	904,572	903,149	902,329	902,293	902,447	902,638	903,238	903,835	905,452
2	Other loads		600			27,438	27,332	27,227	27,960	27,914	27,887	27,908	27,911	27,916	27,934	27,952	28,001
3	Unmanaged net energy for load					941,423	938,410	934,782	932,532	931,063	930,216	930,201	930,358	930,553	931,173	931,787	933,453
4	Managed retail sales to end-use customers	No AAEE	0%	913,986	913,986	913,986	911,077	907,555	904,572	903,149	902,329	902,293	902,447	902,638	903,238	903,835	905,452
5	Managed net energy for load					941,423	938,410	934,782	932,532	931,063	930,216	930,201	930,358	930,553	931,173	931,787	933,453
6	Firm Sales Obligations		0			0	0	0	0	0	0	0	0	0	0	0	0
7	**Total net energy for load (5+6)**			**941,423**	**941,423**	**941,423**	**938,410**	**934,782**	**932,532**	**931,063**	**930,216**	**930,201**	**930,358**	**930,553**	**931,173**	**931,787**	**933,453**
8	[Customer-side solar generation]			18,005	20,277	22,674	24,065	25,620	27,360	29,304	31,474	33,897	36,599	39,614	42,975	46,719	50,890
9	[Light Duty PEV electricity procurement requirement]			7,316	9,510	11,967	14,704	17,685	20,933	24,444	28,246	32,275	36,579	41,144	46,008	51,073	56,406
10	[Other transportation electricity ~~consumption/~~procurement requirement]					0	0	0	0	0	0	0	0	0	0	0	0
11	[Other electrification/fuel substitution; ~~consumption/~~procurement requirement]	HPWH& HPSH				146	288	476	730	1,049	1,423	1,876	2,431	3,083	3,831	4,639	5,507

EXISTING AND PLANNED GENERATION RESOURCES

			2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
	Utility-Owned Generation Resources (not RPS-eligible): [list resource by name]															
12a	Collierville	Hydroelectric	241,017	92,779	115,701	131,668	131,668	131,668	131,668	131,668	131,668	131,668	131,668	131,668	131,668	131,668
	Long-Term Contracts (not RPS-eligible): [list contracts by name]															
12h	Western Base Resource Generation	Is auto-updating	541,539	411,405	409,511	385,814	364,289	364,289	364,289	364,289	364,289	364,289	364,289	364,289	364,289	364,289
12	**Total energy from existing and planned supply resources (not RPS-eligible) (sum of 12a...12n)**		**782,556**	**504,184**	**525,212**	**517,482**	**495,957**	**495,957**	**495,957**	**495,957**	**495,957**	**495,957**	**495,957**	**495,957**	**495,957**	**495,957**
	Utility-Owned RPS-eligible Generation Resources: [list resource by plant or unit]															
13a	New Spicer Hydroelectric	Hydroelectric	5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000
	Long-Term Contracts (RPS-eligible): [list contracts by name]															
13i	PROJECT #1 - HIGHWINDS	Wind	48,207	42,664	42,668	42,754	42,721	42,708	42,672	42,711	42,671	42,709	42,722	12,615	0	0
13j	PROJECT #2 - SHILOH #1	Wind	64,513	57,281	57,290	57,425	57,366	0	0	0	0	0	0	0	0	0
13k	Santa Cruz (Buena Vist Landfill)	Landfill Gas	9,853	8,961	8,961	8,986	8,961	8,961	8,961	8,985	8,961	1,449	0	0	0	0
13l	Ox Mountain (Half Moon Bay)	Landfill Gas	43,880	42,459	42,459	42,575	42,459	42,459	42,459	42,570	42,459	42,459	42,459	42,575	13,959	0
13m	Keller Canyon	Landfill Gas	14,894	13,827	13,827	13,865	13,827	13,827	13,827	13,863	13,827	13,827	13,827	13,865	9,205	0
13n	Johnson Canyon (Ameresco)	Landfill Gas	10,433	9,200	9,200	9,225	9,200	9,200	9,200	9,224	9,200	9,200	9,200	9,225	9,200	9,200
13...	San Joaquin (Ameresco)	Landfill Gas	30,283	27,468	27,468	27,544	27,468	27,468	27,468	27,540	27,468	27,468	27,468	27,544	27,468	27,468
13...	EE Kettleman Land	Solar	53,056	52,791	52,527	52,264	52,003	51,743	51,484	51,227	50,971	50,716	50,462	50,210	49,959	49,709
13...	Elevation Solar C	Solar	100,695	100,191	99,690	99,192	98,696	98,203	97,712	97,223	96,737	96,253	95,772	95,293	94,817	94,343
13...	Western Antelope Blue Sky Ranch B	Solar	50,367	50,115	49,864	49,615	49,367	49,120	48,874	48,630	48,387	48,145	47,904	47,665	47,426	47,189
13...	Frontier Solar	Solar	52,338	52,077	51,816	51,557	51,299	51,043	50,788	50,534	50,281	50,030	49,780	49,531	49,283	49,037
13...	Hayworth Solar	Solar	63,402	63,085	62,770	62,456	62,144	61,833	61,524	61,216	60,910	60,606	60,302	60,001	59,701	59,402
13...	Wilsona Solar	Solar	0	0	0	0	45,136	74,774	74,400	74,028	73,658	73,290	72,924	72,559	72,196	71,835
13...	Palo Alto CLEAN Projects	Solar	2,062	2,052	2,042	2,031	2,021	2,011	2,001	1,991	1,981	1,971	1,961	1,951	1,942	1,932
13...	Small Part of Western Area Power Association	Hydroelectric	5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000
13	**Total energy from RPS-eligible resources (sum of 13a...13n, and 13z)**		**553,984**	**532,171**	**530,582**	**529,489**	**572,668**	**543,350**	**541,370**	**539,743**	**537,511**	**528,123**	**524,782**	**493,034**	**445,156**	**420,115**
13z	**Undelivered RPS energy**		**279,647**	**180,530**	**286,651**	**280,085**	**283,889**	**267,401**	**268,341**	**268,959**	**263,937**	**260,465**	**260,927**	**248,251**	**231,363**	**223,885**
14	**Total energy from existing and planned supply resources (12+13)**		**1,336,540**	**1,036,355**	**1,055,794**	**1,046,970**	**1,068,625**	**1,039,307**	**1,037,327**	**1,035,700**	**1,033,468**	**1,024,080**	**1,020,739**	**988,991**	**941,114**	**916,073**

GENERIC ADDITIONS

				2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
	NON-RPS ELIGIBLE RESOURCES: [list resource by name or description]														
15a															
15	**Total energy from generic supply resources (not RPS-eligible)**			0	0	0	0	0	0	0	0	0	0	0	0
	RPS-ELIGIBLE RESOURCES: [list resource by name or description]														
16a															
16e															
16	**Total energy from generic RPS-eligible resources**			0	0	0	0	0	0	0	0	0	0	0	0
17	**Total energy from generic supply resources (15+16)**			0	0	0	0	0	0	0	0	0	0	0	0
17z	**Total energy from RPS-eligible short-term contracts**														

ENERGY FROM SHORT-TERM PURCHASES

		2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
18	**Short term and spot market purchases:**	81,940	79,524	154,110	182,370	160,888	170,642	172,094	173,495	177,953	184,029	188,028	207,719	239,323	258,553

ENERGY BALANCE SUMMARY

		2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
19	**Total energy from supply resources (14+17+17z)**	1,336,540	1,036,355	1,055,794	1,046,970	1,068,625	1,039,307	1,037,327	1,035,700	1,033,468	1,024,080	1,020,739	988,991	941,114	916,073
19a	**Undelivered RPS energy (from 13z)**	279,647	180,530	286,651	280,085	283,889	267,401	268,341	268,959	263,937	260,465	260,927	248,251	231,363	223,885
20	**Short term and spot market purchases (from 18)**	81,940	79,524	154,110	182,370	160,888	170,642	172,094	173,495	177,953	184,029	188,028	207,719	239,323	258,553
21	**Total delivered energy (19-19a+20)**	1,138,833	935,349	923,253	949,255	945,624	942,548	941,081	940,236	947,485	947,643	947,840	948,459	949,074	950,741
22	**Total net energy for load (from 7)**	941,423	941,423	941,423	938,410	934,782	932,532	931,063	930,216	930,201	930,358	930,553	931,173	931,787	933,453
23	**Surplus/Shortfall (21-22)**	197,409	(6,075)	(18,170)	10,845	10,842	10,016	10,018	10,020	17,284	17,286	17,287	17,287	17,287	17,288

iii. GHG Emissions Accounting Table (GEAT)

State of California
California Energy Commission
Standardized Reporting Tables for Public Owned Utility IRP Filing
GHG Emissions Accounting Table
Form CEC 111 (May 2017)

Scenario Name: Expected

Yellow fill relates to an application for confidentiality.

Emissions Intensity Units = mt CO2e/MWh
Yearly Emissions Total Units = Mmt CO2e

	GHG EMISSIONS FROM EXISTING AND PLANNED SUPPLY RESOURCES															
	Utility-Owned Generation (not RPS-eligible):															
	[list resource by name]	Emissions Intensity	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**
1a	#REF!	0			0	0	0	0	0	0	0	0	0	0	0	0
	Long-Term Contracts (not RPS-eligible):															
	[list contracts by name]	Emissions Intensity														
1h	Western Base Resource Generation	0			0	0	0	0	0	0	0	0	0	0	0	0
1n																
1	**Total GHG emissions of existing and planned supply resources (not RPS-eligible) (sum of 1a…1n)**		**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
	Utility-Owned RPS-eligible Generation Resources:															
	[list resource by plant or unit]	Emissions Intensity														
2a	New Spicer Hydroelectric	0			0	0	0	0	0	0	0	0	0	0	0	0
	Long-Term Contracts (RPS-eligible):															
	[list contracts by name]	Emissions Intensity														
2h	PROJECT #1 - HIGHWINDS	0														
2i	PROJECT #2 - SHILOH #1	0														
2j	Santa Cruz (Buena Vist Landfill)	0														
2k	Ox Mountain (Half Moon Bay)	0														
2l	Keller Canyon	0														
2m	Johnson Canyon (Ameresco)	0														
2n	San Joaquin (Ameresco)	0														
2…	EE Kettleman Land	0														
2…	Elevation Solar C	0														
2…	Western Antelope Blue Sky Ranch B	0														
2…	Frontier Solar	0														
2…	Hayworth Solar	0														
2…	Wilsona Solar	0														
2…	Palo Alto CLEAN Projects	0														
2…	Small Part of Western Area Power Association	0														
2	**Total GHG emissions from RPS-eligible resources (sum of 2a…2n)**		**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
3	**Total GHG emissions from existing and planned supply resources (1+2)**		**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
	EMISSIONS FROM GENERIC ADDITIONS															
	NON-RPS ELIGIBLE RESOURCES:															
	[list resource by name or description]	Emissions Intensity			**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**
4a																
4b																
4	**Total GHG emissions from generic supply resources (not RPS-eligible)**				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
	RPS-ELIGIBLE RESOURCES:															
	[list resource by name or description]	Emissions Intensity														
5a																
5b																
5	**Total GHG emissions from generic RPS-eligible resources**				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
6	**Total GHG emissions from generic supply resources (4+5)**				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
	GHG EMISSIONS OF SHORT TERM PURCHASES															
		Emissions Intensity	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**
7	**Short term and spot market purchases:**	0.428	**35,070**	**34,036**	**65,959**	**78,054**	**68,860**	**73,035**	**73,656**	**74,256**	**76,164**	**78,764**	**80,476**	**88,904**	**102,430**	**110,661**
	TOTAL GHG EMISSIONS															
			2017	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**
8	**Total GHG emissions to meet net energy for load (3+6+7)**		**35,070**	**34,036**	**65,959**	**78,054**	**68,860**	**73,035**	**73,656**	**74,256**	**76,164**	**78,764**	**80,476**	**88,904**	**102,430**	**110,661**
	EMISSIONS ADJUSTMENTS															
8a	**Undelivered RPS energy (MWh from EBT)**		279,647	180,530	286,651	280,085	283,889	267,401	268,341	268,959	263,937	260,465	260,927	248,251	231,363	223,885
8b	**Firm Sales Obligations (MWh from EBT)**		0	0	0	0	0	0	0	0	0	0	0	0	0	0
8c	**Total energy for emissions adjustment (8a+8b)**		279,647	180,530	286,651	280,085	283,889	267,401	268,341	268,959	263,937	260,465	260,927	248,251	231,363	223,885
8d	**Emissions intensity (portfolio gas/short-term and spot market purchases)**		0.428	0.428	0.428	0.428	0.428	0.428	0.428	0.428	0.428	0.428	0.428	0.428	0.428	0.428
8e	**Emissions adjustment (8Cx8D)**		119,689	77,267	122,687	119,877	121,505	114,448	114,850	115,114	112,965	111,479	111,677	106,251	99,023	95,823
	PORTFOLIO GHG EMISSIONS															
8f	**Portfolio emissions (8-8e)**		-84,619	-43,231	-56,728	-41,822	-52,645	-41,413	-41,193	-40,859	-36,801	-32,715	-31,201	-17,348	3,407	14,838
	GHG EMISSIONS IMPACT OF TRANSPORTATION ELECTRIFICATION															
			2017	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**
9	**GHG emissions reduction due to gasoline vehicle displacement by LD PEVs**		**0.02**	**0.03**	**0.04**	**0.04**	**0.04**	**0.05**	**0.05**	**0.05**	**0.05**	**0.05**	**0.05**	**0.05**	**0.05**	**0.05**
10	**GHG emissions increase due to LD PEV electricity loads**		**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
11	**GHG emissions reduction due to fuel displacement - other transportation electrification**		-	-	-	-	-	-	-	-	-	-	-	-	-	-
12	**GHG emissions increase due to increased electricity loads - other transportation electrification**		**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

iv. RPS Procurement Table (RPT)

State of California
California Energy Commission
Standardized Reporting Tables for Public Owned Utility IRP Filing
RPS Procurement Table
Form CEC 112 (May 2017)

Units = MWh

#	RPS ENERGY REQUIREMENT CALCULATIONS	Beginning balances Start of 2017	Compliance Period 3					Compliance Period 4					Compliance Period 5				Compliance Period 6		
			2017	2018	2019	2020		2021	2022	2023	2024		2025	2026	2027		2028	2029	2030
1	(Managed) Retail sales to end-use customers (From EBT)		913,986	913,986	913,986	911,077		907,555	904,572	903,149	902,329		902,293	902,447	902,638		903,238	903,835	905,452
2	Green pricing program/hydro exclusion		28,201	28,201	28,201	28,201		28,201	28,201	28,201	28,201		28,201	28,201	28,201		28,201	28,201	28,201
3	Soft target (%)		27.00%	29.00%	31.00%	33.00%		34.75%	36.50%	38.25%	40.00%		41.67%	43.33%	45.00%		46.67%	48.33%	50.00%
4	Required procurement for compliance period		1,061,982					1,309,770					1,136,541				1,270,199		
	Category 0, 1 and 2 RECs																		
5	Excess balance/historic carryover at beginning/end of compliance period	626,376					756,746					0				0			**438,625**
6	RPS-eligible energy procured (copied from EBT)		553,984	532,171	530,582	529,489		572,668	543,350	541,370	539,743		537,511	528,123	524,782		493,034	445,156	420,115
6A	Amount of energy applied to procurement obligation		239,162	256,878	0	0		0	0	105,139	316,907		331,491	346,067	360,752		375,636	390,450	405,881
7	Net purchases of Category 0, 1 and 2 RECs		0	0	(530,582)	(529,489)		(572,668)	(543,350)	(436,231)	(222,836)		(206,020)	(182,056)	(164,029)		(117,398)	(54,707)	(14,234)
7A	Carryover and REC purchases applied to procurement obligation		0	0	314,822	144,922		272,831	287,131	196,784	0		0	0	0		0	0	0
8	Net change in balance/carryover (6+7-6A-7A)		314,822	275,293	(314,822)	(144,922)		(272,831)	(287,131)	(196,784)	0		0	0	0		0	0	0
	Category 3 RECs																		
9	Excess balance/historic carryover at beginning/end of compliance period	0					0					0				0			
10	Net purchases of Category 3 RECs		0	0	106198	0		32744	32744	32744	32744		32744	32744	32744		32744	32744	32744
11	Carryover and REC purchases applied to procurement obligation		0	0	106198	0		32744	32744	32744	32744		32744	32744	32744		32744	32744	32744
12	Net change in REC balance/carryover		0	0	0	0		0	0	0	0		0	0	0		0	0	0
13	Total generation plus RECs (all Categories) applied to procurement requirement (6A + 7A + 11)		1,061,982					1,309,770					1,136,542				1,270,199		
14	Over/under procurement for compliance period (11 - 4)					-					-				1				0