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STAFF PAPER

Review of Los Angeles Department of Water and Power's 2017 Power 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 to review the integrated resource plans of identified publicly owned utilities to ensure they meet various requirements specified in the law, including GHG 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. Los Angeles Department of Water and Power submitted its *2017 Power Integrated Resource Plan* and supplemental information, which the Los Angeles City Council adopted on June 20, 2018, to the California Energy Commission for review on April 30, 2019. This staff paper presents the results of the Energy Commission staff review of the Los Angeles Department of Water and Power 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

California 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 various targets and planning goals from 2018 to 2030. The Energy Commission must review the IRPs to ensure consistency with the requirements of PUC Section 9621

The Los Angeles Department of Water and Power's (LADWP) *2017 Power Integrated Resource Plan*, submitted on April 30, 2019, outlines the utility's strategy for procuring future resources that meet the requirements of PUC Section 9621. The IRP provides a path forward as LADWP begins studying and determining the investments needed to achieve the goal of 100 percent clean energy. LADWP relied on system modeling to analyze the long-term economic, environmental, and operational impact of alternative resources. The utility concluded the most cost effective approach for meeting long-term energy needs is a combination of strategies, including early coal replacement, along with increases in energy efficiency, Renewables Portfolio Standard eligible renewables, local solar, energy storage, and electrification of the transportation sector.

As LADWP moves toward a 100 percent clean energy portfolio, the utility faces operational cost and integration challenges posed by increasing levels of intermittent renewable resources. LADWP is currently assessing system reliability to determine viable clean alternatives to repowering of its in-basin natural gas-fired generation. LADWP anticipates additional benefits from higher levels of transportation electrification, including reduced local greenhouse gas and other constituent emissions, by switching from higher emitting fuels (gasoline and diesel) to cleaner electricity. Transportation electrification is also expected to increase electric sales and revenue for the utility, while absorbing potential over-generation of renewables by incentivizing charging when solar production is abundant.

In reviewing LADWP'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 in accordance with the requirements of PUC Section 9621:

- *Achieving Greenhouse Gas Emissions Targets and Renewables Portfolio Standard Requirements:* The values reported in the standardized forms, along with the 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 requirements of PUC Section 9621(b)(2).
- *Meeting Planning Goals:* The values reported in the standardized forms, 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 forms, 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 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 forms 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).

The 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 other 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 LADWP, and update the targets as necessary.

CHAPTER 1: Background, Demand Forecast, and Procurement Plan

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 between 2018 and 2030, while achieving policy goals and mandates, meeting physical and operational constraints, and fulfilling other priorities such as reducing effects on customer rates. Each IRP filing must include data and supporting information sufficient to demonstrate the utility is meeting these goals and targets. 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 Los Angeles Department of Water and Power (LADWP) 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 30, 2019, LADWP submitted its IRP and supporting documentation as outlined in the *POU IRP Guidelines* to the CEC for review.³ Staff's review occurred in two stages. First, staff performed a completeness review to ensure the IRP filing contained the POU

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. <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.

board-adopted IRP, the four standardized tables, and 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 LADWP 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) procurement requirements, energy efficiency savings projections and programs, and plans for transportation electrification.

Overview of Los Angeles Department of Water and Power

LADWP is the largest municipal utility in the U.S. and California's third largest utility as described below:

- LADWP supplies power for over 1.5 million residential and business customers in the City of Los Angeles (City), as well as over 5,000 customers in the Owens Valley.
- Business and industry consume about 70 percent of the electricity in Los Angeles, while residents constitute the largest number of customers.
- In 2017, LADWP supplied about 26 million megawatt-hours (MWh) of electricity from its portfolio of over 7,880 MW of diverse thermal and renewable resources.
- LADWP's highest instantaneous peak demand of 6,502 MW occurred on August 31, 2017.
- LADWP has over 3,500 miles of overhead transmission circuits spanning five Western states and 124 miles of underground transmission.
- The LADWP distribution system includes about 6,750 miles of overhead distribution lines and 3,625 miles of underground distribution cables that serve its customers.

Los Angeles Department of Water and Power's Planning Process

LADWP has historically used integrated resource planning to determine the mix of future resources that will best serve its customers' electricity needs. LADWP's IRP is based on its *2017 Power Strategic Long-Term Resource Plan (2017 SLTRP)* that was

approved by the General Manager in April 2018.⁴ The *2017 SLTRP* re-examined and expanded LADWP's analysis of previous resource cases to align with the latest regulatory framework. Revised scenario assumptions included a 55 percent RPS (by 2030), advanced energy efficiency, and higher levels of local solar, energy storage, and transportation electrification. The City of Los Angeles Board of Water and Power Commissioners approved LADWP's IRP on November 27, 2018.

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 9621.⁵ In addition, under the *POU IRP Guidelines* (Chapter 2.E.2), the POU must provide information on the method used in developing the demand forecast if a POU uses a forecast other than the CEC's adopted demand forecast.⁶ The demand forecast and the supporting information provided were determined to present an adequate estimation of future energy and peak demand that meets the *POU IRP Guidelines* requirements.

LADWP forecasts that electricity consumption in its service territory will initially increase slowly and then remain flat over the next eight years as energy efficiency and customer installed solar PV expansion offset growth from economic activity. However, after 2027, annual demand is expected to rise again for LADWP. In total, between 2019 and 2030, LADWP forecasts its annual energy demand will grow about 11 percent, reaching 29.7 million MWh by 2030. LADWP forecasts annual peak demand over the next ten years will decrease from 5,898 MW in 2019 to 5,660 MW in 2030, with more reduction occurring over the latter years due to increased implementation of energy efficiency and solar PV programs. Also aiding the reduction of peak demand is the growth of demand response programs, which reduces peak demand by 125 MW in 2019 and about 500 MW in 2030.

Energy and Peak Forecast Methodology and Assumptions

LADWP's IRP uses its official 2017 Load Forecast for its customer demand for electricity by retail class over the next 20 years.⁷ The utility uses econometric models to forecast sales in residential, commercial and industrial classes. Trend models are used to forecast sales in the streetlight and Owens Valley classes. LADWP used the CEC's 2013 EV forecast for the electric vehicle sales. The drivers in the retail sales models include normalized weather, population, employment, construction activity, and personal

⁴ *2017 Power Strategic Long-Term Resource Plan*. LADWP. 2018.

<https://ladwp.com/ladwp/faces/ladwp/aboutus/a-power/a-p-integratedresourceplanning/a-p-irp-documents>

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

⁶ The most recent adopted demand forecast is for the *2018 Integrated Energy Policy Forecast Update*.

https://www.energy.ca.gov/2018_energypolicy/documents/

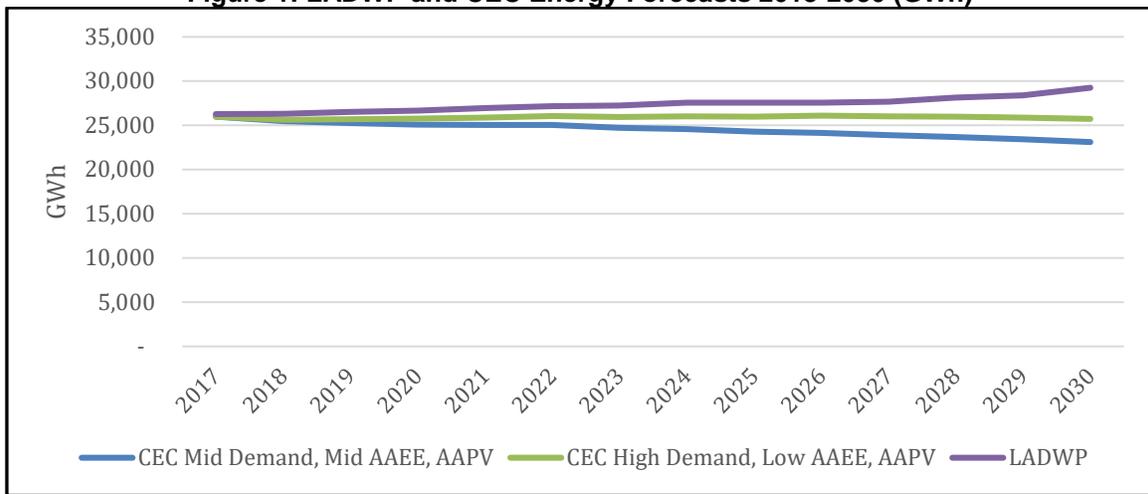
⁷ LADWP's 2017 forecast is used as the basis for transmission and distribution planning, wholesale marketing and other planning activities. The forecast is a public document that uses only publicly available information.

consumption and income. The retail sales forecasted from the class models are adjusted for LADWP programs that affect consumption behind the meter such as energy efficiency and net-metered solar generation, as well as known state regulations.

From the sales forecast, the utility develops an energy, or net energy for load, forecast by applying a normalized loss factor of 12 percent.⁸ LADWP used an econometric model to develop weather response functions to forecast peak demand. The weather response model includes temperature, heat buildup, and time of the summer, as drivers. Peak demand grows over time as a function of the energy forecast adjusted for energy efficiency, net-metered solar, residential lighting, and charging of electric vehicles. The energy forecast is allocated into an hourly shape using the Loadform algorithm developed by Global Energy. The inputs into the algorithm include forecasted energy, peak demand, minimum demand, and historical system average load shape.

The CEC’s energy demand forecast for LADWP in the high demand case (low AAEE and AAPV) remains relatively flat over the forecast periods,⁹ while the mid demand case (mid AAEE and AAPV) decreases.¹⁰ Both CEC forecasts are lower than LADWP’s forecast as shown in **Figure 1**.

Figure 1: LADWP and CEC Energy Forecasts 2018-2030 (GWh)



Source: California Energy Commission, based on 2017 LADWP IRP filing and California Energy Commission 2019 Demand Forecast

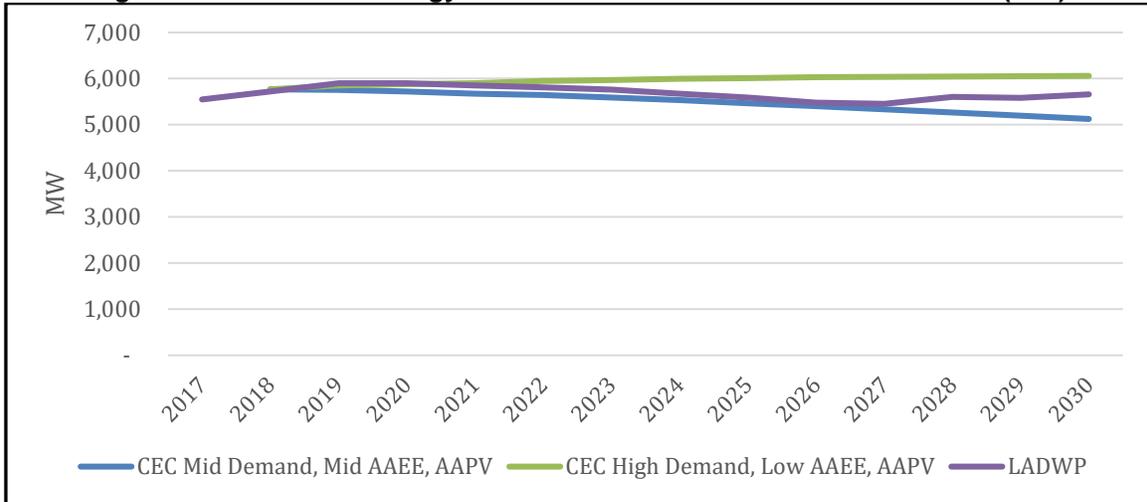
⁸ For the purposes of IRP filings, a load-serving entity’s net energy for load is the total amount of energy that it must generate or purchase to meet its retail load obligations. It includes retail consumption and transmission, distribution, storage and other losses, but excludes energy needed to meet wholesale sales obligations.

⁹ The Energy Commission forecast is *California Energy Demand Updated Forecast 2018-2030 (CEDU 2018)*, adopted February 20, 2019. It is available at <https://efiling.energy.ca.gov/Lists/DocketLog.aspx?docketnumber=18-IEPR-04>

¹⁰ The Energy Commission produced seven different demand forecast for load-serving entities/balancing authorities for the *2018 Integrated Energy Policy Report* that reflect varying demand conditions combined with varying amounts of energy efficiency and solar photovoltaic. AAEE refers to additional achievable energy efficiency and AAPV refers to additional achievable photovoltaic.

Figure 2 shows a comparison of LADWP’s peak demand forecast with the CEC’s forecasts. The CEC’s high demand forecast (low AAEE and AAPV) is relatively flat over the forecast period, while the mid demand case (mid AAEE and mid AAPV) shows a modest decline. For this figure, LADWP’s forecast falls between the CEC’s two cases.

Figure 2: LADWP and Energy Commission Peak Forecasts 2018 — 2030 (MW)



Source: California Energy Commission, based on 2017 LADWP IRP filing and California Energy Commission 2019 Demand Forecast

Resource Procurement Plan

The *POU IRP Guidelines* require that POU’s report the mix of resources they plan to use to meet demand from 2018 to 2030. POU’s are also required to provide an IRP with data and supporting information sufficient to demonstrate that the POU’s plan to meet targets and goals. Staff has determined that LADWP’s IRP meets the requirements. The following is a discussion of the utility’s existing resources, procurement strategy, the portfolio analysis underlying resource selections, and the resources in 2030 identified in the standardized forms.

Existing Resources

LADWP maintains a policy of owning or controlling transmission and generation resources to serve its customer loads. Generation assets not wholly owned by LADWP are entitlement rights from interests in facilities jointly owned with other utilities. At times, LADWP makes purchases from the electricity market to ensure reliability. LADWP’s existing resources are described below.¹¹ LADWP’s existing renewable resources are addressed in the section on Renewables Portfolio Standard Requirements.

¹¹ Descriptions of existing resources in this section come from LADWP’s 2017 *SLTRP*.

Hydroelectric Generating Facilities

LADWP owns the Castaic Pumped-Storage Hydroelectric Plant (Castaic) located in Castaic, California, which is its largest source of hydroelectric capacity. That plant consists of seven units totaling 1,175 MW of dependable capacity.¹² LADWP also has a power purchase agreement with the Western Area Power Administration (WAPA) for 432 MW of dependable capacity from the Hoover Dam, located on the Arizona-Nevada border.

LADWP owns a network of several small hydroelectric generating resources, referred to as the Owens Gorge and Owens Valley Hydroelectric Generation. These plants use water resources from the Los Angeles Aqueduct and three creeks along the eastern Sierra Nevada Mountains to provide about 136 MW of dependable capacity. In 2016, LADWP reconditioned or refurbished selected components of this system to extend the life, increase reliability, and improve efficiency. LADWP has a number of other small hydro resources north of Los Angeles, bringing the total dependable capacity from small hydroelectric facilities to 314 MW.

Natural Gas Power Plants

LADWP is the sole owner and operator of four natural gas-fired electric generation stations located in the Los Angeles Basin (or in-basin units), totaling about 3,533 MW of dependable capacity. LADWP owns and operates three coastal power plants in the southern portion of the Los Angeles Basin: Haynes Generating Station, Harbor Generating Station, and Scattergood Generating Station. These coastal power plants were constructed from the 1940's through the 1970's. The Haynes Generating Station is the largest of LADWP's in-basin natural gas plants with 11 generating units and a dependable capacity of 1,619 MW. The Harbor Generating Station combined cycle plant was modernized in 1995 to increase efficiency and reliability while reducing emissions and maintenance costs. It has eight units consisting of three combined cycle units and five peaking combustion turbines. Its dependable capacity is 558 MW. The Scattergood Generating Station has a dependable capacity of 798 MW; consisting of six units including combined cycles and combustion turbines. In addition to its coastal gas-fired plants, LADWP has the Valley Generating Station located in Sun Valley; which consists of four units with a combined dependable capacity of 558 MW.

To comply with the state's once-through-cooling (OTC) policy, LADWP is required to eliminate the use of ocean water for cooling at the three coastal plants. Originally, LADWP planned to rebuild and modernize these three natural gas facilities to improve fuel efficiency, reduce greenhouse gas (GHG) emissions, and increase flexibility to integrate renewable resources, while maintaining in-basin reliability. The first two

¹² Dependable capacity is the amount of generating capacity that can be reliably counted on during the peak demand.

modernization projects, Haynes CT1 through 6 and Scattergood CC3 and CT3, have been completed. LADWP is studying clean alternatives to repower the remaining units.

Out-of-State Generation

Historically, LADWP received baseload coal generation from four out-of-state coal facilities, including the Navajo Generating Station, of which three have been divested. LADWP has one remaining contractual arrangement for up to 1,192 MW of power from the Intermountain Power Project (IPP), located near Delta, Utah that expires in 2027. LADWP has greatly reduced its dependence on coal power. In 2015, IPP and the Navajo Generating Station accounted for about 36 percent of the power delivered to its customers. By 2025 that drops to 5.8 percent, with all coal removed from its portfolio of resources in 2027.

LADWP and other owners of IPP intend to convert the facility from a coal-fired power plant to a combined cycle natural gas power plant by 2025. This will allow LADWP to accelerate its divestiture of all coal by two years (in 2025 rather than 2027). LADWP notes that the size of the repowered project is being negotiated at 840 MW rather than full replacement of the 1,800 MW coal facility.¹³ LADWP intends to use the plant to provide flexible capacity to help integrate renewable generation by providing firm and shaped power.

LADWP also owns and operates the Apex Power Project, a natural gas facility located north of Las Vegas, Nevada. It was purchased on LADWP's behalf by the Southern California Public Power Authority (SCPPA) to help compensate for the early divestiture of the Navajo Generating Station. The project includes a combined cycle generation station consisting of one steam turbine generator and two simple cycle combustion turbines, for a total of about 500 MW of dependable capacity.

LADWP also has contractual entitlements totaling approximately 380 MW of dependable capacity from the Palo Verde Nuclear Generating Station located near Phoenix, Arizona that expire in the mid-2040s.

Spot Purchases and Sales

LADWP participates in energy markets even though LADWP has a policy of self-sufficiency, generating all of its energy needs from resources it owns or controls. When it is in LADWP's economic interest or when needed to maintain reliability, it purchases energy under short-term or spot arrangements from different providers in the WECC. Since the availability and cost of energy from spot markets fluctuates and it cannot guarantee the future availability of energy below the cost of its own resources, LADWP has not included spot market purchases in its long-term planning.

¹³ California's Emissions Performance Standard limits long-term utility investments in baseload generation by requiring plants to meet an emissions performance standard of 1,100 pounds CO₂ per megawatt hour to minimize GHG emissions. The repowering of IPP to a natural gas facility was certified by the Energy Commission as compliant with this standard in November 2018.

LADWP at times has a surplus of generating capacity and energy, which it offers into wholesale electricity markets at prices above their production costs or for reliability purposes. The utility's customers benefit from the revenue generated by these sales. LADWP notes there is uncertainty about California utilities' ability to price sales competitively in out-of-state markets, largely due to the costs of carbon that other states do not have to consider.

Resource Portfolio Evaluation

In developing its *2017 SLTRP*, LADWP examined 11 scenarios with different combinations of strategies to identify a portfolio of resources to meet the City's future needs at the lowest cost and risk, consistent with environmental priorities and reliability standards. LADWP's IRP includes updated assumptions that have influenced the potential resource portfolios. The strategies considered include early replacement of coal generation and higher levels of renewable resources, energy efficiency, local solar, energy storage, and transportation electrification. LADWP used average incremental generation costs (dollars per megawatt hour) and total CO₂ emissions (in million metric tons) as metrics to compare each scenario. Selection of a preferred scenario was driven mainly by assumptions about the load forecast, prices of fuel, and amount of CO₂ emissions.

One of the metrics used in evaluating the cases in the *2017 SLTRP* was the cost of GHG emissions reductions measured as the incremental cost of removing one metric ton of GHG. LADWP estimates that the scenario for early replacement of IPP coal generation has an incremental cost of \$12 per metric ton of GHG, which is lower than the anticipated cost of purchasing emission allowances under the cap-and-trade program. The incremental cost of removing one metric ton of GHG by increasing the RPS from 50 percent to 65 percent ranges from \$110 to \$130 per metric ton. A solar-focused RPS portfolio results in a net GHG increase compared to a diverse RPS portfolio due to the ramping up of local conventional resources to meet late afternoon peak demand. In addition, higher levels of solar resources increase the operational costs and challenges due to over-generation and ramping requirements.

The incremental cost of removing one metric ton of GHG through increased energy efficiency ranges from \$170 to \$190 per metric ton. Local solar and energy storage is less cost effective in removing GHG, with incremental costs ranging from \$1,200 to \$1,500 per metric ton for local solar and \$200 to \$400 per metric ton for energy storage. In contrast, the cost of GHG reduction through a high transportation electrification scenario ranges from \$40 to \$50 per metric ton.¹⁴ LADWP plans to use transportation electrification to absorb over-generation from renewables by incentivizing peak hour charging when solar energy is abundant.

¹⁴ This includes program cost and increased cost of additional energy needed for electrification (additional RPS, fuel, and emissions cost).

To understand how increasing generation of renewable resources impacts its power system, LADWP conducted additional analysis to evaluate the operational challenges associated with changes in the *net load*.¹⁵ This analysis is discussed in the section on Net Energy Demand in Peak Hours.

Procurement Strategy

Based on its portfolio and other related analyses, LADWP concluded that a combination of different strategies provides the optimal solution for meeting long-term environmental objectives, while providing reliable electric service in a cost effective manner. LADWP's recommended portfolio of resources to achieve GHG reductions includes the following components:

- Replacing coal resources two years ahead of schedule by 2025
- Accelerating RPS to 50 percent by 2025, 55 percent by 2030
- Doubling energy efficiency savings from 2017 through 2027
- Increasing local solar to 900 MW by 2025
- Implementing 404 MW of energy storage by 2025
- Accelerating transportation electrification (assuming 290,000 EVs in 2030 in LADWP's Base Case forecast) to reduce GHG emissions from the transportation sector

LADWP's recommended scenario is intended to balance the City's objectives of exercising environmental stewardship, while maintaining high reliability and competitive rates. The utility notes that the preferred scenario is based on a number of assumptions such as projected fuel and purchase power costs, renewable generation costs and GHG emission costs, which are uncertain. LADWP plans to monitor for any major changes that might affect costs going forward and reflect changes in future IRP and other planning processes. A summary of LADWP's projected capacity and generation portfolio can be seen in **Table 1** and **Table 2**.

¹⁵ Net load reflects the load that must be served by conventional dispatchable generation at times when renewable resources are not available.

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

		2019	2025	2030
Total Net Energy for Load		27,005,030	28,021,270	29,726,920
Non-RPS	Coal	4,557,750	1,635,050	0
	Large Hydroelectric	564,240	564,240	564,350
	Natural Gas	8,898,850	8,508,650	9,710,680
	Nuclear	3,177,000	3,177,000	3,176,380
	Storage (pump storage) + Battery	732,480	1,904,460	2,160,140
	Spot Purchases	0	0	0
	System Power	409,000	409,000	409,000
	non-RPS Solar	654,550	988,640	1,222,730
RPS Resources	Biofuels	104,240	0	0
	Geothermal	1,007,000	549,000	249,000
	Small hydroelectric	609,140	630,240	629,220
	Solar PV	3,260,180	3,751,040	4,346,820
	Wind	2,446,000	2,079,000	1,886,000
	Generic RPS-Eligible	724,000	4,915,000	6,356,000
Total Energy Procured		27,144,430	29,111,320	30,710,320
Undelivered RPS Energy		44,210	369,060	262,720
Surplus/Shortfall		95,190	720,990	720,680

Source: California Energy Commission, based on LADWP 2017 IRP filing

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

		2019	2025	2030
Peak Demand		6,341	7,185	7,800
Planning Reserve Margin		1,717	1,644	1,665
Peak Procurement Requirement		7,660	7,281	7,370
Non-RPS	Coal	1,192	0	0
	Large Hydroelectric	432	432	432
	Natural Gas	4,052	4,728	4,813
	Nuclear	388	388	388
	Pump Storage	1,175	1,335	1,335
	Solar (non_RPS)	367	575	725
	Storage (Battery)	128	221	221
	Planned System CapacRty Contract(s)	18	14	18
RPS Resources	Biofuels	12	0	0
	Geothermal	114	62	28
	Small hydroelectric	219	226	226
	Solar PV	545	897	1,034
	Wind	375	265	301
	Generic RPS	87	921	1,117
Total Capacity Procured		9,104	10,064	10,638
Surplus/Shortfall		1,444	2,783	3,270

Source: California Energy Commission, based on LADWP 2017 IRP filing

CHAPTER 2:

Review for Consistency with PUC Section 9621 Requirements

This chapter summarizes the main elements of LADWP'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 findings 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, in coordination with the CEC and California Public Utilities Commission.¹⁶ 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 LADWP'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 LADWP's portfolio to ensure consistency with other data available to staff.

Staff finds that LADWP'S plan achieves the GHG emission reduction target range established by the California Air Resources Board of 2.655 to 4.691 million metric tons of carbon dioxide equivalent (MMT CO₂e). As shown in **Table 3**, LADWP's resource portfolio is in the middle of the range, at roughly 3.682 MMT CO₂e, which is consistent with the requirement of PUC Section 9621(b)(1).

LADWP plans to use coal replacement, RPS, energy efficiency, local solar, and energy storage to reduce GHG emissions from the electricity sector to nearly 78 percent below 1990 levels over the next 20 years. Transportation electrification provides a significant opportunity to dramatically shift and reduce overall GHG emissions and can further reduce LADWP's GHG emissions to over 82 percent below 1990 levels. While the additional generation needed to charge a growing number of electric vehicles will increase LADWP's GHG emissions, LADWP found that the reduction in GHG emissions from the transportation sector through electrification is approximately four times that amount. The utility also found the amount of GHG emissions reduced by transportation electrification is more than double the amount of GHG emissions reduced through

¹⁶ Public Utilities Code Section 9621(b)(1).

utility specific clean energy resources. LADWP used the CEC Transportation Electrification calculator tool to estimate GHG emission reductions of 5.3 MMT between 2017 and 2030 from increased transportation electrification.

LADWP developed its own specific emission intensity for each power plant and resource in its portfolio. Staff evaluated these emission intensities and found them to be reasonable when compared with data from the Quarterly Fuel and Energy Report.¹⁷ Generation from each resource in LADWP’s portfolio was multiplied by the specific emission intensity to estimate their total portfolio emissions. Significant savings in emissions were achieved early in the planning horizon by divesting from coal plants. Later in the planning horizon between the years 2025 and 2027, 4.0 MMT of GHG emissions are eliminated by divestment of the remaining coal fired generation from IPP.

Table 3 shows GHG emissions for LADWP’s portfolio of resources in 2019, 2025, and 2030.

Table 3: Greenhouse Gas Emissions from LADWP Resource Portfolio

	Fuel Type	GHG Intensity	Total Emissions		
		(MT CO ₂ e/MWh)	(mt CO ₂ e)		
			2019	2025	2030
Harbor	natural gas	0.48	62,814	18,589	140,059
Haynes (New Units)	natural gas	0.42	82,523	129,612	2,117,945
Haynes (Existing Units)	natural gas	0.41	1,424,567	1,162,377	0
Scattergood (New Units)	natural gas	0.40	887,141	1,226,716	896,679
Scattergood (Existing Units)	natural gas	0.73	0	0	0
Valley	natural gas	0.42	277,677	174,301	36,482
APEX_X	natural gas	0.37	10,925	703	0
APEX1P1	natural gas	0.37	422,022	39,248	0
APEX2P1	natural gas	0.37	349,828	32,549	0
Cogen	natural gas	0.43	72,734	72,734	72,734
IPP1	coal	0.92	2,404,093	845,700	0
IPP2	coal	0.92	1,772,629	652,660	0
Utah CC	natural gas	0.37	0	575,377	562,260
DC Loss Payback	system	0.428	175,052	175,052	175,052
Total Portfolio Emissions	NA	NA	7,942,005	5,105,618	4,001,212
Adjusted Portfolio Emissions	NA	NA	7,717,686	4,742,263	3,682,938

Source: California Energy Commission, based on LADWP 2017 IRP filing

Appendix B includes a table identifying the emission intensities and total emissions for individual resources for all years.

¹⁷ The Quarterly Fuel and Energy Report (QFER) is the collection of energy data relating to electric generation, control area exchanges, and natural gas processing and deliveries in California: https://ww2.energy.ca.gov/almanac/electricity_data/web_qfer/index cms.php

Renewables Portfolio Standard Planning Requirements

PUC Section 9621(b)(2) requires that POU IRPs ensure procurement of at least 50 percent renewable energy resources by 2030, consistent with Public Utilities Code Article 16 (commencing with Section 399.11) of Chapter 2.3.¹⁸ Staff reviewed the renewable procurement table, the discussion in the IRP filing, and the renewable procurement plan submitted. Staff finds that LADWP's plans are consistent with the RPS procurement requirements in 2030 and all interim compliance periods and are consistent with the requirements of PUC Section 9621(b)(2).

LADWP's mix of renewable resources in 2018 included 40 percent solar, 34 percent wind, 11 percent eligible small hydro, 13 percent geothermal, and 0.7 percent biogas or biowaste. LADWP currently either owns or has power purchase agreements for nine wind facilities totaling about 232 MW of dependable capacity. In addition, LADWP owns or has power purchase agreements for 19 solar units for a total of about 804 MW of dependable capacity. In 2018, renewable generation accounted for 36 percent of retail sales.

LADWP's 2017 *SLTRP* sets targets that exceed the RPS targets of SB 350, including renewable generation of 55 percent of retail sales by 2030 and 65 percent by 2036. To meet these targets, LADWP plans to use existing as well as newly installed capacity from geothermal and biomass, wind, solar (local and utility), and generic RPS additions.

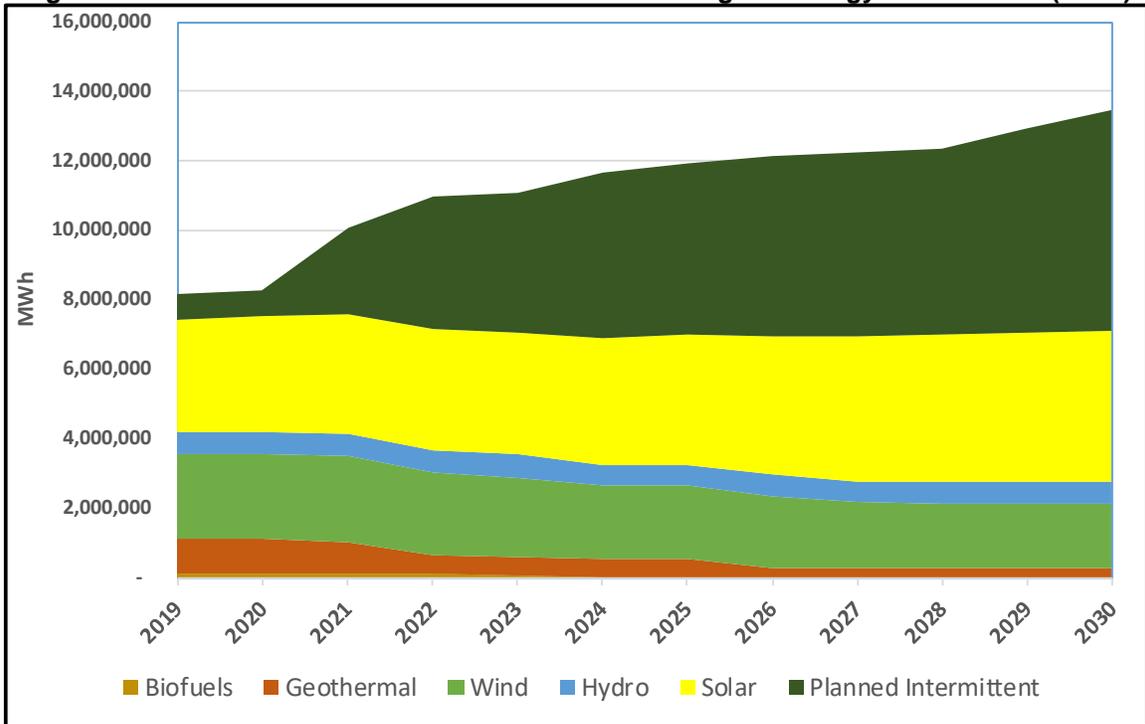
Figure 3 shows how LADWP's renewable portfolio will evolve and grow over the forecast period.

Existing geothermal production decreases substantially in 2022 due to the expiration of the contract with Hudson Ranch facility. Biofuels cease to be a part of LADWP's portfolio in 2024 when the power purchase agreement for this expires. By 2030, nearly half of LADWP's renewable portfolio will be made up of new planned renewable resources (mostly in the form of solar and generic renewables).

This aggressive plan will yield excess procurement renewable energy credits or RECs at the end of each RPS compliance period. According to the RPS Procurement Table, there will be 5,169,062 RECs at the end of the third compliance period. This number will increase to 15,078,329 by the end of the fourth compliance period. LADWP will have the option to use the excess RECs in future compliance periods. LADWP does not plan for future spot market purchases but will instead rely on renewable resource contracts and planned capacity.

¹⁸ PUC Section 9621(b) requires the governing board of POU's 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 energy 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's 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 the RPS requirements in effect when those updates are filed.

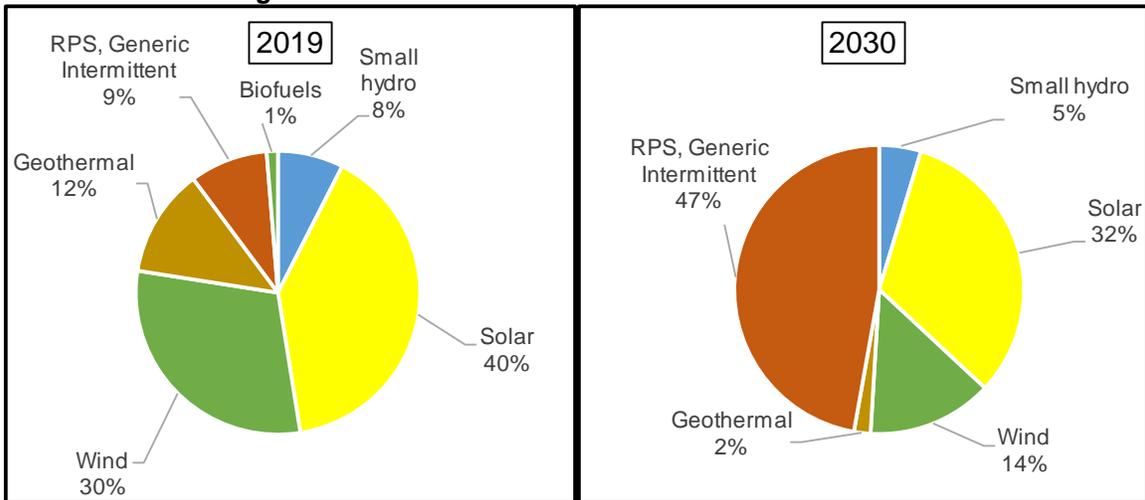
Figure 3: Sources of Renewables Portfolio Standard Eligible Energy 2019 — 2030 (MWh)



Source: California Energy Commission, based on LADWP 2017 IRP filing

Planned intermittent renewables in the form of wind, solar, and geothermal will ramp up significantly starting in 2020. Existing wind and geothermal resources will decrease slightly over the forecast period. **Figure 4** shows how the renewable portfolio of 2019 compares with the projected renewable portfolio of 2030.

Figure 4: LADWP Renewable Portfolios in 2019 to 2030



Source: California Energy Commission, based on LADWP 2017 IRP filing

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 LADWP presented on the rate and bill impacts from different resource portfolios it evaluated and finds the IRP is consistent with PUC Section 9621(b)(3).

For its recommended resource plan, LADWP examined the rate contributions from several component strategies, including energy efficiency, renewable energy, energy storage, coal replacement, OTC repowering, electrification, and power system reliability, between 2017 and 2037. The combined effect of meeting a 65 percent RPS, along with increased local solar, energy storage, and energy efficiency, would increase average retail rates from about 15 cents/kWh in 2017 to 28 cents/kWh in 2037. In contrast, coal replacement and OTC repowering result in avoided cost savings from decreased operations and maintenance and lower GHG emissions that decrease average retail rates. High transportation electrification also results in an overall decrease in rates due to increased energy sales. Together, all of the strategies described above result in significant savings to customers over the long-term, decreasing forecasted rates from 28 cents/kWh to 26 cents/kWh by 2037.

System and Local Reliability

Senate Bill 350 (De León, Chapter 547, Statutes of 2015) (SB 350) requires filing POU's to adopt an IRP that ensures system and local reliability and addresses resource adequacy requirements.¹⁹ Staff reviewed LADWP's capacity reporting table and discussion and finds that LADWP has planned for sufficient resources to maintain a reliable electric system. In addition, LADWP'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).

LADWP is its own balancing authority and as such is responsible for operating its electricity system in real time. This is done by finely balancing power system demand and supply while ensuring reliability.²⁰ This includes controlling generation and transmission of electricity within its control area, as well as between balancing authorities. The Western Electricity Coordinating Council (WECC) establishes operating standards that all balancing authorities must meet to ensure reliability. State law also requires POU's to meet WECC's most recently approved planning reserve and reliability criteria and "prudently plan for and procure resources that are adequate to meet its

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

²⁰ The North American Electric Reliability Corporation (NERC) requires balancing authorities to reliably plan for and operate bulk power systems. NERC delegates the authority to establish and enforce its reliability standards to regional entities, which includes the Western Electric Coordinating Council for the Western region of the U.S. and parts of Canada and Mexico.

planning reserve margin and peak demand and operating reserves, sufficient to provide reliable service to its customers.”²¹

System Reliability

NERC operating standards prescribe the amount of contingency and replacement reserves that a balancing authority must have in case of a generation or transmission outage. To comply with NERC operating standards, LADWP must carry additional generating capacity above its instantaneous load. LADWP plans for a 15 percent reserve margin based on a 1-in-10 peak demand, which typically occurs on hot summer afternoons.²² In addition to contingency reserve, LADWP plans for additional outages by carrying replacement reserves to cover unplanned outages of older generating units. LADWP also conducts an annual 10-year transmission assessment plan to maintain grid reliability and identify necessary improvements needed to avoid potential overloads on key segments of its transmission system.²³ LADWP's IRP filing demonstrates that the utility is planning appropriately to ensure reliable supplies for its customers.

Local Capacity Needs

LADWP uses its local thermal (natural gas) generating plants to provide voltage control and help the local transmission system operate reliably. However, as imports into the Los Angeles Basin have increased over time, the requirements for how much local generation must be on-line at any given time have decreased, reducing the voltage control options available to system operators. To address this issue, LADWP is installing static capacitors and reactors at strategic locations throughout its system.²⁴ Repowered natural gas generating units (Haynes CT 11 - 16 and Scattergood CC3 and CT3) also have the ability to operate condensers and provide voltage support.

As a subset of reserve requirements, LADWP has located significant generating resources in the Los Angeles area. The specific amount of capacity that needs to be located in the Los Angeles Basin is approximately 3,400 MW, but varies depending on the combination of units operating and the amount of power flowing on the transmission system at any given time. The amount of generation required to provide transmission reliability was incorporated into all of the strategic cases LADWP considered in its IRP. This local requirement is particularly important in deciding how to schedule repowering or replacement of OTC generation. Because of their importance to

21 Public Utilities Code Section 9620.

22 A 1-in-10 peak demand is the highest hourly customer demand that is expected to occur on one day in every ten years, or 10 percent of the time.

23 These overload conditions, if encountered, could require load shedding events (intentional power outages) as a means to protect the overall electric system.

24 Static capacitors are used in electrical supply systems for power factor correction. Power factor is the relationship of current and voltage in AC electrical distribution systems. Under ideal conditions, current and voltage are “in phase,” with a power factor of 100 percent.

reliability, no unit will be taken out of service before appropriate replacement options are constructed, tested and ready to be placed in-service.

Recognizing the need to reduce fossil generation, LADWP is reassessing all planned repowering projects until a system-wide, in-depth and independent study is completed. The study is evaluating various hybrid clean energy options, in addition to modernizing its existing natural gas plants, to comply with environmental regulations, improve efficiency, better integrate renewables and provide for transmission capability. The study will consider energy resources and transmission planning, necessary investments in modifying local transmission and other infrastructure, generation reliability requirements, alternative technologies, including energy storage and other viable solutions, costs, and potential rate impacts.²⁵

Flexible Capacity Needs

LADWP will need additional flexible resources to accommodate increasing levels of intermittent renewables while ensuring system reliability. LADWP notes that as their renewable portfolio continues to increase with large amounts of solar and wind, the resource adequacy paradigm shifts from meeting a historical 1-in-10 peak customer load to meeting a net peak load, which measures load minus variable resources. Large amounts of solar generation shift LADWP's peak hour from an afternoon peak to an evening peak. As a result, LADWP projects a resource shortfall starting in 2024, which means they have a critical need for dispatchable or flexible resources to contribute to meeting the evening peak. Meeting this need is further discussed in the section on Net Energy Demand in Peak Hours.

LADWP conducted a Maximum Generation Renewable Energy Penetration Study to assess the reliability implications of high levels of renewables and capture what LADWP characterizes as the true *all-in* costs, including integration costs.²⁶ The analysis concluded that a 50 percent RPS results in significant challenges in managing daily load variability, with increased need for regulation and load following as solar production increases. LADWP will need sufficient flexibility to significantly ramp down its generation as the sun rises and dramatically ramp up its generation as the sun sets. This analysis estimated that up to 150 MW per minute of additional up-regulation ramping capability and 85 MW per minute of additional down-regulation ramping capability could be needed in 2025-2030.²⁷

In 2025, LADWP expects that between 2,500 and 3,500 MW of generation may need to be placed on-line within a 3 to 5 hour period to meet the evening peak load as the sun sets.

25 Depending on the outcome of this study, LADWP will develop a new comprehensive plan for replacing existing in-basin OTC units that may be significantly different from the original plan to the State Water Resources Control Board to comply with the OTC Policy.

26 Maximum Generation Renewable Energy Penetration Study: <http://iec-corporation.com/mreps.html>.

27 Regulation services address normal short-term up and down fluctuations (second-to-second and minute-to-minute) in the aggregate output of resources, voltage, or frequency, which requires dispatchable generation under automatic generation control.

This will require thermal units and large hydro to turn on and off from a minimum loading (or cold start), to nearly maximum generation within a few hours on a daily basis. Additional regulation is also required to compensate for the sub-hourly fluctuations of variable energy resources.

To meet future load following and regulation needs, the study recommended:

- Adopting tools to assess flexibility reserves
- Adding storage for regulation in optimal locations
- Evaluating cost-effectiveness of fast start gas generation and other flexible resources
- Joining the California ISO's Energy Imbalance Market
- Upgrading equipment to reduce reliability must-run requirements.²⁸

To address the steepness of the ramping requirements, the study recommended improved resource diversification, modifying renewable contracts to alleviate integration issues, promoting electric vehicle charging during peak hours, and potential rate restructuring to mitigate renewable impacts.

Transmission and Distribution Systems

PUC Section 9621(b)(3) also 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 LADWP's IRP adequately plans to maintain and enhance its transmission and distribution systems. LADWP has planned for enough transmission capacity to deliver resources to its service area to meet the requirement as discussed below. In addition, 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

LADWP owns and/or operates an extensive transmission system consisting of over 20,000 miles of transmission and distribution circuits with operating voltages ranging from 120 volts to 500 kilovolts (kV). As previously mentioned, LADWP buys and sells excess electricity using its transmission in California and the WECC. LADWP also offers surplus transmission capacity for sale to other parties when it is available.²⁹ In addition, at critical times other neighboring utilities turn to LADWP to provide surplus energy and transmission resources to bolster their power systems and avoid blackouts. For

²⁸ Reliability must-run requirements are the amount of generation that must be online to ensure system reliability.

²⁹ LADWP uses the Open Access Same-Time Information System, an internet-based system for obtaining access to transmission services on high-voltage transmission for moving wholesale electricity, in accordance with Federal Energy Regulatory Commission Orders 888 and 889.

example, with the unexpected retirement of San Onofre Nuclear Generating Station in 2012, the California ISO and the California energy agencies, including the CPUC and CEC, are coordinating efforts with LADWP to ensure reliability in the Southern California region.

LADWP notes that transmission considerations are necessary inputs in resource planning so that alternative options are evaluated in a realistic and effective manner. As resource planning has become more dynamic and complex with the growing number of external factors, so has transmission planning.

LADWP will need adequate transmission for importing new renewable energy from distant locations, dealing with intermittent energy, switching away from coal (that may free up transmission capacity), addressing the need for potential new generation resources, and other resource planning issues. To access renewable resources located far from the City, LADWP has built new transmission and made a number of infrastructure improvements to increase transfer capabilities. In addition, since LADWP controls a large amount of transmission in the state and WECC, it intends to leverage those assets to best meet the needs of the City and its customers.

LADWP has identified a number of major transmission upgrades including:

- The Pacific Direct Current Intertie Upgrade
- The Haskell Canyon - Olive Transmission Line Project
- The Victorville - Los Angeles Project
- The Los Angeles Basin Projects.

Distribution System

Much of LADWP's power infrastructure, including its distribution system, was installed during the City's rapid growth between the 1940s and 1960s, and has reached the end of its useful lifespan. LADWP's Power System Reliability Program addresses the problem of LADWP's aging generation, transmission, substation, and distribution systems. The program maintains a robust and reliable power system through the replacement of infrastructure, such as the distribution poles, crossarms, transformers, and cables, as well as incorporating new technologies such as distribution automation. LADWP is looking ahead to new technologies, including smart grid applications that can benefit operations and improve reliability, while accommodating increased customer-owned distributed generation and renewables.³⁰ LADWP developed a Smart Grid

Implementation Program to adopt these technologies in a prudent, cost-effective, and phased manner that maximizes operational benefits for both customers and the utility. This program will incorporate high-tech digital devices throughout the transmission, substation and distribution system and integrate advanced intelligence to provide the

³⁰ Smart Grid refers to intelligent data gathering and advanced two-way digital communication capabilities overlaid on electric distribution networks to provide real-time data that enhances the utility's ability to optimize energy use.

information necessary to both optimize electric service and empower customers to make informed energy decisions.

The deployment of advanced metering technology will provide LADWP greater visibility into its distribution system, which is increasingly important with higher penetration of solar and other distributed energy resources. The installation of distribution automation devices will improve the measurement and control of voltage and VARs, which will improve reliability, power quality, and system efficiency.³¹ These smart grid technologies will enable LADWP to more efficiently integrate renewable generation. In addition, automated systems that manage the influx of electric vehicles (EV) can help the utility monitor the effects of EV charging on the grid and allow customers to understand how EV charging impacts their electricity use.

Disadvantaged Communities and Localized Air Pollutants

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

LADWP is located in the South Coast Air Basin, which despite significant improvements in air quality over the past 20 years still exceeds federal public health standards for ozone and particulate matter. Nitrous oxide (NO_x) emissions are a precursor to the formation of ground level ozone. In 2017, average annual emissions of NO_x in the South Coast Air Basin is 398 tons per day and is expected to decline to 214 tons per day by 2031. LADWP's in-basin power plants, which have advanced pollution control equipment, emit about 0.68 tons of NO_x per day, representing 0.17 percent of the 2017 average daily emissions for the South Coast Air Basin. As previously discussed, LADWP is currently assessing clean alternatives to the repowering of its in-basin power plants.

LADWP's Equity Metrics Data Initiative assesses how well its programs, services, and resources are distributed throughout the City and provides a tool for decision makers to ensure its programs reach all customers with fairness and equity. LADWP uses the California Environmental Protection Agency's California Communities Environmental Health Screening Tool (CalEnviroScreen) to incorporate metrics such as socioeconomic impacts, water pollution, and air pollution to identify any disparities in the data.

³¹ VAR is a unit of reactive power and stands for Volt Amperes Reactive. Reactive power is a by-product of alternating current systems when voltage and current are not in phase. Reactive power is required to maintain the voltage to deliver active power (watts) through transmission or distribution lines. VoltVAR optimization is a process of optimally managing voltage level and reactive power to achieve more efficient grid operation.

CalEnviroScreen is used to develop and modify LADWP's solar programs to provide services in an equitable and geographically diverse manner. Using a solar penetration metric, LADWP identified areas with low solar penetration and using CalEnviroScreen, confirmed that those areas were also disadvantaged communities. Based on this information, LADWP now has solar programs that offer increased monetary benefits and provide priority enrollment for customers living in areas of low solar penetration.

In addition, many of LADWP's transportation electrification programs and investments will directly benefit low income customers and provide health benefits through improved air quality for the entire community. Additional transportation electrification programs will be designed to address areas within the City with low EV penetration.

Net Energy Demand in Peak Hours

PUC Section 9621(c) requires POU's to consider existing renewable generation, grid operation efficiency, 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, distribution and transmission resources. LADWP's IRP includes a discussion of how preferred resources contribute to meeting peak demand and how that affects resource selection for its portfolio. This is consistent with the requirement that filing POU's address how they can meet peak hour demand with renewable and other preferred resources.

LADWP included a discussion of the potential role of preferred resources in helping to meet net peak demand when selecting its resource portfolio. To understand how increasing levels of renewable resources affect the electricity system, LADWP evaluated the operational challenges from changes in net load. As previously mentioned, LADWP originally designed its electricity grid to accommodate imports from other geographic regions (coming from east and north of the service territory). As a result, local thermal generating units are located in the southern portion of the local grid to provide voltage and frequency support, as well as to balance and ensure the reliability of the system. In the near-term, these local dispatchable natural gas resources are critical to system operations. In the longer term, LADWP will deploy viable clean resource alternatives as they become technically and economically feasible.

LADWP is studying how the utility can move toward a 100 percent clean electricity system. The study will include an examination of how best to use renewable resources, energy storage, demand response and other options to meet net peak energy demand.

Additional Procurement Goals

PUC Section 9621(d)(1) requires filing POU's to address procurement of energy efficiency and demand response, energy storage, transportation electrification, and a diversified portfolio, which are discussed below. The resource adequacy provisions of this code Section are discussed in the System and Local Reliability section on pages 18 to 19.

Energy Efficiency and Demand Response Resources

Staff finds that the LADWP 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 savings it plans to achieve.

Energy Efficiency Resources

Energy efficiency is a key strategic element in LADWP's resource planning efforts to include cost effective resources in its supply portfolio. Since 2007, LADWP has spent approximately \$795 million in capital and operations and maintenance on its energy efficiency programs, resulting in a reduction in energy consumption of approximately 3,275 GWh per year. LADWP is committed to implementing comprehensive energy efficiency programs with measurable, verifiable goals as well as maintaining an overall cost effective energy efficient portfolio.

Assembly Bill 2021 (Levine, Chapter 734, Statutes of 2006) requires POUs such as LADWP to identify, develop, and implement programs for all potentially achievable, cost-effective energy efficiency savings and establish annual targets. Utilities are also required to conduct periodic energy efficiency potential studies to update their forecasts and targets. In its 2017 Energy Efficiency Potential Study, LADWP concluded that it could cost effectively achieve another 15 percent energy efficiency from 2017 through 2027, in addition to the previously committed 15 percent from 2010 through 2020.³² By 2027, LADWP does meet the SB 350 Energy Efficiency Doubling Goals established by the CEC. LADWP's next EE Potential Study (in 2020) will establish targets through 2030. **Table 4** shows LADWP's estimated additional achievable energy efficiency from 2018 to 2030.

The energy efficiency programs required to meet the proposed savings targets of 15 percent will require substantial investments to continue at the same pace. This level of spending and energy savings is comparable to LADWP's most recent historic levels, setting it on a path to achieve the savings targets. Notably, this level of funding keeps LADWP on par with the state's investor owned utilities in terms of energy efficiency investment on a per-ratepayer basis, maintaining the utility's position as having the third largest portfolio of energy efficiency programs in California. Projected budgets per fiscal year between 2021 and 2027 range roughly between \$110 million and \$140 million annually.³³

³² *Energy Efficiency in California's Public Power Sector 11th Edition*. 2017. Southern California Public Power Agency and Northern California Power Agency.
<https://efiling.energy.ca.gov/Lists/DocketLog.aspx?docketnumber=17-IEPR-06>

³³ Figure 4-3: Recommended Targets - Projected Budget per Fiscal Year (FY 2021-FY2027), LADWP, 2017 IRP, p. 17.

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

	AAEE (GWh)	SB 350 Targets (GWh)
2018	690.0	1082.0
2019	965.0	1412.0
2020	1209.0	1713.0
2021	1588.0	2010.0
2022	1962.0	2304.0
2023	2344.0	2609.0
2024	2734.0	2926.0
2025	3132.0	3254.0
2026	3531.0	3586.0
2027	3922.0	3909.0
2028	3973.0	4230.0
2029	4017.0	4546.0
2030	4067.0	

Source: California Energy Commission, based on LADWP 2017 IRP filing

LADWP has numerous energy efficiency programs, including mass-market programs, commercial, industrial and institutional programs, and cross cutting programs. A few of the mass marketing programs include commercial direct install, direct install for schools, refrigerator exchange and recycling, home energy improvements, and consumer rebates. Commercial, industrial, and institutional programs include custom performance (advanced, high efficiency technologies and strategies), commercial lighting incentives, savings by design (building design and construction practices), and low-income economic development. Cross cutting programs include codes and standards advocacy, city plants (free shade trees), upstream heating, ventilation, air conditioning, and embedded energy from water measures.

Demand Response Resources

LADWP considers demand response to be an important energy management tool that facilitates reduction in energy use over a given time period in response to price signals, financial incentives or other triggering mechanisms. One key objective of LADWP's demand response programs is to cost-effectively reduce peak demand to defer generation capacity investments while providing local transmission and distribution support and operating reserves to improve reliability. In addition, demand response can help integrate renewable energy by responding to fluctuations in intermittent wind and solar and in some cases may be initiated to increase demand to absorb abundant solar generation.

LADWP projects a maximum projected demand response portfolio of 506 MW in 2026, almost half (215 MW) of which would come from the Commercial, Industrial, and Institutional Curtailable Program which provides monthly capacity payments in return

for guaranteed load reductions. Another large contributor of savings would be the Residential & Small Commercial Direct Load Control Program (145 MW).

Energy Storage

Staff finds LADWP's IRP is consistent with the requirement in PUC Section 9621(d)(1)(B) to address procurement of energy storage as it discusses the potential role of energy storage on its system. LADWP developed an energy storage target totaling 178 MW by 2020.

LADWP has been using pumped storage from Castaic for more than 40 years, but since the plant was established prior to January 1, 2010, it is disqualified from counting toward LADWP's storage targets. LADWP is developing a strategic plan to identify storage technologies and applications that align with its needs and define various technologies that will support its unique grid and resource mix. In addition, it is examining storage projects that will help enable renewable integration, distributed generation, and demand side management, while ensuring reliability. To support its storage efforts LADWP is participating in several broader initiatives including:

- The U.S. Department of Energy working group to develop energy storage protocols for use in measuring and quantifying the performance of storage systems to make more informed design and operation decisions.
- Electric Power Research Institute projects: Strategic Intelligence and Technology Assessment of Energy Storage and Distributed Generation, Distributed Energy Storage for Power Delivery and End Use, and Bulk Power Storage Solutions.
- Collaboration with SCPPA researching and identifying viable energy storage for unique POU purposes.

Like demand response, advanced energy storage technologies, such as batteries and compressed air energy storage, can help absorb surplus renewable generation to be used in the late afternoon and early evening where they can provide greater benefit. However, these advanced energy storage technologies are still in development and are not yet available on a commercial scale suitable for large electric utilities. Until then, improved operations at Castaic will serve as LADWP's primary energy storage solution to help alleviate over-generation issues. As energy storage continues to develop and improve both technologically and economically, LADWP will consider increasing energy storage on its system.

Transportation Electrification

Staff finds that the LADWP IRP is consistent with the requirement of PUC Section 9621(d)(1)(C) as it addresses transportation electrification, primarily for light-duty electric vehicles. LADWP's IRP recognizes the benefits of transportation electrification in reducing overall GHG and criteria pollutants in the Los Angeles Basin, increasing electric sales, and absorbing potential overgeneration from renewable resources. As a result, LADWP's preferred portfolio incorporates high electrification, including an increase in

the number of electric vehicles equivalents from 127,000 in 2020 to 580,000 in 2030.³⁴ In addition to vehicle electrification, other transportation electrification opportunities are available, including power for cargo ships at the Port of Los Angeles, and electrified cargo transport and mass transit.

LADWP updated its electric transportation program to include the installation of 10,000 city and private commercial chargers for public, workplace, and city-owned vehicles, as well as supporting residential and commercial EV charging. Other transportation electrification efforts include:

- Electrifying the Los Angeles Metro bus fleet by installing charging infrastructure for depot (overnight) charging and en-route charging.
- Purchasing 112 zero-emission electric buses for the Los Angeles Department of Transportation, while converting 100 percent of buses to electricity by 2030.
- Electrifying equipment to reduce emissions from ships, trucks, harbor craft, and cargo-handling equipment for the San Pedro Bay Ports, which could potentially increase load to 900 GWh by 2030.
- Purchasing 20 electric buses to replace 14 diesel-buses and add 6 buses to the Los Angeles World Airport fleet.

LADWP also participates in the electrification working group with SCPPA and the California Electric Transportation Coalition to address opportunities and challenges of a new, electrified transportation system, and identify trends, business models, and strategies for rolling out charging infrastructure.

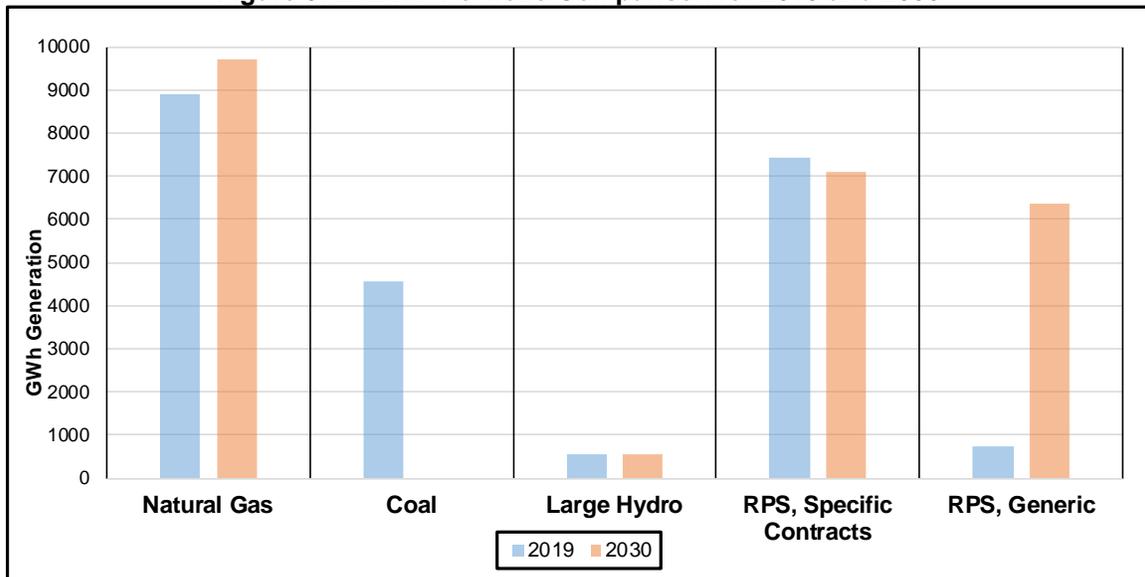
Portfolio Diversification

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 LADWP's existing resources, its portfolio analysis, and the selection of resource additions in its IRP, staff concludes that the utility has fulfilled this requirement.

Figure 5 shows a comparison of the energy mix by resource in LADWP's preferred portfolio in 2019 and 2030.

³⁴ The energy use in 2030 for transportation electrification in the base case is 1,172 GWh, which increases to 2,344 GWh in the high electrification scenario. The 580,000 electric vehicle equivalents figure is based on the High Case IRP 2016 Cumulative # of EV equivalents.

Figure 5: LADWP Portfolio Comparison for 2019 and 2030



Source: California Energy Commission, based on LADWP 2017 IRP filing

In 2019, LADWP’s resource mix consisted of about 2 percent large hydro, 17 percent coal, 33 percent natural gas, 30 percent renewables, and the rest made up by a combination of nuclear, storage, system power, and non-RPS solar. By 2030, LADWP has eliminated coal from its portfolio, kept natural gas generation at 32 percent, increased its reliance on renewables to 45 percent, and large hydro resources remained at 2 percent, with nuclear, storage, system power, and non-RPS solar rounding out its portfolio.

ACRONYMS

Acronym	Term
AAEE	additional achievable energy efficiency
AAPV	additional achievable photovoltaic
CEC	California Energy Commission
CO ₂	carbon dioxide
CO ₂ e	carbon dioxide equivalent
GHG	greenhouse gas
GWh	gigawatt-hour
<i>IEPR</i>	<i>Integrated Energy Policy Report</i>
kWh	Kilowatt-hour
LADWP	Los Angeles Department of Water and Power
IRP	integrated resource plan
mT	metric ton
MT	Thousands of metric tons
MMT	Millions of metric tons
MW	megawatt
MWh	megawatt-hour
POU	publicly owned utility
PUC	Public Utilities Code
REC	renewable energy credit
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 modeling.

Bundled renewable energy credit: A renewable energy credit from an eligible renewable energy resource that is procured as part of the same contract or ownership agreement with the underlying energy from that resource

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 CEC, 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.

Plug-in electric vehicle (EV): A vehicle that uses one or more electric motors for propulsion. Electric vehicles include but are not limited to, 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.

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 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 CEC. 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: STANDARDIZED REPORTING TABLES

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

Technology		2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	
Total Net Energy for Load		27,005,030	27,148,720	27,439,950	27,645,330	27,705,410	28,026,500	28,021,270	28,045,160	28,152,930	28,620,300	28,869,950	29,726,920	
Non-RPS Resources	Castaic	Pump Storage	599,330	609,460	866,340	985,640	965,160	1,054,740	1,020,970	1,003,330	1,091,740	1,038,460	968,130	1,274,700
	Harbor	Natural Gas	119,660	151,210	62,120	44,930	45,930	38,470	35,380	17,650	3,650	4,050	9,830	354,090
	Haynes (New Units)	Natural Gas	147,450	300,040	153,410	91,200	95,740	101,990	232,440	1,777,100	1,443,660	1,880,360	5,524,840	5,342,960
	Haynes (Existing Units)	Natural Gas	3,482,230	3,439,330	3,225,530	3,070,910	3,168,970	2,873,310	2,837,810	2,306,090	2,812,090	2,448,310	0	0
	Palo Verde 1	Nuclear	599,410	601,240	653,070	599,410	599,410	654,890	599,410	599,410	653,070	601,240	599,410	653,070
	Palo Verde 2	Nuclear	661,660	609,220	607,300	661,660	607,300	609,150	661,660	607,300	607,300	663,510	607,300	607,300
	Palo Verde 3	Nuclear	599,410	654,890	599,410	599,410	653,070	601,240	599,410	653,070	599,490	601,240	653,070	599,490
	Scattergood (New Units)	Natural Gas	2,227,680	2,083,620	1,854,500	1,901,730	1,806,600	1,855,900	3,088,710	2,959,980	2,568,930	3,085,180	2,539,810	2,256,710
	Scattergood (Existing Units)	Natural Gas	0	6,600	0	0	0	0	0	0	0	0	0	0
	Valley	Natural Gas	658,910	789,950	508,780	399,890	381,630	364,050	412,080	285,500	182,710	157,430	100,690	83,610
	APEX_X	Natural Gas	29,210	21,650	13,980	11,050	9,720	9,040	1,880	270	370	0	20	0
	APEX1P1	Natural Gas	1,128,400	1,007,410	689,610	402,530	422,590	366,270	104,940	15,960	17,610	2,310	3,900	0
APEX2P1	Natural Gas	935,370	804,290	555,130	356,960	374,210	305,560	87,030	16,770	17,120	2,570	2,960	0	

Source: California Energy Commission, based on LADWP 2017 IRP filing Energy Balance Table

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

		Technology	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Total Net Energy for Load			27,005,030	27,148,720	27,439,950	27,645,330	27,705,410	28,026,500	28,021,270	28,045,160	28,152,930	28,620,300	28,869,950	29,726,920
Non-RPS Resources	Battery_Storage_4Hour	Battery Storage	116,530	115,630	126,930	121,530	153,080	185,480	222,270	222,630	212,700	216,590	220,020	220,030
	Battery_Storage_Customer	Battery Storage	0	3,130	3,280	3,620	3,610	3,590	3,620	3,650	3,570	3,970	4,100	3,690
	Battery_Storage_Hour	Battery Storage	16,620	16,310	16,610	20,570	20,470	19,550	20,970	22,880	19,750	22,460	23,780	19,480
	CAES	Storage	0	0	0	605,840	599,740	612,170	612,050	607,120	612,260	593,350	597,860	615,950
	Cogen	Natural Gas	169,940	170,410	169,940	169,940	169,940	170,410	169,940	169,940	169,940	170,410	169,940	169,940
	Hoover	Large Hydroelectr	564,240	564,250	564,310	564,270	563,990	564,000	564,240	564,250	564,280	564,250	564,210	564,350
	IPP1	Coal	2,623,410	2,430,630	2,566,090	2,349,100	2,453,360	2,227,790	922,850	0	0	0	0	0
	IPP2	Coal	1,934,340	2,178,560	1,894,020	2,069,030	1,850,310	1,995,070	712,200	0	0	0	0	0
	PV SCPPA 1	Nuclear	426,120	427,390	464,280	426,120	426,120	465,550	426,120	426,120	464,280	427,390	426,120	464,280
	PV SCPPA 2	Nuclear	464,280	427,390	426,120	464,280	426,120	427,390	464,280	426,120	426,120	465,550	426,120	426,120
	PV SCPPA 3	Nuclear	426,120	465,550	426,120	426,120	464,280	427,390	426,120	464,280	426,120	427,390	464,280	426,120
	Solar_CNM_nonRPS	Solar PV	375,000	375,000	375,000	375,000	375,000	375,000	375,000	375,000	375,000	375,000	375,000	375,000
	Solar_CNM_nonRPS_P_760_MLS	Solar PV	279,550	326,140	372,730	421,590	468,180	517,050	613,640	660,230	706,820	753,410	801,140	847,730
Utah CC	Natural Gas	0	0	0	0	0	0	1,538,440	2,229,620	2,530,430	2,282,590	1,409,060	1,503,370	

Source: California Energy Commission, based on LADWP 2017 IRP filing Energy Balance Table

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

Technology		2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	
RPS resources	Aqueduct	Small Hydroelectric	225,210	225,210	225,210	225,210	225,210	225,210	225,210	225,210	225,210	225,210	225,210	
	Aqueduct_PP_Improvement_65	Small Hydroelectric	0	0	0	0	18,870	30,000	30,000	30,000	30,000	30,000	30,000	
	Castaic_Improvements	Small Hydroelectric	95,090	95,210	96,580	97,390	97,580	97,580	95,880	96,360	97,700	97,100	97,970	94,870
	NHollywood	Small Hydroelectric	4,350	4,370	4,380	4,370	4,370	4,350	4,360	4,370	4,380	4,370	4,360	4,350
	Owens Gorge	Small Hydroelectric	213,660	213,660	213,660	213,660	213,660	213,660	213,660	213,660	213,660	213,660	213,660	213,660
	Owens Valley	Small Hydroelectric	39,130	39,130	39,130	39,130	39,130	39,130	39,130	39,130	39,130	39,130	39,130	39,130
	Sepulveda	Small Hydroelectric	31,700	31,710	31,750	31,790	31,780	-	-	-	-	-	-	-
	Solar_DWP_Adelanto	Solar PV	19,000	19,000	19,000	19,000	19,000	19,000	19,000	19,000	19,000	19,000	18,000	18,000
	Solar_DWP_PineTree	Solar PV	17,000	17,000	17,000	17,000	17,000	17,000	17,000	17,000	17,000	17,000	17,000	17,000
	Solar_Owens	Solar PV	0	0	0	0	0	132,000	262,000	393,000	522,000	519,000	517,000	514,000
	Wind_PineTree	Wind	381,000	382,000	381,000	382,000	382,000	382,000	382,000	382,000	382,000	382,000	382,000	382,000
	WSHydro_65	Small Hydroelectric	0	13,830	22,000	22,000	22,000	22,000	22,000	22,000	22,000	22,000	22,000	22,000
	Geo_DonCamb	Geothermal	114,000	114,000	114,000	114,000	114,000	114,000	114,000	114,000	114,000	114,000	114,000	114,000
	Geo_DonCamb2	Geothermal	135,000	135,000	135,000	135,000	135,000	135,000	135,000	135,000	135,000	135,000	135,000	135,000
	Geo_Herber1	Geothermal	300,000	300,000	300,000	300,000	300,000	300,000	300,000	25,000	-	-	-	-
	Geo_Hudson_Ranch_65	Geothermal	458,000	458,000	383,000	0	0	0	0	0	0	0	0	0
	SB859_Biomass_PPA_2018	Biofuels	104,240	104,530	104,240	104,240	51,690	-	-	-	-	-	-	-
	Solar_Community	Solar PV	3,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000
	Solar_DWP_Basin_E	Solar PV	6,000	6,000	6,000	6,000	6,000	6,000	6,000	6,000	6,000	6,000	6,000	6,000
	Solar_DWP_Basin_P	Solar PV	36,000	45,000	53,000	64,000	64,000	63,000	63,000	63,000	62,000	62,000	62,000	61,000
	Solar_FIT_150	Solar PV	196,590	196,590	196,590	196,590	196,590	196,590	196,590	196,590	196,590	196,590	196,590	196,590
	Solar_FIT_150_Exp	Solar PV	50,000	148,860	248,860	298,860	298,860	298,860	298,860	296,590	295,450	294,320	292,050	290,910
	Solar_FIT_400_Exp_2035	Solar PV	-	-	-	-	-	-	-	79,550	159,090	238,640	318,180	397,730
	Solar_FIT_E_65	Solar PV	71,590	71,590	71,590	71,590	71,590	71,590	71,590	71,590	71,590	71,590	71,590	71,590
	Solar_PPA_Beacon_1	Solar PV	137,000	137,000	136,000	135,000	135,000	134,000	133,000	133,000	132,000	131,000	131,000	130,000
	Solar_PPA_Beacon_25	Solar PV	216,000	215,000	214,000	213,000	212,000	211,000	210,000	208,000	207,000	206,000	205,000	204,000
	Solar_PPA_Beacon_3	Solar PV	137,000	137,000	136,000	135,000	135,000	134,000	133,000	133,000	132,000	131,000	131,000	130,000

Source: California Energy Commission, based on LADWP 2017 IRP filing Energy Balance Table

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

		Technology	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	
RPS resources	Solar_PPA_Beacon_4	Solar PV	122,000	122,000	121,000	121,000	120,000	119,000	119,000	118,000	118,000	117,000	116,000	116,000	
	Solar_PPA_CopperMountain	Solar PV	515,000	515,000	515,000	515,000	515,000	515,000	515,000	515,000	515,000	515,000	515,000	515,000	
	Solar_PPA_KMopa_65	Solar PV	618,000	618,000	618,000	618,000	618,000	618,000	618,000	618,000	618,000	618,000	618,000	618,000	
	Solar_PPA_RecentBR_65	Solar PV	180,000	179,000	178,000	177,000	177,000	176,000	175,000	174,000	173,000	172,000	171,000	170,000	
	Solar_PPA_Springbok_65	Solar PV	281,000	280,000	279,000	277,000	276,000	274,000	273,000	272,000	270,000	269,000	268,000	266,000	
	Solar_PPA_Springbok2_65	Solar PV	415,000	413,000	411,000	409,000	407,000	405,000	403,000	401,000	399,000	397,000	395,000	393,000	
	Solar_PPA_Springbok3_65	Solar PV	240,000	239,000	238,000	236,000	235,000	234,000	233,000	232,000	231,000	229,000	228,000	227,000	
	Wind_Linden	Wind	145,000	145,000	145,000	145,000	145,000	145,000	145,000	145,000	145,000	145,000	145,000	145,000	145,000
	Wind_Milford1	Wind	434,000	434,000	434,000	434,000	434,000	434,000	434,000	434,000	434,000	434,000	434,000	434,000	434,000
	Wind_Milford2	Wind	231,000	231,000	231,000	231,000	231,000	231,000	231,000	231,000	231,000	231,000	231,000	231,000	231,000
	Wind_PebbleSprings	Wind	193,000	193,000	193,000	193,000	193,000	193,000	193,000	193,000	193,000	16,000	0	0	0
	Wind_PPMWyoming	Wind	171,000	171,000	171,000	86,000	-	-	-	-	-	-	-	-	-
	Wind_WillowCrk	Wind	197,000	197,000	197,000	197,000	197,000	0	0	0	0	0	0	0	0
	Wind_WindyPoint	Wind	694,000	694,000	694,000	694,000	694,000	694,000	694,000	694,000	694,000	694,000	694,000	694,000	694,000
	Geo_PPA_2017_OR	Geothermal	250,000	250,000	250,000	250,000	250,000	250,000	250,000	250,000	250,000	250,000	250,000	250,000	250,000
	Geo_PPA_2018_NNV	Geothermal	474,000	477,000	1,015,000	1,049,000	1,248,000	1,248,000	1,248,000	1,248,000	1,248,000	1,248,000	1,252,000	1,248,000	1,248,000
	Wind_Ext_65	Wind	0	0	0	0	0	0	390,000	390,000	390,000	390,000	390,000	390,000	390,000
	New Geothermal	Geothermal	0	0	0	158,000	208,000	566,000	691,000	1,003,000	1,090,000	1,165,000	1,375,000	1,375,000	1,375,000
	New Solar	Solar PV	0	0	1,216,000	2,336,000	2,336,000	2,336,000	2,336,000	2,336,000	2,336,000	2,336,000	2,336,000	2,336,000	2,336,000
	New Wind	Wind	0	0	0	0	0	0	0	0	0	0	0	263,000	757,000
Total Energy	N/A	27,144,430	27,284,340	27,688,740	28,534,420	28,620,110	28,939,980	29,111,320	29,009,720	29,189,070	29,599,090	29,841,940	30,710,320		
Surplus/Shortfall	N/A	95,190	96,390	97,010	703,070	697,920	710,640	720,990	718,710	727,750	705,980	704,840	720,680		

Source: California Energy Commission, based on LADWP 2017 IRP filing Energy Balance Table

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

		Technology	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Peak Demand			6,341	6,500	6,612	6,620	6,789	7,060	7,185	7,372	7,393	7,422	7,676	7,800
Planning Reserve Margin			1,717	1,717	1,717	1,723	1,723	1,723	1,644	1,643	1,643	1,643	1,657	1,666
Peak Procurement Requirement			7,660	7,658	7,611	7,579	7,529	7,437	7,281	7,164	7,141	7,293	7,282	7,370
Non-RPS Resources	Castaic	Pump Storage	1175	1175	1175	1175	1175	1175	1175	1175	1175	1175	1175	1175
	Harbor	Natural Gas	558	558	558	558	558	558	558	558	558	558	558	502
	Haynes (New Units)	Natural Gas	600	600	600	600	600	600	600	600	936	936	936	1608
	Haynes (Existing Units)	Natural Gas	1019	1019	1019	1019	1019	1019	1019	1019	575	575	575	0
	Palo Verde 1	Nuclear	76	76	76	76	76	76	76	76	76	76	76	76
	Palo Verde 2	Nuclear	77	77	77	77	77	77	77	77	77	77	77	77
	Palo Verde 3	Nuclear	76	76	76	76	76	76	76	76	76	76	76	76
	Scattergood (New Units)	Natural Gas	514	514	514	514	514	514	514	850	850	850	850	850
	Scattergood (Existing Units)	Natural Gas	284	284	284	284	284	284	284	0	0	0	0	0
	Valley	Natural Gas	558	558	558	558	558	558	558	558	558	558	558	558
	APEX_X	Natural Gas	20	20	20	20	20	20	20	20	20	20	20	20
	APEX1P1	Natural Gas	210	210	210	210	210	210	210	210	210	210	210	210
	APEX2P1	Natural Gas	270	270	270	270	270	270	270	270	270	270	270	270
	Battery_Storage_2Hour	Battery Storage	0	25	25	25	25	25	25	25	25	25	25	25
	Battery_Storage_4Hour	Battery Storage	78	78	78	78	100	122	144	144	144	144	144	144
	Battery_Storage_Customer	Battery Storage	0	2	2	2	2	2	2	2	2	2	2	2
	Battery_Storage_Hhour	Battery Storage	50	50	50	50	50	50	50	50	50	50	50	50
	CAES	Storage	0	0	0	160	160	160	160	160	160	160	160	160
	Cogen	Natural Gas	19	19	19	19	19	19	19	19	19	19	19	19
	Hoover	Large Hydroelectric	432	432	432	432	432	432	432	432	432	432	432	432
	IPP1	Coal	596	596	596	571	521	471	0	0	0	0	0	0
	IPP2	Coal	596	596	596	571	521	471	0	0	0	0	0	0
	PV SCPPA 1	Nuclear	53	53	53	53	53	53	53	53	53	53	53	53
	PV SCPPA 2	Nuclear	53	53	53	53	53	53	53	53	53	53	53	53
	PV SCPPA 3	Nuclear	53	53	53	53	53	53	53	53	53	53	53	53
	Solar_CNM_nonRPS	Solar (non-RPS)	191	191	185	184	184	191	189	192	186	185	191	192
	Solar_CNM_nonRPS_P_760_MLS	Solar (non-RPS)	176	204	234	265	294	324	386	416	445	474	504	534
	Utah CC	Natural Gas	0	0	0	0	0	0	624	624	776	776	776	776

Source: California Energy Commission, based on LADWP 2017 IRP filing Capacity Resource Accounting Table

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

		Technology	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	
RPS resources	Aqueduct	Small Hydroelectric	64	64	64	64	64	64	64	64	64	64	64	64	
	Aqueduct_PP_Improvement_65	Small Hydroelectric	0	0	0	0	9	9	9	9	9	9	9	9	
	Castaic_Improvements	Small Hydroelectric	24	24	24	24	24	24	24	24	24	24	24	24	
	NHollywood	Small Hydroelectric	1	1	1	1	1	1	1	1	1	1	1	1	
	Owens Gorge	Small Hydroelectric	109	109	109	109	109	109	109	109	109	109	109	109	
	Owens Valley	Small Hydroelectric	12	12	12	12	12	12	12	12	12	12	12	12	
	Sepulveda	Small Hydroelectric	9	9	9	9	9	0	0	0	0	0	0	0	
	Solar_DWP_Adelanto	Solar PV	5	5	0	0	5	5	5	5	5	5	5	5	4
	Solar_DWP_PineTree	Solar PV	4	4	0	0	4	4	4	4	4	4	4	4	4
	Solar_Owens	Solar PV	0	0	0	0	0	32	64	96	122	127	124	123	
	Wind_PineTree	Wind	1	3	13	30	28	1	1	3	13	28	0	1	
	WSHydro_65	Small Hydroelectric	0	7	7	7	7	7	7	7	7	7	7	7	
	Geo_DonCamb	Geothermal	13	13	13	13	13	13	13	13	13	13	13	13	13
	Geo_DonCamb2	Geothermal	15	15	15	15	15	15	15	15	15	15	15	15	15
	Geo_Herber1	Geothermal	34	34	34	34	34	34	34	34	3	0	0	0	0
	Geo_Hudson_Ranch_65	Geothermal	52	52	44	0	0	0	0	0	0	0	0	0	0
	SB859_Biomass_PPA_2018	Biofuels	12	12	12	12	0	0	0	0	0	0	0	0	0
	Solar_Community	Solar PV	2	3	2	2	2	3	3	3	3	2	2	3	3
	Solar_DWP_Basin_E	Solar PV	2	2	0	2	2	2	2	2	2	0	2	2	2
	Solar_DWP_Basin_P	Solar PV	9	11	13	15	16	15	15	15	15	15	15	15	15
	Solar_FIT_150	Solar PV	100	101	97	97	97	100	99	101	98	97	100	101	
	Solar_FIT_150_Exp	Solar PV	26	76	123	147	147	153	151	153	147	145	148	149	
	Solar_FIT_400_Exp_2035	Solar PV	0	0	0	0	0	0	0	41	79	118	162	204	
	Solar_FIT_E_65	Solar PV	0	45	47	0	39	0	39	0	40	40	40	40	
Solar_PPA_Beacon_1	Solar PV	4	38	38	40	40	4	25	37	37	39	39	4		
Solar_PPA_Beacon_25	Solar PV	7	59	60	63	62	7	39	57	58	61	61	6		

Source: California Energy Commission, based on LADWP 2017 IRP filing Capacity Resource Accounting Table

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

		Technology	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	
RPS resources	Solar_PPA_Beacon_3	Solar PV	4	38	38	40	40	4	25	37	37	39	39	4	
	Solar_PPA_Beacon_4	Solar PV	4	34	34	36	35	4	22	32	33	34	35	4	
	Solar_PPA_CopperMountain	Solar PV	123	125	121	123	125	123	125	125	121	125	123	123	
	Solar_PPA_KMoapa_65	Solar PV	143	144	146	138	122	143	151	143	146	122	148	143	
	Solar_PPA_RecurrentBR_65	Solar PV	55	56	52	56	56	54	55	54	51	55	54	52	
	Solar_PPA_Springbok_65	Solar PV	17	80	78	82	81	17	22	78	76	79	81	16	
	Solar_PPA_Springbok2_65	Solar PV	25	118	115	121	119	25	32	115	112	117	119	24	
	Solar_PPA_Springbok3_65	Solar PV	15	68	67	69	69	14	19	66	65	67	69	14	
	Wind_Linden	Wind	25	25	25	25	25	25	25	25	25	25	25	25	25
	Wind_Milford1	Wind	117	7	115	50	27	115	75	7	115	27	3	117	
	Wind_Milford2	Wind	41	2	43	18	15	41	13	2	43	15	2	41	
	Wind_PebbleSprings	Wind	33	33	33	33	33	33	33	33	33	0	0	0	
	Wind_PPMWyoming	Wind	6	0	0	0	0	0	0	0	0	0	0	0	
	Wind_WillowCrk	Wind	34	34	34	34	34	0	0	0	0	0	0	0	
	Wind_WindyPoint	Wind	118	118	118	118	118	118	118	118	118	118	118	118	
	Geo_PPA_2017_OR	Geothermal	29	28	29	29	29	28	29	29	29	29	28	29	
	Geo_PPA_2018_NNV	Geothermal	54	54	116	120	142	142	142	142	142	142	143	142	
	Wind_Ext_65	Wind	4	38	38	40	40	4	25	37	37	39	39	4	
	New Geothermal	Geothermal	0	0	0	18	24	64	79	114	124	132	157	157	
	New Solar	Solar PV	0	0	286	644	650	636	646	644	616	650	646	634	
New Wind	Wind	0	0	0	0	0	0	0	0	0	0	45	151		
Total Capacity Procured			8,999	9,370	9,569	9,592	9,542	9,193	9,129	9,213	9,594	9,566	9,714	9,505	
Surplus/Shortfall			1,444	1,846	2,441	2,882	2,916	2,648	2,783	3,029	3,415	3,283	3,509	3,270	

Source: California Energy Commission, based on LADWP 2018 IRP filing Capacity Resource Accounting Table

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

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
0.48	62,814	79,397	32,629	23,599	24,110	20,198	18,589	9,265	1,926	2,126	4,883	140,059
0.42	82,523	167,905	85,855	51,026	53,566	57,084	129,612	747,425	604,874	780,270	2,189,098	2,117,945
0.41	1,424,567	1,409,770	1,319,374	1,256,463	1,296,571	1,175,607	1,162,377	944,058	1,151,685	1,002,144	0	0
0.40	887,141	832,462	738,346	756,384	719,357	739,591	1,226,716	1,175,817	1,020,611	1,225,402	1,008,849	896,679
0.73	0	4,733	0	0	0	0	0	0	0	0	0	0
0.42	277,677	337,270	216,851	168,789	161,153	153,580	174,301	121,536	78,436	67,409	43,450	36,482
0.37	10,925	8,097	5,229	4,133	3,635	3,381	703	101	138	0	7	0
0.37	422,022	376,771	257,914	150,546	158,049	136,985	39,248	5,969	6,586	864	1,459	0
0.37	349,828	300,804	207,619	133,503	139,955	114,279	32,549	6,272	6,403	961	1,107	0
0.43	72,734	72,935	72,734	72,734	72,734	72,935	72,734	72,734	72,734	72,935	72,734	72,734
0.92	2,404,093	2,227,429	2,351,565	2,152,715	2,248,259	2,041,547	845,700	0	0	0	0	0
0.92	1,772,629	1,996,432	1,735,680	1,896,059	1,695,624	1,828,282	652,660	0	0	0	0	0
0.37	0	0	0	0	0	0	575,377	833,878	946,381	853,689	526,988	562,260
0.43	175,052	175,052	175,052	175,052	175,052	175,052	175,052	175,052	175,052	175,052	175,052	175,052
NA	7,942,005	7,989,057	7,198,848	6,841,003	6,748,065	6,518,521	5,105,618	4,092,107	4,064,826	4,180,852	4,023,628	4,001,212

Source: California Energy Commission, based on LADWP 2017 IRP filing Greenhouse Gas Emissions Accounting Table

ATTACHMENT I: PUBLIC UTILITIES CODE FOR SENATE BILL 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 CEC, 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 CEC, 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.)