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STAFF PAPER

Review of Sacramento Municipal Utility District's 2018 Integrated Resource Plan

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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 (CEC) 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. Sacramento Municipal Utility District submitted its Integrated Resource Plan and supplemental information, which the Sacramento Municipal Utility District adopted on October 18, 2018, to the CEC for review on April 29, 2019. This staff paper presents the results of the CEC staff review of the Sacramento Municipal Utility District 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 the utilities to file an IRP with data and supporting information sufficient to demonstrate that they meet these requirements and the various targets and planning goals from 2018 to 2030. The CEC must review the IRPs to ensure consistency with the requirements of PUC Section 9621.

The Sacramento Municipal Utility District's (SMUD) IRP filing lays out an ambitious road map for lowering greenhouse gas emissions in the Sacramento region while maintaining low rates and reliability. As part of the IRP process, SMUD modified its greenhouse gas reduction goal to achieve net zero greenhouse gas emissions by 2040. To achieve this, SMUD explored a range of alternatives and scenarios for decarbonizing its system including energy efficiency and demand response, electrification, renewable generation, distributed generation, and energy storage. SMUD's analysis suggests that decarbonizing the region may require a dramatic scale up of building and transportation electrification while maximizing improvements in energy efficiency, demand response and renewable energy (both grid connected and small scale resources).

SMUD plans to meet the greenhouse gas emission target range established by the California Air Resources Board of 1.1 to 1.9 million metric tons of carbon dioxide equivalent (MT CO₂e). SMUD's planned resource portfolio results in roughly 1.3 MT CO₂e in 2030, which is at the lower end of the target range. Although Senate Bill (SB) 100, the "100 Percent Clean Energy Act of 2018" (de León, Chapter 312, Statutes of 2018) was enacted after SMUD completed its IRP modelling, SMUD updated its Renewables Portfolio Standard procurement plan to address the 60 percent renewable procurement requirement by 2030 as part of the IRP process. SMUD anticipates adding primarily wind and solar resources, as well as battery energy storage. SMUD also plans to further reduce greenhouse gas emissions in the Sacramento region by promoting increased transportation and building electrification. While SMUD still plans to use natural gas in its power plants, they expect to offset those emissions by fossil fuel emission reductions from electrification of buildings and transportation.

In reviewing the SMUD IRP and determining consistency with 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's review of the IRP filing results in the following conclusions with respect to consistency 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 discussion 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 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 discussion, demonstrate the utility has considered the role of existing renewable generation, grid operational efficiencies, energy storage, and distributed resources (including energy efficiency) in helping to ensure the utility's energy and reliability needs in the hours that encompass the peak hour as set forth in PUC Section 9621(c).
- *Addressing Resource Procurement Types:* The IRP filing includes values reported in the standardized tables and narrative discussion 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).

This IRP is consistent with the requirements of PUC Section 9621. In addition to the IRP provisions, 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. Staff observes that aggressive energy efficiency and demand response programs are needed for utilities and energy efficiency providers 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 SMUD, 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 (POU) 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 the POUs meeting the demand threshold to submit an IRP and updates to the 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 POU's 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 the Sacramento Municipal Utility District (SMUD) and its IRP development process. In addition, the chapter addresses the *POU IRP Guidelines* requirements that POUs provide a demand forecast and a procurement plan as part of its IRP.

Energy Commission IRP Review Process

On April 29, 2019, SMUD submitted its IRP and supporting documentation, as outlined in the *POU IRP Guidelines*,³ to the CEC for 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 supporting information needed for

¹ PUC Article 16 (commencing with Section 399.11) of Chapter 2.3, Part 1, Division 1. See Appendix I.

² CEC. *Publicly Owned Utility Integrated Resource Plan Submission and Review Guidelines*. Revised Second Edition. October 2018, Publication Number CEC-200-2018-004-CMF.
<https://efiling.energy.ca.gov/GetDocument.aspx?tn=224889>.

³ The *POU IRP Guidelines* define an *IRP filing* to include the IRP adopted by the governing board, along with standardized tables and other supporting information required to review the IRP for consistency with SB 350.

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 SMUD staff, and verified data and information as needed. Staff considered the data supporting the assertions in the IRP in assessing whether the IRP is consistent with the requirements of PUC Section 9621.

Staff relied on internal 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 Renewables Portfolio Standard (RPS) requirements, energy efficiency savings projections and programs, and plans for transportation electrification.

Overview of Sacramento Municipal Utility District

SMUD is a community owned, not-for-profit utility that provides electricity to Sacramento County and a small portion of Placer County as described below:

- SMUD began providing power to its customers in 1946 and is now the sixth-largest community-owned electric utility in the country and the second largest in California.
- SMUD has over 600,000 customers within a service area of 900 square miles. The utility delivers approximately 11,000 GWh per year, with 46 percent of retail sales to residential customers and 53 percent to commercial and industrial customers.
- In 2019, SMUD's expected peak load is 3,026 MW and its dependable capacity is 3,260 MW. It owns over 10,000 miles of power lines.
- SMUD meets slightly more than 50 percent of its customer load with zero-carbon emitting resources and offers SMUD customers the option to receive 100 percent of their power from green sources.
- SMUD is governed by a seven-member board of directors, with each board member representing a specific ward within the service territory. Each member is elected to a four-year term by SMUD customers in their respective wards.
- SMUD is part of the Balancing Authority of Northern California (BANC), a Joint Powers Agency consisting of six public utilities. BANC assumed balancing authority responsibilities from SMUD in 2011.

SMUD's Planning Process

SMUD used a collaborative planning process for its IRP development, with input from all major SMUD departments, the board of directors, and the public. SMUD's resource planning team lead the IRP development process while collaborating with numerous SMUD departments, including: power generation, energy trading, grid planning and operations, load forecasting, pricing and rates, and others. IRP planning presentations

were conducted at six board meetings over the course of 2018, each of which provided the opportunity for public comments. The public provided nearly 50 IRP comments during these meetings, which were considered by SMUD staff and the board in developing the IRP. SMUD plans to use the same process for developing its next IRP in 2022.

SMUD's board has traditionally provided annual guidance to the resource planning process through strategic directions. The utility expects this process of refreshing and revisiting the long-term planning process to continue.

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 methodology used in developing the demand forecast, if a POU uses a forecast other than the CEC's adopted demand forecast.⁵ The demand forecast and supporting information provided were determined to present an adequate estimation of future energy and peak demand that meets the *POU IRP Guidelines* requirements.

Energy and Peak Forecast, Methodology and Assumptions⁶

SMUD's demand forecast was internally developed and based on expected weather conditions. SMUD's demand forecast is expected to be relatively flat due to slow growth in the region, energy efficiency programs, and the growth of customer solar photovoltaic (PV), or rooftop solar, and battery installations.

The expected increase of electric vehicles and building electrification will increase demand. In 2019, time-of-day (TOD) rates became the default rates for residential customers. This widespread implementation of TOD rates is expected to shift demand away from peak hours and to reduce overall annual demand.

SMUD used statistical regression modelling to forecast demand and peak load through 2030. SMUD's forecast techniques normalized electricity use for variation in temperatures, seasonal use, number of customer accounts, and recent trends. Key factors taken into account in the forecasts include demand response, energy efficiency, electrification of transportation and buildings, behind the meter distributed energy resources, and TOD electric rates. Although the CEC and SMUD forecasts have some

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

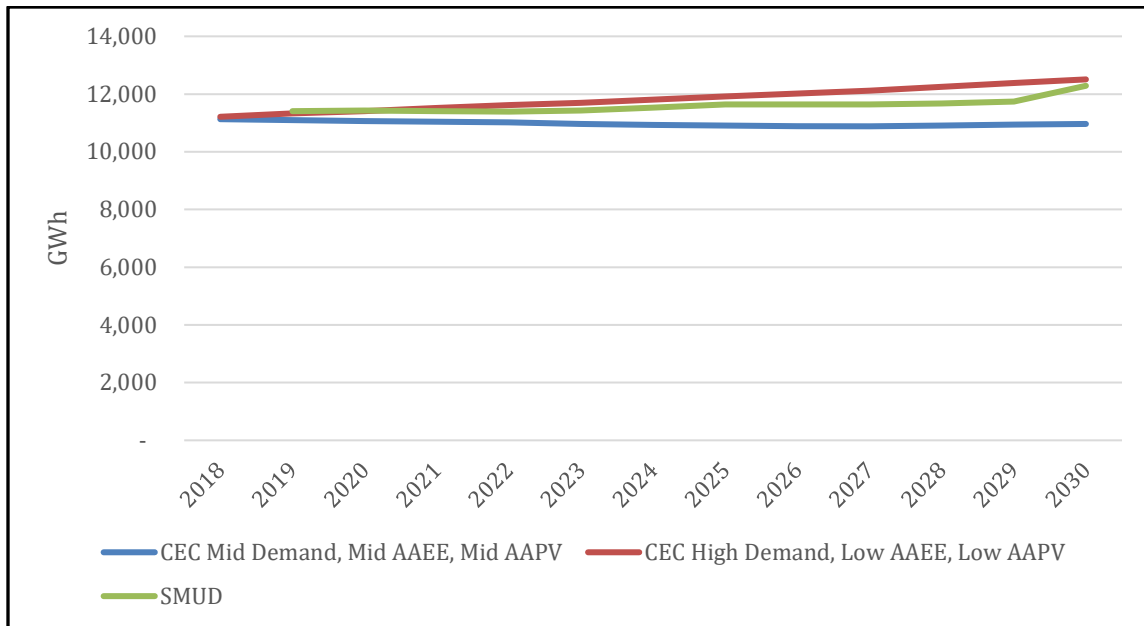
⁵ The most recent adopted demand forecast is for the *2018 Integrated Energy Policy Forecast Update*. https://www.energy.ca.gov/2018_energypolicy/documents/

⁶ For the purposes of IRP filings, a load-serving entity's net energy for load is the total amount of energy that it must generate or purchase to meet its retail load obligations. It includes retail consumption and transmission, distribution, storage and other losses, but excludes energy needed to meet wholesale sales obligations.

differences, the differences are not large enough to have major impacts for a long-term planning context.

As shown in **Figure 1**, SMUD’s demand forecast is between the CEC’s 2018 Mid Demand, Mid AAEE, Mid AAPV IEPR demand forecast and the 2018 High Demand, Low AAEE, Low AAPV IEPR demand forecast.⁷ SMUD expects slow growth in its energy demand over the forecast period. Growth in EV numbers and building electrification will increase energy demand, but that is expected to be offset to some extent by slow growth in housing stock and business activity, along with increases in customer-sited solar and battery storage. SMUD’s energy demand is forecast to increase from 11,404 GWh in 2019 to 12,296 GWh in 2030.

Figure 1: SMUD and CEC Energy Forecasts 2018 to 2030 (GWh)

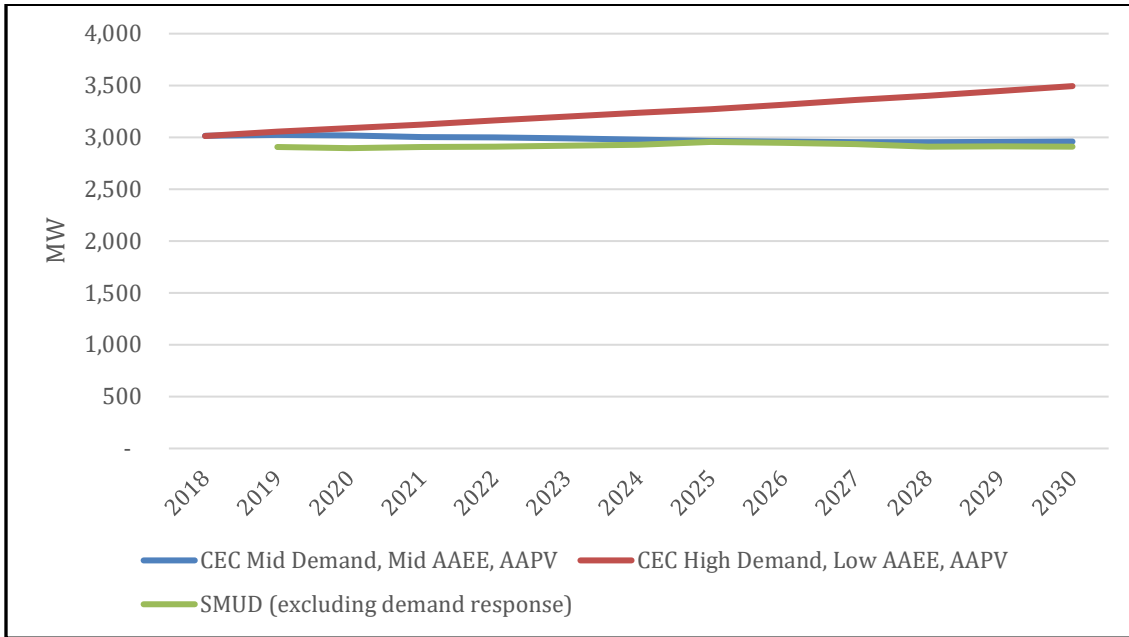


Source: California Energy Commission staff, based on SMUD IRP filing and California Energy Commission 2019 Demand Forecast

As shown in **Figure 2**, SMUD’s peak load forecast is slightly lower than both of the CEC’s peak load forecasts. In contrast to SMUD’s energy demand forecast, SMUD’s peak load is forecast to be flat through 2030. More widespread implementation of TOD rates is a key factor that will contribute to keeping SMUD’s peak load flat through the forecast period.

⁷ The CEC develops several demand forecasts as part of its Integrated Energy Policy Report. Staff compared SMUD’s forecast to the “Mid Demand, Mid AAEE Mid AAPV” and the “High Demand, Low AAEE Low AAPV” forecast. AAEE refers additional achievable energy efficiency and AAPV refers to AAPV.

Figure 2: SMUD and CEC Peak Forecasts 2018 to 2030 (GWh)



Source: California Energy Commission staff, based on SMUD IRP filing and California Energy Commission 2019 Demand Forecast

Resource Procurement Plan

The CEC's *POU IRP Guidelines* require that a POU report the mix of resources they plan to use to meet demand from 2018-2030.⁸ The *POU IRP Guidelines* also require a POU to include in the IRP, data and supporting information sufficient to demonstrate that the POU is meeting the various targets and goals. Based on staff's review, SMUD's IRP filing meets these guideline requirements. The following discusses SMUD's existing resources, its procurement strategy, the portfolio analysis underlying resource selections, and the resources in 2030 identified in the standardized forms.

Existing Resources

SMUD's current resource portfolio consists of a mix of hydroelectric power, combined cycle natural gas plants, peaking natural gas plants, wind, solar, biomass, biogas, and geothermal. SMUD has five thermal generation stations with a capacity of 1012 MW, three hydro resources with a capacity of 1013 MW, and renewable energy capacity of 613 MW. Wind energy is SMUD's largest renewable resource, followed by solar.

SMUD's natural gas resources include the 495 MW Cosumnes Power Plant, the 182 MW Proctor & Gamble cogeneration project, the 160 MW Campbell Soup Cogeneration Plant, the 103 MW Carson Cogeneration Plant, and the 72 MW McClellan Gas Turbine facility. SMUD's hydroelectric resources include the 672 MW Upper American River Project and

⁸ *POU IRP Guidelines*, Chapter 2, page 6.

336 MW of small and large hydroelectric capacity under contract with the Western Area Power Authority (WAPA).

SMUD has numerous biomass, geothermal, small hydro, solar and wind resources, the largest of which are the 230 MW Solano Wind Project and 98 MW of feed-in tariff solar projects.

Resource Portfolio Evaluation

After consulting with staff and stakeholders, SMUD's board determined that the primary objective of the IRP would be to identify a path towards carbon neutrality while maintaining the financial health of the company and providing maximum benefits for customers, the community and the Sacramento region. SMUD began its analysis by examining the long-term role of its existing resources, including natural gas and hydro resources, to understand the flexibility and limitations of its electricity system. The utility then identified opportunities both in its resource portfolio and more broadly across the region to identify greenhouse gas (GHG) reduction options. SMUD then analyzed the costs and benefits of alternative scenarios.

On the demand side, SMUD evaluated customer programs for energy efficiency, renewables (solar rooftop), and building electrification. On the supply side, SMUD limited its assessment to mainly renewable resources and battery storage due to considerations including cost, technical maturity, and potential risks. SMUD used the California Public Utilities Commission RPS Calculator and E3's RESOLVE model to help analyze the types and locations of potential future resource additions, with the constraints of reducing GHG emissions to 1 million metric tons by 2040 and restricting resource options to GHG-free sources, battery storage, and market capacity purchases.^{9,10} The RESOLVE model was used as a capacity expansion model to determine the least cost portfolio of new resources. SMUD's net energy for load is forecasted to increase from 11,300 GWh in 2020 to almost 12,000 GWh in 2030. GHG-free resources are expected to increase from 51 percent of system load in 2019 to 69 percent in 2030.

SMUD examined three IRP scenarios in its planning process. The first scenario, which SMUD adopted, has a goal of 1.35 million metric tons (MMT) GHG emissions by 2030 and significant efforts towards increased building and transportation electrifications. SMUD's electrification plan in this scenario is expected to lead to at least a 1 MMT reduction in GHG emissions from buildings and vehicles by 2040, offsetting emissions from SMUD's power plants.

SMUD's second scenario was similar to the first scenario, except it examined higher levels of GHG emissions reductions. SMUD looked at GHG emissions targets of 750,000, 500,000 and 350,000 metric tons by 2040 in this scenario. All of the GHG targets in this

⁹ E3 is an energy consulting firm.

¹⁰ RESOLVE is a resource investment model that identifies optimal long-term generation and transmission investments in an electric system, subject to reliability, technical, and policy constraints.

scenario would have required significant renewable energy generation outside of SMUD’s service territory, reducing the benefits to the local area.

SMUD’s third scenario looked at a goal of zero GHG emissions by 2040. This scenario would require the retirement of SMUD’s gas-fired generation facilities and would also create large operational challenges. To achieve this scenario, SMUD would incur significant costs and raise rates dramatically. This scenario was dismissed due to the excessive costs that it would have incurred.

Procurement Strategy

SMUD’s existing resource portfolio is well diversified, with significant thermal natural gas, hydroelectric, solar, wind, and other resources. SMUD considered a variety of resource technologies as well as locations for future resources in its IRP, and its adopted scenario will primarily add wind, solar, and battery storage resources. As shown in **Table 1**, from 2019 to 2030, solar energy procurement will almost quadruple and wind energy will increase 77 percent. SMUD will also continue to rely on market purchases from the California Independent System Operator (California ISO) and the Pacific Northwest. SMUD will implement more widespread demand response, increasing demand response from 96.5 MW in 2019 to 171 MW in 2030.

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

		2019	2025	2030
Total Net Energy for Load		11,404,490	11,636,849	12,285,888
Non-RPS	Solar PV	361,848	608,252	1,145,546
	Large Hydroelectric	2,282,252	2,271,005	2,274,609
	Natural Gas	3,939,687	4,032,180	3,057,921
	Nuclear	0	0	0
	Storage	0	0	347,202
	Spot Purchases	3,132,788	2,534,485	2,305,946
	Spot Sales	(1,508,774)	(1,852,371)	(1,850,867)
RPS Resources	Biofuels	1,145,937	1,224,905	1,205,388
	Geothermal	273,903	362,374	351,036
	Small hydroelectric	88,017	88,396	89,827
	Solar PV	53,119	545,875	816,440
	Wind	1,636,348	1,822,554	2,899,211
Total Energy Procured		11,405,125	11,637,655	12,642,259
Surplus/(Shortfall)		635	805	356,371

Source: California Energy Commission staff, based on SMUD IRP filing

SMUD’s adopted scenario is focused on reducing GHG emissions to 1 million metric tons by 2040, allowing it to meet GHG emission goals and RPS requirements while minimizing rate increases. Use of natural gas power plants will decrease in the future while renewable energy increases. SMUD determined that complete elimination of fossil

fuel resources is not feasible because it would result in much higher costs and/or lower system reliability.

As shown in **Table 2**, SMUD’s fossil fuel-based resource capacity is not expected to increase for the forecast period. SMUD is focused on battery storage, renewable energy, and distributed energy resources for future resource additions. Market purchases will be necessary to make up capacity shortfalls throughout the forecast period.

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

		2019	2025	2030
Peak Demand		2,796	2,807	2,712
Planning Reserve Margin		464	493	517
Peak Procurement Requirement		3,260	3,300	3,229
Non-RPS	Solar PV	90	126	145
	Large Hydroelectric	973	973	973
	Natural Gas	932	878	865
	Nuclear	0	0	0
	Storage	0	0	246
RPS Resources	Biofuels	144	150	161
	Geothermal	27	36	36
	Small hydroelectric	40	40	40
	Solar PV	15	109	132
	Wind	104	130	229
Total Capacity Procured		2,324	2,441	2,826
Surplus/Shortfall		(936)	(859)	(403)

Source: California Energy Commission staff, based on SMUD IRP filing

CHAPTER 2:

Review for Consistency with PUC Section 9621 Requirements

This chapter summarizes the main elements of SMUD’s IRP and provides staff’s findings regarding the consistency of the IRP filing with PUC Section 9621 requirements, as well as the *POU IRP Guidelines*. These include whether the utility meets GHG emission 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 (CARB), in coordination with the CEC and the California Public Utilities Commission.¹¹ These GHG targets reflect the electricity sector’s percentage in achieving the economy-wide GHG emission reductions of 40 percent from 1990 levels by 2030. Staff reviewed the GHG emissions associated with SMUD’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 SMUD’s portfolio to ensure consistency with other data and information available to staff.

Staff finds that SMUD plans to achieve the GHG emission target range established by CARB of 1.1 to 1.9 million metric tons of carbon dioxide equivalent (MMT CO₂e). SMUD’s resource portfolio results in roughly 1.3 MMT CO₂e, towards the lower end of the range established by CARB and within the requirement of PUC Section 9621(b)(1). SMUD used the RESOLVE model to determine a portfolio of resources that would meet specific GHG emissions targets. **Table 3** shows GHG emissions for SMUD’s portfolio of resources in 2019, 2025, and 2030. **Table A-3** in **Appendix B** identifies the emission intensities and total emissions for individual resources for all years.

¹¹ Public Utilities Code Section 9621(b)(1).

Table 3: Greenhouse Gas Emissions from SMUD Resources Portfolio

	Fuel Type	GHG Intensity (MT CO ₂ e/MWh)	Total Emissions (MMT CO ₂ e)		
			2019	2025	2030
Campbells CC	natural gas	0.460	0.128	0.262	0.039
Carson CC	natural gas	0.601	0.001	0.000	0.000
Cosumnes CC NG	natural gas	0.378	1.284	1.105	0.927
Proctor Gamble	natural gas	0.474	0.201	0.247	0.181
McClellan	natural gas	0.706	0.002	0.001	0.000
Net spot market	system	0.428	0.695	0.292	0.195
Total Portfolio emissions	NA	NA	2.311	1.906	1.342

Source: California Energy Commission staff, based on SMUD IRP filing

Renewables Portfolio Standard Planning Requirements

PUC Section 9621(b)(2) requires that POU IRPs ensure procurement of at least 50 percent renewables portfolio standard by 2030 consistent with Article 16 (commencing with Section 399.11) of Chapter 2.3.¹² Staff reviewed the renewable procurement table, the discussion in the IRP filing, and the renewable procurement plan submitted. Staff finds that SMUD plans to meet the RPS procurement target requirements and all interim compliance periods, and is consistent with the requirements of PUC Section 9621(b)(2).

SMUD’s existing RPS resources include wind, solar, small hydro, biofuels, and geothermal. Current wind energy resources include the 230 MW Solano Wind Project and the 50 MW High Winds project, both of which are located in Solano County near Rio Vista. SMUD’s solar resources include 60 MW of solar PV located in Fresno County and 11 MW of solar PV at its Rancho Seco site.

SMUD’s RPS procurement plan is consistent with current legislation. Although SB 100 was enacted after SMUD completed its IRP modelling, SMUD updated its RPS procurement plan to address the SB 100 target of 60 percent by 2030 pursuant to the direction of its Board. The procurement targets in SMUD’s IRP incorporate the SB 350 targets of 40 percent by 2024, 45 percent by 2027, and 50 percent by 2030. For the intervening year soft targets, the IRP assumes linear increases from the end of the interim compliance period established by the law. The IRP also forecasts retail sales reductions from SMUD’s green pricing and shared renewable generation programs through 2030.

¹² PUC Section 9621(b) requires the governing board of POU 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. SB 100 (De León, Chapter 312, Statutes of 2018) increases the RPS requirement for 2030 from 50 to 60 percent. However, since the POU were required to adopt their IRPs before SB 100 went into effect, the POU was only required to plan for the 50 percent RPS target in their IRP. Future POU IRPs will need to meet RPS requirements in effect when updates are filed.

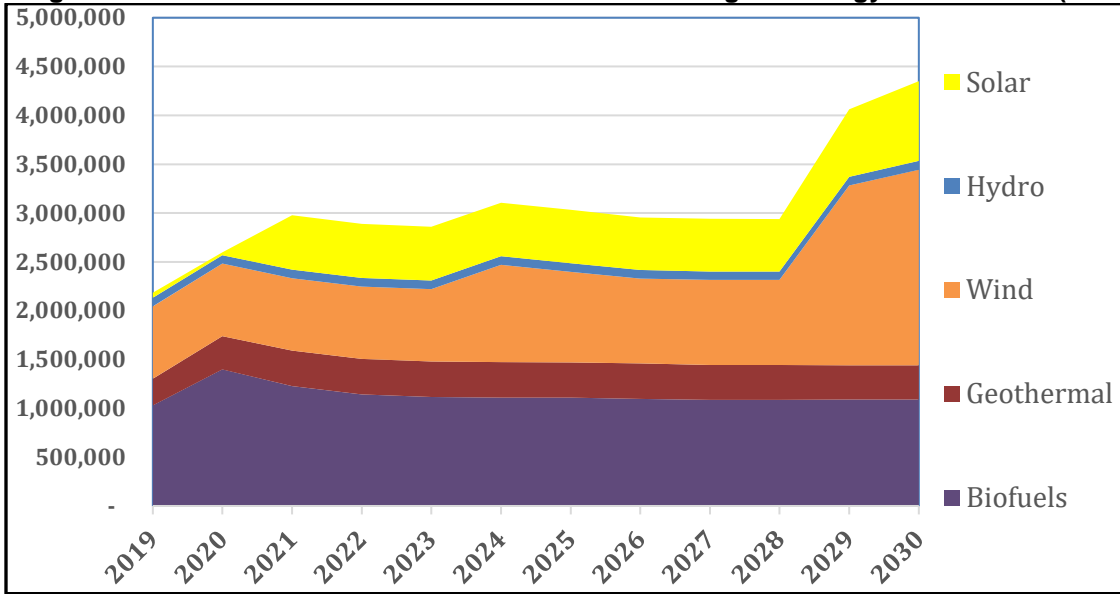
Based on the information reported in the IRP, SMUD forecasts applying sufficient RPS procurement from existing and planned resources, its bank of excess procurement and historic carryover, and generic RPS additions to meet its RPS procurement target in 2030 and all interim compliance periods. SMUD's RPS procurement plan states that SMUD expects to retire RECs from existing and planned resources to fully achieve RPS compliance through 2024, and will either extend contracts or contract for new resources to achieve compliance in subsequent compliance periods.

In addition to meeting the renewable energy procurement target, SMUD must meet portfolio content category requirements and long-term procurement requirements. There are three portfolio content categories defined in the Public Utilities Code, and SMUD's IRP states that it intends to fully meet their requirements. The long-term procurement requirement takes effect January 1, 2021 (unless a POU elects for early compliance) and requires that at least 65 percent of procurement applied for a compliance period come from contracts of 10 years or more in duration or utility ownership. The IRP states that SMUD intends to comply early with the long-term procurement requirement. In addition, SMUD's board has adopted procurement requirements consistent with this requirement.

SMUD investigated a variety of renewable resources for the IRP. SMUD expects to add significant wind and solar resources to meet its future needs, along with smaller increases in geothermal and biomass resources. Many of California's wind resource areas have been developed already, so SMUD plans to increase its wind resource capacity by importing wind energy from New Mexico. Future solar resources include 100 MW of additional capacity at the Rancho Seco site and a long-term contract for 100 MW of solar PV from the Navajo solar project in Southern California.

Figure 3 shows the total energy procured from each renewable energy technology type from 2019-2030.

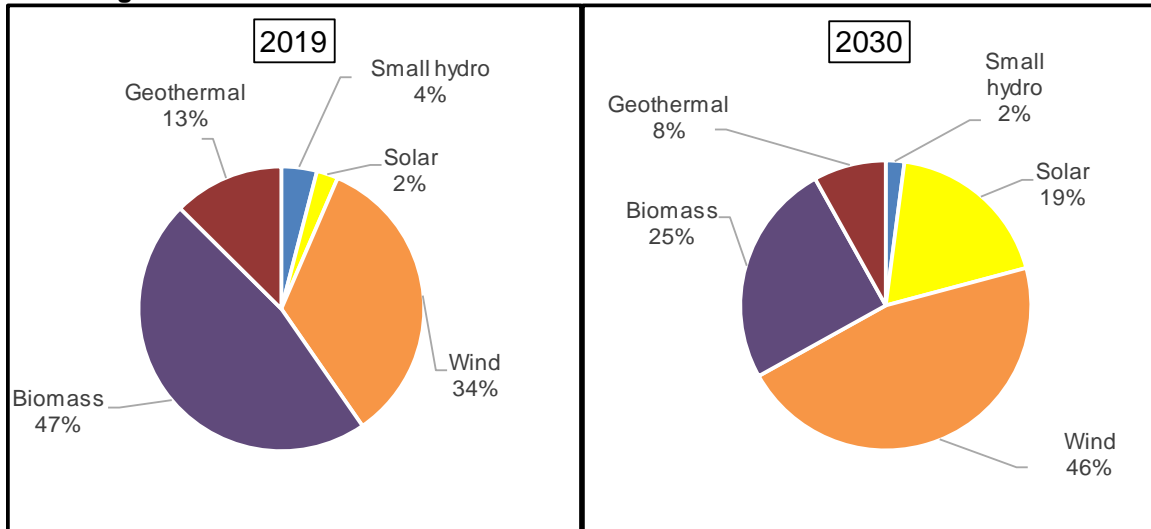
Figure 3: Sources of Renewables Portfolio Standard Eligible Energy 2019 to 2030 (MWh)



Source: California Energy Commission staff, based on SMUD IRP filing

Figure 4 shows the percentage of renewable energy by technology in 2019 and 2030.

Figure 4: SMUD Renewables Portfolio Standard Resource Mix in 2019 to 2030



Source: California Energy Commission staff, based on SMUD IRP filing

These figures illustrate that wind and solar energy procurement will increase significantly while other sources of renewable energy will remain relatively flat through the forecast period. Because of the large growth in solar and wind, the other renewable technology types will decrease in percentage terms of SMUD’s renewable energy sources.

Retail Rates

PUC Section 9621(b)(3) requires POU's 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 SMUD presented in its IRP filing on the rate and bill impacts from different resource portfolios they evaluated. Staff finds the SMUD IRP is consistent with the rates discussion, as required in PUC Section 9621(b)(3).

SMUD typically reviews and sets rates on a two-year cycle. SMUD's board has adopted a guidance document on competitive rates that states, among other things, that SMUD should establish rate targets that are 18 percent below PG&E's rates, reflect the cost of energy when it is used, encourage energy efficiency and conservation, and meet the electricity service needs of people with low incomes and severe medical conditions. In 2019, SMUD is transitioning most of its residential customers to TOD rates, while commercial and industrial customers have been subject to TOD rates for several years. Of the IRP scenarios that SMUD examined, the adopted scenario is expected to result in lower rate increases than the alternative scenarios. Under the adopted scenario, the average system rate is expected to be 12.96 cents per kWh in 2020 and rise to 14.36 cents per kWh in 2030.

System and Local Reliability

SB 350 (De León, Chapter 547, Statutes of 2015) requires filing POU's to adopt an IRP that ensures system and local reliability and addresses resource adequacy requirements.¹³ Staff reviewed the SMUD IRP and the capacity reporting table and discussion and finds that SMUD has planned for sufficient resources to maintain a reliable electric system. In addition, SMUD'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

SMUD is the operator of BANC, which is the third largest balancing authority in California. BANC consists of SMUD and five other member utilities, and is responsible for safeguarding reliability, matching generation to load, and coordinating system operations with neighboring balancing authorities. For planning purposes, SMUD plans to have sufficient resources to meet 1-in-2 peak load¹⁴ conditions plus a 15 percent planning reserve margin, which is consistent with the Western Electricity Coordinating Council's (WECC) criteria and matches requirements used by California ISO and

¹³ Public Utilities Code section 9621(b)(3).

¹⁴ A 1-in-2 peak means there is a 50 percent chance of demand being higher or lower under normal weather conditions.

California Public Utilities Commission for resource adequacy.¹⁵ In addition to its IRP modelling, SMUD's annual transmission assessment evaluates issues related to system reliability.

Local and Flexible Capacity Needs

SMUD does not have significant transmission constraints within its territory that would require separate local reserve requirements. SMUD has over 1,000 MW of thermal capacity within its territory, which allows SMUD to ensure that its transmission ties remain fully available. Other generators in the BANC further contribute to local capacity reserves.

Flexible Capacity Needs

SMUD assessed contingency reserves, frequency response, regulation reserve capacity, and hour-ahead flexibility reserves for the IRP. SMUD's transmission system modelling indicated that SMUD's system meets all required North American Reliability Corporation (NERC),¹⁶ WECC, and SMUD performance criteria. SMUD's dispatchable natural gas and hydroelectric resources provide system flexibility and contribute to meeting flexible capacity needs. However, SMUD's analysis indicated that reactive power¹⁷ support will be required in the future for the proposed level of renewables to maintain steady state stability and to keep bus voltages within acceptable limits under certain conditions. SMUD is planning various system upgrade projects to begin to address these issues. In addition, SMUD joined the California ISO-operated Energy Imbalance Market (EIM) in April 2019. Joining the EIM is expected to provide improved flexibility in SMUD's operations and help to integrate additional renewable energy on SMUD's system.

Transmission and Distribution Systems

PUC Section 9621(b)(3) also requires filing POU's to adopt an IRP that ensures that the POU achieves the goal of strengthening the diversity, sustainability, and resilience of the bulk transmission and distribution systems, and local communities. Staff determined that SMUD plans to adequately maintain and enhance its transmission and distribution systems. Staff finds SMUD has planned for enough transmission to adequately deliver resources to its service area to meet the requirements, as discussed below. Staff also finds that SMUD conducts sufficient 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.

¹⁵ WECC is a not-for-profit organization that works to effectively and efficiently mitigate risks to the reliability and security of the Western Interconnection's Bulk Power System. WECC operates under a Federal Energy Regulatory Commission approved delegation agreement with the North American Electric Reliability Corporation and in accordance with WECC's bylaws.

¹⁶ NERC is a not-for-profit international regulatory authority whose mission is to ensure the effective and efficient reduction of risks to the reliability and security of the grid.

¹⁷ Reactive power is either generated or absorbed by electric generators or, in some cases, capacitors to maintain a constant voltage level, commonly referred to as providing "voltage support."

Transmission System

SMUD's transmission systems consist of 115 kV and 230 kV overhead and underground lines that are interconnected to the PG&E and WAPA transmission systems via 230 kV interties and a shared 230 kV substation. SMUD's transmission system is evaluated annually as part of BANC's annual 10-year transmission assessment. The assessment includes analyses to ensure the reliability of the system and to ensure compliance with the NERC TPL-001 Reliability Standard.¹⁸ The 2018 assessment demonstrated that SMUD's transmission system meets all required performance criteria.

SMUD also analyzed its transmission system using loads and resources forecasted for 2040. As indicated earlier, additional reactive power support will likely be needed in the future. SMUD has several transmission system projects planned through 2022 to increase the reliability of its transmission system and address potential issues identified in its analyses.

Distribution System

SMUD prepares distribution system plans to evaluate past performance of the distribution system and to anticipate future needs. The plan identifies parts of the distribution system that may be affected by local load growth, such as development projects in the downtown Sacramento area and the growth of indoor cannabis cultivation operations. SMUD's current distribution plan includes adding 85 miles of distribution lines and 31 substation projects.

SMUD is also working towards implementing an advanced distribution management system, expanding substation automation and line automation, and reinforcing its infrastructure to support the integration of higher levels of distributed energy resources.

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 SMUD's IRP filing to determine the extent to which they are minimizing local air pollutants with a priority placed on disadvantaged communities. Staff finds that SMUD has made efforts to address these issues in selecting the resources they plan to include in their portfolio consistent with the requirement.

¹⁸ The purpose of NERC TPL-001 is to establish transmission system planning performance requirements within the planning horizon to develop a Bulk Electric System that will operate reliably over a broad spectrum of system conditions and following a wide range of probable contingencies.

SMUD used the CalEnviroScreen¹⁹ tool to identify disadvantaged communities. Three of SMUD's natural gas plants are located within disadvantaged communities. Criteria air pollutants from these power plants are projected to decline over time as SMUD increases its renewable energy resources and decreases its utilization of fossil fuel resources.

SMUD has also added equipment to its cogeneration plants that are located in disadvantaged communities that will decrease steam demand from the cogeneration facilities and allow them to operate less often, thereby decreasing emissions. In addition, transportation electrification efforts in the Sacramento area, which are discussed in the Transportation Electrification section on page 20, will lower emissions from freeway corridors that in many cases run through disadvantaged communities.

Net Energy Demand in Peak Hours

PUC Section 9621(c) requires POUs to consider existing renewable generation portfolio, grid operation efficiency, energy storage, distributed energy resources, and energy reduction measures (such as energy efficiency and demand response) in an effort to reduce the need for new or additional gas-fired generation, distribution and transmission resources. SMUD's IRP includes a discussion of how preferred resources can contribute to meeting peak demand. The IRP is consistent with the requirement that POUs address how they can meet peak hour demand with renewable and other preferred resources.

Currently, SMUD's peak demand occurs from 4 to 6 p.m. during the summer. The load shape is expected to flatten over time as energy efficiency, building electrification, and electric vehicle charging all increase. SMUD has analyzed future net demand for various expected future conditions, including summer peak hours and spring low-load conditions. The flexibility of SMUD's system will allow it to operate while minimizing renewable energy curtailment. SMUD's hydroelectric, natural gas, and future battery storage resources provide significant flexibility to the system.

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.

Energy Efficiency and Demand Response Resources

Staff finds that SMUD's IRP is consistent with the requirements in PUC Section 9621(d)(1)(A) as it includes a discussion of energy efficiency and demand response

¹⁹ The California Environmental Protection Agency's California Communities Environmental Health Screening Tool (CalEnviroScreen) identifies California communities by census tract that are disproportionately burdened by, and vulnerable to, multiple sources of pollution.

programs it plans to implement and quantifies the amount of energy efficiency savings it plans to achieve.

SMUD's energy efficiency programs have resulted in 1,668 GWh of savings over the past ten years, equal to about 1.5 percent of system load. SMUD has a number of programs to promote energy efficiency. For commercial and industrial customers, SMUD provides incentives to promote the installation of energy-efficient lighting, HVAC, motors, and refrigeration equipment and controls. SMUD also provides incentives to builders to design commercial and industrial buildings that are 10 to 30 percent more energy efficient than required by the Building Energy Efficiency Standards. For residential customers, SMUD provides incentives and financing for energy efficient improvements such as mini split heat pumps, whole house fans, and heat pump water heaters. SMUD also provides residential customers with incentives for energy efficient appliances and lighting.

Building electrification is a key component of SMUD's energy efficiency strategy. To meet its goals, SMUD estimates that 85 percent of residential and 75 percent of commercial space and water heating must be converted from gas to electric. SMUD currently has incentives in place to encourage switching from gas to electric water heating. The building electrification effort is expected to accelerate towards the end of the forecast period. Although building electrification will increase demand, the GHG emissions from this increase will be more than offset by reduced emissions from natural gas

SMUD also has a number of demand response programs in place and is continually researching new programs. SMUD uses demand response to contribute towards capacity reserves and reserve margin needs. As of 2018, SMUD's demand response capacity is 86 MW, an amount that could double by 2030.

The Peak Corps Program is a residential air conditioning load management program that has the capacity to reduce demand by 60 MW. The Peak Corps Program is not recruiting new customers and will decline in the coming years, but it will be replaced by a different air condition load management program that is expected to grow to 40 MW by 2030. SMUD also has individual agreements with some large industrial customers that provides the ability to curtail up to 6.5 MW of load within 10 minutes.

Table 4: SMUD Additional Achievable Energy Efficiency Estimates (GWh)

	AAEE (GWh)	SB 350 Targets (GWh)
2019	16	98
2020	85	195
2021	178	300
2022	276	414
2023	394	530
2024	508	643
2025	612	746
2026	754	840
2027	900	925
2028	1050	1001
2029	1196	1068
2030	1322	

Source: California Energy Commission staff, based on SMUD IRP filing

Energy Storage

Staff finds that SMUD’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.

In 2017, SMUD adopted an energy storage target of 9 MW of energy storage and is currently developing battery and thermal storage programs to meet this target. SMUD has conducted a number of small-scale energy storage research projects in the past but does not expect large-scale energy storage to become cost effective until 2025 or later. SMUD’s flexible hydroelectric and gas generation resources perform many similar functions to those performed by energy storage, limiting the need to add energy storage. After 2025, SMUD expects energy storage to become cost-effective on a larger scale; the adopted scenario includes the addition of 246 MW of battery energy storage in 2030.

Transportation Electrification

Staff finds that SMUD’s IRP is consistent with the requirement of PUC Section 9621(d)(1)(C), as it addresses transportation electrification, primarily for light-duty vehicles.

Transportation electrification is part of SMUD’s overall strategy of increased electrification in its service territory. SMUD promotes the adoption of electric vehicles (EVs) through purchase incentives, investments in charging infrastructure, and consumer education. As of 2018, there were about 9,400 light duty EVs (LDEV) in Sacramento County. SMUD estimates that the Sacramento region will need over 200,000 light duty EVs by 2030 and approximately 1 million by 2050 in to meet the State’s greenhouse gas emission goals.

Specific EV-related incentives that SMUD offers include cash incentives for EV buyers, residential Level 2 charger incentives, and incentives for EV chargers at workplaces and multi-family residential housing. SMUD also offers EV owners an EV TOD rate that is designed to encourage EV charging after midnight. SMUD has looked at the grid impacts of increased EV charging and is investigating smart charging solutions, in addition to strengthening its distribution system to mitigate potential impacts.

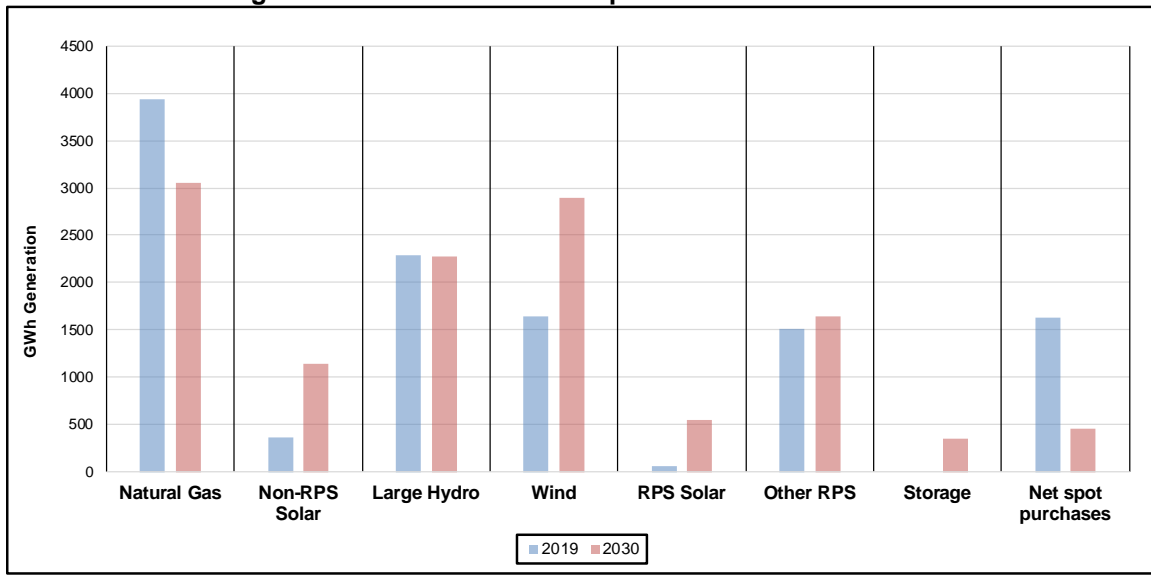
SMUD is also participating in research projects related to medium and heavy duty EVs to prepare for the expected future increase in EV adoption in that segment of the market. School bus fleets, refuse trucks, and shuttle buses are expected to be the first fleets to electrify in the medium-duty and heavy-duty EV sector.

Portfolio Diversification

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

SMUD’s current resource portfolio is very diverse, with a mix of fossil fuel and renewable resources. Natural gas, hydroelectric, solar, and wind are all significant portions of SMUD’s current resource mix. SMUD analyzed several resource portfolio options and selected the one that would allow it to meet State requirements while limiting cost increases. SMUD does not expect to need additional fossil fuel resources over the forecast period. In order to meet GHG reduction and RPS goals, SMUD is planning to procure additional wind, solar, and energy storage resources. **Figure 5** shows a comparison of the energy mix by resource in SMUD’s preferred portfolio in 2019 and 2030.

Figure 5: SMUD Portfolio Comparison for 2019 and 2030



Source: California Energy Commission staff, based on SMUD IRP filing Energy Balance Table

Geothermal resources from the Pacific Northwest and Nevada are potential resources that SMUD may procure if they are available at competitive prices. SMUD will also increase its demand response from 96.5 MW in 2019 to 171 MW in 2030, and the utility will promote energy efficiency, transportation electrification, and building electrification.

ACRONYMS

Acronym	Term
AAEE	Additional achievable energy efficiency
AAPV	Additional achievable photovoltaic
California ISO	California Independent System Operator
CARB	California Air Resources Board
CEC	California Energy Commission
CO ₂	Carbon dioxide
CO ₂ e	Carbon dioxide equivalent
GHG	Greenhouse gas
<i>IEPR</i>	<i>Integrated Energy Policy Report</i>
IRP	Integrated resource plan
mt	Metric ton
MW	Megawatt
MWh	Megawatt-hour
POU	Publicly owned utility
PUC	Public Utilities Code
RPS	Renewables Portfolio Standard
SB 350	Senate Bill 350 (De León, Chapter 547, Statutes of 2015)

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 2019 California Building Energy Efficiency Standards that new residential 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 modelling.

Bundled renewable energy credit: An electricity product that, when procured by the POU claiming the electricity product to satisfy its RPS procurement requirements, includes both 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 pursuant to 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.

Noncoincident peak demand: The largest amount of power a POU must generate or procure in any hour of the year. Compare this to coincident peak demand which is the amount of power the POU must generate or procure in the hour in which system wide demand is greatest. Noncoincident peak demand is referred to as peak demand throughout these guidelines.

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.

Renewables 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 (e.g., firm and spot market sales).

Scenario: A set of assumptions about future conditions used in power system modelling 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, but not limited to, 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)

Technology		2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	
Total Net Energy for Load		11,404,490	11,423,942	11,402,233	11,390,547	11,427,872	11,523,820	11,636,849	11,638,930	11,639,869	11,669,288	11,738,155	12,285,888	
Non-RPS Resources	Campbells CC	Natural Gas	275,699	211,919	558,292	564,698	543,861	517,579	569,356	498,437	381,666	362,270	84,821	
	Carson CC	Natural Gas	2,203	1,396	1,114	1,318	1,107	1,448	613	548	520	512	826	
	Cosumnes CC NG	Natural Gas	3,258,795	2,905,294	2,980,351	2,927,064	2,945,304	2,945,392	2,938,274	2,918,784	2,851,186	2,793,558	2,777,754	2,567,432
	Proctor Gamble	Natural Gas	400,494	408,264	525,406	542,282	509,903	521,588	523,137	480,463	471,140	415,361	485,061	405,050
	McClellan	Natural Gas	2,496	1,216	968	1,184	1,152	1,280	800	416	608	352	704	192
	Loon	Large Hydroelectric	70,703	70,488	70,520	70,645	70,581	70,599	70,718	70,748	70,906	70,939	71,139	71,777
	Union Valley	Large Hydroelectric	109,007	109,264	109,341	109,340	109,314	109,075	109,298	109,280	109,165	109,206	109,196	109,186
	Jaybird	Large Hydroelectric	501,947	503,690	504,531	504,525	504,178	503,979	504,385	504,501	504,432	503,409	503,518	494,457
	Camino	Large Hydroelectric	344,673	345,936	345,490	346,132	346,012	346,061	344,485	344,598	346,534	345,530	345,899	349,760
	White Rock	Large Hydroelectric	537,168	536,681	536,782	538,007	537,620	536,452	537,859	538,411	538,875	536,186	538,565	545,000
	WAPA Base Res	Large Hydroelectric	718,754	718,690	718,750	718,754	718,867	718,790	704,260	704,455	704,377	704,424	704,819	704,429
	FIT SS	Solar PV	161,599	185,787	0	0	0	0	0	0	0	0	0	0
	Rancho Seco PV 2	Solar PV	0	0	241,967	239,849	240,434	238,229	237,110	237,561	235,596	233,223	231,425	232,543
	RanchoSeco PV	Solar PV	23,095	23,041	22,852	22,742	22,631	22,576	22,410	22,300	22,189	22,077	21,968	21,880
	Recurrent PV	Solar PV	177,154	174,906	174,386	174,386	171,618	172,130	171,618	168,850	168,850	169,353	168,850	166,082
	Generic Solar	Solar PV	0	55,148	53,820	86,970	119,210	148,952	177,114	211,114	252,900	296,815	377,893	377,893
	Generic Storage	Storage	0	0	0	0	0	0	0	0	0	0	0	347,202
	Spot Purchases	N/A	3,132,788	3,113,292	2,308,310	2,369,155	2,427,070	2,460,447	2,534,485	2,516,721	2,575,448	2,632,997	1,980,260	2,305,948
	Spot Sales	N/A	(1,508,774)	(1,554,508)	(1,737,707)	(1,724,957)	(1,711,874)	(1,910,142)	(1,852,371)	(1,654,334)	(1,545,092)	(1,422,125)	(1,949,717)	(1,850,867)
	RPS resources	Cosumnes CC	Biofuels	633,305	1,002,330	1,002,631	1,086,385	1,085,661	1,086,987	1,087,289	1,087,590	1,086,867	1,088,193	1,088,494
Jones Fork		Small Hydroelectric	14,185	14,121	14,234	14,242	14,096	14,099	14,132	14,203	14,182	14,159	14,040	15,018
Robbs Peak		Small Hydroelectric	41,637	41,474	41,107	41,264	41,115	41,053	41,729	41,683	41,203	41,326	41,263	43,580
SlabCreek		Small Hydroelectric	11,264	11,742	11,677	11,763	11,832	11,688	11,564	11,442	11,163	10,959	10,713	10,490
Solano Phase 1		Wind	91,820	91,911	91,729	91,820	91,820	91,911	91,729	91,820	91,820	91,958	91,820	91,820
Solano Phase 2		Wind	147,580	147,726	147,434	147,580	147,580	147,726	147,434	147,580	147,801	147,801	147,580	147,580
Solano Phase 3		Wind	375,400	375,789	375,400	375,400	375,400	375,789	375,400	375,400	375,400	375,789	375,400	375,400
Cal Energy		Geothermal	136,884	199,308	223,380	223,380	223,380	223,992	223,380	223,380	223,380	223,992	223,380	223,380
Camp Far West		Small Hydroelectric	20,931	20,402	20,856	20,887	20,914	20,466	20,971	20,918	20,832	19,731	20,779	20,739
FIT RPS		Solar PV	53,119	28,190	211,970	210,818	210,572	209,780	208,179	207,060	205,655	205,126	204,071	202,940
Grady Wind		Wind	894,884	899,684	894,884	894,884	894,884	899,684	894,884	894,884	894,884	899,684	894,884	894,884
High Winds		Wind	126,664	126,821	126,664	126,683	126,664	126,821	58,138	0	0	0	0	0
Kiefer 1		Biofuels	69,122	69,322	69,122	69,122	69,122	69,122	69,122	69,122	69,122	69,322	69,122	69,122
Kiefer 2		Biofuels	47,470	47,606	47,470	47,470	47,470	47,606	47,470	47,470	47,470	47,606	47,470	47,470
Patua 1		Geothermal	137,019	140,188	139,882	140,750	140,981	140,140	138,994	137,453	134,738	132,981	130,013	127,656
Rancho Seco PV 2		Solar PV	0	0	44,599	44,063	43,478	43,625	44,149	41,044	43,009	43,312	44,527	40,755
Simpson Biomass		Biofuels	339,976	340,907	169,522	0	0	0	0	0	0	0	0	0
Yolo Landfill		Biofuels	21,024	21,082	21,024	21,024	21,024	21,082	21,024	10,426	0	0	0	0
Generic Solar		Solar PV	0	0	299,360	296,454	296,454	294,465	293,547	290,641	290,641	288,634	445,246	572,745
Generic Biomass		Biofuels	35,040	35,136	35,040	35,040	8,640	0	0	0	0	0	0	0
Generic Wind	Wind	0	0	0	0	0	254,969	254,969	254,969	254,969	255,196	1,226,268	1,389,527	
Undelivered RPS Energy		(635)	(301)	(925)	(576)	(203)	(1,820)	(805)	(1,005)	(2,346)	(4,762)	(28,446)	(9,169)	
Total Energy	N/A	11,404,490	11,423,942	11,402,233	11,390,547	11,427,872	11,523,820	11,636,849	11,638,930	11,639,869	11,669,288	11,738,155	12,285,888	
Surplus/Shortfall	N/A	0	0	0	0	0	0	0	0	0	0	0	0	

Source: California Energy Commission staff, based on SMUD IRP filing

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

	Technology	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	
Peak Demand		2,796	2,780	2,782	2,781	2,784	2,787	2,807	2,795	2,776	2,741	2,728	2,712	
Planning Reserve Margin		464	469	477	481	484	488	493	497	502	507	511	517	
Peak Procurement Requirement		3,260	3,249	3,259	3,262	3,268	3,275	3,300	3,292	3,278	3,248	3,239	3,229	
Non-RPS Resources	Campbells CC	Natural Gas	160	160	160	160	160	160	160	160	160	160	160	
	Carson CC	Natural Gas	103	103	103	103	103	103	103	103	103	103	103	
	Cosumnes CC NG	Natural Gas	415	368	370	361	362	362	361	361	358	356	348	
	Proctor Gamble	Natural Gas	182	182	182	182	182	182	182	182	182	182	182	
	McClellan	Natural Gas	72	72	72	72	72	72	72	72	72	72	72	
	Loon	Large Hydroelectric	79	79	79	79	79	79	79	79	79	79	79	79
	Union Valley	Large Hydroelectric	41.3	41.3	41.3	41.3	41.3	41.3	41.3	41.3	41.3	41.3	41.3	41.3
	Jaybird	Large Hydroelectric	136	136	136	136	136	136	136	136	136	136	136	136
	Camino	Large Hydroelectric	153.4	153.4	153.4	153.4	153.4	153.4	153.4	153.4	153.4	153.4	153.4	153.4
	White Rock	Large Hydroelectric	228	228	228	228	228	228	228	228	228	228	228	
	WAPA Base Res	Large Hydroelectric	336	336	336	336	336	336	336	336	336	336	336	
	FIT SS	Solar PV	47	52	0	0	0	0	0	0	0	0	0	
	Rancho Seco PV 2	Solar PV	0	0	63.2	62.2	61.6	60.3	58.9	58.3	56.9	56.1	55.2	
	RanchoSeco PV	Solar PV	6	6	6	6	6	5	5	5	5	5	5	
	Recurrent PV	Solar PV	36.8	35.6	35.3	34.4	33.9	33.5	32.6	32	31.5	31.1	30.7	
	Generic Solar	Solar PV	0	11	10	15	21	25	29	33	39	44	50	
	Generic Storage	Storage	0	0	0	0	0	0	0	0	0	0	246	
RPS resources	Cosumnes CC	Biofuels	81	127	125	134	133	133	134	134	137	139	147	
	Jones Fork	Small Hydroelectric	12	12	12	12	12	12	12	12	12	12	12	
	Robbs Peak	Small Hydroelectric	22	22	22	22	22	22	22	22	22	22	22	
	SlabCreek	Small Hydroelectric	3	3	3	3	3	3	3	3	3	3	3	
	Solano Phase 1	Wind	10	10	10	10	10	10	10	10	11	11	11	
	Solano Phase 2	Wind	16.4	16.7	16.8	16.8	17	17	17.2	17.3	17.5	17.6	17.6	
	Solano Phase 3	Wind	31	32	32	33	33	33	33	34	34	34	34	
	Cal Energy	Geothermal	17	25.5	25.5	25.5	25.5	25.5	25.5	25.5	25.5	25.5	25.5	
	Camp Far West	Small Hydroelectric	4	4	4	4	4	4	4	4	4	4	4	
	FIT RPS	Solar PV	15.4	7.9	58.9	58.2	56.9	56.4	55.3	54.4	53.2	52.5	51.5	
	Grady Wind	Wind	33	32	32	32	32	32	31	31	31	31	31	
	High Winds	Wind	13.9	14.2	14.3	14.3	14.4	14.6	0	0	0	0		
	Kiefer 1	Biofuels	8	8	8	8	8	8	8	8	8	8	8	
	Kiefer 2	Biofuels	5.7	5.7	5.7	5.7	5.7	5.7	5.7	5.7	5.7	5.7	5.7	
	Patua 1	Geothermal	10	10	10	10	10	10	10	10	10	10	10	
	Rancho Seco PV 2	Solar PV	0	0	11.7	11.4	11.1	11.1	11	10.1	10.4	10.4	10.6	
	Simpson Biomass	Biofuels	43	43	43	0	0	0	0	0	0	0	0	
Yolo Landfill	Biofuels	2.4	2.4	2.4	2.4	2.4	2.4	2.4	0	0	0	0		
Generic Solar	Solar PV	0	0	48	46	45	44	43	41	58	62	61		
Generic Biomass	Biofuels	4	4	4	4	0	0	0	0	0	0	0		
Generic Wind	Wind	0	0	0	0	0	0	0	0	31	60	75		
Total Capacity Procured		2,324	2,342	2,461	2,420	2,418	2,419	2,404	2,401	2,452	2,489	2,506	2,787	
Surplus/Shortfall		-936	-907	-798	-842	-850	-856	-897	-891	-826	-759	-733	-442	

Source: California Energy Commission staff, based on SMUD IRP filing

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

	Fuel Type	GHG Intensity (MT CO ₂ e/MWh)	Total Emissions (MT CO ₂ e)											
			2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Campbells CC	natural gas	0.46	0.128	0.098	0.258	0.260	0.251	0.238	0.262	0.229	0.175	0.140	0.166	0.039
Carson CC	natural gas	0.60	0.001	0.001	0.001	0.001	0.001	0.001	0.000	0.000	0.000	0.000	0.000	0.000
Cosumnes CC NG	natural gas	0.38	1.284	1.136	1.156	1.127	1.125	1.116	1.105	1.089	1.055	1.025	1.011	0.927
Proctor Gamble	natural gas	0.47	0.201	0.202	0.258	0.263	0.245	0.248	0.247	0.224	0.218	0.190	0.220	0.181
McClellan	natural gas	0.71	0.002	0.001	0.001	0.001	0.001	0.001	0.001	0.000	0.000	0.000	0.000	0.000
Net spot market	system	0.43	0.695	0.667	0.244	0.276	0.306	0.236	0.292	0.369	0.441	0.518	0.013	0.195
Total Portfolio emissions	NA	NA	2.311	2.105	1.918	1.928	1.929	1.840	1.906	1.912	1.890	1.875	1.411	1.342

Source: California Energy Commission staff, based on SMUD IRP filing

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 gigawatthours, 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 gigawatthours, 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.)