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STAFF REPORT

Review of City of Palo Alto Utilities' 2018 Electric Integrated Resource Plan

Gavin Newsom, Governor

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California Energy Commission

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ABSTRACT

Senate Bill 350 (De León, Chapter 547, Statutes of 2015, (Public Utilities Code Section 9621) requires the California Energy Commission to review the integrated resource plans of identified publicly owned utilities to ensure they meet various requirements specified in the law, including greenhouse gas emission reduction targets and renewable energy procurement requirements.

Integrated resource plans are long-term planning documents that outline how publicly owned utilities will meet demand reliably and cost effectively while achieving state policy goals and mandates. The City of Palo Alto submitted its *2018 Electric Integrated Resource Plan* and supplemental information, which the city council adopted on December 3, 2018, to the Energy Commission for review on April 30, 2019. This staff paper presents the results of the Energy Commission staff review of the City of Palo Alto's integrated resource plan.

Keywords: Publicly owned utility, integrated resource plan, demand, resources, portfolio, generation, transmission, distribution, Renewables Portfolio Standard, forecast, energy efficiency, transportation electrification, demand response, greenhouse gas, GHG, emissions, system reliability, integration, local reliability, energy storage, distributed generation.

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EXECUTIVE SUMMARY

Public Utilities Code (PUC) Section 9621 requires publicly owned utilities meeting an electrical demand threshold to adopt an integrated resource plan (IRP) that meets certain requirements, targets, and goals, including greenhouse gas emission reduction targets and renewable energy procurement requirements. The California Energy Commission's (CEC) *Publicly Owned Utility Integrated Resource Plan Submission and Review Guidelines* require those utilities to file an IRP with data and supporting information sufficient to demonstrate that they meet these requirements and the targets and planning goals from 2018 to 2030. The CEC must review the IRPs for consistency with the requirements of PUC Section 9621.

Palo Alto Utilities' (Palo Alto) IRP demonstrates a shift from heavy reliance on hydroelectric supply toward variable, distributed, low-emission electricity resources. In 2013, Palo Alto implemented a carbon-neutral electric supply plan that ensures all generation produces zero greenhouse gas emissions on a net annual basis. Today, Palo Alto's resource mix is 52 percent hydroelectric resources, 30 percent solar, 9 percent wind and 9 percent landfill gas. In dry hydro years, Palo Alto relies on market power purchases matched with renewable energy credits to meet its zero-net carbon goals.

Long-term, Palo Alto must decide whether to renew its existing contract with the Western Area Power Administration that supplies hydropower from the Central Valley Project. This contract expires in 2024 and accounts for roughly half of Palo Alto's hydroelectric resources. Uncertainty exists regarding future costs and the availability of this resource, which depends on precipitation. However, Palo Alto has almost six years remaining to make this decision.

In its portfolio analysis, Palo Alto examined alternative resources, including renewing the contract for hydropower from the Central Valley Project, in-state solar, out-of-state wind, geothermal, local solar, and market purchases matched with renewable energy credits. Palo Alto's recommended portfolio assumes that the Western Area Power Administration hydroelectric contract is replaced with generic (undetermined) carbon-neutral resources, including hydroelectric and renewables, while its existing utility-owned hydroelectric resource is retained. In 2030, Palo Alto's planned supply mix consists of 14 percent hydroelectric resources, 41 percent solar, 41 percent generic carbon-neutral resources, and 4 percent landfill gas. This portfolio will allow Palo Alto to meet RPS procurement requirements, greenhouse gas emission reduction targets, and net-carbon neutrality.

In reviewing Palo Alto's IRP and determining consistency with the requirements of PUC Section 9621, CEC staff relied on the four standardized reporting tables and narrative descriptions in the IRP, as well as analysis and verification of the

materials submitted. Staff presents the following conclusions with the requirements of PUC Section 9621:

- *Achieving Greenhouse Gas Emissions Targets and Renewables Portfolio Standard Requirements:* The values reported in the standardized tables, along with the narrative in the IRP filing, demonstrate the utility plans to meet the greenhouse-gas emission reduction requirements of PUC Section 9621(b)(1) and the renewable energy procurement requirement of PUC Section 9621(b)(2).
- *Meeting Planning Goals:* The values reported in standardized tables, along with the analysis and discussion provided in the IRP filing, demonstrate the utility intends to meet planning goals related to retail rates, reliability, transmission and distribution systems, localized air pollution, and disadvantaged communities as set forth in PUC Section 9621(b)(3).
- *Considering Peak Needs:* The values reported in the standardized tables, along with analysis and narrative, demonstrate the utility has considered existing renewable generation, grid operational efficiencies, energy storage, and distributed resources (including energy efficiency) in helping ensure the utility's energy and reliability needs in the peak hours as set forth in PUC Section 9621(c).
- *Addressing Resource Procurement Types:* The IRP filing includes values reported in the standardized tables and narrative that demonstrate the utility has addressed the procurement requirements for energy efficiency and demand response, energy storage, transportation electrification, portfolio diversification, and resource adequacy as set forth in PUC Section 9621(d).

The IRP is consistent with the requirements of PUC Section 9621. In addition to the provisions regarding IRPs, Senate Bill 350 (De León, Chapter 547, Statutes of 2015) requires the CEC to establish statewide and utility-specific targets to achieve a statewide doubling of energy efficiency by 2030. CEC staff observe that aggressive energy efficiency and demand response programs will be needed for utilities and other energy efficiency deliverers to meet the 2030 energy efficiency doubling targets and capture the benefits of demand response. As part of the *2019 Integrated Energy Policy Report*, the CEC will report on progress in achieving the doubling targets, including those for the City of Palo Alto Utilities, and update the targets as necessary.

CHAPTER 1:
Background, Demand Forecast, and Procurement

Introduction

California Public Utilities Code (PUC) Section 9621 requires publicly owned utilities (POUs) with an annual electrical demand exceeding 700 gigawatt-hours (GWh) to develop integrated resource plans (IRPs). IRPs are electricity system planning documents that describe how utilities plan to meet their energy and capacity resource needs while achieving policy goals and mandates, meeting physical and operational constraints, and fulfilling other priorities such as reducing impacts on customer rates. PUC Section 9621 requires the governing board of a POU to adopt an IRP and a process for updating it at least once every five years by January 1, 2019.[1]

Further, PUC Section 9621 requires POUs meeting the demand threshold to submit an IRP and updates to the California Energy Commission (CEC) for review to determine consistency with the requirements of PUC Section 9621. If the CEC determines an IRP is inconsistent with these requirements, the CEC shall provide recommendations to correct the deficiencies. The CEC adopted the *Publicly Owned Utility Integrated Resource Plan Submission and Review Guidelines* (*POU IRP Guidelines*) to govern the submission of the POUs IRPs.[2] PUC Section 9622 requires the CEC to review POU IRPs to ensure they achieve PUC Section 9621 provisions. (See Attachment I).

This chapter outlines the CEC's review process and provides an overview of City of Palo Alto Utilities (Palo Alto) and its IRP development. In addition, the chapter addresses the IRP guidelines requirements that POUs provide a demand forecast and procurement plan as part of their IRP.

Energy Commission IRP Review Process

On April 30, 2019, Palo Alto submitted its IRP and supporting documentation as outlined in the *POU IRP Guidelines*, for the CEC's review. Staff's review occurred in two stages. First, staff performed a completeness review to ensure the IRP filing contained the POU board-adopted IRP, the four standardized tables, and

1 Public Utilities Code Article 16 (commencing with Section 399.11) of Chapter 2.3 of Part 1 of Division 1. See Attachment I.

2 California Energy Commission. *Publicly Owned Utility Integrated Resource Plan Submission and Review Guidelines.* Revised Second Edition. October 2018, Publication Number CEC-200-2018-004-CMF.

supporting information needed for staff to conduct the review. Then staff conducted a detailed review to determine consistency with the requirements of PUC Section 9621.

Staff assessed and analyzed the data in the standardized tables and narrative provided, conducted informal discussions with Palo Alto staff, and verified data and information, as needed. Staff considered the data supporting assertions in the IRP in assessing whether the IRP is consistent with the requirements of PUC Section 9621.

Staff relied on staff subject matter experts to review technical sections of the IRP filing, including energy and peak demand forecasts, projections for renewable resource additions and whether they achieved renewable energy procurement requirements, energy efficiency savings projections and programs, and plans for transportation electrification.

Overview of Palo Alto

Palo Alto is the only city in California that owns and operates full-scale municipal utility services, including electric, fiber optics, natural gas, water, and wastewater. It has provided services to its citizens and businesses since 1896.

- Palo Alto serves a population of more than 66,000 in a 26-square-mile area.
- The utility has more than 25,000 residential and almost 4,000 nonresidential metered customers.
- Palo Alto has 304 miles of primary distribution lines, with 117 miles overhead and 187 underground.
- The utility's annual energy load in 2018 was 925 GWh, with a summer peak load of 182 MW.
- Its average retail rate in 2018 was 13.9 cents per kilowatt-hour (kWh).
- Palo Alto achieved a renewable energy supply of 57 percent and reduced GHG emissions by 109,000 metric tons of carbon dioxide equivalent (mT CO2e) in 2018.

Palo Alto's Planning Process

In preparing its IRP, Palo Alto staff provided several reports and presentations on various aspects of its IRP to the Utilities Advisory Commission (UAC), which advises the Palo Alto City Council on acquisition and development of electric resources. Topics covered in developing the IRP included the utility's distributed energy resource assessment and plan, hydroelectric resources and carbon-neutral alternatives, renewable procurement strategy, cost drivers for the wholesale energy market and electric portfolio, and others. The UAC reviewed

the IRP before it was presented to the Finance Committee for approval in October 2018 and to the Palo Alto City Council for approval in November 2018.

Palo Alto regularly engages in long-term planning that aligns with the electric portfolio decision-making objectives and strategies established by its city council. Palo Alto completed its last IRP, the *Long-Term Electric Acquisition Plan*, in April 2012. Its current IRP aligns with the City of Palo Alto's *2018 Strategic Plan.*[3] Palo Alto's IRP is a snapshot of a continuous process that evolves over time as conditions and circumstances change, including technology, regulations, and customer behavior. The utility employs a framework for assessing its changing business and operating requirements; with resource planning assumptions, scenarios, and results are reviewed and updated on a continual basis, either formally or informally.

Demand Forecast

The *POU IRP Guidelines* (Chapter 2.E.1) identify the need for a forecast of energy and peak demand to determine whether a POU's IRP is consistent with the requirements of PUC Section 9621.[4] Under the *POU IRP Guidelines* (Chapter 2.E.2), the POU must provide information on the method used in developing the demand forecast if the POU uses a forecast other than the CEC's adopted demand forecast.[5] The demand forecast and supporting information were determined to present an adequate estimation of future energy and peak demand that meets the *POU IRP Guidelines* requirements.

Energy and Peak Forecast, Method and Assumptions

Palo Alto forecasts a peak demand of 166 MW in 2019, decreasing to 144 MW in 2030, roughly a 1 percent annual average decrease. Palo Alto's energy demand of 942 GWh in 2019, decreases to 933 GWh in 2030, equivalent to an annual average decrease of 0.1 percent. The utility expects customer-side solar generation to increase from 22 GWh in 2019 to 50 GWh in 2030, and for its electric vehicle (EV) charging load to increase from 11 GWh in 2019 to 56 GWh in 2030. Palo Alto also expects additional load from building electrification and fuel substitution to increase by 5.5 GWh in 2030.

Palo Alto developed an econometric model to forecast monthly energy and peak demand. The model maps a set of calendar, weather, and economic driver variables onto Palo Alto's monthly energy consumption measured at its California Independent System Operator (California ISO) meter. Monthly calendar variables are used in the model to capture underlying changes in Palo Alto customers'

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3 City of Palo Alto's Strategic Plan.

4 *POU IRP Guidelines,* Chapter 2, E., Pp 5-6.

5 The most recently adopted demand forecast is for the *2018 Integrated Energy Policy Forecast Update.*

electric consumption caused by changing daylight hours and seasonal electricity usage. Monthly *heating degree days* and *cooling degree days* are used to explain the variation in energy due to the weather.[6] Investment in nonresidential equipment and software as reported by the Bureau of Economic Analysis are used as the economic driver. This variable represents business activity in the computer software and equipment sector of the economy, which directly affects Palo Alto customers' energy consumption.

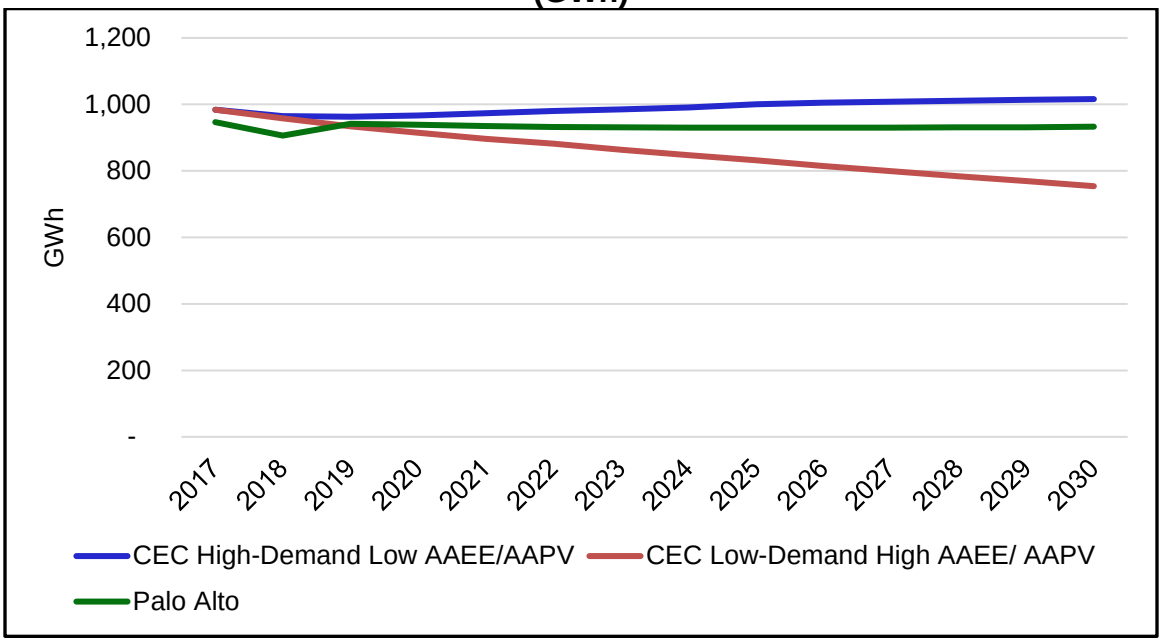
Similar to the energy demand forecast, the peak demand forecast uses monthly variables to capture underlying changes in Palo Alto customers' electric consumption throughout the year. Daily heating and cooling degree days corresponding to the peak day of the month are used as the weather driver. Monthly historical energy usage is added as the final variable explaining peak demand.

Palo Alto separately developed forecasts to capture the impact from new distributed energy resources it expects in its service territory. The distributed resources considered include energy efficiency, solar photovoltaic (PV), electric vehicles, demand response, energy storage, and heat pump water and space heaters. Energy and peak demand profiles for each of these resources were applied to the energy and peak forecast as adjustment outside the model.

Staff compared Palo Alto's energy and peak demand forecasts to the CEC's *2018 Demand Forecast Update* report. As shown in **Figure 1**, Palo Alto's energy demand forecast lies between the CEC's high-demand low AAEE/AAPV (high) forecast and the low-demand high AAEE/AAPV (low) forecast, and decreases slightly over the planning period (roughly 1 percent annual average decrease).

6 *Heating degree day* is a measure to quantify the demand for energy needed to heat a building. It is the number of degrees that the average temperature for a day is below 65 degrees Fahrenheit. Cooling degree days measure the energy needed to cool buildings or the number of degrees that the average temperature for a day is above 65 degrees.

Figure 1: Palo Alto and Energy Commission Energy Forecasts 2018-2030 (GWh)



Sources: California Energy Commission, based on Palo Alto's 2018 IRP filing and California Energy Commission 2019 Demand Forecast.

The utility's forecast accounts for variables that can reduce demand: increased energy efficiency, rooftop solar, demand response, and energy storage. The forecast also includes variables that can increase demand: increased EV load and electric heat and water pump usage. The utility's forecast appears reasonable for long-term planning, given it is similar to the CEC demand forecasts.

Palo Alto's peak forecast shows a similar trend to its energy demand forecast, with an annual average decrease of 1.2 percent over the planning period. As with its demand forecast, Palo Alto accounted for energy efficiency, demand response, EV load, and rooftop solar in its peak forecast. Based on staff's review, Palo Alto's peak forecast appears suitable for long-term planning.

Resource Procurement Plan

The *POU IRP Guidelines* require that a POU report the mix of resources it plans to use to meet demand from 2018 to 2030.[7] The POUs are also required to provide an IRP with data and supporting information sufficient to demonstrate that the POUs plan to meet targets and goals. Staff has determined that Palo Alto's IRP filing meets the requirements. The following discusses Palo Alto's existing resources, procurement strategy, the portfolio analysis underlying

7 *POU IRP Guidelines*, Chapter 2.F., P. 6.

resource selections, and the resources in 2030 identified in the standardized forms.

Existing Resources

Palo Alto has sufficient supply resources to meet projected load through 2030 with about 45 percent from hydroelectric resources and 55 percent from renewable contracts. Palo Alto operates under a carbon-neutral plan for its supply portfolio that ensures that all its electricity needs are met by resources with zero carbon emissions on a net annual basis.[8] Palo Alto's existing hydro and spot market purchases and sales are discussed below. The utility's existing renewable resources include power purchase agreements with landfill gas projects, Solano County wind projects, and utility-scale PV projects.

Palo Alto has a long-term contract with the Western Area Power Administration (WAPA) for hydro output from the Central Valley Project (or federal hydro). This contract supplies nearly 40 percent of the utility's needs under normal hydro conditions and expires at the end of 2024.[9] Palo Alto also participates with members of the Northern California Power Agency (NCPA) and the Calaveras County Water District in the Calaveras Project, a hydroelectric facility that came on-line in 1983. Palo Alto's share of the project is roughly 13 percent, with 58 MW of capacity and 132 GWh of annual energy. The water district has a Federal Energy Regulatory Commission (FERC) license for the project, while NCPA acts as the project operator. Unlike many hydro facilities, because the project is designed primarily for hydroelectric generation, water is stored and managed to optimize generation to match the project owner's energy needs.[10]

Palo Alto also has several agreements that promote competitive forward market purchases and sales to meet its short- to medium-term energy needs. Palo Alto has purchase commitments for 79 GWh and sales commitments for 161 GWh from July 2018 to June 2020. During normal hydro conditions, gross market purchases are expected to meet about 15 percent of its energy need, with gross market sales amounting to about 25 percent of its energy needs. To ensure it meets its carbon neutral goals, in years when Palo Alto was a net purchaser of

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8 *Electric Supply Portfolio Carbon-Neutral Plan*. City of Palo Alto City Council Staff Report. 2013.

9 In 2000, Palo Alto executed a 20-year contract with WAPA for 12.3 percent of the output of the project and is obligated to pay the same percentage of revenue requirements regardless of how much energy is received. In normal hydro conditions, the utility receives about 40 percent of its electricity need from this contract. Since 2005, the amount has varied from a low of 22 percent and a high of 64 percent, with costs ranging from $22 to $61 per MWh.

10 As of January 2019, Palo Alto's outstanding debt on the Calaveras project is about $89 million, of which a large portion will mature in 2024 and the remainder in 2032.

market power, such as during dry hydro years, it procured renewable energy certificates (RECs) equivalent to its power purchases.

Palo Alto also has a 4 percent entitlement share (or 50 MW) to the California Oregon Transmission Project (COTP) that it can use to import zero-carbon energy from the Pacific Northwest.[11] The entitlement is in a long-term layoff agreement with several POUs through 2023, then reverts back to Palo Alto for use to import power in 2024.

Following the California energy crisis, Palo Alto invested in a set of four locally sited natural gas-fired backup generators totaling 5 MW of capacity. These plants are seldom operated, generally only for maintenance, but would be available in emergencies.

Resource Portfolio Evaluation

Palo Alto used various economic analyses and methods to assess alternative supply and demand scenarios, along with sensitivities for key assumptions, to develop an economically optimal resource plan subject to various constraints, such as regulatory mandates and local policies. Since the largest uncertainty facing Palo Alto involves a decision about whether to renew its WAPA federal hydro contract, the utility evaluated a large number of potential new supply and demand-side options based on the feasibility, availability, cost, and associated uncertainty of each option. Palo Alto narrowed the analysis to focus on several options, including a renewed WAPA contract, in-state solar, out-of-state wind, geothermal, local solar, and market purchases matched with RECs. Palo Alto used several indicators to compare the different portfolio options, including the net value of a resource, the portfolio fit, the amount of diversification, contract term flexibility, and cost certainty.

Palo Alto has significant operating experience with WAPA power and solar resources. In general, the WAPA hydro resource has a large amount of seasonal variability, as well as year-to-year uncertainty, in costs and level of output. In contrast, solar has a great deal of seasonal variability that contributes to the utility's seasonal imbalance in its portfolio but has far less uncertainty in costs and annual output. In addition, solar costs have dropped dramatically in recent years.

Palo Alto found that wind resources from the Pacific Northwest or New Mexico, in some cases, come in below solar costs, but the availability of transmission pathways to deliver the power into the California ISO reliably is not assured and raises the costs. In general, an out-of-state wind generation profile is a good fit for Palo Alto, with more energy in the fall and winter and less in spring and

11 The COTP is a 339-mile-long. 1,600 MW, 500 kV transmission project between Southern Oregon and Central California.

summer. In the longer run, once the layoff arrangement for the utility's allocation of the COTP project ends in 2023, Pacific Northwest wind could be an attractive option. Geothermal binary cycle technology may also be an option in the longer term but is still less valuable compared to solar and out-of-state wind. Local solar is the only local supply resource considered, but supplies are more limited and have a higher cost.[12]

Market energy purchases combined with RECs are an attractive option for Palo Alto in the near term, especially if it decides to reduce the amount it receives from the WAPA contract or wants more flexibility in the duration and volume of long-term contracts. The potential for increased costs for future carbon allowances could make market purchases less attractive, but they could help lower the risk of stranded resources. Palo Alto also notes that reliance on market purchases could perpetuate the utility's reliance on GHG-emitting generators.

Palo Alto's Procurement Strategy

Because some of the major decisions on future resources do not have to be made for almost six years, Palo Alto has laid out a series of policy and strategic decisions that must be made in the coming years. The utility has identified several initiatives to begin over the next three to six years that will help it decide the optimal mix of resources to meet demand in 2030. These initiatives will address:

- The merits of committing to a new 30-year contract with WAPA starting in 2025, with a recommended initial commitment in early 2020 and final commitment in early 2024.
- The merits of rebalancing the supply portfolio to lower its seasonal and daily price exposure by more closely matching long-term supplies with its hourly and monthly electric loads, with a scoping assessment due by December 2019.
- The best use of the Palo Alto's share of the COTP once the layoff ends in 2023, with an initial assessment by December 2019, in tandem with more closely matching hourly and monthly loads.
- The carbon content of the portfolio on an hourly basis and the merits of buying carbon offsets to achieve carbon neutrality, with a staff recommendation by December 2019.

12 Palo Alto's CLEAN (Clean Local Energy Accessible Now) program secured only 3 MW of capacity in the last two years at a contract price of 16.5 cents/kWh. A 500 kW project at the Palo Alto golf course was estimated to be 10 to 14 cents/kWh, which is still more costly than other options even when avoided transmission charges for the local solar are considered.

- The merits and economics of monetizing excess RECs to minimize the cost of maintaining the RPS and carbon-neutral portfolio, with an initial staff recommendation by December 2019.
- The opportunities with NCPA and other agencies, such as community choice aggregators, to lower Palo Alto's operating costs and rebalance the supply portfolio, with an initial assessment by December 2019.
- The contingencies to address potential for large changes in load level and profile considering customer installation of distributed energy resources, changing customer expectations, and potential regulatory changes.

Palo Alto's Preferred Portfolio

Under Palo Alto's Carbon Neutral Plan,[13] the utility purchases about half of its electricity needs under long-term renewable contracts, while the other half is met with existing carbon-free hydroelectric resources.[14] One of the primary questions addressed in Palo Alto's IRP is whether to renew the contract for federal hydro with WAPA for an additional 30 years or seek other renewable supplies to meet the utility's loads. This decision has significant long-term implications for the utility's overall supply costs, cost uncertainty, market price exposure, amount of RPS resources, and the GHG emissions of the supply portfolio. However, Palo Alto has several years in which to consider and make firm resource commitments.

Palo Alto's WAPA contract expires in 2024, and WAPA's proposed 2025 Power Marketing Plan has been submitted to the U.S. Department of Energy. If approved, it would allow the utility to renew up to 98 percent of its existing allocation for 30 years (2025-2054).[15] While the process to extend the contract is underway, it can take five to seven years to complete, and future prices for the resources are uncertain.[16] In addition, there is uncertainty about long-term supply availability, depending on unpredictable precipitation conditions, long-term effects of climate change, and the potential for new environmental policies or projects that could lessen the value of the generation. Palo Alto and NCPA staffs are assessing the risks associated with these factors.

Palo Alto does not face a near-term decision on the utility-owned Calaveras hydro project. Historically, debt and other costs have resulted in the overall value

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13 "Electric Supply Portfolio Carbon Neutral Plan" 2013. City of Palo Alto Utilities.

14 Not all renewable resources in Palo Alto's supply portfolio are RPS-eligible. The utility has substantial amounts of large hydro resources that are carbon-free.

15 United States Federal Register Notification No. 27433. May 6, 2016.

16 The Bureau of Reclamation is responsible for completing a cost allocation study that is not yet available.

of the project being below market. However, because the plant has low variable and operating costs, it is regularly dispatched and could be used to meet several California ISO requirements, such as the need for load following and ancillary services, as well as some of Palo Alto's resource adequacy requirements. Palo Alto expects that the value of Calaveras will increase in the long term, but at some point it will need to evaluate operating strategies and the potential value of Calaveras.

Palo Alto's 2030 preferred resource portfolio includes 4 percent landfill gas, 13 percent owned hydro, 41 percent solar, and 42 percent generic (undetermined) carbon-neutral resources to replace WAPA federal hydro resources. **Table 1** summarizes the amount of energy from different resources in Palo Alto's portfolio in 2019, 2025, and 2030.

Table 1: Energy Resources by Type 2019, 2025, and 2030 (GWh)

Resources	2019	2025	2030
Total Net Energy for Load	**942**	**930**	**933**
Non-RPS Resources			
Large Hydroelectric	560	481	481
Natural Gas	0.025	0.025	0.025
Spot Purchases	95	147	196
Spot Sales	**(246)**	**(239)**	**(189)**
RPS Resources			
Biofuels	103	103	38
Small Hydroelectric	9	9	9
Solar PV	322	386	377
Wind	100	43	0
Total Energy Procured	942	930	912
Surplus**/(Shortfall)**	**0**	**0**	**(21)**

Source: California Energy Commission, based on Palo Alto's 2018 IRP filing.

Table 2 shows capacity resources Palo Alto will rely on to meet peak demand and reliability requirements in 2019, 2025, and 2030. **Table B-1** and **Table B-2** in **Appendix B** identify the energy and capacity for individual resources for all years.

Table 2: Capacity Resources by Type for 2019, 2025, and 2030 (MW)

Resources	2019	2025	2030
Peak Demand	**166**	**158**	**144**
Planning Reserve Margin	**25**	**24**	**22**
Peak Procurement Requirement	**253**	**182**	**166**
Non-RPS Resources			
Large Hydroelectric	232	232	232
Natural Gas	5	5	5
Planned System Capacity Contract(s)	35	0	0
RPS Resources			
Biofuels (landfill gas)	14	14	6
Small Hydroelectric	6	6	6
Solar PV	77	64	64
Wind	21	10	0
Total Capacity Procured	**389**	**331**	**313**
Surplus/(Shortfall)	**136**	**149**	**147**

Source: California Energy Commission, based on Palo Alto's 2018 IRP filing.

CHAPTER 2:
Review of Palo Alto Utilities Integrated Resource Plan

This chapter summarizes the main elements of Palo Alto's IRP and provides staff's findings regarding the consistency of the IRP filing with PUC Section 9621 requirements, as well as with the *POU IRP Guidelines*. These elements include whether the utility meets GHG reduction targets and RPS energy procurement requirements, as well as planning goals for retail rates, reliability, transmission and distribution systems, net load, and disadvantaged communities. In addition, the IRP must address procurement of energy efficiency and demand response, energy storage, transportation electrification, and portfolio diversification.

Greenhouse Gas Emission Reduction Targets

POUs are required to meet the GHG targets established by the California Air Resources Board, in coordination with the CEC and California Public Utilities Commission.[17] These GHG targets reflect the electricity sector's percentage in achieving the economywide GHG emission reductions of 40 percent from 1990 levels by 2030. Staff reviewed the GHG emissions associated with Palo Alto's portfolio of resources in 2030, as identified in its IRP and standardized reporting tables. Staff independently assessed the emission factors associated with various resources in Palo Alto's portfolio to ensure consistency with other data available to staff.

Based on this review, staff finds that Palo Alto plans to achieve a GHG emission target range established by the California Air Resources Board of 52,000 to 92,000 metric tons of carbon dioxide equivalent (mT CO_2e). Given that Palo Alto's resource portfolio consists entirely of carbon-free resources (hydro, wind, solar, and biogas), it is on track to emit far less than the low end of the target range, which is consistent with the requirement of PUC Section 9621(b)(1). Palo Alto estimated its GHG emissions at 3,020 mT CO_2e by 2030.

Table 3 shows GHG emissions for Palo Alto's portfolio of resources in 2019, 2025 and 2030. **Table B-3** in **Appendix B** identifies the emission intensities and total emissions for individual resources for all years.

17 Public Utilities Code Section 9621(b) (1).

Table 3: Greenhouse Gas Emissions From Palo Alto Resources Portfolio

Source	Fuel Type	GHG Intensity (MT CO_2e/MWh)	Total Emissions (MMT CO_2e)		
			2019	2025	2030
COBUG Natural Gas Reciprocating Engine	natural gas	0.556	13.9	13.9	13.9
Spot Market Purchases	natural gas	0.428	40,473	62,873	83,755
Spot Market Sales	natural gas	**(0.428)**	**(105,505)**	**(102,348)**	**(80,749)**
Total Portfolio Emissions	**NA**	**NA**	**0***	**0***	**3,020**

Source: California Energy Commission, based on Palo Alto's 2018 IRP filing.

* For portfolio GHG emissions, POUs cannot have negative emissions.

Renewables Portfolio Standard Planning Requirements

PUC Section 9621(b)(2) requires that POU IRPs ensure procurement of at least 50 percent renewable energy resources under the Renewables Portfolio Standard by 2030 consistent with Article 16 (commencing with Section 399.11) of Chapter 2.3.[18] Staff reviewed the renewable procurement standardized reporting table, the discussion in the IRP filing, and the renewable procurement plan submitted. Staff finds that Palo Alto's plans are consistent with the RPS procurement requirements in 2030 and all interim compliance periods, as well as the requirements of PUC Section 9621(b)(2).

Palo Alto has several existing long-term contracts with RPS-eligible renewable energy resources, including 21 MW of wind, 14 MW of landfill gas, and 77 MW of solar PV described below.

- Palo Alto has two long-term contracts with Avangrid Renewables (formerly Iberdola Renewables) for wind output that supply about 12 percent of its energy needs. It has a 25 MW share of the Shiloh I project that expires in 2021 and a 20 MW share in the High Winds I project that expires in 2028, both in Solano County.

18 PUC Section 9621(b) requires the governing boards of POUs to adopt an IRP on or before January 1, 2019, while PUC Section 9621(b) (3) requires the IRP ensure procurement of at least 50 percent eligible renewable resources by 2030. Senate Bill 100 (De León, Chapter 312, Statutes of 2018) increases the RPS requirement for 2030 from 50 to 60 percent. However, because the POUs were required to adopt their IRPs before SB 100 went into effect, the POUs were required to plan only for the 50 percent RPS target in their IRPs. Future POU IRPs will need to meet RPS requirements in effect when those updates are filed.

- Palo Alto has five long-term contracts with Ameresco for the output of landfill gas that provides roughly 14 MW of capacity and serves 11 percent of Palo Alto's energy needs. The electricity projects include a 1.5 MW share in Watsonville, a 5.1 MW share located near Half Moon Bay, a 1.9 MW share in Pittsburg, a 4.1 MW share in Linden, and the entire project output of 1.4 MW in Gonzales. The 20-year contracts expire between 2025 and 2034.
- The utility also has several contracts for utility-scale solar PV projects that provide roughly 33 percent of its electricity needs. These are 25-year contacts with expiration dates starting in 2040.

In December 2018, Palo Alto adopted an updated RPS procurement plan, which identifies how the utility plans to fulfill long-term RPS procurement requirements. Palo Alto plans to procure the minimum amount of electricity products from eligible renewable resources, including RECs, as a specified percentage of retail sales during each compliance period to achieve the targets. Palo Alto's diverse portfolio of qualified renewable resources will include wind, solar, bioenergy (landfill gas), and small hydro.

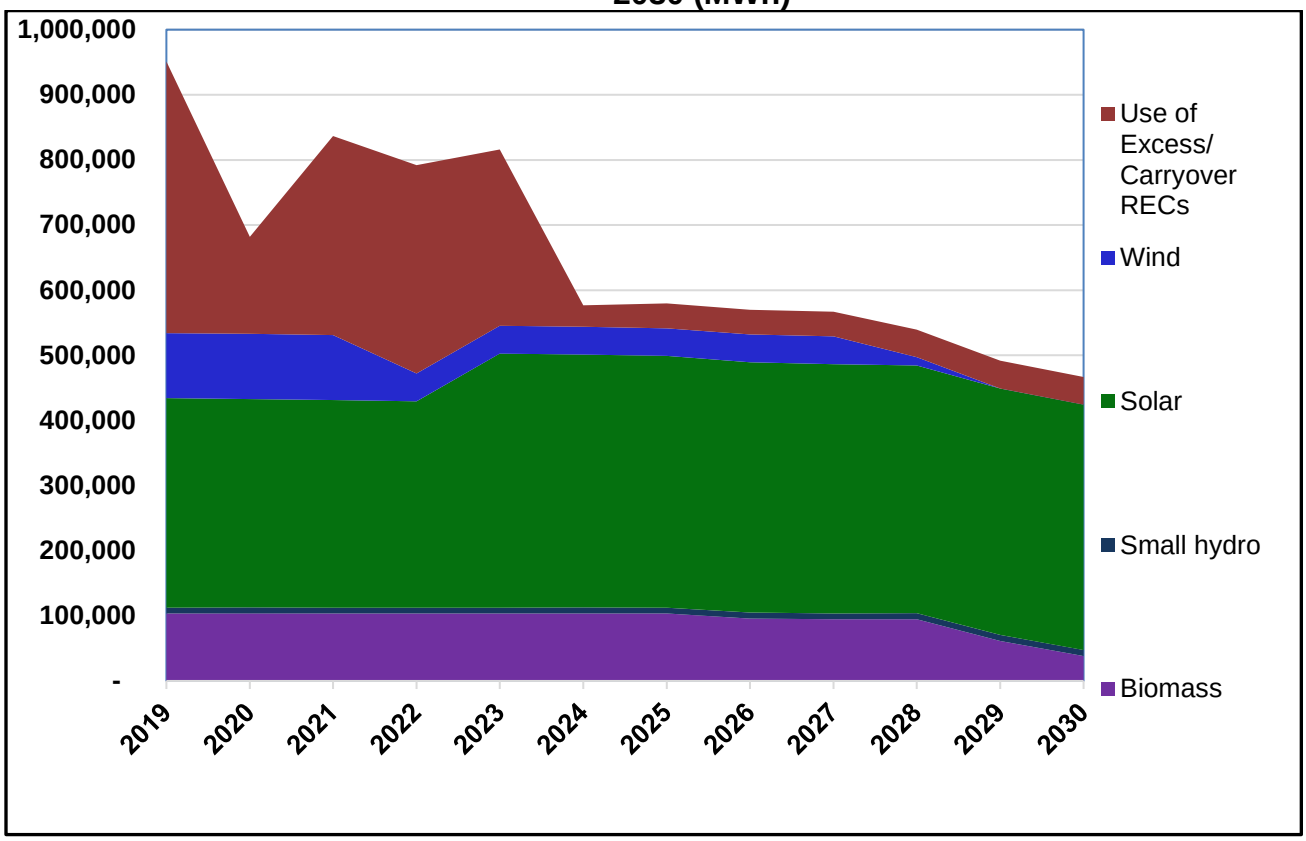
The utility's RPS portfolio will include grandfathered contracts executed before June 1 2010, and Portfolio Content Category (PCC) 1 contracts for eligible resources directly or dynamically connected to a California balancing authority. The utility's RPS portfolio may also include PCC 2 eligible resources that are scheduled into a California balancing authority, and PCC 3 eligible resources, which are typically unbundled renewable energy credits (RECs). Palo Alto intends to satisfy portfolio balancing requirements that limit quantities for each of the PCCs. To meet long-term contract requirements, the utility plans to meet 65 percent of its procurement requirements with contract terms of 10 years or longer.

Palo Alto plans to meet its RPS procurement requirements in 2030, as well as for each three-year compliance period. To help meet its 50 percent 2030 RPS target, Palo Alto must procure an average of 551 GWh of renewable energy each year in its planning period.

Palo Alto has a large balance of excess generation from PCC1 and PCC2 resources (626 GWh at the start of Compliance Period 3) that it uses to help meet RPS requirements, along with its contracted renewable plants. The utility plans to use this excess balance in Compliance Periods 3 and 4 to meet RPS requirements, and by 2024 it plans to have used up all its excess balance. Over its entire planning period (2019-2030), Palo Alto will use PCC 3 resources (unbundled RECs) to help meet its RPS obligations.

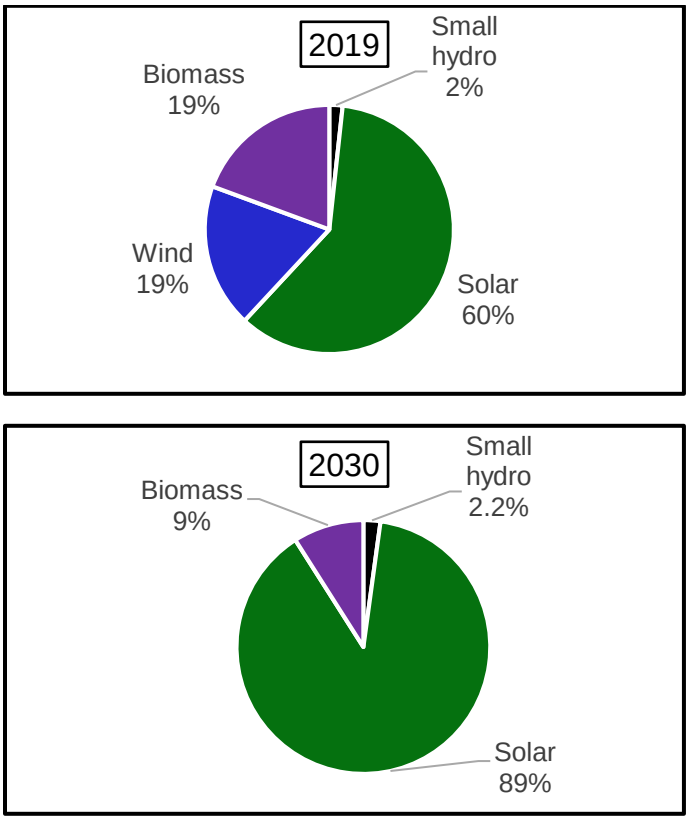
Figure 2 and **Figure 3** show Palo Alto's renewable portfolio consists primarily of solar, with some landfill gas, small hydro, and wind. In 2019, solar makes up 60 percent of Palo Alto's renewable resources, and by 2030 it makes up 89 percent.

Figure 2: Sources of Renewables Portfolio Standard Eligible Energy 2019–2030 (MWh)



Source: California Energy Commission, based on Palo Alto's 2018 IRP filing.

Figure 3: Renewables Portfolio Standard Portfolios in 2019 and 2030



Source: California Energy Commission, based on Palo Alto's 2018 IRP filing.

Retail Rates

PUC Section 9621(b) (3) requires POUs to develop IRPs that enhance each POU's ability to fulfill its obligation to serve its customers at just and reasonable rates and minimize impacts to ratepayer bills. Staff reviewed the analysis and information Palo Alto presented on rate and bill impacts from resource portfolios it evaluated. Staff finds that Palo Alto's IRP is consistent with PUC Section 9621(b) (3).

Palo Alto projects supply costs to rise substantially for the next several years, largely driven by increases in transmission costs and new renewable energy projects coming on-line. The utility also projects retail rates to increase due to substantial additional capital investment in the electric distribution system and operational cost increases. To ensure adequate revenue recovery, the Palo Alto City Council recently approved a 6 percent retail rate increase for FY 2019 (in effect July 1, 2018) and adopted a financial plan that calls for an additional 3 percent rate increase for FY 2020 with 0 to 2 percent annual rate increases projected thereafter. However, Palo Alto's current electric rates are far lower than the statewide average electric retail rates, and under the recommended portfolio, staff projects rates will remain so. In fact, even under the worst-case

scenarios staff evaluated, Palo Alto's retail electric rates remain lower than the projected statewide average rates.

System and Local Reliability

SB 350 requires filing POUs to adopt an IRP that ensures system and local reliability and addresses resource adequacy requirements.[19] Staff reviewed Palo Alto's capacity reporting table and discussion and finds Palo Alto has planned for sufficient resources to maintain a reliable electric system. Palo Alto's selected portfolio of resources contains sufficient capacity to meet anticipated resource adequacy requirements in 2030. Staff finds that the IRP is consistent with the reliability requirements in PUC Section 9621(b) (3) and resource adequacy requirements in PUC Section 9621(d) (1) (E).

System Reliability

Palo Alto expects to continue operating within the Northern California Power Agency's (NCPA's) agreement with the California Independent System Operator (California ISO).[20] Long-term planning for the reliability of the bulk power system is the responsibility of the California ISO. Under NCPA's operating agreement, Palo Alto has access to sufficient system, local, and flexible capacity, along with resources to provide ancillary services, to meet its loads reliably. Palo Alto's federal and owned hydro plants provide system reliability or system resource capacity to the California ISO, as do three of its contracted landfill gas projects. If Palo Alto decides to scale back or eliminate its long-term contract with WAPA, which is the largest source of resource adequacy capacity, the utility could face additional challenges in ensuring sufficient system resource adequacy to meet its planning reserve requirements. The utility plans to rely on short-term resource adequacy contracts to make up deficits but will address this issue once a decision on the WAPA contract is made.

Local and Flexible Capacity Needs

Most Palo Alto's long-term generation contracts (and its one owned gas-fired backup generator) are fully deliverable and provide resource adequacy capacity to satisfy its California ISO regulatory requirements. Two of Palo Alto's contracted landfill gas projects are in the Bay Area local capacity area, as are the utilities' two long-term wind projects. Three of its long-term solar PV contracts also provide local capacity, with the Hayworth Solar project in the Kern local capacity area and the Western Antelope Blue Sky Ranch B project and Elevation Solar C project in the Big Creek/Ventura local capacity area. While the natural

19 Public Utilities Code Section 9621(b) (3).

20 NCPA has a metered subsystem aggregation agreement in which NCPA balances Palo Alto's loads and resources to comply with the California ISO planning and operating protocols.

gas-fired backup generators are seldom operated, they provide the utility with another source of local capacity in the Bay Area.

Palo Alto's owned hydro, the Calaveras project, provides up to 58 MW of flexible capacity. The remainder is purchased through short-term bilateral contracts. One challenge Palo Alto faces over the planning period is ensuring it can continue to procure adequate supplies of local and flexible resource adequacy capacity. This procurement could prove more challenging if Palo Alto does not opt to renew its WAPA hydro contract, but it appears to have sufficient time to plan for alternative sources of local and flexible capacity. Palo Alto's portfolio shows a deficit of local and flexible resource adequacy capacity, which it plans to meet with short-term bilateral resource adequacy capacity purchases.

Transmission and Distribution Systems

PUC Section 9621(b) (3) requires filing POUs to adopt an IRP that achieves the goal of strengthening the diversity, sustainability, and resilience of the bulk transmission and distribution systems and local communities. Staff determined that Palo Alto's IRP adequately plans to maintain and enhance its transmission and distribution systems. Staff finds Palo Alto has planned for enough transmission to deliver resources to its service area to meet the requirement discussed below. Staff also finds that the utility conducts planning to address the adequacy of its distribution system. As such, staff finds the IRP is consistent with the transmission and distribution requirements set forth above.

Transmission System

Palo Alto has two main efforts regarding transmission during the planning period. First, the utility must determine how best to use its transmission rights on the California Oregon Transmission Project when Palo Alto's long-term layoff of this resource ends in 2023. Second, Palo Alto is pursuing an additional interconnection point with Pacific Gas and Electric Company's (PG&E) transmission system to provide redundancy and, therefore, increased local reliability. Redundancy and increased local reliability are needed in the event that an outage affects the three current interconnection lines. Although three lines would normally provide redundancy and backup power delivery, all three lines run in a common corridor on the bay side of the city, a corridor that close to the Palo Alto Airport. The common corridor and proximity to an airport mean that the city's power supply is susceptible to events that can affect all three lines, as happened in February 2010 when a small aircraft hit the power lines, resulting in a citywide power outage for more than 10 hours. To minimize the possibility of another citywide outage caused by an interconnection line outage, the utility is pursuing a physically diverse connection to the PG&E transmission system. Palo Alto has been investigating options for an alternative connection to the transmission grid for years.

Distribution System

As discussed above, Palo Alto's electric distribution system is directly interconnected with the transmission system of 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, about 12 miles of 60 kV subtransmission lines, and nearly 469 miles of 12 kV and 4kV distribution lines, including 223 miles of overhead lines and 245 miles of underground lines.

In 2018, Palo Alto completed a distribution system assessment to understand the distribution system upgrades that will be required to integrate increasing penetration of distributed energy resources, particularly electric vehicles. Palo Alto concluded that at the system level, there is sufficient capacity to accommodate growth in distributed energy resources for the next five years. However, some subcomponents of the system require further assessment and monitoring (for example, residential distribution transformers). The utilitywide implementation of advanced metering infrastructure (AMI), which is planned to occur by 2022, will greatly enhance the visibility into distribution system operational characteristics and further enable the integration of distributed energy resources by offering new customer programs (such as time-varying rates).

Palo Alto's current five-year capital plan for electric distribution facilities contemplates spending roughly $16.5 million per year over this five-year period, primarily to fund infrastructure replacement and new customer connections.

Disadvantaged Communities and Localized Air Pollutants

PUC Section 9621(b) (3) requires POUs to minimize localized air pollutants and GHG emissions with early priority on disadvantaged communities. Staff reviewed Palo Alto's IRP filing to determine the extent to which it is minimizing local air pollutants with a priority on disadvantaged communities. Staff finds that Palo Alto has made efforts to address these issues in selecting the resources to include in its portfolio consistent with the requirement.

The city does not have any areas that qualify as disadvantaged communities but offers rate assistance programs for income-qualified residents.

Given that Palo Alto's electricity supply is from clean, carbon-neutral generating resources, the city believes the best way to improve local air quality is to reduce emissions from the transportation sector by electrifying vehicles. The city has several programs to promote the adoption of electric vehicles. The EV Charge Rebate Program, launched in early 2017 and using funds monetized from the Low Carbon Fuel Standard credits, offers rebates targeted to multifamily and mixed-use properties, schools, and nonprofits. Palo Alto also launched an online calculator for residents to evaluate the costs and benefits of installing rooftop

solar, which can now be used to evaluate electric vehicles and see the financial and environmental benefits of charging vehicles with the utility's carbon-neutral electricity. Palo Alto also has a solar hot water program that offers rebates for residential, commercial, and industrial systems that can displace natural gas combustion and improve air quality. The utility also offers several programs promoting electrification of space and water heating that also reduce emissions.

Palo Alto has three programs that provide financial assistance to low-income customers. The Residential Energy Assistance Program provides free energy efficiency measures to low-income customers, including insulations, lighting, and refrigerator or furnace replacement. The Rate Assistance Program provides a 25 percent discount on electric charges for qualified customers including low-income applicants, as well as applicants with medical or financial needs. Palo Alto also offers a Project PLEDGE program that provides a one-time contribution of up to $750 applied to the bills of qualified residents, including those experiencing employment difficulties or health emergencies. This program is funded by voluntary customer contributions.

Net Energy Demand in Peak Hours

PUC Section 9621(c) requires POUs to consider existing renewable generation, grid operation efficiencies, energy storage, distributed energy resources, and energy reduction measures (such as energy efficiency and demand response) to reduce the need for new or additional gas-fired generation and distribution and transmission resources. Palo Alto's IRP discusses how these factors contribute to meeting net demand in peak hours. This plan is consistent with the requirement that filing POUs address how they can meet peak-hour demand with renewable and other preferred resources.

Palo Alto reviewed and considered resource options that included all of the technologically feasible and cost-effective options available to it. These options included those meeting energy needs and reliability requirements during the hours of peak demand for the utility. Palo Alto included new and existing preferred resources to ensure its customers have the cleanest and most cost-effective generation resources while meeting all of the statutory requirements of PUC Section 9621. As part of the IRP, Palo Alto assessed distributed energy resources and aggressive forecasts and programs for energy efficiency, demand response, and solar PV, which have the potential to lower Palo Alto's peak demand.

Additional Procurement Goals

PUC Section 9621(d) (1) requires filing POUs to address procurement of energy efficiency and demand response, energy storage, transportation electrification, and a diversified portfolio, which are discussed in the next section. The resource

adequacy provisions of this code section are discussed in the System Reliability section on page 17 of this analysis.

Energy Efficiency and Demand Response Resources

Staff finds that Palo Alto's IRP is consistent with the requirement in PUC Section 9621(d) (1) (A) as it includes a discussion of energy efficiency and demand response programs it plans to implement and quantifies the amount of energy efficiency and demand response savings it plans to achieve. Palo Alto does not include a forecast of additional achievable energy efficiency (AAEE) savings in its IRP as it implemented aggressive AAEE programs starting in 2016, and these savings are already included in its demand forecast.

Palo Alto has been investing in energy efficiency programs for several decades and recognizes it as the highest priority energy resource. Palo Alto has achieved cumulative energy efficiency savings of 4.4 percent since 2012. Based on Palo Alto's adopted energy efficiency plan, 10-year energy efficiency goals for 2018 to 2027, the utility updated its cumulative electric efficiency savings goals to 5.7 percent between 2018 and 2027. This goal is a 20 percent increase over the last goals adopted.

Table 4 shows the SB 350 cumulative electricity savings targets, which Palo Alto plans to meet or exceed.

Palo Alto offers energy efficiency programs and is developing additional programs to achieve the 2030 doubling energy efficiency goals. The Multifamily Residence Plus+ Program focuses on this hard-to-reach customer segment by having a team of experts identify energy efficiency measures, such as installing light-emitting diode (LED) lighting; sealing leaky air ducts; and adding insulation and weatherization in attics, roofs, wall, doors, and windows. The Home Efficiency Genie Program is a home efficiency assessment program using licensed auditors to identify not only efficiency improvements, but sustainability programs like heat pump water heaters. The Green Building Ordinance is Palo Alto's local building reach code for residential and commercial buildings that is more stringent than the CEC's Title 24 Building Energy Efficiency Standards.

Since 2013, Palo Alto has run a voluntary demand response program for large commercial and industrial customers with an average of four to five events per year resulting in 0.5 to 1 MW of peak-load reduction. More robust growth in voluntary large commercial demand response is expected after Palo Alto implements its advanced metering program in 2023.

Table 4: Palo Alto Additional Achievable Energy Efficiency Estimates (GWh)

	AAEE (GWh)	SB 350 Targets (GWh)
2018	25	26
2019	32	34
2020	40	43
2021	48	52
2022	56	61
2023	64	70
2024	73	78
2025	82	86
2026	91	91
2027	100	102
2028	109	109
2029	118	116
2030		

Source: California Energy Commission, based on 2018's Palo Alto IRP filing.

Energy Storage

Staff finds that Palo Alto's IRP is consistent with the requirement in PUC Section 9621(d) (1) (B) to address procurement of energy storage as it discussed the potential role of energy storage on its system. Assembly Bill 2514 (Skinner, Chapter 469, Statutes of 2010) requires POUs to evaluate the potential of energy storage systems as a resource and establish procurement targets, if determined to be appropriate. Palo Alto's AB 2514 analysis recommended that an energy procurement target for wholesale storage is not appropriate due to lack of cost-effectiveness. Staff finds Palo Alto's IRP is consistent with the requirement in PUC Section 9621(d) (1) (B) to address procurement of energy storage as it discussed the potential role of energy storage on its system.

Detailed analysis in 2017 showed that batteries are not cost-effective within Palo Alto's service territory or at its remote renewable generation sites, and therefore, Palo Alto does not provide any rebates for energy storage systems and is not planning to install storage at this time. Palo Alto is promoting customer adoption of energy storage systems by streamlining the process for permitting and interconnecting systems. The utility plans to revisit its energy storage analysis in 2020.

Transportation Electrification

Staff finds that the Palo Alto IRP is consistent with the requirement of PUC Section 9621(d) (1) (C) as it addresses transportation electrification, primarily for

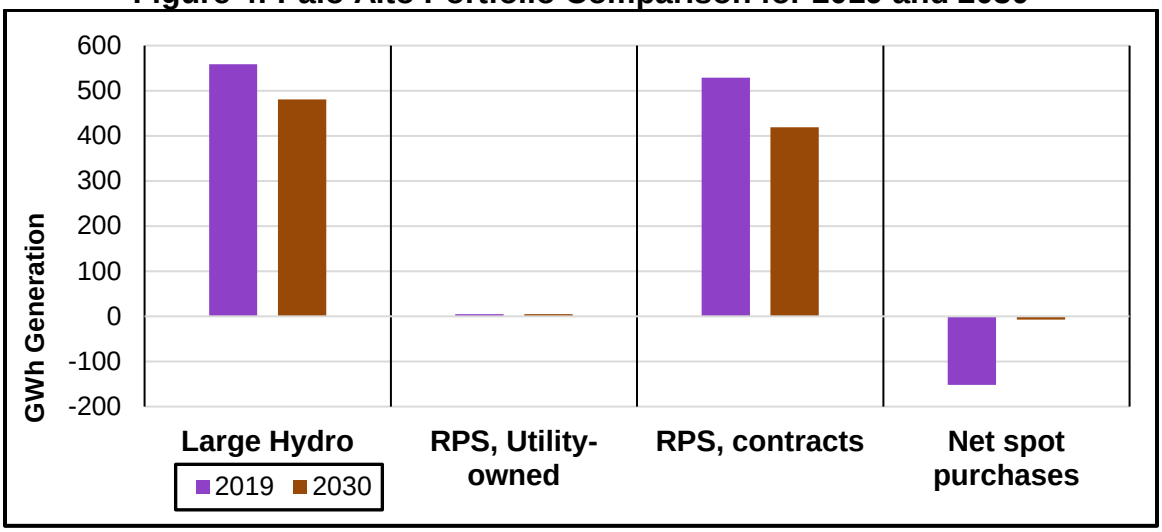
light-duty vehicles. In 2017, there were 2,500 electric vehicles (EVs) registered in Palo Alto. Palo Alto has observed residential EV adoption rates roughly three times greater than the California statewide average, and this residential adoption rate relative to statewide average projections is assumed to continue to 2030. There are also EVs that commute into Palo Alto, some of which charge while in Palo Alto and add to CPAU electricity sales. In addition to the residential EVs in its service area, Palo Alto estimates about 3,100, 5,900, and 20,000 commuter EVs in 2017, 2020 and 2030, respectively. In the standardized table, Palo Alto reports energy use for EVs of 12,000 MWh in 2019, 32,000 MWh in 2025, and 56,000 MWh in 2030.

Portfolio Diversification

PUC Section 9621(d) (1) (D) requires that POUs address the procurement of a diversified portfolio of resources consisting of short- and long-term electricity and electricity-related and demand-response products. Based on staff's review of Palo Alto's existing resources, its portfolio analysis, and the selection of resource additions in its IRP, staff concludes that Palo Alto has fulfilled this requirement.

Figure 4 shows a comparison of the energy mix by resource in Palo Alto's preferred portfolio in 2019 and 2030.

Figure 4: Palo Alto Portfolio Comparison for 2019 and 2030



Source: California Energy Commission, based on Palo Alto's 2018 IRP filing.

In 2030, the utility's resource mix includes 53 percent large hydroelectric, 41 percent solar, 4 percent landfill gas, and 1 percent small hydroelectric and spot-market purchases. Palo Alto's one natural gas resource is not included in **Figure 4** as it accounts for less than 0.03 GWh, or less than 0.003 percent, of Palo Alto's resource portfolio.

ACRONYMS

Acronym	Term
AAEE	Additional achievable energy efficiency
AAPV	Additional achievable photovoltaic
CARB	California Air Resources Board
CEC	California Energy Commission
California ISO	California Independent System Operator
CO_2	Carbon dioxide
CO_2e	Carbon dioxide equivalent
COTP	California Oregon Transmission Project
CPUC	California Public Utilities Commission
GHG	Greenhouse gas
GWh	Gigawatt-hour
IEPR	*Integrated Energy Policy Report*
IRP	Integrated resource plan
LD PEV	Light-duty plug-in electric vehicle
mT	Metric ton
MT	Thousands of metric tons
MMT	Millions of metric tons
MW	Megawatt
MWh	Megawatt-hour
NCPA	Northern California Power Agency
PG&E	Pacific Gas and Electric
POU	Publicly owned utility
PRC	Public Resources Code
PUC	Public Utilities Code
RPS	Renewables Portfolio Standard
SB 350	Senate Bill 350 (De León, Chapter 547, Statutes of 2015)
WAPA	Western Area Power Administration

APPENDIX A: Definitions

Additional achievable energy efficiency (AAEE): Energy efficiency savings not yet considered committed but deemed likely to occur, including impacts from future updates of building codes and appliance standards and utility efficiency programs expected to be implemented.

Additional achievable photovoltaic (AAPV): Distributed PV developed as a result of the requirement in the California Building Standards that new home construction include solar PV as of January 1, 2020.

Assumption: A statement made about the future for a given load forecast, or demand-side or supply-side energy resource, that should be used for procurement and transmission modeling.

Bundled renewable energy credit: An electricity product that, when procured by the POU claiming the electricity product to satisfy its RPS procurement requirements, includes the electricity and the associated renewable energy credits from an eligible renewable energy resource. For example, if the POU claiming an electricity product owns the associated eligible renewable energy resource, then all electricity products, including those associated with electricity consumed onsite, may be considered bundled electricity products.

Committed energy efficiency: Energy efficiency savings estimated to occur from utility and public agency programs, codes, standards, legislation, and ordinances having final authorization, firm funding, and a design that can be readily translated into evaluable characteristics.

Demand forecast: A forecast of electricity demand served by the electric grid, measured by both peak demand and energy consumption. Some factors that determine load forecast include economics, demographics, behind-the-meter resources, and retail rates.

Excess balance: Any amount of RPS-eligible RECs that a utility holds at the end of a compliance period that may be used to meet their compliance obligation in the next compliance period. Excess balance can include excess procurement, historic carryover, or purchased RECs that have not been retired.

Filing POU: A local publicly owned electric utility with an annual electrical demand exceeding 700 gigawatt-hours, as determined on a three-year average commencing January 1, 2013.

Integrated resource plan (IRP): A plan adopted by the governing board of a POU under PUC Section 9621.

IRP filing: An IRP adopted by the filing POU's governing board that is electronically submitted to the Energy Commission, along with the standardized tables and supporting information, by the filing POU or authorized representative.

Net-peak demand: The highest hourly electricity demand in the utility area, when excluding demand met by variable renewable generation resources directly connected to a California balancing authority. Net-peak demand is calculated by taking the highest hourly demand (peak demand) and subtracting the electricity produced by variable renewable resources meeting that demand.

Plug-in electric vehicle (EV): A vehicle that uses one or more electric motors for propulsion. Electric vehicles include battery-electric and plug-in hybrid vehicles.

Renewable energy credit (REC): A certificate of proof, as defined in PUC Section 399.12(h), associated with the generation of electricity from an eligible renewable energy resource. RECs are certificates that represent the environmental attributes or "greenness" of renewable electricity production.

Renewable Portfolio Standard (RPS): A regulation that requires a minimum procurement of energy from renewable resources, such as wind, solar, biomass, and geothermal.

Retail sales: Electricity consumption after accounting for behind-the-meter onsite generation including storage charge and discharge. It indicates the net energy delivered through the meter to the end-use customer and thus excludes any generation or procurement in satisfaction of firm wholesale commitments (for example, firm and spot market sales).

Scenario: A set of assumptions about future conditions used in power system modeling performed to support generation or transmission planning.

Sensitivity: A technique that determines how scenario analysis changes when an assumption is varied with all other scenario assumptions unchanged.

Standardized tables: The four tables that are required with the IRP filing submitted to the Energy Commission. These tables include information and data necessary to help staff determine if the IRP is consistent with PUC Section 9621. The four standardized tables are Capacity Resource Accounting Table, Energy Balance Table, Renewable Procurement Table, and Greenhouse Gas Emissions Accounting Table.

Supporting information: Analyses, studies, data, and work papers, or other material (on which inputs, assumptions, or conclusions are based) that the POU used or relied upon in creating the IRP (such as market conditions current at the time of the analyses, energy infrastructure, state policies and laws, and needs of the filing POU) but are not included in the IRP itself; and additional information

required by these guidelines. Supporting information may also include the inputs and assumptions that are based on the analyses, studies, data, work papers, and other material.

Unbundled renewable energy credit: A renewable energy credit from an eligible renewable energy resource that is not procured as part of the same contract or ownership agreement with the underlying energy from that eligible renewable energy resource; this includes RECs that were originally procured as a bundled product but were subsequently resold separately from the underlying energy.

APPENDIX B:
Summary Tables

Table B-1: Energy Resources, All Years (MWh)

		Tech	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
	Total Net Energy for Load		**942,023**	**939,028**	**935,400**	**932,327**	**930,861**	**930,017**	**929,980**	**930,138**	**930,335**	**930,953**	**931,568**	**933,233**
Non-RPS	Collierville	Large Hydro	143879	116311	116311	116311	116311	116311	116311	116311	116311	116311	116311	116311
	Palo Alto COBUG NG Recip Engine	Natural Gas	25	25	25	25	25	25	25	25	25	25	25	25
	Western Base Resource Generation	Large Hydro	415836	371021	367310	364289	364289	364289	364289	364289	364289	364289	364289	364289
	Total energy from non-RPS resources		**559,739**	**487,357**	**483,646**	**480,625**	**480,625**	**480,625**	**480,625**	**480,625**	**480,625**	**480,625**	**480,625**	**480,625**
RPS resources	New Spicer Hydro electric	Small Hydro	5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000
	High Winds\	Wind	42,668	42,754	42,721	42,708	42,672	42,711	42,671	42,709	42,722	12,615	0	0
	Shiloh #1	Wind	57,290	57,425	57,366	0	0	0	0	0	0	0	0	0

		Tech	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
	Santa Cruz (Buena Vista Landfill)	Landfill Gas	8,961	8,986	8,961	8,961	8,961	8,985	8,961	1,449	0	0	0	0
	Ox Mountain (Half Moon Bay)	Landfill Gas	42,459	42,575	42,459	42,459	42,459	42,570	42,459	42,459	42,459	42,575	13,959	0
	Keller Canyon	Landfill Gas	13,827	13,865	13,827	13,827	13,827	13,863	13,827	13,827	13,827	13,865	9,205	0
	Johnson Canyon (Ameresco)	Landfill Gas	9,200	9,225	9,200	9,200	9,200	9,224	9,200	9,200	9,200	9,225	9,200	9,200
	San Joaquin (Ameresco)	Landfill Gas	29,042	29,122	29,042	29,042	29,042	29,118	29,042	29,042	29,042	29,122	29,042	29,042
	EE Kettleman Land	Solar	52,527	52,264	52,003	51,743	51,484	51,227	50,971	50,716	50,462	50,210	49,959	49,709
	Elevation Solar C	Solar	99,690	99,192	98,696	98,203	97,712	97,223	96,737	96,253	95,772	95,293	94,817	94,343
	Western Antelope Blue Sky Ranch B	Solar	49,864	49,615	49,367	49,120	48,874	48,630	48,387	48,145	47,904	47,665	47,426	47,189
	Frontier Solar	Solar	51,816	51,557	51,299	51,043	50,788	50,534	50,281	50,030	49,780	49,531	49,283	49,037
	Hayworth Solar	Solar	62,770	62,456	62,144	61,833	61,524	61,216	60,910	60,606	60,302	60,001	59,701	59,402
	Wilsona Solar	Solar	0	0	0	0	74,774	74,400	74,028	73,658	73,290	72,924	72,559	72,196
	Palo Alto CLEAN Projects	Solar	4,914	4,914	4,914	4,914	4,914	4,914	4,914	4,914	4,914	4,914	4,914	4,914
	Western Base Resource Small Hydro	Small Hydro	4,200	4,200	4,200	4,200	4,200	4,200	4,200	4,200	4,200	4,200	4,200	4,200
	Total energy from RPS-eligible resources		**534,229**	**533,150**	**531,199**	**472,253**	**545,431**	**543,816**	**541,588**	**532,208**	**528,875**	**497,139**	**449,265**	**424,232**

		Tech	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
	Total energy from specified resources		**1,093,968**	**1,020,507**	**1,014,844**	**952,877**	**1,026,056**	**1,024,441**	**1,022,213**	**1,012,832**	**1,009,500**	**977,764**	**929,890**	**904,857**
	Short term/ spot market purchases		94,563	148,848	149,418	152,422	150,514	144,997	146,899	147,437	150,723	160,558	180,913	195,688
	Short term/ spot market sales		**(246,508)**	**(230,327)**	**(228,863)**	**(172,972)**	**(245,708)**	**(239,421)**	**(239,132)**	**(230,131)**	**(229,863)**	**(207,343)**	**(179,210)**	**(188,666)**
	Total delivered energy	N/A	**942,023**	**939,028**	**935,400**	**932,327**	**930,861**	**930,017**	**929,980**	**930,138**	**930,360**	**930,978**	**931,593**	**911,880**
	Surplus/ (Shortfall)	N/A	**0**	**0**	**ssss0**	**0**	**0**	**0**	**0**	**0**	**25**	**25**	**25**	**(21,354)**

Source: California Energy Commission, Energy Assessments Division, based on Palo Alto's 2018 IRP filing Energy Balance Table.

Table B-2: Capacity Resources, All Years (MW)

		2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Peak Demand		166	165	164	163	162	161	160	158	156	155	153	151
Demand response		0	0	0	0	**(1)**	**(2)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**
Planning Reserve Margin		25	25	25	25	24	24	24	23	23	22	22	22
Firm sales obligations		63	63	0	0	0	0	0	0	0	0	0	0
Peak capacity requirement		**253**	**253**	**189**	**188**	**186**	**183**	**182**	**179**	**175**	**172**	**169**	**166**
Utility owned generation	**Fuel**												
Collierville	Large Hydro	57	57	57	57	57	57	57	57	57	57	57	57
Palo Alto COBUG Natural Gas Reciprocating Engine	Natural Gas	5	5	5	5	5	5	5	5	5	5	5	5
New Spicer Hydroelectric	Small Hydro	1	1	1	1	1	1	1	1	1	1	1	1
Long-Term Contracts (not RPS-eligible):													

		2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Western Base Resource Generation	Large Hydro	175	175	175	175	175	175	175	175	175	175	175	175
Shell Natural Gas Combustion Turbine	Natural Gas	35	0	0	0	0	0	0	0	0	0	0	0
Long-Term Contracts (RPS-eligible):													
High Winds	Wind	10	10	10	10	10	10	10	10	10	0	0	0
Shiloh #1	Wind	12	12	12	0	0	0	0	0	0	0	0	0
Santa Cruz (Buena Vista Landfill)	Landfill Gas	2	2	2	2	2	2	2	0	0	0	0	0
Ox Mountain (Half Moon Bay)	Landfill Gas	5	5	5	5	5	5	5	5	5	5	0	0
Keller Canyon	Landfill Gas	2	2	2	2	2	2	2	2	2	2	2	0
Johnson Canyon (Ameresco)	Landfill Gas	1	1	1	1	1	1	1	1	1	1	1	1
San Joaquin (Ameresco)	Landfill Gas	4	4	4	4	4	4	4	4	4	4	4	4
EE Kettleman Land	Solar	0	0	0	0	0	0	0	0	0	0	0	0
Elevation Solar C	Solar	34	34	34	34	34	34	0	0	0	0	0	0
Western Antelope Blue Sky Ranch B	Solar	17	17	17	17	17	17	17	17	17	17	17	17
Frontier Solar	Solar	0	0	0	0	0	0	0	0	0	0	0	0
Hayworth Solar	Solar	22	22	22	22	22	22	22	22	22	22	22	22
Wilsona Solar	Solar	0	0	0	0	22	22	22	22	22	22	22	22
Palo Alto CLEAN Projects	Solar	3	3	3	3	3	3	3	3	3	3	3	3
Western Base Resource - Small Hydro	Small Hydro	5	5	5	5	5	5	5	5	5	5	5	5
Total Capacity	**NA**	**389**	**354**	**355**	**343**	**365**	**365**	**331**	**329**	**329**	**320**	**315**	**313**
Capacity Surplus/(Shortfall)	**NA**	**136**	**102**	**166**	**155**	**180**	**181**	**149**	**150**	**154**	**147**	**145**	**147**

Source: California Energy Commission, Energy Assessments Division, based on Palo Alto's 2018 IRP filing Capacity Resource Accounting Table.

Table B-3: GHG Emissions from Palo Alto's Resource Portfolio, All Years

	Fuel Type	GHG Intensity ($mT CO_2e$/ MWh)	Total Emissions ($mT CO_2e$) 2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Palo Alto COBUG NG Recip Engine	natural gas	0.56	14	14	14	14	14	14	14	14	14	14	14	14
Spot market purchases	system	0.428	40,473	63,707	63,951	65,236	64,420	62,059	62,873	63,103	64,509	68,719	77,431	83,755
Spot market sales	system	0.428	**(105,505)**	**(98,580)**	**(97,953)**	**(74,032)**	**(105,163)**	**(102,472)**	**(102,348)**	**(98,496)**	**(98,381)**	**(88,743)**	**(76,702)**	**(80,749)**
Portfolio emissions	portfolio	NA	0	0	0	0	0	0	0	0	0	0	743	3,020

Source: California Energy Commission, Energy Assessments Division, based on Palo Alto's 2018 IRP filing Greenhouse Gas Emissions Accounting Table.

ATTACHMENT I:
Public Utilities Code for SB 350

Public Utilities Code PUC

DIVISION 4.9. RESTRUCTURING OF PUBLICLY OWNED ELECTRIC UTILITIES IN CONNECTION WITH THE RESTRUCTURING OF THE ELECTRICAL SERVICES INDUSTRY [9600 - 9622]

(Division 4.9 added by Stats. 1996, Ch. 854, Sec. 12.)

9621.

(a) This section shall apply to a local publicly owned electric utility with an annual electrical demand exceeding 700 gigawatt-hours, as determined on a three-year average commencing January 1, 2013.

(b) On or before January 1, 2019, the governing board of a local publicly owned electric utility shall adopt an integrated resource plan and a process for updating the plan at least once every five years to ensure the utility achieves all of the following:

(1) Meets the greenhouse gas emissions reduction targets established by the State Air Resources Board, in coordination with the commission and the Energy Commission, for the electricity sector and each local publicly owned electric utility that reflect the electricity sector's percentage in achieving the economywide greenhouse gas emissions reductions of 40 percent from 1990 levels by 2030.

(2) Ensures procurement of at least 50 percent eligible renewable energy resources by 2030 consistent with Article 16 (commencing with Section 399.11) of Chapter 2.3 of Part 1 of Division 1.

(3) Meets the goals specified in subparagraphs (D) to (H), inclusive, of paragraph (1) of subdivision (a) of Section 454.52, and the goal specified in subparagraph (C) of paragraph (1) of subdivision (a) of Section 454.52, as that goal is applicable to each local publicly owned electric utility. A local publicly owned electric utility shall not, solely by reason of this paragraph, be subject to requirements otherwise imposed on electrical corporations.

(c) In furtherance of the requirements of subdivision (b), the governing board of a local publicly owned electric utility shall 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.

(d) (1) The integrated resource plan shall address procurement for the following:

(A) Energy efficiency and demand response resources pursuant to Section 9615.

(B) Energy storage requirements pursuant to Chapter 7.7 (commencing with Section 2835) of Part 2 of Division 1.

(C) Transportation electrification.

(D) A diversified procurement portfolio consisting of both short-term and long-term electricity, electricity-related, and demand response products.

(E) The resource adequacy requirements established pursuant to Section 9620.

(2) (A) The governing board of the local publicly owned electric utility may authorize all source procurement that includes various resource types, including demand-side resources, supply side resources, and resources that may be either demand-side resources or supply side resources, to ensure that the local publicly owned electric utility procures the optimum resource mix that meets the objectives of subdivision (b).

(B) The governing board may authorize procurement of resource types that will reduce overall greenhouse gas emissions from the electricity sector and meet the other goals specified in subdivision (b), but due to the nature of the technology or fuel source may not compete favorably in price against other resources over the time period of the integrated resource plan.

(e) A local publicly owned electric utility shall satisfy the notice and public disclosure requirements of subdivision (f) of Section 399.30 with respect to any integrated resource plan or plan update it considers.

(Amended by Stats. 2017, Ch. 389, Sec. 2. (SB 338) Effective January 1, 2018.)

Public Utilities Code - PUC

DIVISION 1. REGULATION OF PUBLIC UTILITIES [201 - 3260]

(Division 1 enacted by Stats. 1951, Ch. 764.)

PART 1. PUBLIC UTILITIES ACT [201 - 2120]

(Part 1 enacted by Stats. 1951, Ch. 764.)

CHAPTER 3. Rights and Obligations of Public Utilities [451 - 651]

(Chapter 3 enacted by Stats. 1951, Ch. 764.)

ARTICLE 1. Rates [451 - 467]

(Article 1 enacted by Stats. 1951, Ch. 764.)

454.52.

(a) (1) Beginning in 2017, and to be updated regularly thereafter, the commission shall adopt a process for each load-serving entity, as defined in Section 380, to file an integrated resource plan, and a schedule for periodic updates to the plan, to ensure that load-serving entities do the following:

(A) Meet the greenhouse gas emissions reduction targets established by the State Air Resources Board, in coordination with the commission and the Energy Commission, for the electricity sector and each load-serving entity that reflect the electricity sector's percentage in achieving the economywide greenhouse gas emissions reductions of 40 percent from 1990 levels by 2030.

(B) Procure at least 50 percent eligible renewable energy resources by December 31, 2030, consistent with Article 16 (commencing with Section 399.11) of Chapter 2.3.

(C) Enable each electrical corporation to fulfill its obligation to serve its customers at just and reasonable rates.

(D) Minimize impacts on ratepayers' bills.

(E) Ensure system and local reliability.

(F) Strengthen the diversity, sustainability, and resilience of the bulk transmission and distribution systems, and local communities.

(G) Enhance distribution systems and demand-side energy management.

(H) Minimize localized air pollutants and other greenhouse gas emissions, with early priority on disadvantaged communities identified pursuant to Section 39711 of the Health and Safety Code.

(2) (A) The commission may authorize all source procurement for electrical corporations that includes various resource types including demand-side resources, supply side resources, and resources that may be either demand-side resources or supply side resources, taking into account the differing electrical corporations' geographic service areas, to ensure that each load-serving entity meets the goals set forth in paragraph (1).

(B) The commission may approve procurement of resource types that will reduce overall greenhouse gas emissions from the electricity sector and meet the other goals specified in paragraph (1), but due to the nature of the technology or fuel source may not compete favorably in price against other resources over the time period of the integrated resource plan.

(3) In furtherance of the requirements of paragraph (1), the commission shall consider the role of existing renewable generation, grid operational efficiencies, energy storage, and distributed energy resources, including energy efficiency, in helping to ensure each load-serving entity 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.

(b) (1) Each load-serving entity shall prepare and file an integrated resource plan consistent with paragraph (2) of subdivision (a) on a time schedule directed by the commission and subject to commission review.

(2) Each electrical corporation's plan shall follow the provisions of Section 454.5.

(3) The plan of a community choice aggregator shall be submitted to its governing board for approval and provided to the commission for certification, consistent with paragraph (5) of subdivision (a) of Section 366.2, and shall achieve the following:

(A) Economic, reliability, environmental, security, and other benefits and performance characteristics that are consistent with the goals set forth in paragraph (1) of subdivision (a).

(B) A diversified procurement portfolio consisting of both short-term and long-term electricity and electricity-related and demand reduction products.

(C) The resource adequacy requirements established pursuant to Section 380.

(4) The plan of an electric service provider shall achieve the goals set forth in paragraph (1) of subdivision (a) through a diversified portfolio consisting of both short-term and long-term electricity, electricity-related, and demand reduction products.

(c) To the extent that additional procurement is authorized for the electrical corporation in the integrated resource plan or the procurement process authorized pursuant to Section 454.5, the commission shall ensure that the costs are allocated in a fair and equitable manner to all customers consistent with Section 454.51, that there is no cost shifting among customers of load-serving entities, and that community choice aggregators may self-provide renewable integration resources consistent with Section 454.51.

(d) To eliminate redundancy and increase efficiency, the process adopted pursuant to subdivision (a) shall incorporate, and not duplicate, any other planning processes of the commission.

(e) This section applies to an electrical cooperative, as defined in Section 2776, only if the electrical cooperative has an annual electrical demand exceeding 700 gigawatt-hours, as determined based on a three-year average commencing with January 1, 2013.

(Amended by Stats. 2018, Ch. 92, Sec. 174. (SB 1289) Effective January 1, 2019.)