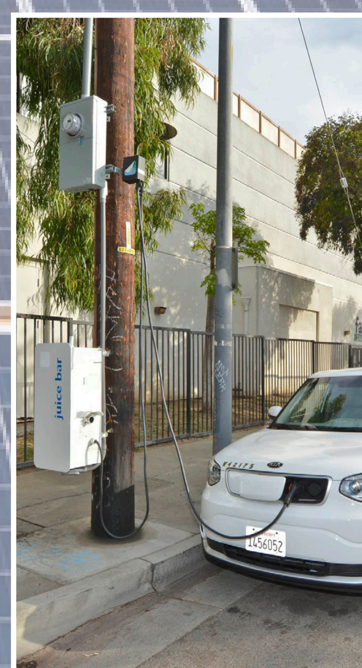
DOCKETED

Docket Number:	18-IRP-01
Project Title:	Integrated Resource Plan
TN #:	227897
Document Title:	2017 LADWP Integrated Resource Plan 08242018
Description:	N/A
Filer:	Ramon D. Gamez
Organization:	Los Angeles Department of Water and Power
Submitter Role:	Applicant
Submission Date:	4/30/2019 11:58:24 AM
Docketed Date:	4/30/2019

Los Angeles Department of Water & Power

2017
POWER INTEGRATED RESOURCE PLAN

August 2018



This page intentionally left blank

TABLE OF CONTENTS

Power System

Andrew C. Kendall
Senior Assistant General Manager - Power System Construction, Operations and Maintenance

Reiko Kerr
Senior Assistant General Manager - Power System Engineering, Planning and Technical Services

Power Facts and Figures

LADWP's Power System supplies more than 26 million megawatt-hours (MWh) of electricity a year for the City of Los Angeles' 1.5 million residential and business customers as well as over 5,000 customers in the Owens Valley.

Approved Budget

For fiscal year 2017-18, the Power System budget is $4 billion. This includes $1.1 billion for operations and maintenance, $1.4 billion for capital projects, and $1.5 billion for fuel and purchased power.

City Transfer

The Power System transfers some of its gross operating revenue ($264 million was transferred in FY 2016-17 and $242 million is estimated for FY 2017-18) to the City's General Fund each year to provide critical City services such as public safety.

Electric Capacity

LADWP has over 7,880 megawatts (MW) of generation capacity from a diverse mix of energy sources.

Power Resources (2016)*

Renewable energy	29%
Biomass & Biowaste	2%
Geothermal	5%
Small hydroelectric	2%
Solar	5%
Wind	15%
Natural gas	34%
Nuclear	9%
Large hydro	3%
Coal	19%
Unspecified purchased power	6%

*Percentages are preliminary pending final audits.

Power Use

Typical residential energy use per customer is about 500 kilowatt-hours (kWh) per month. Business and industry consume about 70 percent of the electricity in Los Angeles, bu residents constitute the largest number of customers. The record instantaneous peak demand is 6,502 MW reached on August 31, 2017; the second highest peak is 6,430 MW reached on September 1, 2017.

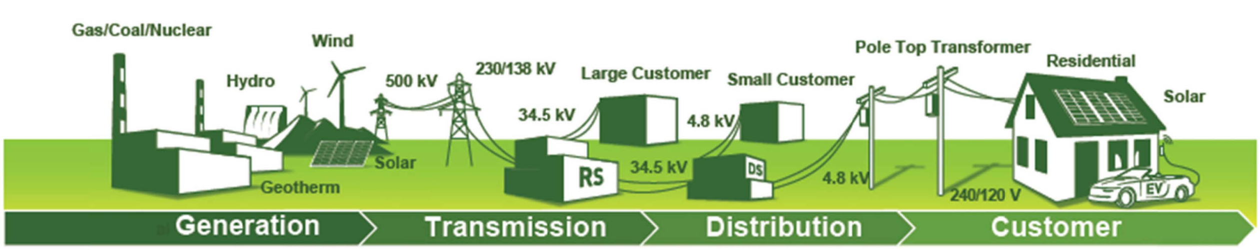
Power Infrastructure

The Power System is responsible for inspecting, maintaining or replacing, and operating the following:

Generation
4 in-basin thermal plants
1 out-of-basin thermal plant
14 small hydroelectric
plants 1 large hydroelectric
plant 1 wind plant
2 solar photovoltaic plants

Transmission
3,507 miles of overhead transmission circuits (AC and DC) spanning five Western states
124 miles of underground transmission circuits
15,452 transmission towers

Distribution
6,752 miles of overhead distribution lines
3,626 miles of underground distribution
cables 160 substations
50,636 substructures
308,523 distribution utility poles
3,166 pole-mounted capacity banks
1.28 million distribution crossarms
31,728 utilitarian streetlights
128,693 distribution transformers



1. Introduction

The 2017 Power Integrated Resource Plan (IRP) is based on the latest General Manager approved Power Strategic Long-Term Resource Plan. Accordingly, the assumptions and forecast used in this IRP is a snapshot of an anticipated future system in 2017 and may no longer produce the most current future system. The goal of the 2017 IRP is to identify a portfolio of generation resources and Power System assets that meets the city's future energy needs at the lowest cost and risk consistent with LADWP's environmental priorities and reliability standards. The IRP examines two different case scenarios with a combination of strategies, including early coal replacement, accelerated renewable portfolio standard (RPS), energy efficiency, local solar, energy storage, and transportation electrification. The recommended IRP case scenario balances LADWP's objectives and identifies four key initiatives – greenhouse gas reduction, transportation electrification, dispatchable resources, and Power System reliability.

A primary focus of this IRP is on reducing greenhouse gas (GHG) emissions while ensuring reliable electric service and maintaining cost competitive rates by examining multiple strategies to reduce GHG emissions. While coal replacement, RPS, energy efficiency, local solar, and energy storage reduce GHG emissions from the Utility sector, transportation electrification provides a significant opportunity to dramatically shift and reduce GHG emissions from the transportation sector. The combination of these greenhouse gas strategies will reduce LADWP's GHG emissions to nearly 78 percent below 1990 levels over the next 20 years and over 82 percent below 1990 levels overall when considering GHG emissions absorbed from the transportation sector.

Similarly, accelerating transportation electrification is the most impactful component for reducing overall GHG emissions. Even though LADWP's GHG emissions will increase from additional generation to charge a growing number of electric vehicles, the amount of GHG emissions reduced due to the electrification of the transportation sector has a multiplier effect of approximately four times. The amount of GHG emissions reduced by transportation electrification is more than double the amount of GHG emissions reduced through utility specific clean energy resources. Transportation electrification can also be utilized as a strategy to absorb over-generation of renewables by incentivizing peak hour charging when solar is abundant.

As higher levels of renewable resources are integrated in the Power System, the level of operational costs and integration challenges will increase exponentially due to over-generation and evening ramping requirements. To understand how increasing penetration of renewable resources will impact the Power System, an analysis was conducted to evaluate what operational challenges are apparent when there are changes in the "net load". The net load reflects the load that must be served by conventional dispatchable generation at times when renewable resources are not available. The analysis indicated that there is a risk of over-generation where more electrical power is generated than is needed to satisfy real-time demand. At the same time, in the late afternoon hours, as the sun sets, there will be a sudden drop in the availability of solar power that requires Power System to ramp-up critical generation from local conventional sources to meet increasing or peak demand within a short period of time. Therefore, there will be an urgent and critical need for dispatchable resources to support the afternoon ramp until a viable clean resource alternative becomes technically and economically feasible. Furthermore, it should be noted that the Power System grid was originally designed in a manner that is dependent on imports from the north and east geographic regions and the utilization of local thermal generating units that are located in the southern portion of the local grid in order to provide voltage and frequency support as well as to balance and ensure the reliability of the system.

LADWP is currently in the process of conducting an OTC Study to provide a comprehensive system reliability assessment to determine viable alternative solutions to repower OTC units without sacrificing system reliability, including a cost-benefit analysis for each alternative. These alternatives will be filtered through feasibility evaluations based on resource adequacy, technical feasibility, transmission reliability, system simulation, operability, constructability, and metrics scoring, before a final recommendation is made.

As the Power System transforms over the next 20 years to significantly reduce greenhouse gas emissions through the acceleration of RPS and transportation electrification, LADWP is investing heavily in its Power System Reliability Program in order to maintain a robust, reliable Power System through the replacement of aging infrastructure assets related to generation, transmission, substations, and distribution.

Lastly, as LADWP starts the process of investing, studying, and determining the investments needed for a 100 percent clean energy portfolio, the 2017 IRP provides a path towards this goal with a combination of GHG reduction strategies, including early coal replacement two years ahead of schedule by 2025, accelerating RPS to 50 percent by 2025, 55 percent by 2030, and 65 percent by 2036, doubling of energy efficiency from 2017 through 2027, repowering coastal in-basin generating units with new, highly efficient potential clean energy projects by 2029 to provide grid reliability and critical ramping capability, accelerating electric transportation to absorb GHG emissions from the transportation sector, and investing in the Power System Reliability Program to maintain a robust and reliable Power System.

2. Scenarios and Sensitivity Analysis

The 2017 IRP recommended case incorporates the latest developments in legislation and regulation, and tactical plans developed by the Power System. This 2017 IRP also includes updated assumptions that have influenced the composition of potential resource portfolios that can fulfill LADWP's goals of environmental stewardship, reliability, and competitive rates. The purpose of the 2017 IRP recommended case is to balance and optimize all three goals in the best interest of our customers.

One of LADWP's primary goals is to take a leadership position in environmental stewardship and make practical and progressive decisions that will benefit Los Angeles for generations to come. In response to regulations regarding GHG emission, which continue to evolve on the federal and state level, this 2017 IRP considered various potential strategies aimed to reduce GHG emissions in the City of Los Angeles to meet Long-Term GHG emission goals. The strategic initiatives for reducing GHG analyzed in this IRP include:

1. Early Coal Replacement
2. Higher Levels of Renewable Portfolio Standard (RPS)
3. Energy Efficiency

4. Increased levels of Local Solar
5. Implement Energy Storage
6. Electrification of the Transportation Sector

The table below describes the recommended case scenario in this IRP:

Table 2-1. 2017 IRP RECOMMENDED CASE SCENARIO

Case Scenario	IPP Replacement	RPS	Energy Efficiency	Local Solar	Energy Storage	Electrification
Recommended Case	2025	55% *(2030)*	15% *(2017-2027)*	900 MW *(2025)*; 1,500 MW *(2035)*	404 MW *(2025)*	580,000 EVs *(2030)*

3. Demand Forecast

3.1 Overview

Utilities are required to forecast the demand for energy and determine how that demand will be met. Meeting forecasted demand is accomplished by the planning and delivery of electric power generating ("supply-side") resources through transmission and distribution systems. Another key element of IRP planning is to determine how to reduce or tailor energy demand and increase the efficiency of the utility customer's use of electricity, known as "demand-side resources."

This section of the IRP addresses the following:

- Forecasting of future energy demand, including transportation electrification
- Demand-Side Resources (DSR), including Energy Efficiency and Demand Response
- Distributed Generation
- Supply-side Resources
- Transmission/Distribution, including grid reliability
- Advanced Technologies, including Smart Grid and Energy Storage
- Climate Change Effects on Power Generation
- Reserve requirements

The discussions include the technical, regulatory, and economic factors that affect LADWP's planning and execution of programs and projects.

Data for this analysis comes from publicly available reports from organizations such as the California Energy Commission (CEC), California Public Utilities Commission (CPUC), the North American Electric Reliability Corporation (NERC), the Federal Energy Regulatory Commission (FERC), other industry forecasts, and internal LADWP sources. Also highlighted in this IRP are additional studies that are either underway or will be performed in the near future to provide additional clarity regarding the boundaries and needs of the system.

3.2 Forecast of Future Energy Needs

This 2017 IRP utilizes LADWP's official 2017 Load Forecast, dated September 15, 2017, of customer demand for electricity over the next 20 years. The 2017 Load Forecast divides customer sales into six classes. Econometric models are used to forecast sales in the Residential, Commercial, and Industrial classes. Trend models are used to forecast sales in the Streetlight and Owens Valley classes. For the Electric Vehicle (EV) sales class, the California Energy Commission 2013 EV forecast was adopted. The drivers in the retail sales models include normalized weather, population, employment, construction activity, and personal 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 most notably the Huffman Bill (AB 1109, 2007-08). From the sales forecast, a Net Energy for Load (NEL) forecast is developed by applying a normalized loss factor of 12 percent. NEL is defined as the energy production necessary to serve retail sales. Losses can vary in a given year depending on the sources of energy production and other factors. An econometric model is also used 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 NEL forecast adjusted for energy efficiency, net-metered solar, residential lighting, and charging of electric vehicles. The NEL forecast is allocated into an hourly shape using the Loadfarm algorithm developed by Global Energy. The inputs into the algorithm are forecasted NEL, peak demand, minimum demand, and historical system average load shape.

3.3 Retail Electrical Sales and Demand Forecast

The 2008 recession coupled with historically ambitious energy efficiency and distributed generation programs implemented between 2000 and 2017 lowered the trajectory of electric sales significantly. The electricity consumption within LADWP's service territory is forecasted to decrease 1.9% over the next five years. Without the growth in electric vehicles, based solely on the economic variables in the Forecast and assuming energy efficiency codes and standards remain in a steady-state; sales will not reach 2008 levels until 2022.

The LADWP billing system underwent a conversion in September 2013, through December 2014. Sales in FYE 2014 declined unexpectedly given a strong underlying local economy. In the 2016 Forecast much of this decline was attributed to the change in billing systems. It was understood that some bills were deferred as the new billing system was being fine-tuned; therefore the 2016 Forecast models included variables to quantify the billing system change effect. Subsequent research suggests that these billing system change variables were correlated with other factors and might have overstated the impact due to the change in billing systems. Also the billing change variable might have been picking up effects from rate changes and other effects from energy efficiency and distributed generation. In the 2017 Forecast, all the billing change variables have been removed. Figure 2-1 below shows the historical Retail Sales:

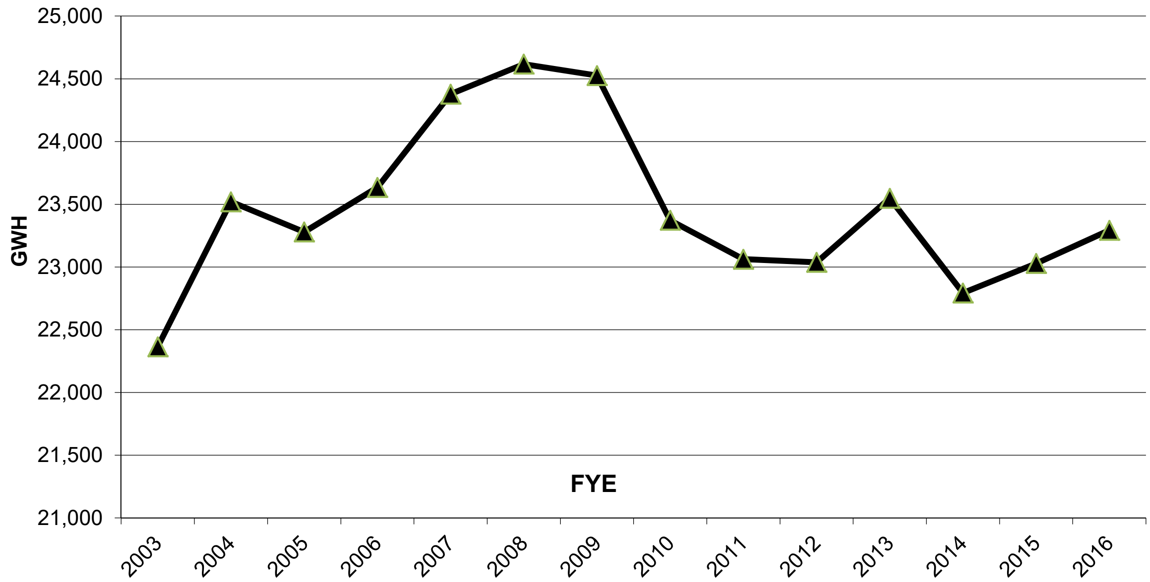


Figure 3-1. Retail Sales Net of Energy Efficiency and Distributed Generation.

Losses incurred in Production

In Fiscal Year 2013-14 and 2014-15, percentage losses were the highest recorded since 1981. The formula for percentage losses is ((NEL – Sales) x100) / NEL. Percentage losses averaged is 11.6% with a standard deviation of 0.9% from Fiscal Year 1980-81 to 2009-10. In Fiscal Year 2013-14 and 2014-15 the losses were 14.8% and 13.7% respectively, while in both Fiscal Year 2015-16 and 2016-17 the losses dropped to 12.6%. Figure 2-2 below shows the historical percentage losses:

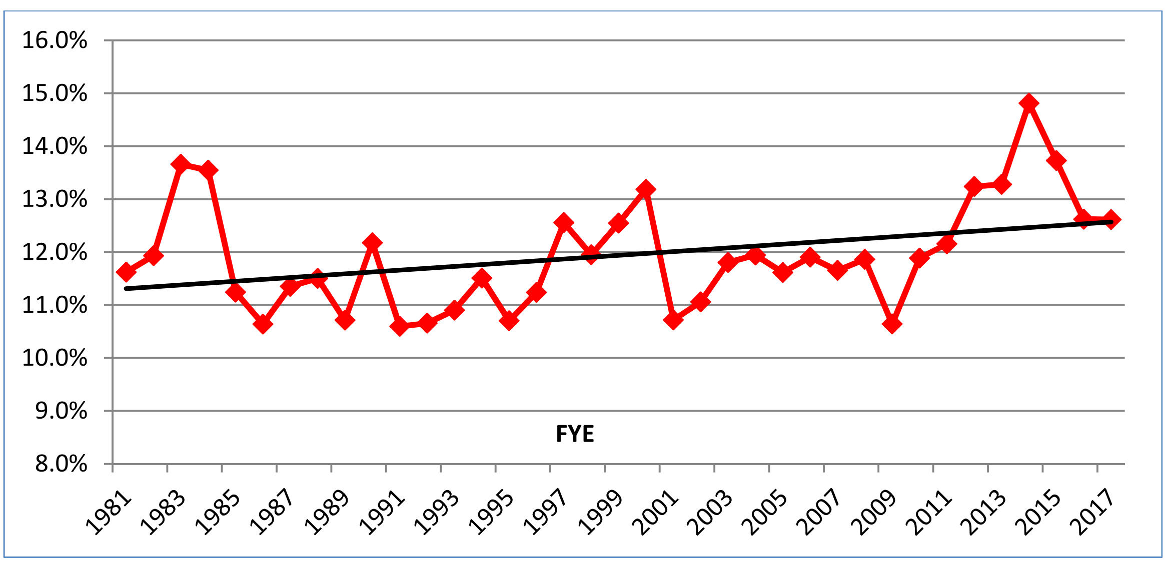


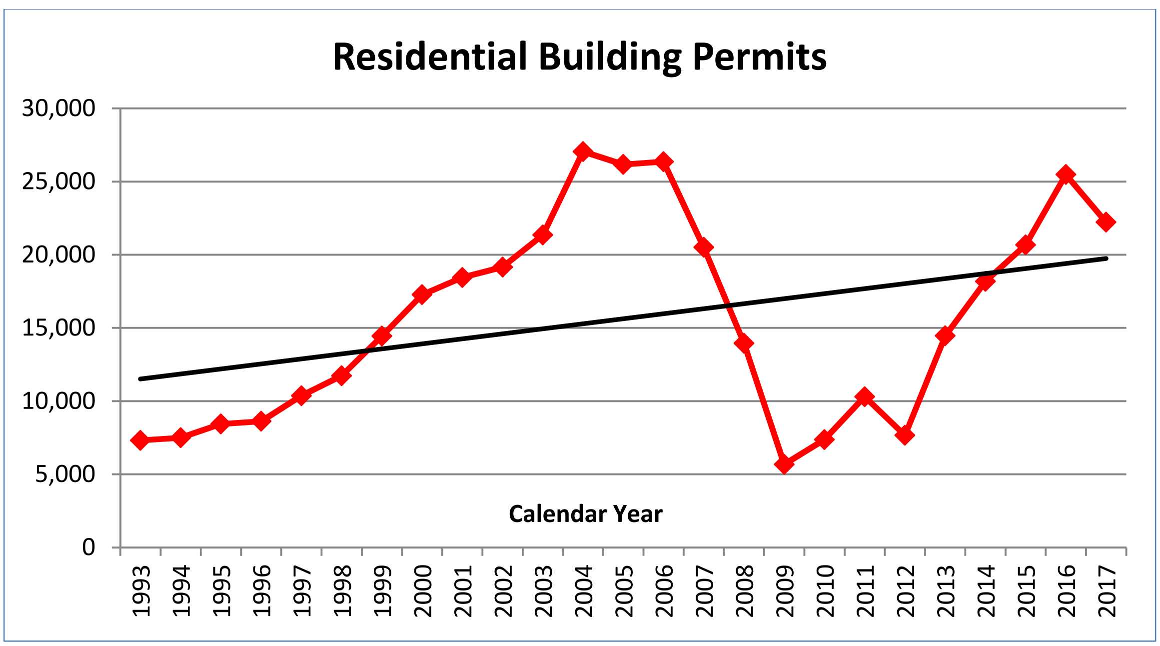
Figure 3-2. Historical Percentage Losses by Calendar Year.

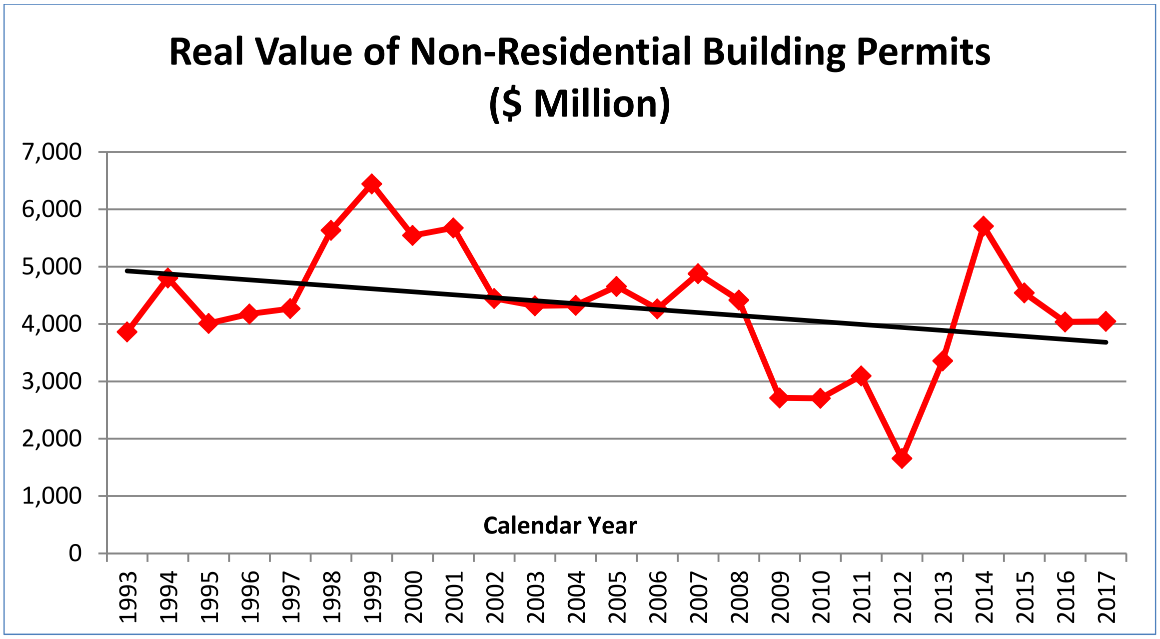
Economics

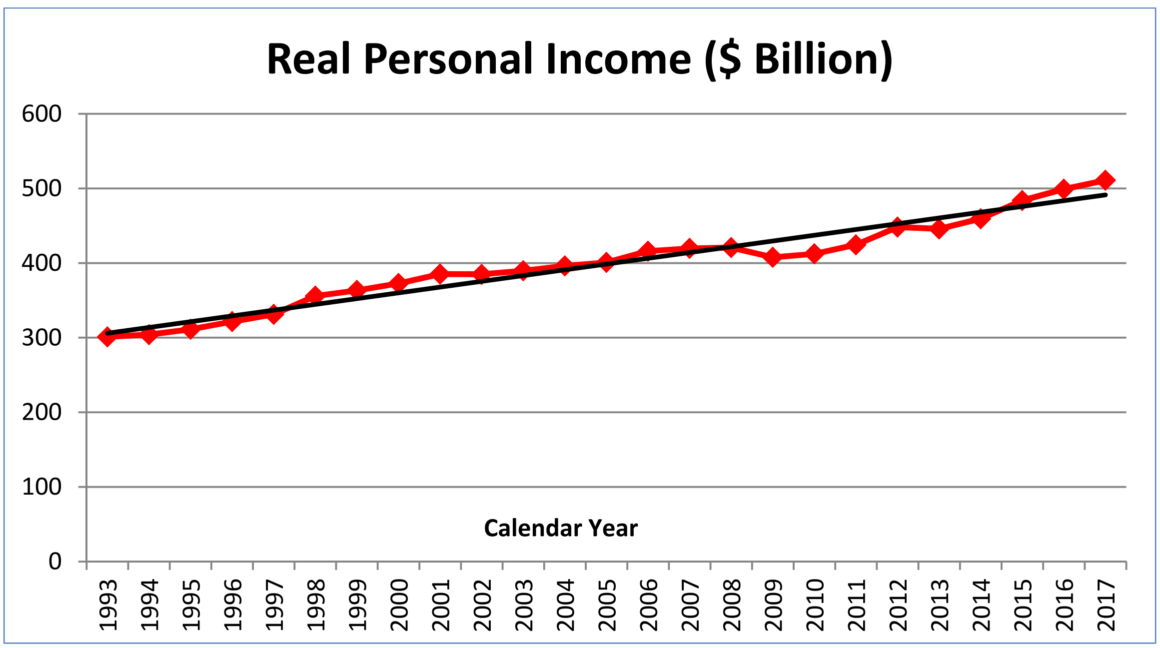
The economic outlook is fundamentally changed in the 2017 Forecast. On the Federal level, the current Administration's proposed budget is calling for higher deficit spending in the near term through tax cuts as a part of tax reform bill coupled with higher spending on military and infrastructure. The details of all these proposals have yet to be written into law and in the end the final law will inevitably differ from the proposal. Even if we do not see all these increases on the Federal level, California, on the state level, has made a commitment to increasing infrastructure spending through its increased gas tax mechanism.

The current expansion is into its 96th month versus the average historical expansion of 60 months. Full employment is sustainable for a long period but the next recession is likely now somewhere on the horizon. Faster growth would require positive growth in net migration.

In 2016, net migration was a negative 15,000 people in Los Angeles County. The last positive year for net migration in Los Angeles County was 2011. Population growth has been due to natural increase (the difference between the number of live births and the number of deaths). The LADWP service area is most commonly modeled as a constant share of Los Angeles County. Data at the County level is considered more accurate. All the data and forecasts in Figure 2-3 below are from the 2016 UCLA Anderson Forecast.




Real Value of Non-Residential Building Permits
($ Million)
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
Calendar Year
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017


Real Personal Income ($ Billion)
600
500
400
300
200
100
0
Calendar Year
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017

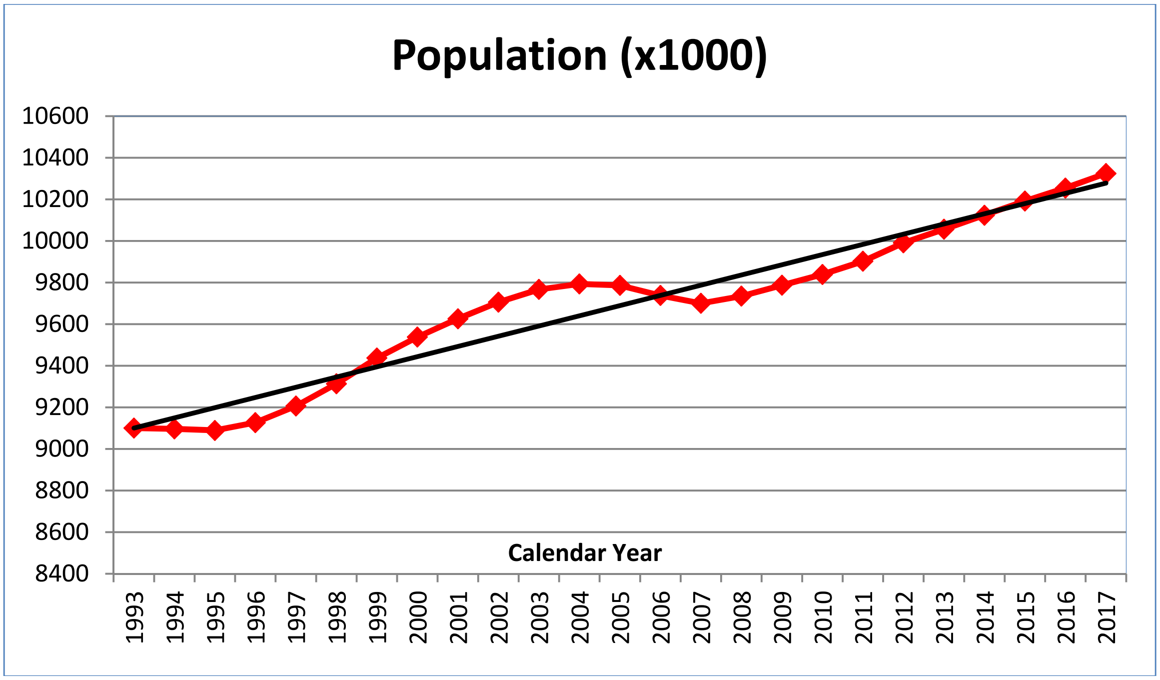


Figure 3-3. 2016 UCLA Anderson Forecasts by Calendar Year (LA County).

The electricity consumption within LADWP's service territory is forecasted to decrease 1.2% over the next five years as energy efficiency and customer installed solar PV expansion offset growth from economic activity. The growth in annual peak demand over the next ten years is predicted to be about 0.4 percent –approximately 30 MW per year - with less growth over the next few years due to energy efficiency, and solar PV programs. Some of this growth will not be realized at the meter with the implementation of the demand response program which is not presently included in the peak demand forecast but is considered in this IRP as a resource to serve peak demand.

Forecast Data Sources

The 2017 Forecast is LADWP's official Power System forecast. This Forecast is used as the basis for LADWP Power System planning activities including, but not limited to, integrated resource planning, transmission and distribution planning, and wholesale marketing. The forecast is a public document that uses only publically available information.

Table 2-1 summarizes the data sources used to develop the forecast and where these data sources have been updated from previously published forecasts.

Table 3-1: LOAD FORECAST DATA SOURCES

Data Sources		Updates
1.	Historical Sales through December 2016 were reconciled to the General Accountings Consumption and Earnings Report.	*Historical Sales, Net Energy for Load and weather data is updated through December 2016.*
2.	Historical Los Angeles County employment data is provided by the State of California Economic Development Division using the March 2016 benchmark.	*Employment data is updated through December 2016 using the March 2016 benchmark.*
3.	The plug-in electric vehicle (PEV) forecast is based on the California Energy Commission (CEC) 2013 Integrated Energy Policy Report forecast.	
4.	The LADWP program energy efficiency forecast is based on the AB2021 goals adopted by Board Resolution on August 5, 2014. Historical installation rates are provided by the Energy Efficiency group.	
5.	Projected solar PV installations are consistent with the 2016 Integrated Resources Plan. Historical installations are provided by the Solar Programs Development Group.	
6.	Electric Price Forecast is developed by Financial Services organization. Real electric prices beyond FYE 2022 are assumed to be constant.	

3.3.1 Five-year Sales Forecast

The Forecast represents total sales that will be realized at the meter incorporating future savings from known energy efficiency technologies and future loads expected to be served by distributed generation. The Forecast does not include changes in sales that may result from emerging technologies. Private enterprise and government are both currently funding new research to aggressively address climate change. For example, the State of California has adopted an ambitious Energy Action Plan that includes four "Big Bold Strategies" for significant energy savings. The Energy Action Plan requires all new residential construction to be zero net energy by 2020; all new commercial construction to be zero net energy by 2030; Heating, Venting and Air Conditioning (HVAC) industry to be re-shaped to deliver maximum performance HVAC systems; and all eligible low-income customers be provided with all cost-effective energy efficiency measures in their residences by 2020.

The historical accumulated energy efficiency and solar savings reported in the Forecast are from 1999 forward. The 2016 Forecast only included savings from Codes and Standards from 2012 forward; in the 2017 Forecast, historical Codes and Standards savings for the years 1999 through 2011 based on California Energy Commission (CEC) analysis are included. True accumulated energy efficiency would more likely be dated back to 1974 when the Warren-Alquist Act passed in California but accurate records are not available. In the Forecast, projected energy efficiency and customer sided solar savings are expected to occur uniformly throughout the year as a simplifying assumption.

Estimated sales for FYE 2017 are 255 GWh or 1.1 percent below recorded sales in FYE 2016, and the compounded growth rate for sales is estimated to be 0.1 percent over the five-year budget period. This result is mainly attributed to accelerated incremental savings from LADWP's energy efficiency and solar distributed generation programs, and expected increases in retail electric rates. In the Forecast, electric rate increases are lagged one year to allow for customer behavior to change.

Historical and future retail sales would be significantly higher absent LADWP energy efficiency and solar distributed generation programs. Based on installed savings, sales have been reduced by 2679 GWh since FYE 2000 through LADWP-sponsored programs. LADWP is accelerating these savings programs and retail sales are expected to be reduced by another 2,244 GWh over the next five years.

Table 3-2 shows projections of short-term retail sales growth:

Table 3-2. SHORT-TERM GROWTH

Fiscal Year	Retail Sales		Additional Load if not for EE & Solar Savings
Ending June 30	(GWh)	Growth Rate (Year-Over-Year)	(GWh)
2017-18	22,880	0.0%	3,260
2018-19	22,663	-0.9%	3,854
2019-20	22,520	-0.6%	4,366
2020-21	22,492	-0.1%	4,724
2021-22	22,613	0.5%	4,923

For IRP modeling and analysis, adjustments are made to the approved load forecast to account for the alternative energy efficiency targets and customer net-metered solar projections.

4. Resource Procurement Plan

4.1 Renewable Portfolio Standard

SBX1-2

The increase of renewables, as a percentage of electricity sales, to the regulatory mandated 33% by year 2020 requires the continued diligence of LADWP to pursue renewable projects and power purchase contracts. The development of a solar feed-in tariff and continued encouragement for customer net-metered solar and community solar is also necessary to support increased solar capacity. Because the acquisition of additional renewables is mandated by law, the strategic case analyzed in this IRP include a portfolio that meets or exceed the required amount of renewable resources. The 2017 recommended case includes the following targets for new renewable acquisitions between 2016 and 2020, subject to change based on technology development, commodity price fluctuations, policy changes, and customer participation:

New Renewable Installed Capacity (MW) 2017-2020			
Geothermal & Biomass	Wind	Solar PPA	Local Solar
87	0	352	202

Furthermore, maintaining at least 33% of renewables beyond 2020 and achieving 55% of renewables by 2030 requires additional renewables to account for system loading, project turnover, and output degradation as projects age. The 2017 Recommended Case includes the following additional targets for new renewable acquisitions between 2017 and 2037, subject to change based on technology development, commodity price fluctuations, policy changes, and customer participation:

	New Renewable Installed Capacity (MW) 2017-2037			
Geothermal & Biomass	Wind	Solar PPA	Local Solar	Generic
445	541	1762	1246	495

SB 350 – Clean Energy and Pollution Reduction Act of 2015

This bill enacts the "Clean Energy and Pollution Reduction Act of 2015," which establishes targets to increase retail sales of renewable electricity to 50% by 2030 and double the energy efficiency savings in electricity and natural gas end uses by 2030.

Key objectives

- Establishes a Renewable Portfolio Standard (RPS) as follows:
  - 40% by the end of the December 31, 2024
  - 45% by the end of the December 31, 2027
  - 50% by the end of the December 31, 2030
- Doubling of energy efficiency savings in electricity and natural gas final end uses by 2030
- Reducing emissions of greenhouse gases to 40% below 1990 levels by 2030
- Before January 01, 2019, the Governing board of a POU shall adopt an IRP and process for updating the plan at least once every five years. On September 5, 2017, the California Energy Commission adopted the Publicly Owned Utility Integrated Resource Plan Submission and Review Guidelines (Docket Number 17-IEPR-07).

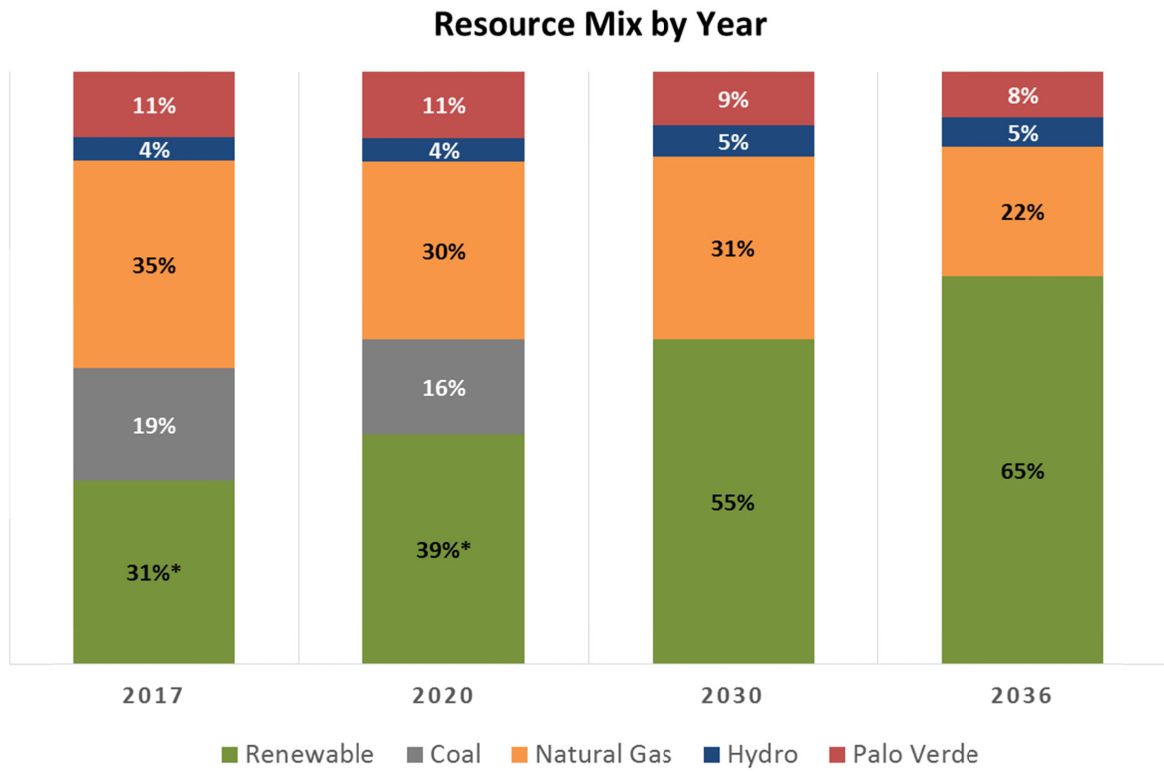
Additional Compliance Periods

- Compliance Period 4: Jan. 1, 2021 – Dec. 31, 2024
- Compliance Period 5: Jan. 1, 2025 – Dec. 31, 2027
- Compliance Period 6: Jan. 1, 2028 – Dec. 31, 2030

Portfolio Balance Requirement

- Beginning January 01, 2017:
  - Portfolio Content Category 1 (PCC1) – at least 75%
  - Portfolio Content Category 3 (PCC3) – No more than 10%

Figure 4-1 illustrates the changing generation resource percentages for 2017, 2020, 2030, and 2036 based on the Recommended Case and after a doubling of energy efficiency from 2017 through 2027 is factored in. This is in addition to the 1,256 GWh or 5.5 percent of sales, which was previously implemented between 2000 and 2010. The Recommended Case shown in Figure ES-6 illustrates the accelerated growth of renewable energy and progressive decline of natural gas usage from LADWP's energy supply.



**preliminary estimate*

Note: Includes 15% energy efficiency from 2010 through 2020 and 15% energy efficiency from 2017 through 2027 in the overall mix of resources

Figure 4-1. Recommended case generation resource percentages for 2017, 2020, 2030, and 2036.

Figure 4-2 shows the breakdown of renewable generation by technology.

Note: Chart is subject to change due to technology development, commodity price fluctuations, and policy changes

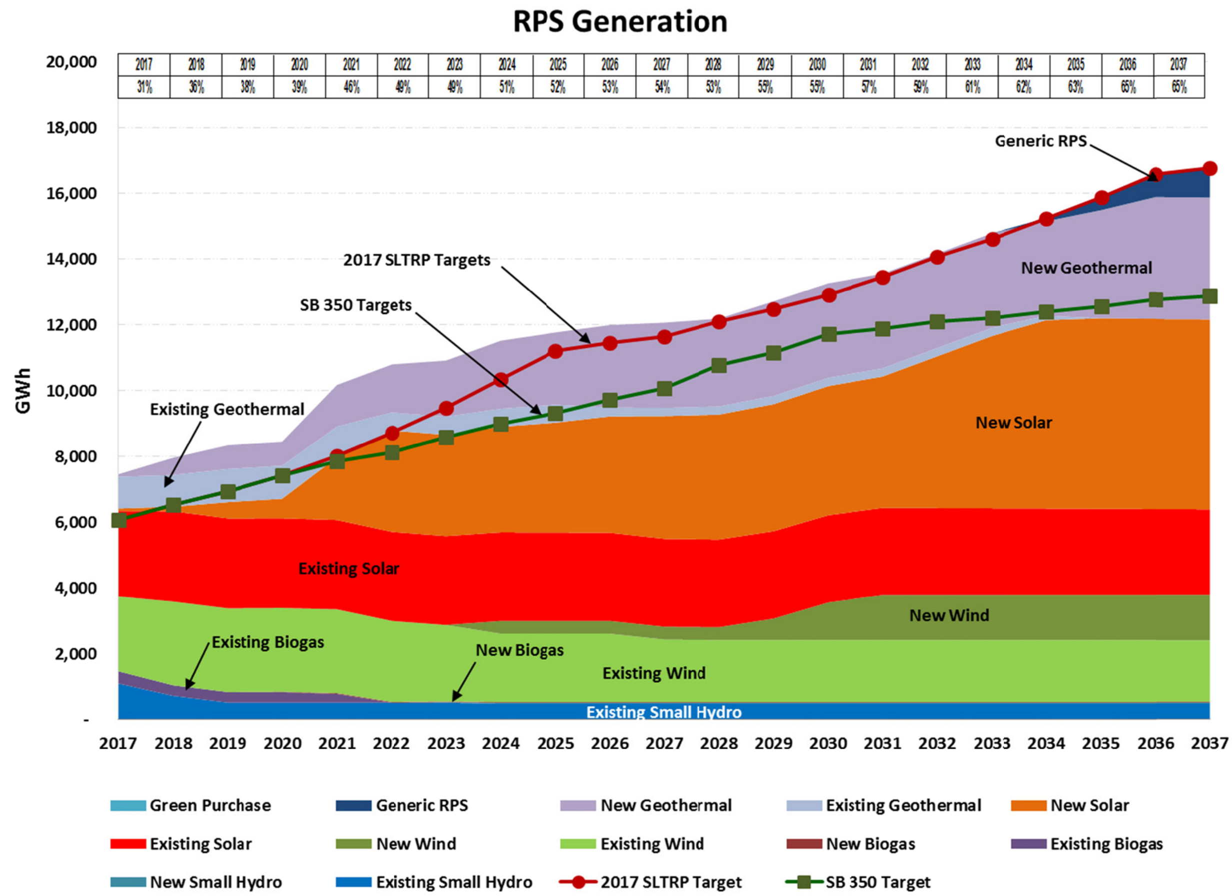


Figure 4-2. Recommended case renewable generation forecast by technology as of 2017.

<u>SB 32 – FiT</u>

SB 32, signed into law on October 11, 2009, and SB 1332, signed into law on September 27, 2012, requires LADWP to make a tariff available to eligible renewable electric generation facilities within its service territory until LADWP meets its 75 MW share of the statewide target. On February 1, 2013 the FiT program was expanded to 100 MW through a Set Pricing Program. In July 2013, 50 MW of local solar from Beacon Bundled was added to the FiT program. Through this program, owners or operators of eligible renewable energy systems may sell their energy directly to LADWP. The purchase of SB 32 qualifying energy includes all environmental attributes, capacity rights, and renewable energy credits. This energy is just one of the many renewable energy sources that will apply towards LADWP's 33 percent by 2020 and 50 percent by 2030 renewable requirement.

<u>SB 859 - Bioenergy</u>

SB 859, signed into law on September 14, 2016, requires LADWP to procure a proportionate share of 125 megawatts of cumulative rated capacity, based on the ratio of the LADWP's peak demand to the total statewide peak demand, from existing bioenergy projects that commenced operations prior to June 1, 2013, subject to terms of at least 5 years.

Power Purchase Agreement (PPA) Option to Own Clause
LADWP's goal is to own or have a purchase option for (either directly or through joint powers authority) at least 50% of its eligible solar and wind renewable energy resource portfolio. PPAs for renewable energy often contain purchase options which LADWP may choose to exercise at different times during the term of the agreement.

4.2 Energy Efficiency and Demand Response

4.2.1 Energy Efficiency

Energy Efficiency (EE) is a key strategic element in LADWP's resource planning efforts. EE is an overall cost effective resource in LADWP's supply portfolio, and serves an important and multi-faceted role in meeting customer demand. A common example of a successful EE measure is the replacement of compact fluorescent lamps (CFLs) with light-emitting diode (LED) lamps. LEDs consume up to 60% less energy than CFLs while producing an equivalent amount of illumination and last up to 7 times longer.

Since 2007, LADWP has spent approximately $795 million in capital and O&M on its energy efficiency (EE) programs and these programs have reduced consumption by approximately 3,275 GWh/yr. LADWP is committed to implementing comprehensive energy efficiency programs with measurable, verifiable goals as well as maintaining an overall cost effective energy efficiency portfolio.

Under Assembly Bill 2021 (AB 2021), publicly-owned utilities such as LADWP, must identify, develop and implement programs for all potentially achievable, cost-effective EE savings and establish annual targets.

Furthermore, utilities are required to conduct periodic EE potential studies to update their forecasts and targets. LADWP completed and finalized its 2013 EE Potential Study in 2014. The revised energy savings and demand reduction targets, based on the EE Potential Study, was recommended and adopted by the Board of Water and Power Commissioners on August 5, 2014. The next EE Potential study was conducted in 2017, which concluded that LADWP could cost effectively achieve another 15% energy efficiency from 2017 through 2027 in addition to the previously committed 15% from 2010 through 2020. If LADWP keeps the same pace through 2030, it would double its energy efficiency portfolio per SB 350.

4.2.1.1 Total EE Investment Required to Reach Required 15% Energy Savings

The energy efficiency programs required to meet the proposed savings targets totaling 3,593 GWh for the ten-year period between FY 2017-18 and FY 2026-27 will require substantial investments in efficiency programs to continue at the same pace over the ten-year period. This level of spending is comparable to LADWP's most recent historic levels and produces the energy savings required to put LADWP on a path to achieve the recommended targets. Notably, this level of funding keeps LADWP on par with California's Investor Owned Utilities (IOUs) in terms of EE investment on a per-ratepayer basis, maintaining LADWP as the third largest portfolio of EE programs in California.

Note that budgets have already been established for the overlap period of FY2017-18 through FY2019-20 from the 2013 Potential Study and therefore removed from the recommended target budgets below.

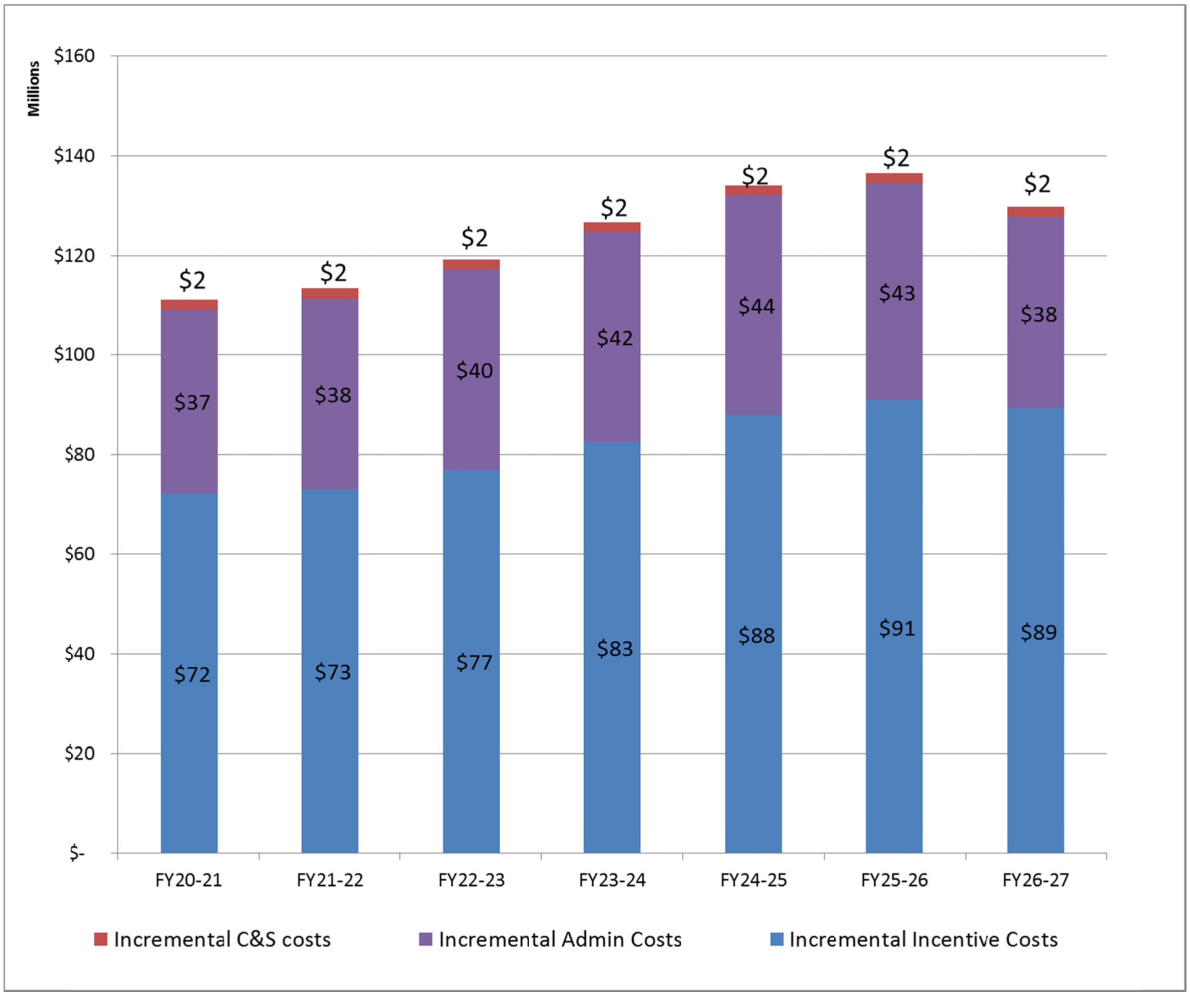


Figure 4-3: Recommended Targets - Projected Budget per Fiscal Year FY2021-FY2027

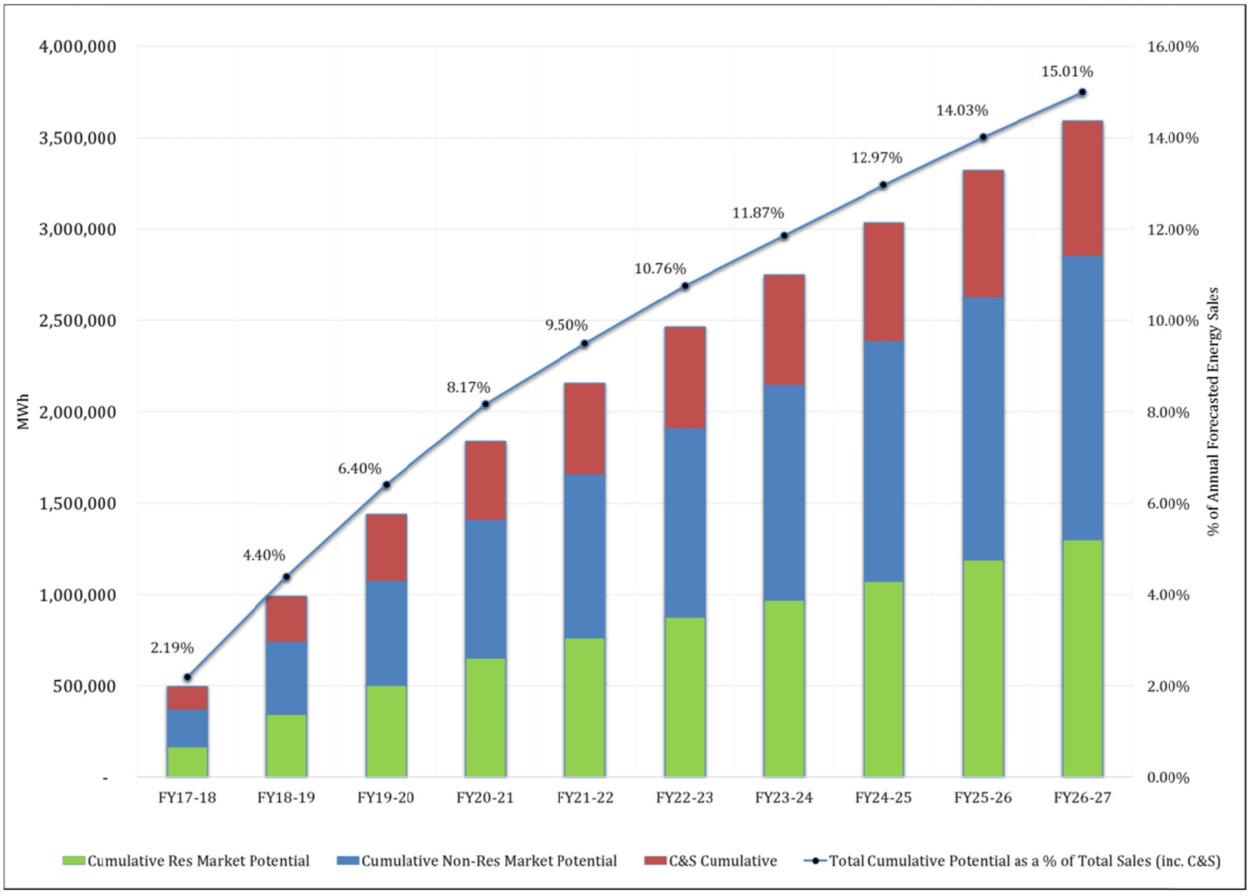


Figure 4-4: Recommended Cumulative Targets - Energy Savings per Fiscal Year

Note: LADWP reserves the right to adjust programs, budgets, and individual program savings target at any time in order to respond to changing business conditions and market needs

Energy Efficiency Forecast

The Energy Efficiency (EE) forecast used in the 2017 IRP as show in Figure 4-3 incorporates the new energy efficiency projections based on the FY 2016-17 Energy Efficiency (EE) Potential Study that finalized in June 2017. The new EE Potential Study examined the timeframe 2017 through 2027 and identified that LADWP could cost-effectively achieve 15 percent energy efficiency for that timeframe. If LADWP keeps the same pace through 2030, it would achieve the doubling of energy efficiency goal required by SB 350.

The cumulative EE savings incorporated in the 2017 IRP will reach 1,563 GWh from 2010 through 2020 and 3,516 from 2017 through 2027. Using The Total Sales to Ultimate Customers of 23,163 as the baseline, the 2017 IRP EE case forecasts a doubling of energy efficiency savings from 2017 through 2027. Historical efficiency savings of 1,620 GWh from fiscal year 2000/01 through fiscal year 2011/12, which is equivalent to 6.4 percent of customer sales, are already embedded in the load forecast. Figure 3-1 below shows the projected cumulative gross savings from 2017 through 2037.

State energy efficiency codes and standards savings and a small share of Federal codes and standards savings, retroactively to 2010, are counted towards energy efficiency savings targets, due to LADWP's and City of Los Angeles' multi-pronged efforts to support code development and enforcement. The revenue impacts are accounted for in the sales load forecast and contributes to reducing overall sales and load growth.

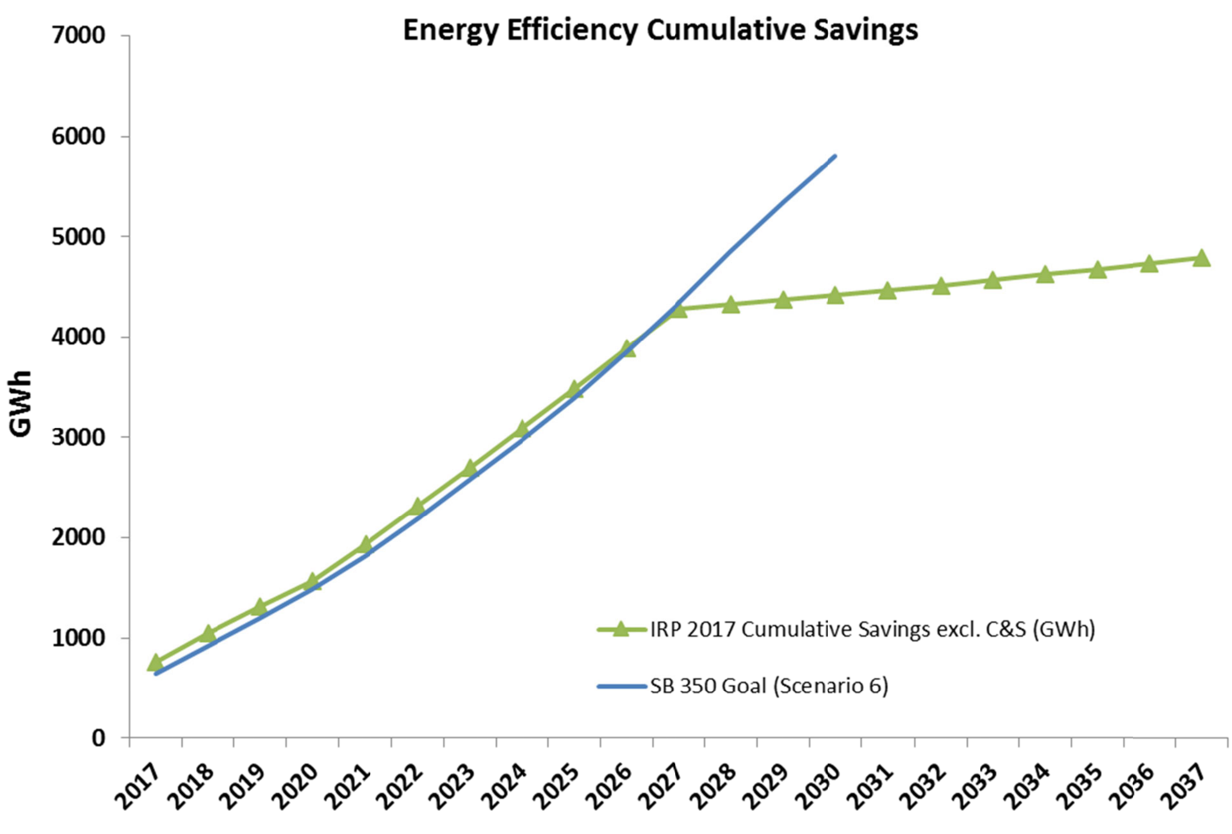


Figure 4-5. 2017 IRP Cumulative Energy Efficiency Forecasts by Fiscal Year

Although LADWP's Energy Efficiency Targets appears to fall short of the CEC SB 350 Scenario 6 targets by 2030, the next IRP filing will include updated targets to meet this goal. The latest EE Potential Study conducted in 2017 established targets out 10 years through 2027 and considered cost effectiveness in setting these targets. The next EE Potential Study that will be conducted in 2020, will establish energy efficiency target out to 2030 with the goal of doubling energy efficiency by 2030.

4.2.1.2 Program Descriptions

The different EE program elements are briefly described as follows:

Mass Market Programs

- Commercial Direct Install (CDI) Program: This program is available to qualifying businesses whose average monthly electrical demand is 200 kilowatts (kW) or less. The qualifying energy and water saving measures include: upgrades to energy efficient lighting system and lamps, LED exit signs, pre-rinse spray valves, low-flow showerheads, faucet aerators, and low-flow toilets.
- LAUSD Direct Install: The Los Angeles Unified School District Direct Install (LAUSD DI) Program is designed to improve energy and water efficiency throughout LAUSD's facilities through upgrades in electricity, water and natural gas consuming systems, in partnership with the Southern California Gas Company (SoCal Gas). This Program provides energy efficiency design assistance, project management experience and retrofitting installation, utilizing LADWP engineering and Integrated Support Staff (ISS), to assist LAUSD facilities in need of aid in reducing energy usage and corresponding utility expenses.
- Refrigerator Exchange Program: Provides new energy-efficient refrigerators to low-income customers in exchange for existing inefficient, older models. Program planning includes improved outreach and continued expansion to apartment owners.
- Refrigerator Recycling Program: The program provides free pick-up and recycling of old, inefficient refrigerators, along with a cash incentive for each recycled refrigerator.
- Home Energy Improvement Program: This program, offers residential customers the opportunity to reduce their energy bills by allowing qualified Department staff to make energy efficiency and water conservation upgrades to their home. For residential customers residing in multi-family dwelling, common area efficiency upgrades will also be addressed. All residential customers may apply; however, first consideration will be given to registered low-income and lifeline customers, and Tier 2 residential customers who demonstrate the greatest economic need.
- California Advanced Home Program: The California Advanced Home Program (CAHP) is an incentive program that utilizes the statewide CAHP through its partner utility, SoCalGas, for cost-effective energy efficiency upgrades in residential new construction. CAHP intends to target high density, residential new construction, including single and multi-family high rise buildings, as this is the area with the greatest new construction energy savings potential in LADWP's service territory.

- Energy Upgrade California: This is a collaborative program administered by the CEC in partnership with public and private utilities, the CPUC, and participating counties. The program is funded by grants and contracts from the U.S. Department of Energy, the Energy Commission, and California utility customers. This is a new program not included in the base efficiency program.
- Consumer Rebate Program (CRP): The CRP is designed to both educate and encourage the LADWP's residential customers to purchase high efficiency refrigerators, air-conditioners, appliances, and other energy-saving products that meet or exceed Energy Star efficiency rating.
- Home Energy Improvement Program (HEIP): Available to residential customers, the HEIP is a whole-house approach to conserving energy, water and gas. An assessment of the home is completed by a trained technician and the customer has the option to accept or decline any of the suggested measures provided by LADWP. Items that can be installed, repaired or replaced include: insulation, compact fluorescent light bulbs, low-flush toilets, low-flow showerheads and faucet aerators, weather-stripping, window panes, wall patches, smoke & carbon monoxide detectors. While not limited to low-income customers, HEIP's priority is to serve customers with the greatest need for these services.

Commercial, Industrial & Institutional Programs

- Custom Performance Program (CPP): The CPP offers incentives for energy saving measures not covered by other LADWP non-residential energy efficiency programs. These involve more advanced, high efficiency technologies and innovative energy saving strategies that meet or exceed code or minimum industry standards. Examples include equipment controls, industrial processes, high efficiency HVAC and chillers, CO monitoring systems, Retrocommissioning measures, hotel guest room controls, variable frequency drives, and other high efficiency technologies.
- Commercial Lighting Incentive Program (CLIP): The CLIP offers incentives to help make a wide variety of high-performance lamps and lighting fixtures cost-effective, and targets any size business that still utilizes standard fixtures. Incentive levels are based on the calculated energy savings of each project, with rates ranging from $0.08 to $0.24 per kilowatt-hour (kWh) of annualized savings. CLIP's calculated savings approach allows customers to tailor lighting efficiency upgrades to better meet their lighting needs and attain greater energy savings.
- Savings by Design (SBD): Administered by California Utilities, SBD is a state-wide program which encourages energy-efficient building design and construction practices. SBD promotes the efficient use of energy by offering up-front design assistance supported by financial incentives based on project performance. SBD encourages high-performance, non-residential building design and construction, and offers a variety of solutions to building owners and design teams. SBD participants can save money by reducing operating costs, increasing comfort, health, and productivity for building occupants, and conserving natural resources. LADWP and SoCal Gas are working together to offer incentives designed to benefit owners and developers of new commercial buildings.
- Food Service Program: The Food Service program offers incentives to encourage retrofit measures and technologies to reduce energy consumption in supermarkets, liquor stores,

convenience stores, restaurants, etc. Rebates are offered for commercial food appliances and refrigerator cases, ice machines, reach-in freezers/refrigerators, display cases, walk-in coolers, etc., as well as other refrigeration equipment.

- Low Income Economic Development Program: LADWP Economic Development provides grants to low income housing developers, and projects must achieve 15% greater savings than codes. This is the first time LADWP is quantifying and reporting these savings.

Crosscutting Programs

- Codes & Standards (C&S) Program: The Codes & Standards /Compliance (C&S) is a resource program that conducts advocacy activities to improve building and appliance efficiency regulations. The principal audience is the LA City Department of Building Safety and the LA City Council, which together develop and adopt codes & standards specific to LA that go beyond state and federal regulation. A secondary audience is the CEC, which conducts periodic rulemakings, usually on a three-year cycle (for building regulations), to update building and appliance energy efficiency regulations.
- City Plants: The City Plants Program provides free shade trees for residents and property owners in Los Angeles to promote the planting of trees to improve building energy efficiency. This is a joint program implemented by LA Department of Public Works and supported by LADWP. Through this partnership, CP is able to provide free shade trees for residents and property owners in the City of Los Angeles along with information on where to plant the trees for maximum energy efficiency benefits. CP currently focuses on providing trees for residential customers but will also provide trees to commercial customers.
- Upstream HVAC: Upstream HVAC allows LADWP to participate in the California statewide IOU's upstream HVAC program, which bring synergies and cost savings. This program expects approximately 5-10 GWh per year and is the same program offered by Southern California Edison.
- LADWP Facilities Program: The LADWP Facilities Program strives to improve energy efficiency throughout LADWP's facilities with energy efficiency upgrades in HVAC and lighting. It identifies and assists those LADWP facilities in reducing energy usage, which will result in a reduction in energy consumption and procurement expense for LADWP that would otherwise be borne by LADWP customers.
- Embedded Energy from Water Measures: LADWP maintains a comprehensive suite of water efficiency programs to help our residential and non-residential water customers reduce their water usage through the adoption of various hardware measures. These actions to promote water use reduction have corresponding energy use reduction benefits, due to the amount of energy embedded in LADWP water throughout the cycle of treatment, distribution, and wastewater collection and treatment. All of this embedded energy is sourced from the LADWP grid (out-of-territory conveyance is omitted for now), so reductions in water usage due to these programs also save LADWP electricity.
- Plumbing Ordinance, Article V Codes & Standards: LADWP wrote the plumbing ordinance and shepherded it through City Council. Using the same factor used by Environmental Affairs to translate LADWP's water savings into embedded energy savings, an estimate of water use reduction due to the ordinance is used to estimate kWh savings; however, not

enough data exists to estimate kW at this time and the numbers are subject to further refinement.

- Low Impact Development (LID) Ordinance: LADWP wrote this ordinance and supported its passage through City Council. Environmental Efficiency engineers are working to estimate the energy savings due to this ordinance.

4.2.2 Demand Response

Background & Purpose

Demand Response (DR) is an important energy management tool that facilitates the reduction in energy use over a given time period in response to a price signal, financial incentive, or other triggering mechanism. The key objective of DR is to cost-effectively reduce the summer time system peak and avoid the need for long term investment in expensive natural gas power plants. To meet this objective, customers are incentivizes to reduce energy usage at critical peak demand periods in a manner that decreases overall system costs. LADWP's DR programs will be based on incentives to encourage customer participation, including bill reduction, rebates, or other financial incentives. The permanent load impacts of EE and temporary load impacts of DR are compared in Figure 4-8:

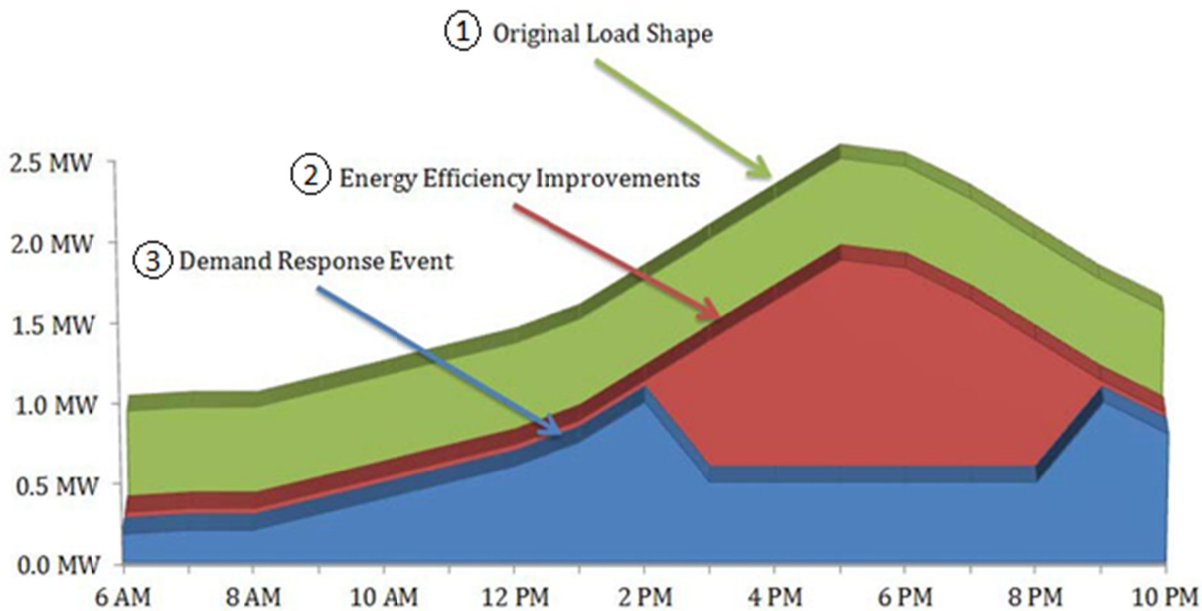


Figure 4-6 – Comparison of Load Impact between EE and DR

Figure 4-8 illustrates the impact of energy efficiency improvements (2) on the original load shape (1). Energy efficiency improvements reduce the overall original load shape without targeting specific periods of time. In contrast, demand response is effective in reducing energy usage over targeted periods of time and can assist in targeting the peak hours of the energy load shape. The resulting load shape from a demand response event (3) is shown in Figure 4-8, which targets the hours between 2 p.m. and 9 p.m. thereby flattening the load shape between those hours. The combination of demand response and energy efficiency complements one another and can be an important asset in reducing overall peak load.

A well designed and cost-effective set of DR programs will benefit both LADWP and its customers through:

Reduced System Costs. DR eliminates or defers the need to build additional power plants and the associated transmission and distribution infrastructure. Additionally, DR may reduce purchased energy costs by reducing the amount of energy that would otherwise be purchased to meet load, especially during the expensive peak demand periods. The overall effect is to save money which helps keep rates low.

Reduced Customer Bill. Customers who participate in DR programs will enjoy bill reductions, rebates, or other financial incentives for reducing energy consumption during peak periods or emergency situations. In addition, cost-effective DR benefits customers who do not participate as DR reduces the need for long term investment in new power plants, transmission, and distribution equipment.

Increased Reliability. The ability to strategically lower energy consumption is one way to help overcome supply-demand constraints and reduce the chance of overload and power failure. This is especially important at those few critical peak times each year when demand is at its highest, as well as those times when generation units are off-line, whether due to a forced outage or scheduled maintenance.

Reduced Environmental Impact. By eliminating or deferring the need to build additional infrastructure, the associated construction and operational impacts are also eliminated or deferred. Furthermore, the reduction in energy usage results in less operational impacts, including less fuel consumption, less carbon emissions, and less transmission use.

Integrating Renewables. Advanced Automated DR can enable customer loads to respond to fluctuations in generation from wind and solar power. Additionally, as renewable energy continues to become a larger percentage of LADWP's generation portfolio, there may be times where DR events are initiated to increase demand and absorb the renewable energy, reducing overall system costs.

Major Legislation and Policy Drivers

The updated Title 24 standard that took effect on July 1st, 2014 includes an updated requirement for Automated Demand Response (Auto DR) readiness. Any new building larger than 10,000 sq-ft and any existing building replacing 10% or more of existing luminaries must enable lighting fixtures to be controllable by a building management system capable of receiving Auto DR signals via the internet. Additionally, HVAC in non-critical zones must also be responsive to Auto DR signals. This regulation is important for the development of the DR portfolio because it may assist LADWP in identifying potential customers who are already capable of participating in future DR programs. Furthermore, the Title 24 updates show a continued commitment by the Federal Government to promote DR readiness and participation.

Program Development

LADWP's vision for DR is to enroll a realistically achievable quantity of a dispatchable, demand-side resource within LADWP's service territory that is both reliable and cost effective. The DR resource will help to defer generation capacity investments and to provide local transmission and distribution support, operating reserves, and integration of intermittent renewable energy.

The guiding principles for the development and operation of the DR portfolio are:

1. DR will be operated by the Energy Control Center (ECC), managed by the Power System, integrated with billing and customer information systems (CIS), and aligned with Energy Efficiency and Premier Account activities.
2. DR will be customer-friendly, which means an easy process for enrollment into programs, flexibility to change participation decisions, transparent incentives and rates, and inclusive of all rate classes.
3. Load curtailment will be available primarily during summer peak periods, within one to two hours of dispatch, with a significant share of the capacity available within 10 minutes.
4. DR will be treated as a resource by LADWP and included in the resource planning process, where the DR goals will be revisited during the IRP update process and realigned with projections of supply and demand and with changing strategic priorities at LADWP.

LADWP's focus is on DR resources that are cost-effective and proven. Cost-effectiveness tests determine whether the DR resource is a better investment overall than alternatives for meeting future load growth, given the best available current information. Upon review of these considerations, the current plan calls for LADWP to build 200 to a maximum of 500 MW of capacity by 2026 – 481 MW dispatchable – accelerating its implementation and evaluation of DR programs from an initial 5-10 MW of new peak demand capacity beginning in 2014, and to gradually build to 100 to 200 MW by 2020 and adding additional, cost-effective resources over the subsequent decade. Ramping the program in this manner—gradually and through internal programs rather than outsourced contracts for capacity—will promote the development of in-house expertise, and will also allow time to deploy the supporting information systems necessary to implement these systems successfully.

In spring 2013, LADWP hired Navigant Consulting to assist with developing a Demand Response Strategic Implementation Plan. The strategic implementation plan serves as LADWP's near term and long term plan for developing a measurable, cost-effective, and customer friendly DR portfolio. The DR implementation plan details the estimated DR resources, measurement and verification methods for load and billing impacts, cost-effectiveness methodology and results, enabling hardware and software requirements, customer outreach plans, and program staffing requirements. The DR implementation plan is updated annually and is incorporated into LADWP's IRP. All customer classes and sizes will be eligible to participate in some form of demand response, with the principal sources of load curtailment provided by the following customers and programs:

1) Commercial, Industrial, and Institutional (CII) Curtailable (215 MW) – Participants receive monthly capacity payments in return for providing guaranteed load reduction of at least 100kW when requested by LADWP. Additional incentives are provided based on energy reduced during DR events.

2) Residential & Small Commercial Direct Load Control (DLC) (145 MW) – Participants with less than 30kW peak load receive an annual payment that varies based on their ability and willingness to reduce power consumption from equipment which may include central air-conditioning units, wall-mounted air-conditioning units, pool pumps, and other equipment.

3) Critical Peak Pricing (93 MW) – Residential, small commercial, large commercial, and industrial participants of all sizes will be given a dynamic Time-of-Use rate that includes a high "critical peak" price in effect during periods of high energy prices, exceedingly high customer demand, or emergency situations.

4) Electric Vehicle (EV) Rider (12 MW) – Participants will have an EV charging station with a separate meter installed. During a DR event, their usage may be curtailed in exchange for a discounted rate while using the charging station.

5) Alternative Maritime Power (AMP) (41 MW) – The California Air Resources Board is requiring large vessels docked at the Port of Los Angeles be connected to electric power through LADWP's grid to reduce the emissions caused by on-ship diesel generation. In cases of system-wide emergencies, LADWP system operators may temporarily disconnect AMP customers in order to maintain grid reliability.

LADWP's maximum projected DR Portfolio in 2026 is as follows:

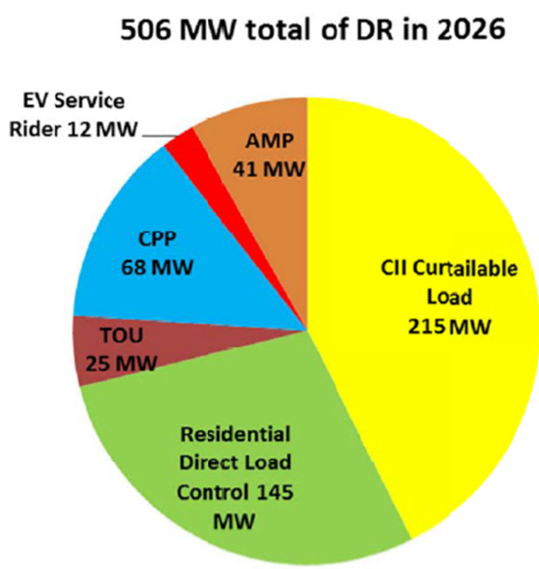


Figure 4-7: Demand Response Portfolio in 2026 – Maximum Potential

Implementation Schedule

The initial vision for DR extends through 2026, with the steady growth of CII and mass market load curtailment capability beginning in 2014. Early pilot programs have provided real DR capacity and built confidence in the resource, while also refining LADWP's choice of technologies, program designs, and outreach strategies. The first new offerings extended new DR opportunities to large CII customers. Future phases will extend to residential customers with central air conditioning. By 2020 new avenues for participation will be available such as critical peak pricing for CII customers and inclusion of pool pumps and window air conditioning for residential direct load control. Once advanced metering infrastructure (AMI) is established within the service territory, residential customers will have additional options via an expanded TOU rate offering and new Critical Peak Pricing (CPP) options.

Currently, LADWP requires customers to have existing Building Energy Management Systems (BEMS) and commit to a minimum load reduction of 100 kW for each called-for Demand Response Event during the five-month curtailment season of June 15th through October 15th.

Achieving the planned trajectory of DR growth from 55 MW today to 100 to 200 MW by 2020 and 200 to a maximum of 500 MW by 2026 will require laying a strong foundation of internal resource deployment, stakeholder participation, program development, and technology acquisition. Figure 4-10 illustrates the growth of demand response by program:

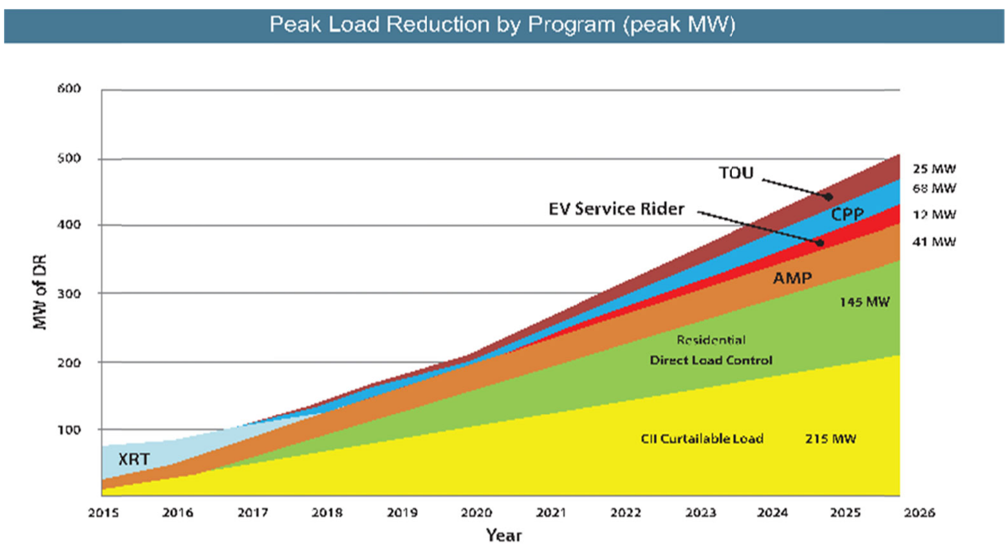


Figure 4-8: Demand Response Growth (2015-2026)

Demand Response's Role in Renewable Over-generation, Co-generation, and Energy Storage

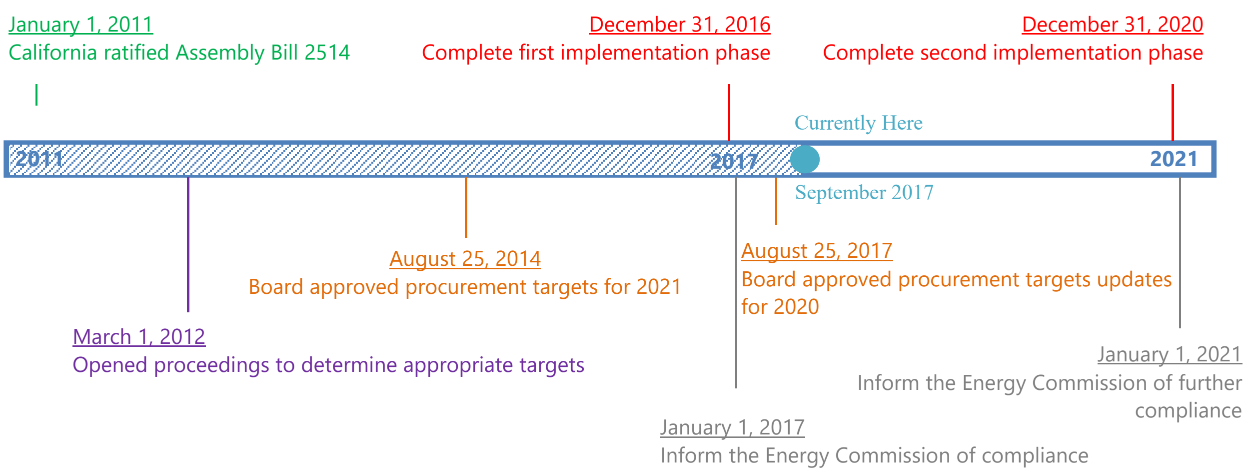
With the elimination of coal-fired power plants and the influx of renewable energy, particularly solar photovoltaic, LADWP predicts there will soon be periods where generation will exceed customer demand. Since many utilities are likely to encounter similar imbalances between generation and demand, it is unlikely that LADWP will be able to sell excess generation to neighboring utilities. Curtailing renewable generation is both costly and a waste of clean energy, and the cost-effectiveness of utility energy storage is still unknown, thus in the near term, LADWP will study the feasibility of demand response programs to encourage consumption during periods of over-generation.

As LADWP investigates opportunities to address the over-generation challenges described above, customers with significant co-generation capabilities will be engaged to determine capabilities to ramp-up and ramp-down co-generation in response to future periods of over-generation.

Assembly Bill 2514 requires IOUs to procure cost-effective energy storage systems in accordance with CPUC rulemaking. LADWP and other publicly owned utilities will be required to adopt their own energy storage goals and report progress towards those goals to the California Energy Commission (CEC). As details of LADWP's Energy Storage goals develop, staff will identify any coordination opportunities and potential synergies between DR and Energy Storage programs.

4.3 Energy Storage

California Assembly Bill (AB) 2514, which became law on January 1, 2011, requires governing boards of local publicly-owned electric utilities[1], including LADWP, to identify as well as evaluate viable and cost-effective energy storage (ES) systems. Procurement of said ES systems is to be achieved through two implementation phases – the first by December 31, 2016 and the second by December 31, 2020. The procurement targets for each phase were formally approved by the Board of Water and Power Commissioners on August 25, 2014. On August 15, 2017, the Board approved a revision of the procurement targets. AB2227 supersedes AB2514 and moves the target date of December 31, 2021 to December 31, 2020. In the long-term, LADWP plans to have 404 MW of energy storage systems by 2025.



Per Section 2835 of AB 2514, ES systems eligible towards the procurement targets must (1) be cost effective; (2) have been installed and first operational after January 1, 2010; and (3) store energy[2] that was generated from a mechanical, chemical, or thermal process at one time for use at another time with the purpose of:

- Reducing emissions of greenhouse gases;
- Reducing demand for peak electrical generation;

[1] Serving greater than or equal to 60,000 customers within California
[2] Examples: stored thermal energy for future heating/cooling needs, energy generated from renewable resources, and energy generated from mechanical processes that would otherwise be wasted

- Deferring or substituting for an investment in Generation, Transmission, or Distribution assets; and/or
- Improving the reliable operation of the electrical Transmission or Distribution grid

It is important to note that LADWP has been practicing pumped storage (one form of ES) for more than forty years through its operation of the Castaic Power Plant. Unfortunately, its establishment before January 1, 2010 disqualifies it from being counted for all, if any, ES procurement targets set by LADWP. This should not discourage the use of pumped storage as it offers similar, if not more viable, benefits compared to all emerging storage technologies.

LADWP is developing a strategic plan to identify ES benefits aligning with LADWP needs as well as assess and define various ES technologies that will support its unique electric grid, resource plan, and projects related to renewable integration, distributed generation, demand-side management and reliability.

To support the development process of the strategic plan, LADWP plans to follow through with the initiatives below:

1. Participation in a working group with the US Department of Energy (DOE) for the development of an ES protocol for use in measuring and quantifying the performance of ES systems and testing use cases. It is anticipated that the protocol will assist with evaluating the performance of ES systems and to make more informed design and operation decisions.

2. Incorporate results from three ES research projects conducted by the Electric Power Research Institute (EPRI):

    a. Strategic Intelligence and Technology Assessments of Energy Storage and Distributed Generation, Project 94.001
        i. This project provides analysis and strategic information on ES and distributed energy resource systems. It includes assessments and evaluations of various technologies.

    b. Distributed Energy Storage Options for Power Delivery and End Use, Project 94.002
        i. This project provides information and guidelines for using distributed ES and distributed generation systems for power delivery and end user applications such as peak management, peak shifting, etc.

    c. Bulk Power Energy Storage Solutions, Project P94.003
        i. This project provides information and guidelines for using bulk ES to shift off-peak energy and integration of variable renewable generation.

3. Collaboration with a working group established by the Southern California Public Power Authority (SCPPA) to work alongside other municipal utilities on researching and identifying the most viable ES systems for any given unique purpose.

4. Continued dialog with various vendors and third-party entities (i.e. contractors) on the current and future development of all energy storage technologies as well as application at the utility scale.

On August, 15, 2017, the Board of Water and Power Commissioners approved an update to the Energy Storage Systems Targets, revising the target totals to 22.6 MW by 2016 and 178 MW by 2020. These targets are subject to cost benefit assessments and feasibility studies, prior to implementation. A summary of the ES target updates is shown in Table 2-6 below:

Table 4-2: Summary of Energy Storage System Targets

<table>
<tr><th colspan="2"></th><th colspan="2">Prior to Update</th><th colspan="2">Current</th></tr>
<tr><th>Connection Level</th><th>Pre 2010 Existing ES</th><th>2016 Targets</th><th>2020 Targets</th><th>As of Nov 2017</th><th>2020 Targets</th></tr>
<tr><td>Generation</td><td>1,275 MW</td><td>21 MW</td><td>60 MW</td><td>21 MW</td><td rowspan="2">108.4 MW</td></tr>
<tr><td>Transmission</td><td>-</td><td>-</td><td>50 MW</td><td>20 MW</td></tr>
<tr><td>Distribution</td><td>-</td><td>-</td><td>4 MW</td><td>-</td><td>25 MW</td></tr>
<tr><td>Customer</td><td>9.08 MW</td><td>3.08 MW</td><td>40.3 MW</td><td>1.6 MW</td><td>2 MW</td></tr>
<tr><td>Subtotal</td><td>1,284.08 MW</td><td>24.08 MW</td><td>154.3 MW</td><td>42.6 MW</td><td>135.4 MW</td></tr>
<tr><td>Total</td><td>1,284.08 MW</td><td colspan="2">178 MW</td><td colspan="2">178 MW</td></tr>
</table>

LADWP is continuously reevaluating energy storage target schedules as the technologies evolve. On October 14, 2017, SB 801 was approved by the Governor, which required LADWP, in coordination with the city council of the City of Los Angeles, by June 1, 2018, to determine the cost effectiveness and feasibility of deploying a minimum aggregate total of 100 megawatts of cost-effective energy storage solutions and, if it determines that doing so is cost effective and feasible, to consider deploying those cost-effective energy storage solutions after June 1, 2018. LADWP determined that a minimum aggregate total of 100 megawatts of energy storage would be cost effective in 2022 and beyond.

Over-generation is generation that exceeds customer load demand, particularly on sunny days where load demand is correspondingly low, is of great concern with increasing amounts of solar generation. The operational issues associated with over-generation will require costly solutions to integrate these resources while maintaining a reliable system. Multiple solutions will need to be employed including: increased use of pumped hydro-electric energy storage, customer demand response incentives, and sales of excess energy. These solutions will drive up the incremental cost of these renewable resources especially as more renewable resources are added beyond the generation system's basic load requirements. Advanced energy storage technologies, such as batteries and compressed air energy storage, offer alternative energy storage solutions to help shift these resources to peak demand hours where these resources can provide greater benefit in meeting peak load that occurs in the late afternoon, early evening. However, these advanced energy storage technologies are still in development and have not yet been proven commercial on a scale suitable for large electric utilities. Until then, improved operations at the Castaic pumped hydro-electric facility will serve as the primary energy storage solution to help alleviate over-generation problems. See Section 5.1 for discussion on the suitability of multi-hour storage as a resource to address reliability, including peak-hour capacity needs.

4.4 Transportation Electrification

In 2012, Governor Brown executed an Executive Order calling for 1.5 million zero emission vehicles by 2025. This would require California to have as many as 279,000 electric vehicle chargers in-service, including 1.3 million electric vehicles on the road. Zero Emissions vehicles, or ZEVs, also include hydrogen fuel cell vehicles. The CEC estimates that 1.3 million of the ZEVs will be plug-in vehicles. At the end of 2017, there were nearly 14,000 public charging stations, including 1,500 direct current fast chargers, and 121,000 chargers at multi-unit dwellings in California. The number of registered vehicles in Los Angeles accounts for approximately 10% of the State, according to DMV records. In 2012, LADWP added an EV service rider time-of-use charging incentive of 2.5 cents/kWh discount for customers that installed a separate EV meter with discounted rates after 8 p.m.

In January 2018, Governor Brown executed another executive order, which raised the state target for ZEVs to 5 million on the road by 2030 and called for the construction and installation of 250,000 chargers, including 10,000 DC fast chargers.

As a strategy to absorb higher levels of renewables in the IRP cases, high levels of electrification were analyzed for the 65 percent RPS case. Electrification can come from a variety of sources including electric vehicle charging, hydrogen fuel production, Port of LA shore power for cargo ships, and mass transit and cargo transport among others. As one example, increased electrification of the transportation sector would provide an opportunity for load shifting and absorbing potential over-generation from renewable resources by promoting electric vehicle charging during times of over-generation. An additional benefit would include reduced local GHG and other constituent emissions from switching higher emitting fuels such as gasoline and diesel to much cleaner electricity, and increased electric sales and revenue.

The 2017 IRP recommended case doubles the base case electrification, which is based on a forecast published by the 2013 California Energy Commission's Integrated Energy Policy Report (IEPR). The IEPR provides a forecast of plug-in electric vehicle growth for the State of California. Based on the IEPR forecast, LADWP deduces that by 2020, 127,000 plug-in electric vehicles will be on the road in the Los Angeles basin; by 2030, an estimated 290,000 plug-in electric vehicles are expected to be on the road. This is equivalent to an annual energy demand of 1,172 GWh in 2030 that is required to charge these vehicles.

Recognizing the benefit of electrification on a utility level, the IRP Advisory Committee suggested high electrification levels. The high electrification case assumes a doubling of electric vehicles, as shown in Figure 4-11 below:

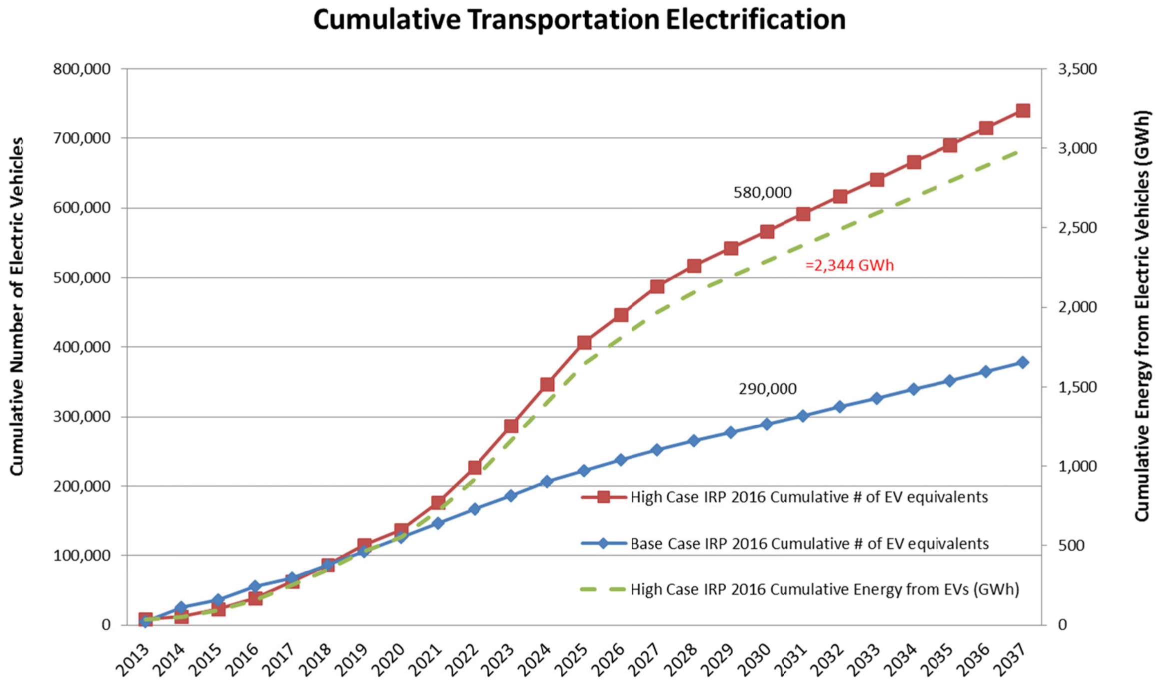


Figure 4-9. Electrification levels in the Los Angeles basin

A base and high level of electrification assumes 290,000 and 580,000 electric vehicles, respectively, in the Los Angeles basin by 2030. This is equivalent to 1,172 GWh and 2,344 GWh of energy usage in 2030 attributed to base and high electrification, respectively.

LADWP Electric Transportation Program (Fiscal Year 2015-2020)

Realizing the benefits of overall GHG reduction in the LA Basin and increased electric sales, LADWP has updated its electric transportation program in support of electrification goals detailed in the City of Los Angeles' Sustainability pLAn and LADWP's 2016 IRP recommended case. The new five year goal seeks to achieve an equivalent of 145,000 EV in LA by increasing EV adoption to 15% of vehicle purchases, counting public and workplace chargers as EV equivalents, and considering non-light duty vehicles as EV equivalents (i.e. medium and heavy duty trucks). The Electric Transportation Program is summarized by the following elements:

1. Education and Outreach: Achieve 15% plug-in electric vehicles sales of all new vehicle purchases in LA by 2021, through increased ride and drive events, social media, launching a joint program with other utilities and car dealers etc.
2. Electrify LADWP and LA City Fleet: 100% of new LADWP light duty vehicles and 50% of new LA City light duty vehicles are to be electric vehicles.
3. Residential Charging Rebates: Continue LADWP's "Charge-Up LA!" residential rebates and launch Phase II: Smart Charger Rebate Program.
4. Commercial Charging Rebates: Provide rebates for workplace and public charging. Phase II of the program includes direct install and Green Building Ordinance, which would require newly constructed buildings to supply electric vehicle chargers.

5. City EV Charging Infrastructure: Install curbside and parking lot public chargers, City Fleet Chargers, City DC Fast Chargers, and City workplace chargers throughout L.A.
6. Medium and Heavy Duty Fleet Charging: Electrify Port of LA, Los Angeles World Airports, forklifts, rail, and busses.

LADWP's Electric Transportation Program would clearly illustrate LA's visible support for EV technology through 10,000 City and private commercial chargers for public, workplace, and City vehicles, support residential charging, and assist in meeting LADWP's goals of GHG reductions, integration of renewables, better utilization of assets, and customer savings.

Charging Profiles

Based on various studies, including a UC Davis Institute of Transportation Study, "Charging Behavior Impacts on Electric Vehicle Miles Travel," approximately 20% of EV drivers charge at work and 80% of EV drivers charge at home. LADWP partnered with Stanford University to collect EV hourly charging data from LADWP headquarters to assess charging patterns. The data was then aggregated to develop a composite EV hourly charging profile used in the IRP modeling.

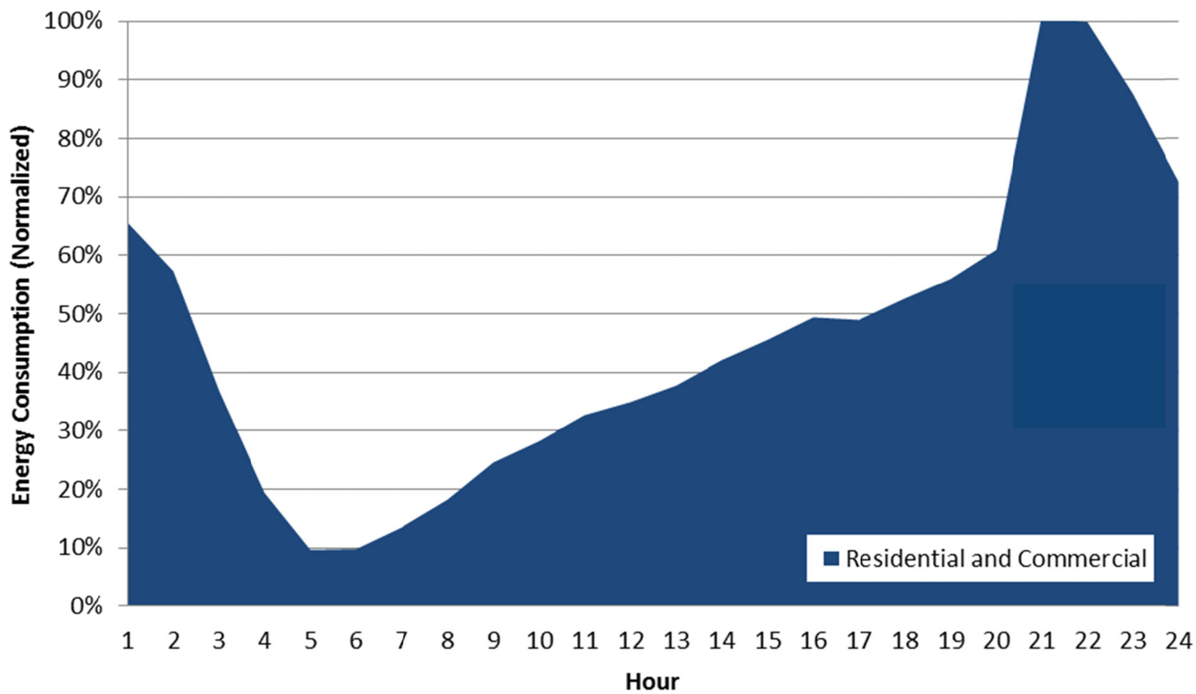


Figure 4-10. 2017 IRP Electric Vehicle Hourly Charging Profile Assumption

The EV hourly charging profile represents LADWP's business as usual, including time of use pricing for residential EV charging. As renewable penetration increases on the grid, LADWP will consider the need for a new rate design to shift charging behavior away from the afternoon net peak hour and over to the solar and wind peak hours to maximize renewable generation and reduce the risk of curtailment.

Charging Infrastructure

LADWP currently does not collect data on the quantity of level 1 charging. As of March 31, 2018, level 2 and level 3 EV chargers in Los Angeles are quantified as follows:

EV Installations			
Level 2	Residential	1,982	Single-Family Dwelling
	Customer-Owned	1,015	Workplace
	City-Owned	656	Public/Employee
Level 3	DC Fast Chargers	67	Public

Other transportation electrification

In addition to deploying electric vehicle chargers and promoting electric vehicles, LADWP is providing support to the following entities to assist with their transportation electrification efforts:

- LA Metro has plans to electrify their bus fleet, converting the orange and silver lines to electric. LADWP is supporting this effort by installing charging infrastructure for both depot charging (overnight) and en route charging.
- LA Department of Transportation (LADOT) is planning to purchase 112 zero-emissions electric buses in an effort to convert 100 percent of buses to electric by 2030.
- Harbor Department is taking steps to meet the Clean Air Action Plan goals set by the San Pedro Bay Ports. This includes electrification of equipment to reduce emissions from ships, trucks, harbor craft, and cargo-handling equipment. Electrification of the Port could potentially increase load to 900 GWh by 2030.
- LA World Airports (LAWA) is purchasing 20 electric buses to replace 14 diesel-buses and add 6 buses to its fleet.

Prioritization

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. In addition, programs will be designed to address areas within the City of LA with low EV penetration. These programs complement initiatives and measures set forth by California statutes AB 32, SB 32, AB 617, and local air district policies.

Utility Costs

Utility costs that are associated with serving transportation electrification vary in nature and are difficult to separate specifically for EV load. With any service upgrade or added load, LADWP considers it a revenue-generating project so LADWP absorbs almost all labor and materials needed to serve the request and this cost is recouped through the increase of electric sales. For additional load additions via EV chargers, the absorbed cost to the Utility would be through service cable upgrades and public property transformer upgrades. The added cost of conduit construction are charged to the customer. For line extensions (either overhead or underground), LADWP calculates a "credit" based on the anticipated amount of load and charge the customers the difference (essentially split cost in proportion to an expected revenue to cost ratio). If a transformer is needed on the property, the customer is charged a transformer deposit, which is collected in order to ensure the cost is recouped through the power revenue. If the transformer is used at 50% of its capacity or more for the first five years, LADWP considers its cost recouped and refunds the deposit.

Local Air Pollution Reduction and Zero-Emission Vehicle Initiatives

LADWP's electrification goals are in line with supporting the goals established by the latest Executive Order executed by Governor Brown in 2018 that raised the state target for ZEVs to 5 million on the road by 2030 and called for the construction and installation of 250,000 chargers, including 10,000 DC fast chargers. When the IRP electrification goals were initially established in 2014, the IRP analyzed doubling the 2013 Integrated Energy Policy Report base case of electric vehicles form 290,000 EV equivalents to 580,000 EV equivalents by 2030 and established it as the recommended target. The Electric Transportation Program at LADWP plans to reach the equivalent of 145,000 plug-in EVs and 10,000 commercial chargers by 2021. LADWP has a goal of converting 100% of its light duty City fleet vehicles to plug-in electric.

Community or Regional Infrastructure Needs

LADWP participates in electrification working group with the Southern California Public Power Authority (SCPPA) and California Electric Transportation Coalition (CALETC) that addresses the opportunities and challenges of a new, electrified transportation system, and identifies trends, business models and strategies to roll out charging infrastructure.

LADWP also holds electric transportation collaboration meetings with Southern California Edison (SCE) to smooth the pathway to broad customer adoption of electric vehicles, expand consumer education, continued incentives for EV purchases and increase the charging infrastructure across territories.

Disadvantaged Communities

LADWP is installing charging stations on power poles and facilities such as the Crenshaw Customer Service Center, sponsoring a car sharing pilot in disadvantaged communities, and launched a Used EV Rebate Program that offers a $450 incentive to residential customers that purchased an EV that is at least two model years old.

Customer Education and Outreach Efforts

LADWP sponsors at least three ride and drive events per year which include National Drive Electric Week, Best.Drive.Ever and Ciclavia and attends various community events and neighborhood council meetings (Earth Day, AutoMobility LA, Blue LA, LA Auto Show) to promote electric transportation programs. In addition, LADWP is collaborating with Southern California Edison and Plug-in America to establish EV dealer program which provides training to dealer staff and connects them with consumers.

Coordination with Distributed Energy Resources Programs or Planning

The Electric Transportation Group is working in collaboration with the Distributed Energy Resources Planning Group at LADWP on a Distributed Energy Resources Management System (DERMS) pilot project. DERMS will be able to provide visibility on the power consumption of electric vehicle charging in the power system. This will allow grid operators to make decisions based on electric vehicle charging and other distributed energy resources. DERMS can also utilize electric vehicle charging within demand response events, which entails curtailing electric vehicle charging to alleviate high power demand on the electric grid. DERMS will be able manage incentives and be coordinated with billing systems.

5. System and Local Reliability

5.1 Reliability Criteria

Integrating 50 percent RPS results in significant challenges associated with frequent daily variability, wherein the regulation and load following requirements increases dramatically as solar variable energy penetration increases. The Maximum Generation Renewable Energy Penetration Study (MGREPS) commissioned by LADWP estimated that up to 150 MW/min of additional up-regulation ramping capability and 85 MW/min of additional down-regulation ramping capability could be needed in the 2025-2030 period.

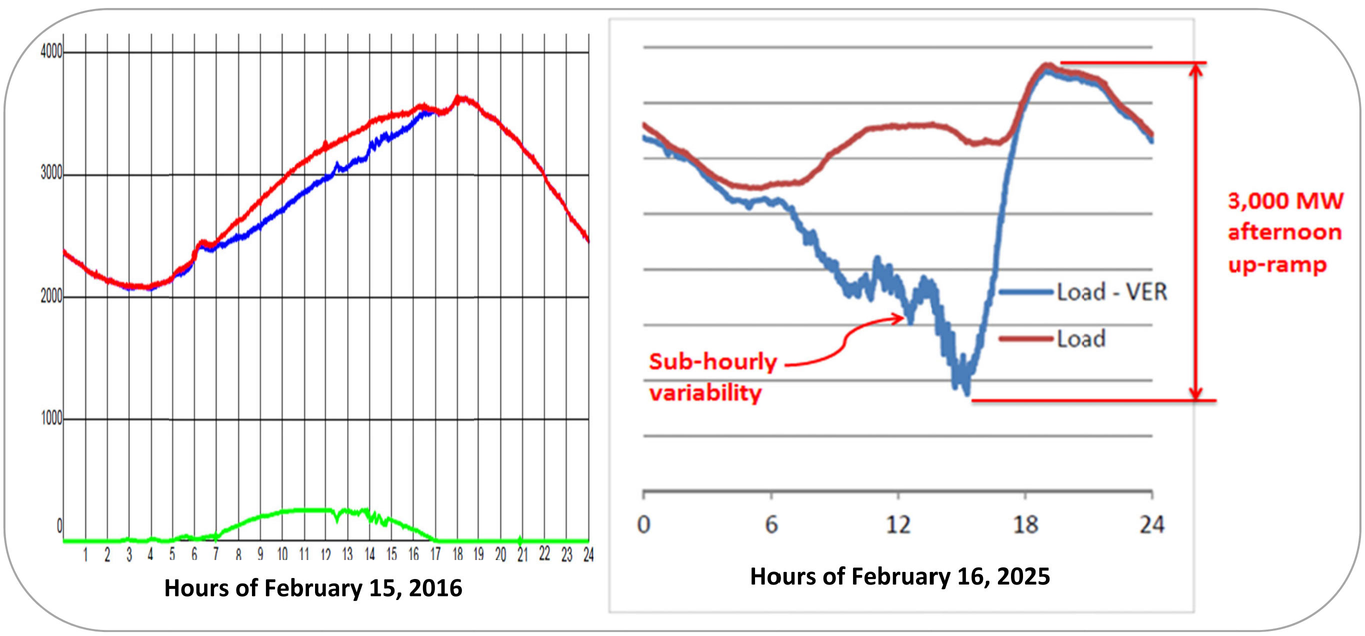


Figure 5-1. Sub-hourly duck curve

Figure 5-1 above illustrates the "duck curve" that is associated with 35 percent (left) and 50 percent (right) renewables. The smooth curves illustrate the load on an actual and simulated day, February 16, 2018 and 2025, respectively, and the lower lines illustrate the load that dispatch-able resources such as gas-fired and hydro generation must follow after variable energy resources are introduced into the system. Whereas the afternoon ramp required in 2018 is expected to be 1,500 MW, the afternoon ramp required in 2025 is expected to be double. The Power System will need to have sufficient flexibility to significantly ramp down its generation as the sun rises and dramatically ramp up its generation as the sun sets to accommodate solar resources. In 2025, it is expected that between 2,500 and 3,500 MW of generation will need to be placed on-line within a 3 to 5 hour period to meet the afternoon peak load as the sun sets. This will result in significant stress on the Power System – thermal units and large hydro will be expected to turn on/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.

A 50 percent RPS high solar scenario indicates upward trends in load-following and regulation requirements over time. The most notable trends are increases in:

- Hourly downward load-following requirements during the morning solar ramp, from almost none in 2014 up to 860 MW in 2030
- Hourly regulation requirements during peak solar hours, from 60 MW up-regulation in 2014 up to 360 MW in 2030
- Hourly upward load-following requirements in the afternoon, from 350 MW in 2014 to 1,400 MW in 2030.

In addition, a 50 percent RPS high solar scenario would result in the following capacity shortfalls in system ramping capability in 2030:

- 47 hours in which 60 minute ramping capability falls short, by a maximum of 480 MW
- 6 hours in which 30 minute ramping capability falls short, by a maximum of 380 MW
- 220 hours in which 10-minute ramping capability falls short, by a maximum of 640 MW.

Although some shortfall can be mitigated through re-dispatch of thermal capacity and large hydro, there is a need for fast-responding resources to compensate for fast fluctuations in solar power output.

In order to meet future load-following and regulation requirement needs, the MGREPS study recommended adopting tools to assess flexibility reserves, adding additional storage for regulation in optimal locations, evaluating the cost effectiveness of fast start gas generation and other flexible resources, joining the CAISO's Energy Imbalance Market, and making upgrades to reduce reliability must run requirements. To remedy the steepness of a future "duck curve," strategies such as improved resource diversification, modifying renewable contracts to alleviate renewable integration issues, and promoting electric vehicle charging during peak hours needs to be evaluated and quantified with potential rate restructuring to help mitigate impacts. The future generator load profile in 2025 is expected to have a steep afternoon up-ramp and there will be cost associated with this ramp—flexible, quick starting gas-fired units will need to be built to compensate for the loss of renewables. This IRP considers the true "all-in" cost of renewables including associated integration cost, as well as strategies to reduce the reliability and cost impact of a steep "duck curve" and next year's IRP will evaluate additional strategies, such as co-locating batteries with new solar facilities.

Reserve Requirements

Two important aspects of electric power system reliability are "resource adequacy" and "security." Resource adequacy refers to the availability of sufficient generation and transmission resources to meet customer's projected energy needs plus reserves for contingencies. Security refers to the ability of the system to remain intact after experiencing sudden disturbances, outages or equipment failures.

LADWP, as part of the electric power grid of the western United States and Canada (and a small section of northern Mexico), is required to meet operational, planning reserve and reliability criteria, and the resource adequacy standards of the WECC and the North American Electric Reliability Corporation (NERC). Based on these standards, the system reserve margin requirements and other criteria which LADWP uses to plan and operate are defined as follows:

Generation Capacity Requirement = Net Power Demand + System Reserve Requirement
System Reserve Requirement = Operating Reserve + Replacement Reserve
Operating Reserve = Contingency Reserve + Regulation

The "Net Power Demand" is the total electrical power requirement for all of LADWP's customers at any time. The other reserve requirements are defined below, as well as numerically calculated.

The loss of the largest single contingency of generation or transmission is a key reserve margin determinant for LADWP and defines the amount of Contingency Reserves required. Replacement Reserves are required in addition to contingency reserves in order to replace the contingency reserves within 60 minutes of a contingency event. The Regulation Requirement of 25 MW is related to system load variations due to customer load changes. This regulation requirement is anticipated to increase in the future as additional amounts of intermittent renewable generation are added to the generation mix. To account for unplanned outages, historical forced outage information is used to determine an appropriate reserve margin which is approximately 300 MW. With the repowering of Scattergood 1 and 2 generating units over the next 4 years, the unplanned outage reserve margin will drop in stages to eventually reach an expected level of 150 MW. Given LADWP's current total generation portfolio, the system reserve requirement is 1,717 MW in 2017 with the repowering of Scattergood 3, and will drop to a level of 1,666 MW with the repowering of Scattergood 1 and 2 in 2024. Therefore, if the system demand is 5,000 MW, LADWP must currently have a total of 6,717 MW of dependable and dispatchable generating capacity (and the transmission for that capacity) to meet the 5,000 MW demand.

Due to the variable and intermittent nature of some renewable resources, particularly resources such as wind and solar photovoltaic, their generation capacity cannot be fully depended upon to meet peak demand conditions. As LADWP acquires a larger proportion of such resources, studies on the characteristics of these variable and intermittent resources will need to be carried out to determine their effect on reserve and regulation requirements.

The capacity value of a generating resource is based on its ability to provide dependable and reliable energy and capacity during peak periods when the system requires reliable resources for stable operation. Resources that can provide firm capacity will have a higher capacity value than resources that cannot. The 2017 IRP considers the net dependable capacity (load minus variable energy resources) for resource adequacy analysis.

Over-generation

Over-generation as shown in Figure 5-2, or generation that exceeds customer load demand, particularly on sunny days where load demand is correspondingly low, is of great concern with increasing amounts of solar generation. The operational issues associated with over-generation will require costly solutions to integrate these resources while maintaining a reliable system. Multiple solutions will need to be employed including: increased use of pumped hydro-electric energy storage, customer demand response incentives, and sales of excess energy. These solutions will drive up the incremental cost of these renewable resources especially as more renewable resources are added beyond the generation system’s basic load requirements. Advanced energy storage technologies, such as batteries and compressed air energy storage, offer alternative energy storage solutions to help shift these resources to peak demand hours where these resources can provide greater benefit in meeting peak load that occurs in the late afternoon, early evening. However, these advanced energy storage technologies are still in development and have not yet been proven commercial on a scale suitable for large electric utilities. Until then, improved operations at the Castaic pumped hydro-electric facility will serve as the primary energy storage solution to help alleviate over-generation problems. Another promising solution which is currently being investigated is to offer our customers demand response incentives to shift customer electricity use to hours where over-generation occurs.

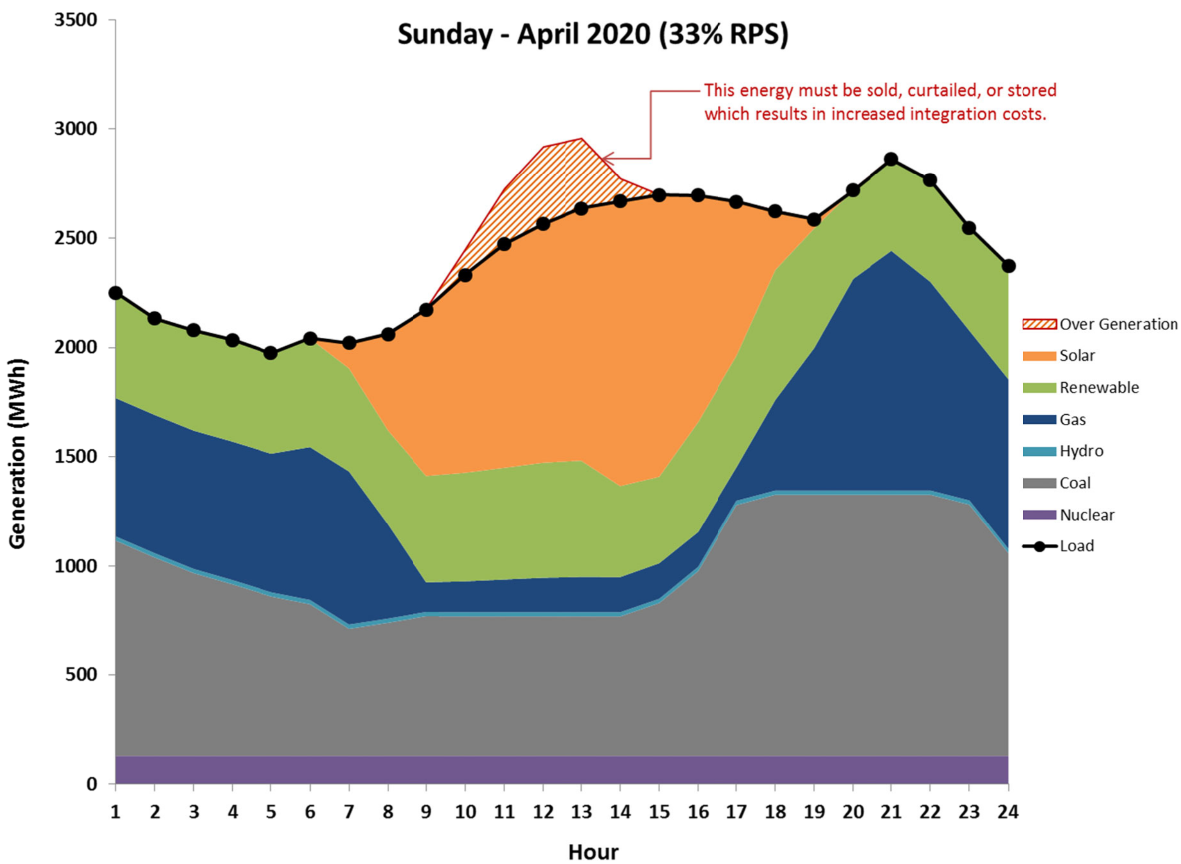


Figure 5-2. Generation profile for year 2020 illustrating over-generation and ramping issues.

Based on the findings of a January 2014 study by the consulting firm E3 entitled, "Investigating a Higher Renewables Portfolio Standard in California", over-generation levels experienced by the 5 largest electric utilities was found to be 0.2%, 1.8%, and 8.9% of all in the 33%, 40%, and 50% RPS levels, respectively, in 2032 when considering a high solar scenario. The amount of over-generation on LADWP's system is expected to be lower than that experienced by other California utilities. The reason for the lower expected over generation most likely lies in the development of a RPS portfolio that includes a diverse mix of renewable resources. LADWP owns and operates a large pumped hydro-electric facility, which has the capability of pumping water to store energy during over-generation events. As a result, LADWP will have capability to absorb over generation with increased RPS levels.

Figure 5-3 below estimates the annual potential over-generation and curtailment of renewables for the 2017 IRP recommended case, which includes renewable targets of 50% RPS by 2025, 55% RPS by 2030, and 65% RPS by 2036. Although LADWP currently only includes approved energy storage targets through 2025, future IRPs will consider long-term energy storage targets based on over-generation and system needs as energy storage becomes more cost effective.

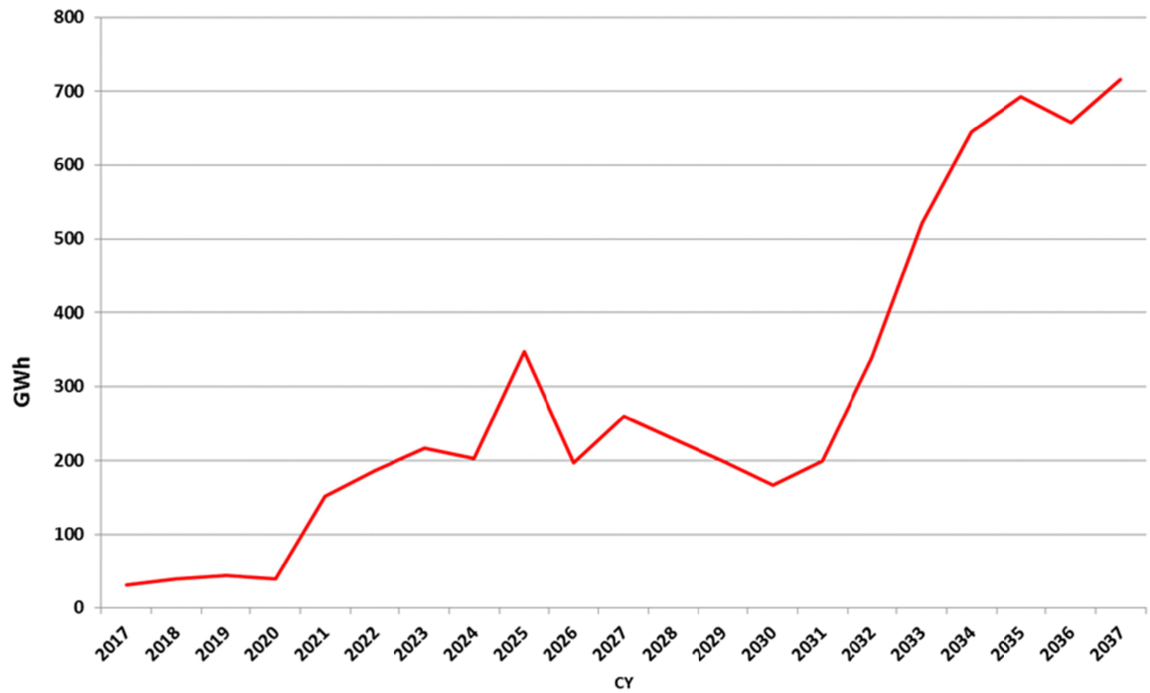


Figure 5-3. Annual Over-generation Forecast for 2017 IRP Recommended Case

5.2 Local Reliability Area

Challenges to ensuring continued reliable electric service include the replacement of aging generation facilities, maintaining grid reliability, the integration of intermittent renewable energy resources, infrastructure enhancement to accommodate additional renewables, and the replacement of equipment related to generation, transmission, distribution, and substations.

Aging Facilities and Infrastructure

LADWP's generating plants sited within the Los Angeles Basin were primarily built in the late 1950s and early 1960s. While many generating units at these plants have undergone extensive upgrades, others are approaching the end of their service lives. Replacement of these older units (also known as "repowering") began in 1994, and will continue through 2029. As older generating units continue to age, unplanned outage rates have been increasing, requiring additional planning reserve margins until these units are repowered with more reliable units. The new repowered units will produce lower GHG emissions and other pollutants and be more reliable, efficient, and community-friendly than the units they are replacing. Repowering LADWP's gas-fired units will also assist in integrating intermittent renewable resources into LADWP's energy mix by providing quick–response, back-up generation capacity.

Grid Reliability

LADWP's local transmission system cannot be reliably operated without generation from local thermal generating plants. The amount of generation required to provide transmission reliability is termed Reliability Must Run (RMR) generation. Repowering these local units will maintain transmission reliability by maintaining the reliability of RMR generation.

Historically, LADWP's local generation has provided voltage control for the basin transmission system. Over the years, as imports into the basin transmission system have increased, fewer local generators are needed on-line at any given time to supply power, reducing voltage control options for Power System operators. LADWP is countering this with plans to install static capacitors and reactors at strategic locations throughout the city. These installations are increasingly important as more renewables are imported. New repowered units, such as Haynes 12 and 14, and Scattergood 6 and 7, also have the ability to operate as condensers and provide voltage control.

LADWP's latest 2017 Ten-Year Transmission Assessment Plan has identified a number of infrastructure improvements that are needed to avoid potential overloads on key segments of the Basin transmission system. These overload conditions, caused by either loss of a particular substation or loss of more than two transmission components simultaneously, could lead to load shedding events (intentional power outages) to minimize the overall impact on the Power System.

Transmission Facilities/Grid Reliability

Electricity from LADWP's power generation sources is delivered to customers over an extensive transmission system. To deliver energy from generating plants to customers, LADWP owns and/or operates approximately 20,000 miles of alternating current (AC) and direct current (DC) transmission and distribution circuits operating at voltages ranging from 120 volts to 500 kilovolts (kV). Major transmission lines connecting to out-of-basin generating resources are shown in Figure 5-4.

In addition to using its transmission system to deliver electricity from its power generation resources, LADWP arranges for the transmission of energy for others through its Open Access Same-Time Information System (OASIS) when surplus transmission capacity is available and saleable. LADWP uses its extensive transmission network to sell its excess energy and capacity in the California, Northwest, and Southwest energy markets. Revenues from these excess energy sales are used to reduce costs to customers and for capital improvements.

In critical times, neighboring utilities look to LADWP's surplus energy and transmission resources to bolster their power system and avoid blackouts. For example, after the nearby San Onofre Nuclear Generating Station retired, the California Independent System Operator is attempting to secure the delivery of replacement energy from other potentially available generation sources.

LADWP annually performs a Ten-Year Transmission Assessment Plan, in compliance with the North American Electricity Reliability Corporation (NERC) Compliance Enforcement Program. LADWP's 2017 plan identified a number of transmission improvements that are needed to maintain reliability.

Transmission for Renewable Energy

Since renewable resources are often located long distances from the City of Los Angeles and where transmission facilities do not exist, accessing renewable resources will require extensive infrastructure improvements, including the construction of new transmission lines, upgrades to existing out of basin and local transmission lines, and improvements at transmission facilities and stations to increase their transfer capability. The following sections provide a summary of the major transmission upgrade projects:

Barren Ridge Renewable Transmission Project

The Barren Ridge Renewable Transmission Project, completed in 2016, will increase the capacity of the existing 230-kV Barren Ridge-Rinaldi transmission segment from 450 MW to approximately 1,700 MW. Barren Ridge will provide customers access to approximately 1,000 MW of wind and solar power, which includes 250 MW from the Beacon solar project, 60 MW from RE Cinco solar, 260 MW from the Springbok 1 and 2 solar projects, 143 MW from the Pine Tree solar and wind facility, and hundreds of megawatts from several of LADWP's hydroelectric plants from the north.. This project will also increase the transmission capacity to the Castaic Pump Storage Power Plant, providing enhanced operational flexibility and integration of variable renewable energy.

Important components of the Barren Ridge Renewable Transmission Project are as follows:

- New Haskell Canyon Switching Station.
- New double-circuit 230-kV transmission line from the Barren Ridge Switching Station to the new Haskell Canyon Switching Station.
- Expand the existing Barren Ridge Switching Station.

Up-to-date information on this project is available at:

https://www.ladwp.com/ladwp/faces/ladwp/aboutus/a-power/a-p-projects

Pacific Direct Current Intertie (PDCI) Upgrade

LADWP and its southern DC partners have signed a letter of agreement with the Bonneville Power Administration (BPA) to implement an initial 120 MW capacity increase of PDCI, if the cost is reasonable. In any case, BPA has committed to an extensive overhaul of Celilo HVDC Converter Station which requires coordination at the southern end of the HVDC line at Sylmar HVDC Converter Station. BPA's Celilo upgrade project was placed in-service in January 2016. As a result of the upgrade, plans for upgrade of the Filter Banks at Sylmar Converter Station are required. The Sylmar Filters Replacement Project is to replace the old AC and DC filters at Sylmar Converter Station East and West with new filters installed at Sylmar Converter Station East and to upgrade the control system. LADWP issued a Notice to Proceed to ABB in January 2017 to start the design. Construction of the new AC Filters 3 and 4 is scheduled to start January 2018 and commissioned by December 2018. LADWP Construction Crew, which is building all the new switchyard equipment, is mobilizing to site on November 1, 2017 to prepare the site for construction activities and start grading the AC filters 3 and 4 areas. ABB is responsible for upgrading the control system to the latest and greatest control system that ABB offers and to match the control system at Celilo. The project is scheduled to be completed in the first quarter of 2020.

The Haskell Canyon-Olive Transmission Line Project

LADWP plans to reconnect the existing Power Plant 115-kV Transmission Lines 1 and 2 to the new Haskell Canyon Switching Station, and then replace existing double-circuit 115-kV towers with new 230-kV towers from the new Haskell Canyon Switching Station to the north side of the Los Angeles Basin transmission system, with one 230-kV circuit going to a new position at the existing Sylmar Switching Station. This project will maintain system reliability and increase the transfer capability from the new Haskell Canyon Switching Station to the Los Angeles Basin transmission system as well as assist with supporting 1,700 MW of renewables coming from Owens Valley. In the short term horizon, LADWP plans to change the circuit rating of Olive-Northridge, Haskell-Sylmar, and Haskell-Olive 230 kV lines in order to support 1,050 MW of renewables from Owens Valley.

The Victorville-Los Angeles (Vic-LA) Project

The Vic-LA Projects, which are targeted to be completed by August 2022, involve making infrastructure and operational improvements between the Victorville area and the Los Angeles Basin which will allow LADWP to add up to 500 MWs of transfer capacity, subject to operational requirements. The upgrade work to be performed and scheduled will be determined by a joint Grid Planning and Development Section. The upgrade work could include, but not be limited to, the following work activities:

- Upgrading equipment at Victorville, Mead, and Century Substation including wave traps and capacitor voltage transformer to raise the operating voltage from 287 kV to 300 kV,
- Replace Transformer Bank K, upgrading antiquated equipment at Victorville Switching Station,
- Installing shunt capacitors at different strategic locations to improve Los Angeles Basin load power factor,
- Replace Toluca Bank H,
- Replacing the 230 kV circuit breakers and the disconnect switches at the Rinaldi Receiving Station, and
- Reconductoring Valley-Toluca 230 kV circuits and Valley-Rinaldi 230 kV circuits.

Los Angeles Basin Projects

The annual Ten-Year Transmission Assessments have consistently identified the need to install Scattergood-Olympic 230kV Cable A for many years now. With each passing year, the urgency becomes more apparent so that now even remedial actions have limited benefit. For this reason, LADWP is moving forward with the installation. With construction that began in 2012, the new 15-mile long Scattergood-Olympic 230kV Cable A in the Westside should be in-service before May 2018. Other Los Angeles Basin projects include:

- Upgrade circuit breakers and disconnects at Receiving Station-U and Receiving Station J.
- Replace Transformer Banks E and F at Receiving Station K
- Install 90 MVAR Reactors at RS-D and RS-E

- Reconductoring of the Rinaldi-Tarzana Line 1 and Line 2 230 kV Circuits

These infrastructure improvements are critical to avoid potential overloads and over-voltage violations on key segments of the Los Angeles Basin transmission system.

FERC Order 1000 – WestConnect Regional Transmission Planning

On July 21, 2011, the FERC issued its order on transmission planning and cost allocation (Order 1000). On May 17, 2012, FERC issued Order 1000 A, stating that non-jurisdictional entities (such as LADWP) must formally enroll in a transmission planning region before it can be assessed costs under the regional cost allocation methodology. FERC also stated that non-jurisdictional entities must have a right to withdraw and avoiding cost allocations from the region.

However, Order 1000 and 1000A contains language that would significantly broaden FERC's authority to allocate transmission costs. FERC takes the unprecedented position that transmission costs may be allocated to entities in the absence of a contract or service relationship.

Most jurisdictional transmission providers filed their compliance filings to amend their tariffs to include a regional planning process in October 2012. FERC has recently issued orders with findings that many of the compliance filings in planning regions did not meet the requirements of Order 1000 with respect to cost allocation. LADWP as a non-jurisdictional entity was not required to make a filing.

The Final Rule urges, but does not require, government owned utilities such as LADWP and cooperative utilities to participate in regional transmission planning and cost allocation. FERC indicates that if "non-jurisdictional" transmission owners do not comply with Order No. 1000, they may not meet reciprocity requirements, and thus may have access to third party transmission services limited.

Even though Order 1000 doesn't require non-public TOs to enroll in a region the LADWP decided to enroll in WestConnect as a Coordinated Transmission Owner (CTO) because it may benefit from the regional planning process which can identify transmission regional needs. A board package to enroll into of WestConnect was compiled and presented in the November 2015 board meeting and was approved. LADWP officially joined WestConnect on May 1, 2016.

Figure 5-4 shows its major out-of-basin generation resources. Noteworthy is the fact that while LADWP customers represent roughly ten percent of California's electrical load, approximately 25 percent of the state's total transmission capacity is owned by LADWP. LADWP also differentiates itself from its counterparts by continuing to operate as a vertically integrated electric utility, owning and operating its generation, transmission, and distribution resources rather than as a parent company with subsidiaries carrying out the various functions that comprise the supply chain.

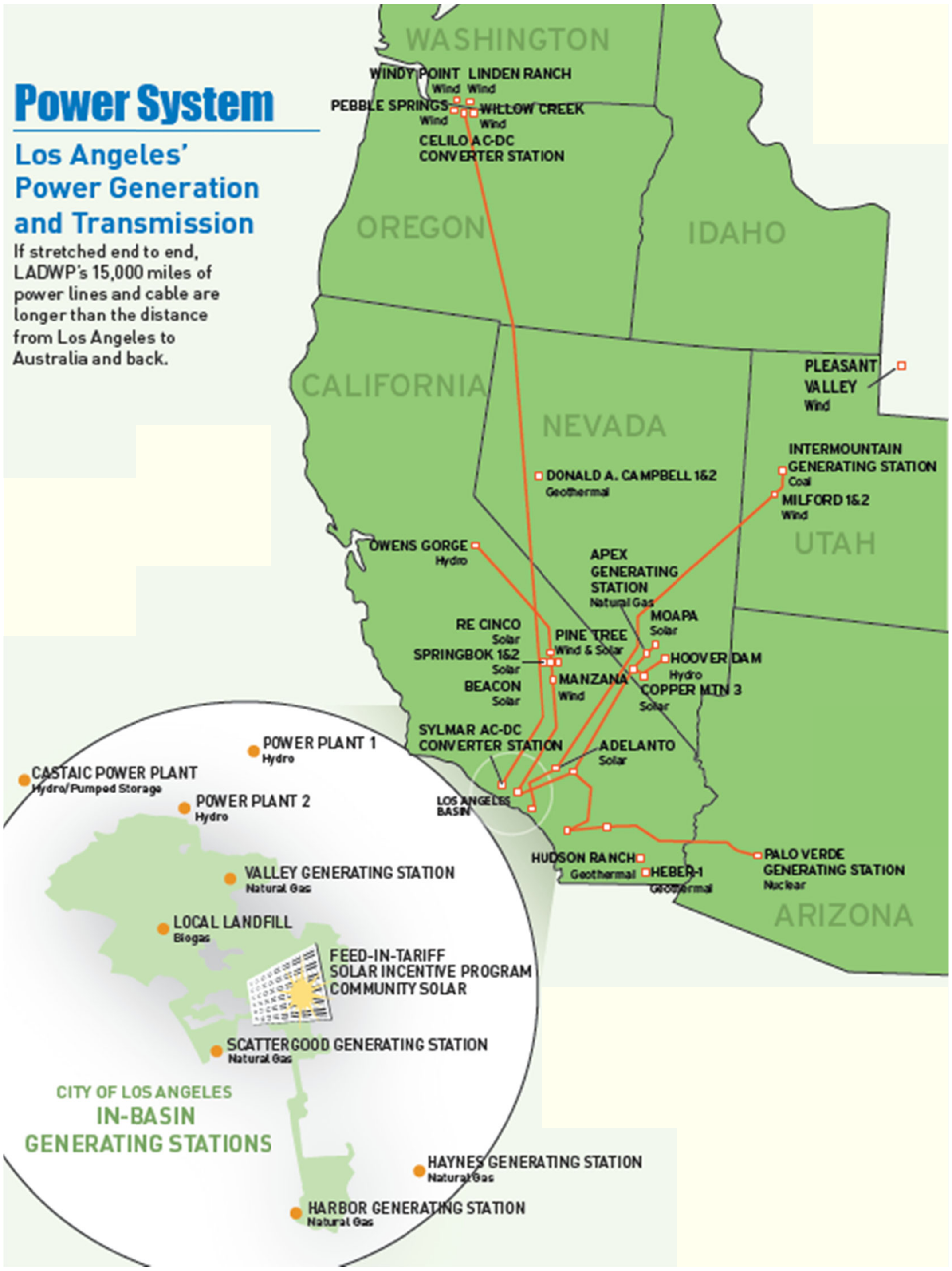


Figure 5-4: Major in-basin and out-of-basin generating stations and major transmission lines.

As a subset of the reserve requirements, LADWP has located a significant amount of generating resources within the Los Angeles (LA) area. The specific amount of capacity that needs to be located in the LA Basin is approximately 3,400 MW, but varies, depending on the combination of which units are operating and how much power is flowing on the transmission system at the time. LADWP's local transmission system cannot be reliably operated without generation from local thermal generating plants. The amount of generation required to provide transmission reliability is termed Reliability Must Run (RMR) generation. RMR generation is incorporated into all of the strategic cases considered in this IRP. An OTC Study that is expected to be completed in late 2018 will inform the extent of which repowering projects are required and identify all viable alternatives that are environmentally responsible while meeting reliability standards.

This local requirement is particularly important in the context of deciding how to schedule the repowering of units that utilize once-through cooling. It is for this reason that no unit will be taken out of service before an equivalently-sized, locationally-equivalent replacement unit is constructed, tested and ready to be placed in-service.

5.3 Addressing Net Demand in Peak Hours

Resource Adequacy

Table 5-1 presents a summary of the major price assumptions and peak hour capacity contribution for supply-side resources. Lower prices for solar and geothermal have been incorporated into the 2017 IRP modeling, as price competition has resulted in lower prices for both resources. Dependable capacity is an on-going area of study and could change in future IRP's as more data becomes available.

The 2017 IRP analyzed the suitability of multi-hour storage, including compressed air energy storage, half hour, 2 hour, and 4 hour batteries as a resource to address reliability, including peak-hour capacity needs and financial impacts associated with over-generation and meeting evening ramping needs. The multi-hour storage resources were analyzed through the economic dispatch model and its levelized cost, capacity factor, and peak load dependable capacity compared to other resources are detailed in Table 5-1 below:

Table 5-1. SUMMARY OF SUPPLY-SIDE RESOURCE ASSUMPTIONS

	Levelized Cost ($/MWh) [1]	Capacity Factor	Peak Load Dependable Capacity (3 to 5 PM)	Net Load Dependable Capacity [2] (7 to 9 PM)
Solar Photovoltaic - PPA	$56	28% - 35%	27%- 38%	0% - 2%
Solar Photovoltaic - LA Solar	$175	19% - 23%	27%	3% - 5%
Solar - Owens	$30	25%	27%	3% - 5%
Solar Feed-in Tariff	$173	20%	27%	3% - 5%
Wind	$105	24% - 33%	10%	0%
Wind Firmed and Shaped	$106 to 132	24% - 33%	45% - 100%	45% - 100%
Geothermal	$78	91% - 95%	90%	90%
Castaic Improvement	$29	46%	100%	100%
Beacon Battery (1/2 hour)	$480	4%	43-61%	12%
Distribution Battery (2 hour)	$178	12%	100%	48%
Transmission Battery (4 hour)	$93	17%	99%	96%
New Combined Cycle Gas	$75 to 85	42%	96%	96%
New Simple Cycle Gas	$500 to 600	3% - 5%	96%	96%
CAES	$55	44%	92%	96%

[1]Net Present Value (annual costs, 2017-2037) / NPV of Energy Produced
[2]Net Load represents the hour when the net energy for load minus variable energy resources is maximum

As RPS continues to increase, especially with large percentages of solar and wind, the resource adequacy paradigm shifts from a historical 1-in-10 peak customer load to a net peak load, which evaluates load minus variable energy resources over a 20 year period. As a result, the peak hour shifts from an afternoon peak to an evening peak due to high levels of solar penetration. This method revises the net load dependable capacity contribution from renewable resources. For example, solar contributes very little to the evening peak in 2018 and beyond, compared to the afternoon peak. The 2017 IRP estimates that a resource shortfall will start in 2024; therefore, there is a critical need for dispatch-able resources, including geothermal and energy storage such as batteries that will contribute to the evening peak. Future IRPs will continue to monitor the resource shortfall and reduce the shortfall with generation resources that best fits the needs of the Power System.

One of the primary objectives of resource planning is to ensure that adequate resources are secured to meet system peak load, while also supplying adequate reserves or back up generation to supply contingency and replacement reserves, as required under NERC operating standards. Unplanned outages are an additional planning concern for utilities, especially as generation units age and generally become less reliable. This 2017 IRP quantifies the dependable capacity from intermittent variable energy resources (VERs) such as wind and solar using a stochastic method.

Dependable capacities for solar and wind resources were calculated by computing their average energy outputs for each hour of the day over each month, capturing any seasonality fluctuations. Similarly, standard deviation of energy output was computed for each hour of the day over each month. Two standard deviations were then subtracted from each hourly average value to arrive at a dependable capacity value at a 95% confidence level.

For existing non-VER units, monthly planned and unplanned outage factors were calculated using historical operational data. Only outages less than 90 days were considered in the calculation to filter out lengthy one-time outages (e.g., upgrades to Castaic). Future non-VER units were assumed to have a monthly 4% outage factor for scheduled maintenance and a monthly 4% outage factor for unplanned outages.

Dependable capacities for energy storage assets were determined by running an hourly full-system dispatch to determine the likely quantity of energy stored by each asset. Only the energy stored, as determined by the dispatch model, was counted towards the asset's dependable capacity for that hour.

A 61% capacity factor was applied to energy efficiency to reflect customer adoption rates as reported by the 2017 study *Evaluation, Measurement and Verification of the Los Angeles Department of Water and Power Energy Efficiency Programs* conducted by Navigant Consulting.

To comply with NERC operating standards, LADWP must carry additional generating capacity above the current instantaneous load. NERC standards prescribe the level of contingency reserve—capacity that can quickly compensate for any outages of generation or transmission. In addition to contingency reserve, LADWP plans for additional outages by carrying replacement reserves and reserves for unplanned outages of older generating units as well as new generating units. The additional margin for unplanned outages for existing units was determined using historical operational data, while a 4% unplanned outage factor was assumed for new units.

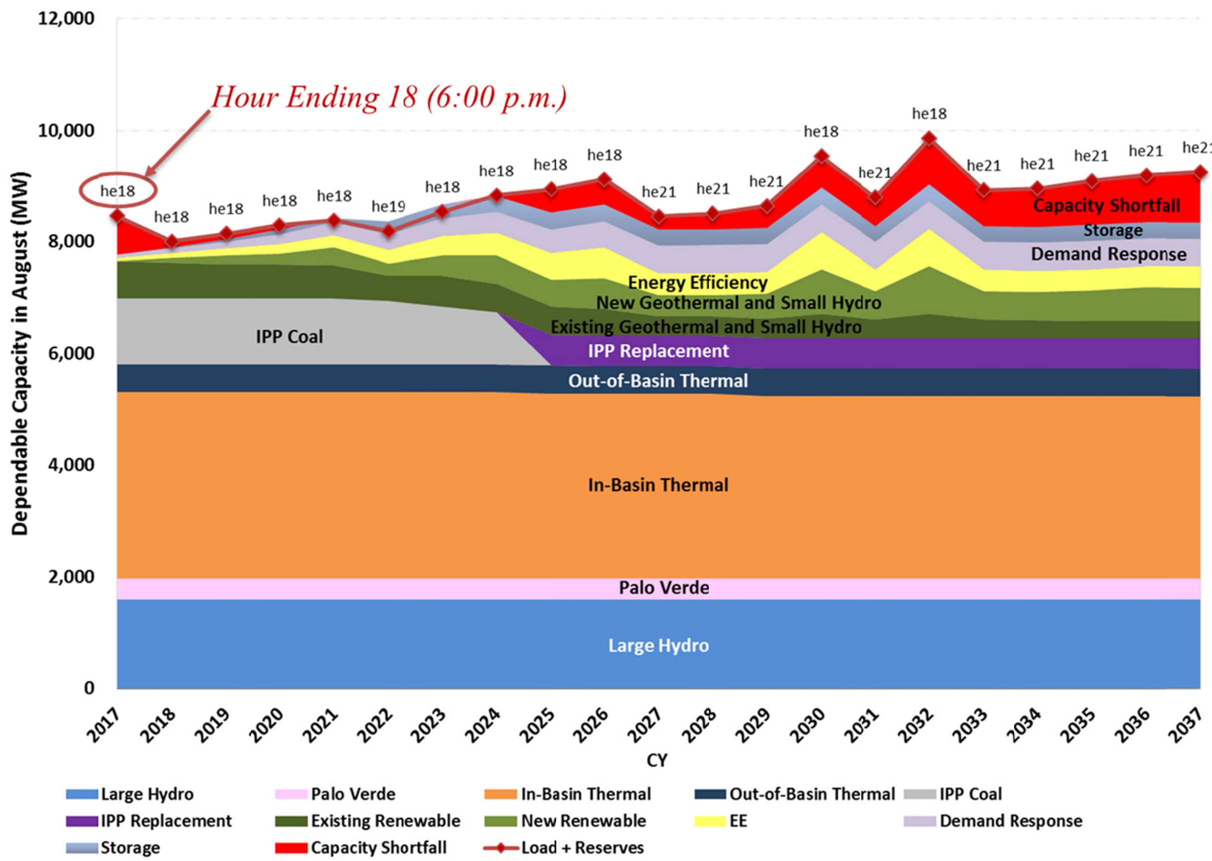


Figure 5-5. Dependable capacity profile, Recommended Case

6. Greenhouse Gas Emissions

The overall goal of AB 32, SB 32, and AB 197 is to reduce California's statewide GHG emissions by 40 percent below 1990 levels by 2030. As part of efforts to meet the 2030 GHG reduction target, the California Air Resources Board (CARB) amended the GHG allowance allocations for electric utilities from 2021 to 2030 and finalized its Scoping Plan in 2017. Under the new Scoping Plan, LADWP's allocation would be reduced approximately 50% from 2021 to 2030.

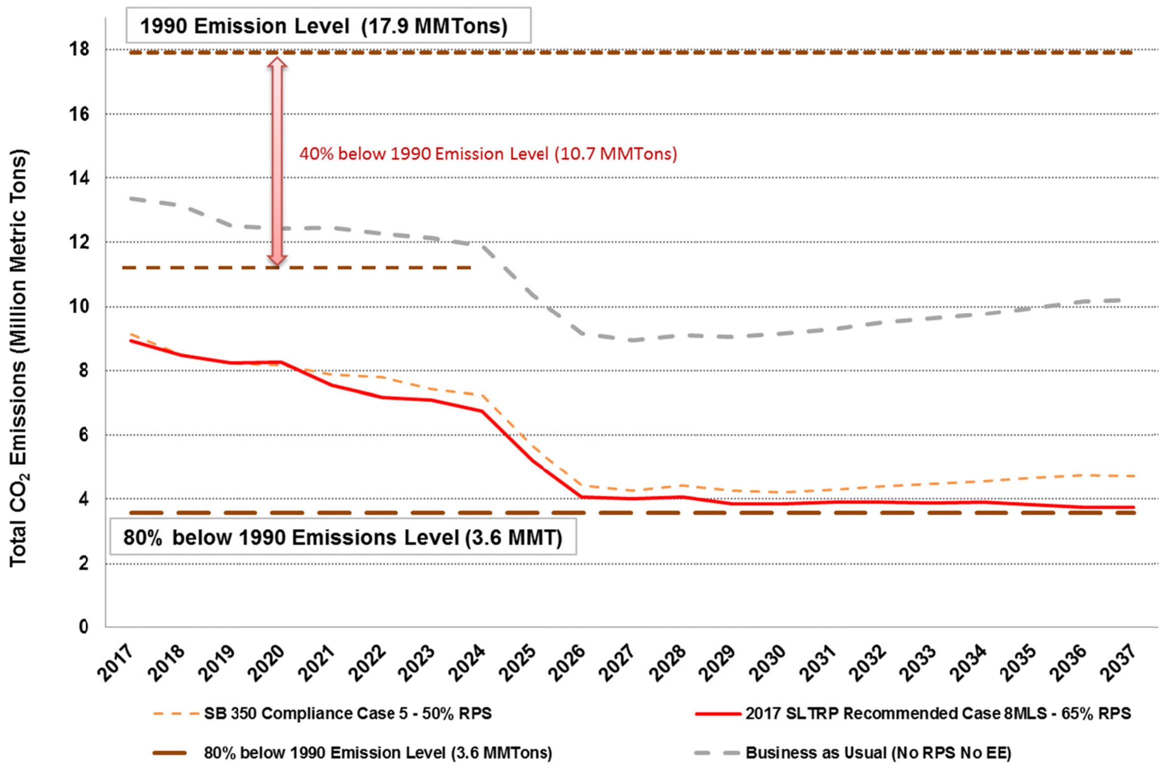
In 2015, the City of Los Angeles released it's first-ever Sustainability Plan with a vision to reduce GHG emissions by 45 percent below 1990 levels by 2025, 60 percent below 1990 levels by 2035, and 80 percent below 1990 levels by 2050. Additionally, in 2016, California Governor Jerry Brown signed two major bills–SB 32 and AB 197, which requires the state to further reduce GHG emissions to 40% below 1990 levels by 2030 and to do so in an open and transparent manner. In 2017, Governor Brown signed AB 398 which authorizes extension of California's cap-and-trade program to 2030. The 2017 IRP investigates multiple strategies to reduce GHG in a cost effective manner. It is important to note that GHG targets are subject to changing regulations and local priorities, which will significantly impact LADWP's future strategy in pursuing higher renewables, energy efficiency, and future electrification of existing fossil fuel processes.

GHG emissions levels for 2016 were 10.6 million metric tons (MMT), which is 41 percent, below 1990 levels due to the prior elimination of power from the Mojave, Colstrip, and Navajo coal plants, completed repowering of units at Haynes, Valley, and Scattergood generating stations with cleaner natural gas-fired replacements, and increased renewable generation from 3% in 2003 to 29% of overall sales in calendar year 2016. GHG emissions levels for 2016 shows a decrease compared to 2015 in which LADWP achieved a 19 percent GHG emissions reduction below 1990 levels.

IPP coal replacement results in approximately 4.0 MMT less GHG emission reduction between 2025 and 2027. In 2016, a GHG adder was implemented in the economic dispatch protocol for both real-time operations and long-term modeling, which resulted in a higher price for coal resources compared to natural gas resources. Over the 2020 to 2037 time period, the Power System is expected to reduce its GHG emissions to approximately 77 percent below 1990 levels. Emissions levels for accelerated renewable, energy efficiency, local solar, energy storage, and transportation electrification cases were also evaluated and are shown in Figure 6-1.

Increased transportation electrification from base to high could potentially result in a net GHG emission level reduction of approximately 5.3 MMT from 2017 through 2030, utilizing CEC's Transportation Electrification calculator tool, which considers fuel switching of the transportation sector to cleaner electricity. Although emissions generated by LADWP would increase to supply electricity for transportation, the overall net emissions in the Los Angeles Basin would decrease due to petroleum fuel replacement through transportation electrification. As LADWP absorbs emissions from the transportation sector through fuel switching, there is a critical need for GHG emissions credit in order to encourage transportation electrification and assist in meeting GHG emissions goals.

LADWP achieved 40% reduction in GHG emissions below 1990 levels in 2016, 14 years earlier than mandated by SB 32, and will continue to decrease its GHG emissions over the next 20 years. Significant GHG reductions have been accomplished through the completed sale of the Navajo coal-fired generating station on July 1, 2016 (5.59 MMT savings over 3 years) as well as due to price declines in natural gas. As shown in Figure 6-1, the case scenarios analyzed in this IRP indicates significant GHG reductions compared to "business as usual," if no renewable portfolio standard or energy efficiency programs are implemented. LADWP has taken proactive and significant measures to reduce GHG emissions with significant investments.



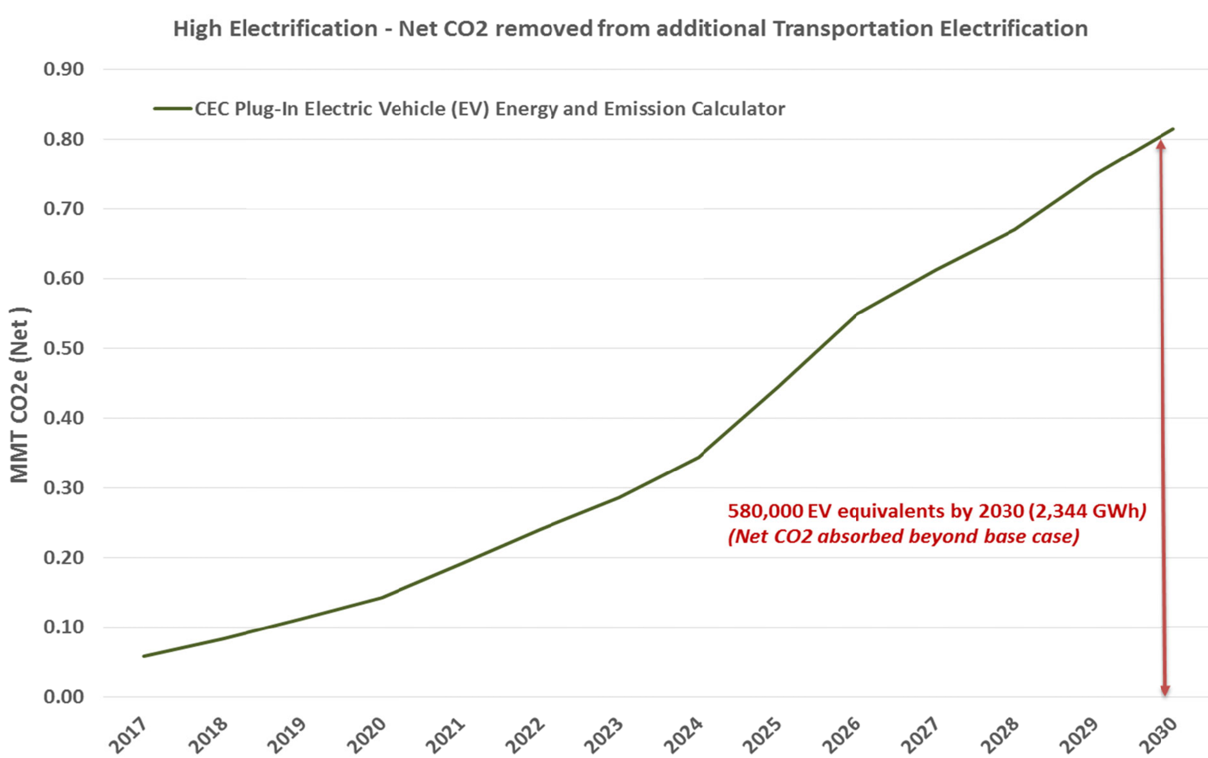


Figure 6-1. **GHG emissions comparison for SB 350 compliance case and 2017 IRP recommended case; Net GHG emissions savings absorbed from transportation sector through additional electrification**

7. Retail Rates

Figure 7-1 illustrates the fiscal year breakdown for the Recommended Case comprising rate contributions from power system reliability program, energy efficiency, renewable energy, energy storage, coal replacement, OTC repowering, electrification, and fuel costs between 2017 and 2037. These individual contributions represent incremental adders to the rates in the short run and, for most individual contributions, also the long run. The Power System Reliability Program (PSRP) includes prioritizing O&M and capital expenditures to effectively maintain and proactively replace aging distribution, substation, transmission, and generation assets that have exceeded their life expectancy; seeking appropriate levels of funding to accelerate permanently restoring temporary repairs of equipment failures; and improving problem circuits and stations that contribute heavily to LADWP's reliability indices.

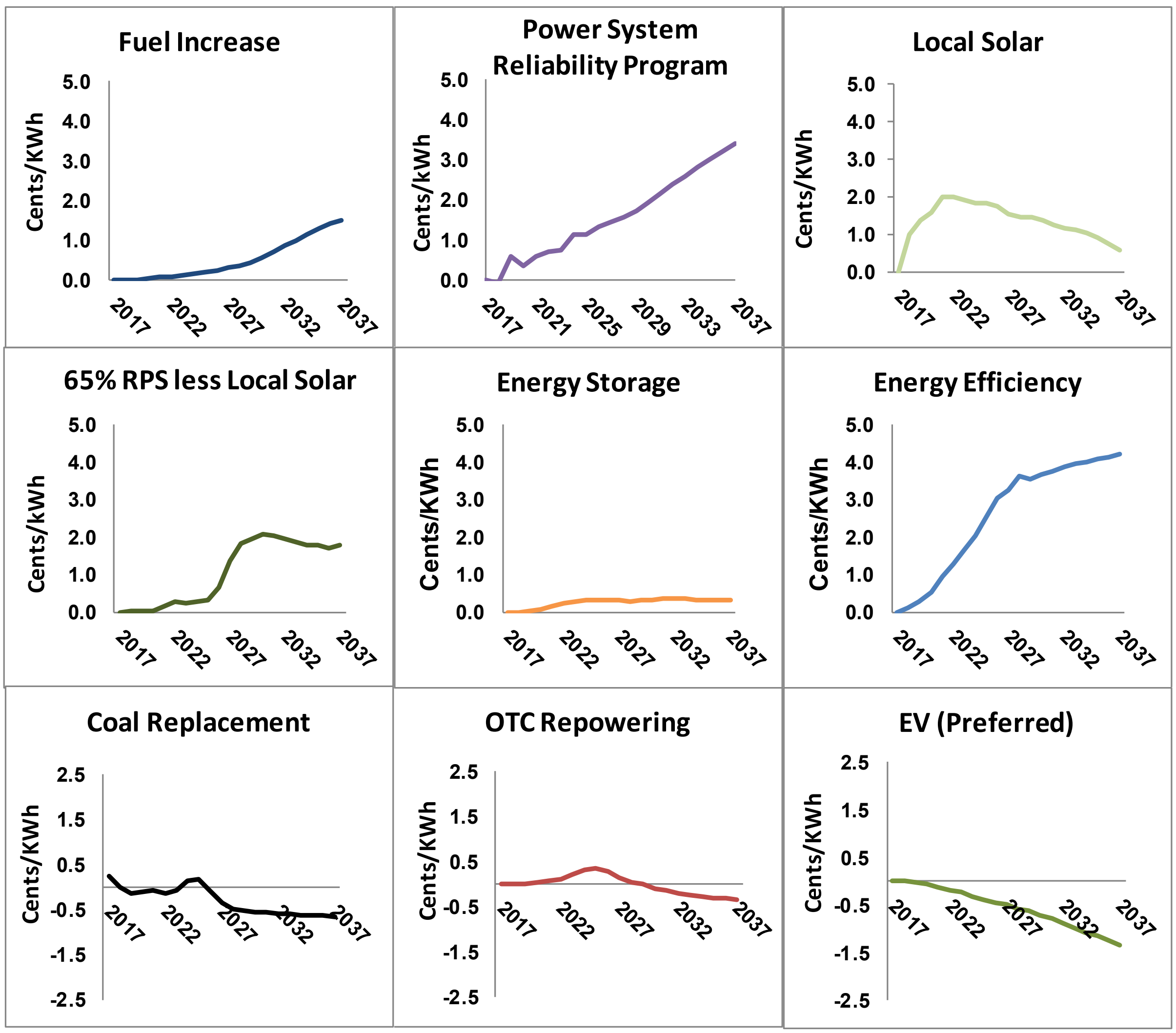


Figure 7-1. Retail electric rate contributions breakdown, based on the 2017-18 budget forecast (Recommended Case).

Figure 7-2 illustrates the total retail rate impact after combining all of the program rate components. The time period 2017 through 2020 reflects the recently approved Rate Action. One can draw the conclusion that rising fuel costs and complying with various regulatory requirements are the primary drivers of the growth in rates. The Energy Efficiency program based on the latest 2017 Energy Efficiency Potential Study results in the greatest retail rate impact due to the compound effect of program costs and reduced energy sales. The combined effect of the various programs including fuel, Power System Reliability, 65% RPS with local solar, energy storage, and energy efficiency increases the average retail rate from approximately 15 cents/kWh in 2017 to 28 cents/kWh by 2037. In contrast, programs such as coal replacement and OTC Repowering results in avoided cost savings associated with increased renewable energy and efficiency, decreased O&M, and decreased GHG emissions that have a positive impact in lowering rates. Additionally, high transportation electrification results in an overall decrease in rates due to increased energy sales. These programs result in significant savings to customers over the long-term, decreasing the forecasted rate to 26 cents/kWh by 2037. This rate forecast is in nominal dollar prices and on par with the average rate of inflation.

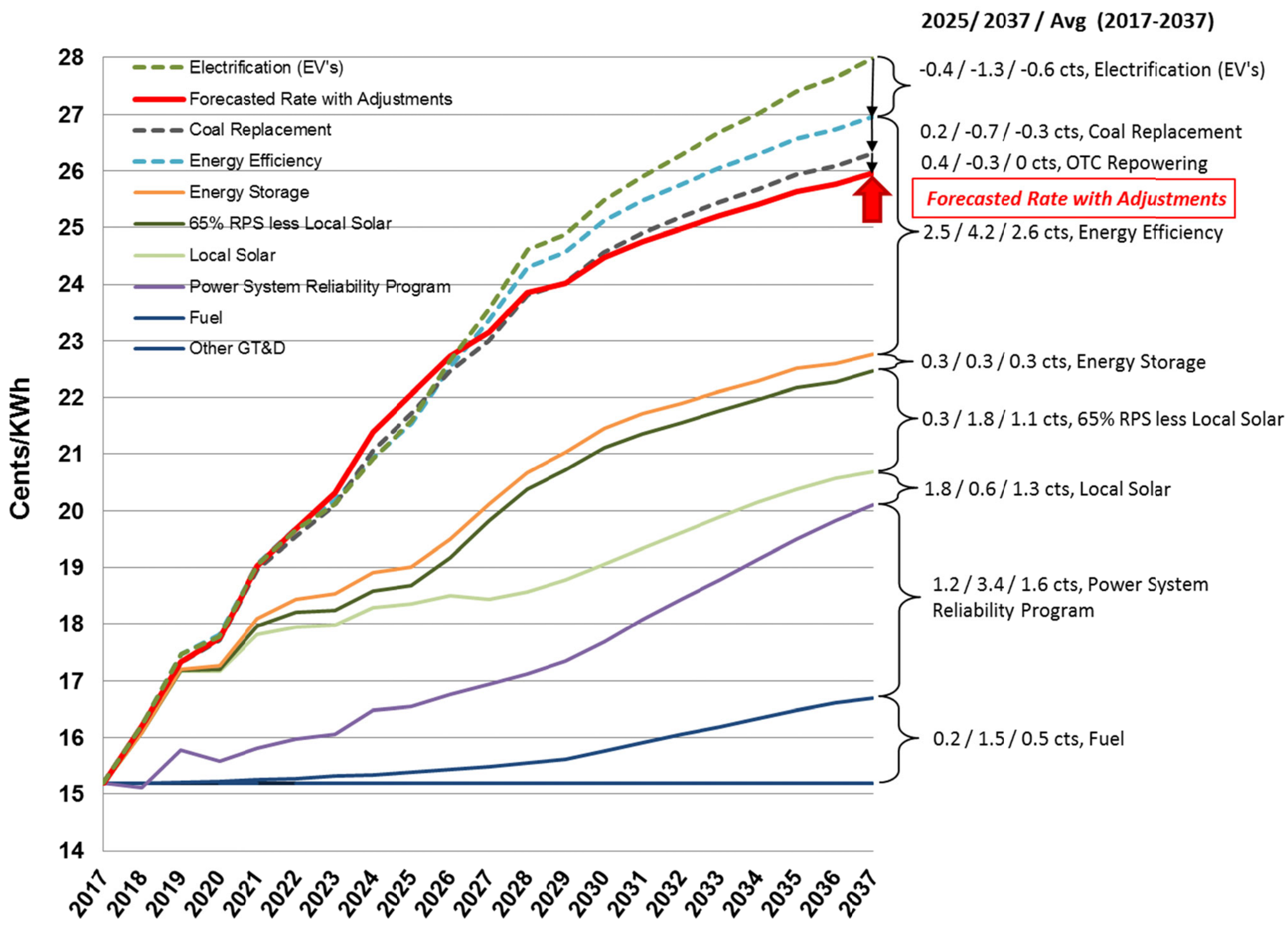


Figure 7-2. Total retail electric rate composite by fiscal year, based on the 2017-18 budget forecast (Recommended Case).

8. Transmission and Distribution Systems

8.1 Bulk Transmission System

LADWP's Ten-Year Transmission Plan is prepared each year to ensure that LADWP remains compliant with NERC Transmission Planning Standards. LADWP's 2016 plan identified a number of transmission and substation improvements and additions that are needed to maintain reliability and support high levels of renewables. The planning process involves complex modeling of the LADWP system, and concludes with findings and recommendations to maintain operational flexibility and avoid potential future overload conditions. LADWP will continue to implement the recommended projects, including construction of a new 230 kV transmission line between Scattergood Generating Station and Receiving Station K, upgrades at various other receiving and switching stations, and upgrades of the Pacific DC Intertie. Refer to Section 5.2 for more information on bulk transmission system reliability concerns and measures to address them over the planning horizon.

8.2 Distributed System

In 2015, LADWP commissioned the Maximum Distribution Renewable Energy Study (MDREPS). The key objectives of MDREPS were to understand the distributed solar photovoltaic penetration level that LADWP's distribution and subtransmission systems can support, select and understand a sample of eighteen distribution circuits for evaluating the hosting capacity, understand the impact high solar penetration will have on system operational reliability, and identify mitigation solutions for increased hosting capacity. The studies recommendations included managing the interconnection process by limiting aggregate DG capacities with respect to local load, adopting the use of smart inverters, and the collection of SCADA data at the distribution level.

Enhancements to the Distribution System

LADWP's power system reliability fares better when compared to most peer utilities in the State. However, there has been a steady increase in the frequency and duration of outages in recent years due to the increased number of heat and rain storms, as well as aging and failing infrastructure. Much of LADWP's power infrastructure was installed during the city's rapid growth between the 1940s and 1960s, and has reached the end of its rated lifespan.

To address the problem of aging infrastructure, LADWP launched the Power Reliability Program (PRP) in 2007. In 2014, the PRP evolved into the current Power System Reliability Program (PSRP), which is critical for the replacement of the rapidly aging backbone and infrastructure of the Generation, Transmission, Substation, and Distribution Systems. This includes the replacement of distribution poles, crossarms, transformers, and cables, as well as incorporating new technologies such as Distribution Automation. Annual replacement targets have steadily increased since the program's inception. More assets were replaced in FY 16-17 than any previous fiscal years, and LADWP has further increased targets from 14% to 43% (depending on the asset type) for the current fiscal year.

LADWP is also ramping up efforts to enable advanced monitoring and controls of its distribution system assets. These efforts includes the implementation of the Distributed Energy Resource Management System (DERMS) and Distribution Automation (DA) pilots. Through these pilots, LADWP hopes to obtain new tools and develop new utility practices to reliably integrate more renewables while mitigating power quality concerns that are associated with high penetrations of intermittent resources.

Demand-side Energy Management

At this time, the Demand Response (DR) team is manually executing DR events for the Commercial, Industrial, and Institutional (CII) DR program. LADWP notifies the participants about the DR events by email. The participant will then control their Building Management System (BMS) to execute the pre-established measures during the event. The DR team is planning to automate the CII program by implementing a Demand Response Management System (DRMS). The DRMS will connect to the customers' BMS via internet connection with an OpenADR protocol to pre-established measures for the DR events. Automating the program will ensure the efficiency of the process and decrease the notification time required before the event. The DRMS will be a part of the Distributed Energy Resource Management System (DERMS) pilot. Due to the nature of the communications with participants via internet connection, the DR team needs assistance from the IT team to secure and set up the connection.

Another initiative that is being implemented by the DR Team is the Residential DR program. This program will allow participating residential customers to enroll their Wi-Fi-enabled programmable thermostats (smart thermostats), as part of a bring-your-own-thermostat (BYOT) solution, for AC load adjustment. An aggregator will assist with developing and implementing the program. It has a goal of 25 MW, which translates to approximately 36,000 customers. The program will require customers to enroll through MyAccount at LADWP.com. After the customer signs up for the program on LADWP's website, the aggregator will receive the enrollment data through Application Programming Interface (API). Data will flow opposite direction through API if the customer signs up for the program on the aggregator's mobile application. Since the Residential DR program requires the aggregator to interface with LADWP's website, IT assistance is necessary to secure the API between the two parties.

9. Local Air Pollutants and Disadvantaged Communities

Local Air Pollutants

In its 2016 Air Quality Management Plan (AQMP), the South Coast Air Quality Management District (SCAQMD) emissions inventory shows the average annual NOx emissions were 540 tons per day in 2012. SCAQMD projects that average annual NO_X emissions in the SCAB will decrease to 398 tons per day in 2017, 353 tons per day in 2019, 257 tons per day in 2023 and 214 tons per day in 2031. The majority of this reduction is expected to come from vehicle emissions due to controls for on- and off-road equipment and new vehicle standards. However, projected growth in population and vehicle miles traveled within the SCAB between 2012 and 2031 will increase emissions slightly and offset a portion of the vehicle emissions reduced.

For comparison, the combined average daily NO_X emissions from LADWP's in-basin generating stations (Harbor, Haynes, Scattergood, and Valley) were 0.68 short tons of NO_X per day in 2016, which represents 0.17 percent of the 2017 average daily NO_X emissions in the South Coast Air Basin. The low NO_X emissions from LADWP's in-basin generating stations are due to the use of natural gas and advanced NOx emission control systems on all of LADWP's generating units.

A key regulation employed by the SCAQMD to reduce NO_X emissions from stationary sources is the Regional Clean Air Incentives Market (RECLAIM) trading program. RECLAIM is a market-driven regulatory program started in 1994 that replaced the SCAQMD's existing "command and control" rules for facilities with NO_X emissions exceeding 4 tons per year. The "command and control" rules which limited the emission rates of stationary combustion equipment were replaced by a facility-wide emissions cap, which gradually declines each year. Facilities received emission allocations, called RECLAIM Trading Credits (RTCs), in which one credit grants the right to emit one pound of NO_X. Facilities must have sufficient RTCs in their RECLAIM facility accounts to cover their actual emissions each year. RECLAIM is a market-driven program because the RTCs can be purchased and sold, which allows for the emissions reductions to be made in the most cost-effective manner.

Despite achieving significant improvements in Air Quality over the past 20 years, the South Coast Air Basin still exceeds the federal public health standards for both ozone and particulate matter. The SCAQMD's 2016 Air Quality Management Plan lays out the strategy to reduce emissions and bring the area into attainment with the federal standards. NOx emissions are a precursor to the formation of ground level ozone, one of the non-attainment pollutants.

In December 2015, the SCAQMD amended the RECLAIM regulation to reduce NOx emissions 12 tons per day by year 2022. In March 2017 as part of the 2016 Air Quality Management Plan, the SCAQMD adopted Control Measure CMB-05 to assess reducing NOx emissions an additional 5 tons per day no later than 2025, as well as sunset the RECLAIM program and transition back to a command-and-control regulatory structure requiring Best Available Retrofit Control Technology (BARCT) level controls. Assembly Bill 617, signed by the Governor in 2017, requires that implementation of BARCT be completed no later than December 31, 2023.

At LADWP's power plant facilities, all of the electricity generating units have advanced pollution control equipment which reduces NO_X emissions by at least 90 percent. LADWP is participating in SCAQMD rulemakings that will transition RECLAIM facilities (such as LADWP's Los Angeles Basin generating facilities) to command-and-control rules and determine BARCT and the implementation schedule.

Disadvantaged Communities

In August 2016, the Board of Water and Power Commissioners adopted the Equity Metrics Data Initiative. EMDI is a data-driven framework that is used to assess how well LADWP's programs, services, and resources are distributed throughout the City of Los Angeles. Data can be examined both geographically and demographically, using the CalEnviroScreen Tool, to see whether and where any disparities exist. Data collection and analysis through EMDI provides important information about LADWP's services and operations. It provides a tool for decision makers to ensure that all customers, regardless of zip code, are reached with fairness and equity. The initiative also enables LADWP to weave equity throughout the organization and embed it as a cornerstone of LADWP management and best practices.

With input from key stakeholders, LADWP staff identified fifty equity metrics, from which fifteen were selected for EMDI's initial focus in four core categories that are the most relevant to multiple aspects of LADWP's operations: water and power infrastructure investment, customer incentive programs and services, procurement, and employment. The metrics are also aligned with LADWP's priorities that are tracked and reported to Los Angeles city officials, with more of the fifty identified metrics to be included as the EMDI program evolves and benefits from stakeholder input.

William Funderburk, Vice President, LADWP Board of Water and Power Commissioners

"The Equity Metrics Data Initiative is not just about equity, it's about our culture here at LADWP. As a Commissioner, I've come to see that providing public water and power is about balancing the needs of the community with the needs of all ratepayers by providing water and power at the most competitive cost and making sure that we deploy our resources equitably. EMDI empowers our customers to hold us accountable as a Commission and make sure that we live up to our equity goals. Equity metrics helps to engage the community and informs us as policy makers with data that is based on facts rather than perception so that we can do the right thing by the ratepayers."

:

Figure 8-1. Equity Matters, The Role of Public Utilities

EMDI is a way to tell an objective story in a visual manner. Utilities tend to have a lot of data, yet from the customer's perspective, sometimes spreadsheets and pie charts don't tell the whole story. As the adage goes, one can be data rich and information poor. Tracking this data, helps LADWP make informed decisions and manage tradeoffs by seeing the data mapped to actual neighborhoods. It also sends a message that LADWP pays attention to the customer who may wonder, "When my lights go out in South LA, will I receive the same level of service as if I lived on the West Side?"

LADWP stakeholders who are interested in better understanding the EMDI effort can find more information on LADWP's public website at www.ladwp.com/equitymetrics.

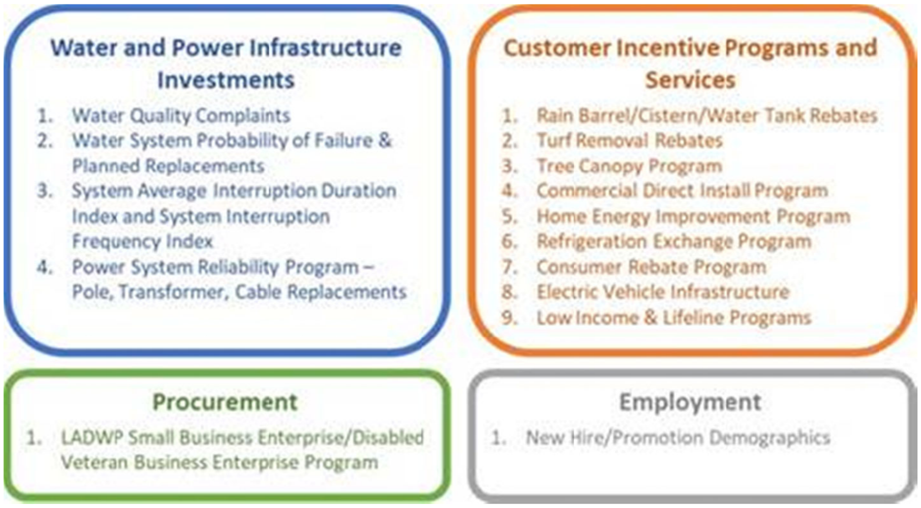


Figure 8-2. Equity Matters, The Role of Public Utilities

LADWP's Corporate Performance Group is responsible for gathering and managing the data for EMDI reporting. Data is regularly collected from program managers across the organization. The frequency of data collection ranges from monthly to semi-annual, depending on the type of information. Much of the data is already being collected for other purposes. The program staff developed standardized reporting formats to better integrate EMDI reporting needs with existing reporting systems and streamline data management.

The data for each metric is aggregated by zip code and can be displayed geographically on one of three map layers showing boundaries by zip code, city council district or neighborhood council area. The data itself can be presented as a heat map, as clusters or as numbers by zip code. A heat map layer incorporating ranking metrics such as socioeconomic impacts, water pollution, and air pollution, by census tracts can be turned on to assess implementation of programs relative to neighborhood economic demographics across the City. This layer is based on the California Communities Environmental Health Screening Tool (CalEnviroScreen), a tool that CalEPA uses to designate California communities as disadvantaged. Data tables are also provided for most metrics, providing additional detail.

EDMI reports are submitted to the Board semi-annually and are made available to the public on the LADWP website. The report includes a map for each metric along with a dashboard. The dashboard summarizes the background, criteria, achievements, issues, and the outreach strategy/plan for the program associated with each metric. The dashboard is an important tool to bring transparency and accountability to the operation units that are responsible for overseeing the various programs and services at LADWP. Figures 4 and 5, show an example EMDI map and dashboard report for the Refrigerator Exchange Program. Complete sets of reports can be found on LADWP's public website, www.ladwp.com/equitymetrics.

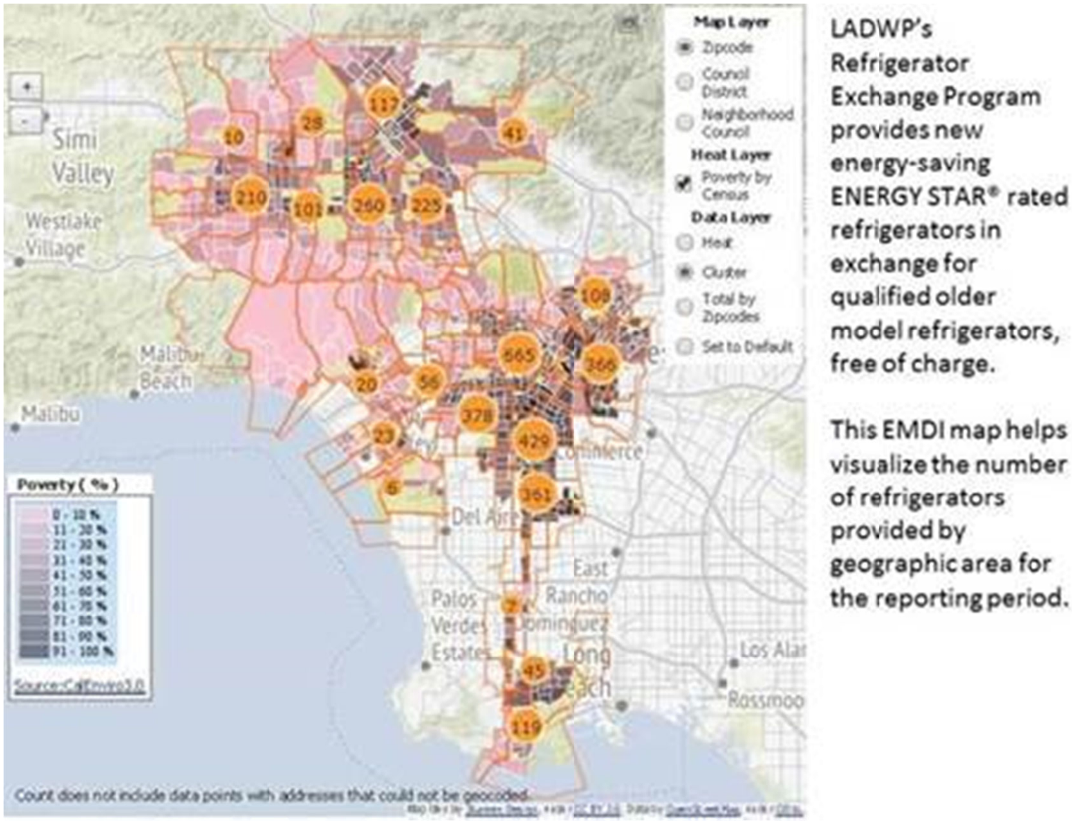


Figure 8-3. EDMI – Refrigerator Exchange Program

EMDI is an evolving process. As LADWP goes through the public outreach process, the public can review the semi-annual reports, participate in stakeholder workshops, and provide input to the data initiative. The comments have been positive with respect to the development of the tool and the transparency that it brings to the public. Stakeholders have noted that these metrics allow both LADWP and community partners to strategically invest resources in areas with the most need when possible. Recommendations for improvements are also being made. Stakeholders have asked that LADWP articulate clear goals for programs, show cumulative progress between reporting periods, and engage academic parties to conduct more detailed analysis of the data.

LADWP evaluates the findings and will continue to do so regularly. Program managers are able to use the data to assess the performance of their programs in comparison to stated goals and set additional goals where needed. They can make changes to programs and continue to follow results to determine the effectiveness of those changes. As the EMDI program proceeds, policies will be set to address variances from goals and performance gaps.

Community Solar

For the past few years, the Los Angeles Department of Water and Power (LADWP) has been utilizing the CalEnviroScreen datasets to guide its Strategic Development and Programs Section in developing and modifying solar programs to better serve its ratepayers in an equitable and geographically diverse manner. In order to understand the existing solar distribution within the LADWP's service territory, quantitative analysis was performed on LADWP's Solar Incentive

Program resulting in the Solar Penetration metric. LADWP's Solar Penetration metric is equal to the total installed nameplate capacity (residential sector only) per residential account per zip code and broken up into three primary classifications of low, medium, and high solar penetration. Identified areas of low solar penetration were confirmed to correlate with areas of poor CalEnviroScreen scores; often called disadvantaged communities (DACs).

Once validated, the Solar Penetration metric was used to provide increased benefits for customers living in areas of low solar penetration. Specifically, the Solar Incentive Program (2017) offered increased monetary benefits, and the Solar Rooftops Program (2017) provided priority enrollment for customers living in areas of low solar penetration. The outlined incentive and enrollment strategies also provide geographic diversity to LADWP's grid, which enhances reliability capabilities. The integration of CalEnviroScreen datasets is still ongoing within LADWP as new programs are being developed.

There are overlapping efforts to better understand the state of the existing solar disparity within LADWP's service territory. The LADWP has been proactive in understanding and characterizing its service territory to better quantify how its services are distributed. As of 2016, the LADWP has initiated its EMDI in order to examine the issues of fairness and service disparities among ratepayers. In addition, the Community Solar Program metric is a part of the EMDI, and the Low-Income Customer Access (LICA) program has included CSP and many efficiency programs for underserved customers. Thus, the CalEnviroScreen is an ideal complementary tool to aid in the efforts stated above. Due to LADWP's large service territory, a diverse contrast of CalEnviroScreen scores helps to provide additional insight on ways to improve services and programs. LADWP is looking forward to continuing its efforts in assisting and prioritizing disadvantaged communities when possible.

10. Standardized Tables

Refer to attached standardized tables.

Standardized Reporting Tables
for Publicly Owned Utility IRP Filing
California Energy Commission
Energy Assessment Division

POUs must submit the following four Standardized Tables to the Energy Commission as part of the IRP Filing. The Energy Commission encourages POUs to submit data for multiple scenarios, though POUs are only required to submit data for one scenario that meets the requirements of PUC Section 9621. Annual data must be reported in the Standardized Tables through the planning horizon.

Instructions for filling out the tables are in Appendix B Standardized Reporting Tables

Description of Worksheet Tabs

Admin Info: A listing of contact information of the tables' preparer with information for any back-up personnel.

year and the contribution of each energy resource (capacity) in the POU's portfolio to meet that demand.

EBT: Energy Balance Table (EBT): Annual total energy demand and annual estimates for energy supply from various resources.

GEAT: GHG Emissions Accounting Table (GEAT): Annual GHG emissions associated with each resource in the POU's portfolio to demonstrate compliance with the GHG emissions reduction targets established by CARB.

RPT: Resource Procurement Table (RPT): A detailed summary of a POU resource plan to meet the RPS requirements.

State of California
California Energy Commission
Standardized Reporting Tables for Public Owned Utility IRP Filing
Administrative Information
Form CEC 113 (May 2017)

Name of Publicly Owned Utility ("POU")	POU Name on Admin Tab
Name of Resource Planning Coordinator	Jay Lim
Name of Scenario	2017 SLTRP Case 8MLS

Persons who prepared Tables	**CRAT**	**Energy Balance Table**	**Emissions Table**	**RPS Table**	**Application for Confidentiality**
Name:	Robert Hodel	Robert Hodel	Robert Hodel	Robert Hodel	
Title:	Mechanical Eng. Associate	Mechanical Eng. Associate	Mechanical Eng. Associate	Mechanical Eng. Associate	
E-mail:	robert.hodel@ladwp.com	robert.hodel@ladwp.com	robert.hodel@ladwp.com	robert.hodel@ladwp.com	
Telephone:	213 367 0553	213 367 0553	213 367 0553	213 367 0553	
Address:	111 N Hope St.	111 N Hope St.	111 N Hope St.	111 N Hope St.	
Address 2:					
City:	Los Angeles	Los Angeles	Los Angeles	Los Angeles	
State:	CA	CA	CA	CA	
Zip:	90012	90012	90012	90012	
Date Completed:	8/6/2018	8/6/2018	8/6/2018	8/6/2018	
Date Updated:	4/24/2019	4/24/2019	4/24/2019	4/24/2019	

Back-up / Additional Contact Persons for Questions about these Tables (Optional):					
Name:	Scott Hirashima	Scott Hirashima	Scott Hirashima	Scott Hirashima	
Title:	Supervisor of Regulatory Standards and Compliance	Supervisor of Regulatory Standards and Compliance	Supervisor of Regulatory Standards and Compliance	Supervisor of Regulatory Standards and Compliance	
E-mail:	Scott.Hirashima@ladwp.com	Scott.Hirashima@ladwp.com	Scott.Hirashima@ladwp.com	Scott.Hirashima@ladwp.com	
Telephone:	213-367-0852	213-367-0852	213-367-0852	213-367-0852	
Address:	111 North Hope Street	111 North Hope Street	111 North Hope Street	111 North Hope Street	
Address 2:	Room 1246	Room 1246	Room 1246	Room 1246	
City:	Los Angeles	Los Angeles	Los Angeles	Los Angeles	
State:	CA	CA	CA	CA	
Zip:	90012	90012	90012	90012	

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

Scenario Name:

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

PEAK LOAD CALCULATIONS

		2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
1	Forecast Total Peak-Hour 1-in-2 Demand	6,501	6,187	6,341	6,500	6,612	6,620	6,789	7,060	7,185	7,372	7,393	7,422	7,676	7,800
2	[Customer-side solar: nameplate capacity]	351	380	411	439	470	500	530	559	622	652	680.89	710.22	740.26	769.58
2a	[Customer-side solar: peak hour output]	351	380	411	439	470	500	530	559	622	652	680.89	710.22	740.26	769.58
3	[Peak load reduction due to thermal energy storage]														
4	[Light Duty PEV consumption in peak hour]														
5	Additional Achievable Energy Efficiency Savings on Peak	104	209	318	428	537	534	703	1,016	1,168	1,421	1440.47	1317.39	1595.84	1640.46
6	Demand Response / Interruptible Programs on Peak	68	88	125	175	225	275	325	375	425	475	500	500	500	500
7	**Peak Demand (accounting for demand response and AAEE) (1-5-6)**	**5,550**	**5,721**	**5,898**	**5,897**	**5,850**	**5,811**	**5,761**	**5,669**	**5,592**	**5,476**	**5,453**	**5,605**	**5,580**	**5,660**
8	Planning Reserve Margin	1,717	1,717	1,717	1,717	1,717	1,723	1,723	1,723	1,644	1,643	1643.382	1643.382	1656.822	1665.862
9	Firm Sales Obligations	45	45	45	45	45	45	45	45	45	45	45	45	45	45
10	**Total Peak Procurement Requirement (7+8+9)**	**7,311**	**7,483**	**7,660**	**7,658**	**7,611**	**7,579**	**7,529**	**7,437**	**7,281**	**7,164**	**7,141**	**7,293**	**7,282**	**7,370**

EXISTING AND PLANNED CAPACITY SUPPLY RESOURCES

Utility-Owned Generation and Storage (not RPS-eligible):

For fuel type, choose from list or enter value

	[list resource by name]	Fuel type	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
11a	Castaic	Pump Storage	1,175	1,175	1,175	1,175	1,175	1,175	1,175	1,175	1,175	1,175	1,175	1,175	1,175	1,175
11b	Harbor	Natural Gas	558	558	558	558	558	558	558	558	558	558	558	558	558	502
11c	Haynes (New Units)	Natural Gas	600	600	600	600	600	600	600	600	600	936	936	936	1,608	1,608
11d	Haynes (Existing Units)	Natural Gas	1,019	1,019	1,019	1,019	1,019	1,019	1,019	1,019	1,019	575	575	575	0	0
11e	Palo Verde 1	Nuclear	76	76	76	76	76	76	76	76	76	76	76	76	76	76
11f	Palo Verde 2	Nuclear	77	77	77	77	77	77	77	77	77	77	77	77	77	77
11g	Palo Verde 3	Nuclear	76	76	76	76	76	76	76	76	76	76	76	76	76	76
11h	Scattergood (New Units)	Natural Gas	514	514	514	514	514	514	514	514	850	850	850	850	850	850
11i	Scattergood (Existing Units)	Natural Gas	284	284	284	284	284	284	284	284	0	0	0	0	0	0
11j	Valley	Natural Gas	558	558	558	558	558	558	558	558	558	558	558	558	558	558

Long-Term Contracts (not RPS-eligible):

	[list contracts by name]	Fuel type	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
11aj	APEX_X	Natural Gas	20	20	20	20	20	20	20	20	20	20	20	20	20	20
11ak	APEX1P1	Natural Gas	210	210	210	210	210	210	210	210	210	210	210	210	210	210
11al	APEX2P1	Natural Gas	270	270	270	270	270	270	270	270	270	270	270	270	270	270
11am	Battery_Storage_2Hour	Battery Storage	0	0	0	25	25	25	25	25	25	25	25	25	25	25
11an	Battery_Storage_4Hour	Battery Storage	0	0	78	78	78	78	100	122	144	144	144	144	144	144
11ao	Battery_Storage_Customer	Battery Storage	0	0	0	2	2	2	2	2	2	2	2	2	2	2
11ap	Battery_Storage_Hhour	Battery Storage	20	50	50	50	50	50	50	50	50	50	50	50	50	50
11aq	CAES	Storage	0	0	0	0	0	160	160	160	160	160	160	160	160	160
11ar	Cogen	Natural Gas	19	19	19	19	19	19	19	19	19	19	19	19	19	19
11as	Hoover	Large Hydroelectric	432	432	432	432	432	432	432	432	432	432	432	432	432	432
11at	IPP1	Coal	596	596	596	596	596	571	521	471	0	0	0	0	0	0
11au	IPP2	Coal	596	596	596	596	596	571	521	471	0	0	0	0	0	0
11av	PV SCPPA 1	Nuclear	53	53	53	53	53	53	53	53	53	53	53	53	53	53
11aw	PV SCPPA 2	Nuclear	53	53	53	53	53	53	53	53	53	53	53	53	53	53
11ax	PV SCPPA 3	Nuclear	53	53	53	53	53	53	53	53	53	53	53	53	53	53
11ay	Solar_CNM_nonRPS	Solar (non-RPS)	184	191	191	191	185	184	184	191	189	192	186	185	191	192
11az	Solar_CNM_nonRPS_P_760_MLS	Solar (non-RPS)	145	145	176	204	234	265	294	324	386	416	445	474	504	534
11ba	Utah CC	Natural Gas	0	0	0	0	0	0	0	0	624	624	776	776	776	776
11	**Total peak dependable capacity of existing and planned supply resources (not RPS-eligible) (sum of 11a...11n)**		**7,588**	**7,625**	**7,734**	**7,789**	**7,813**	**7,953**	**7,904**	**7,863**	**7,679**	**7,604**	**7,779**	**7,808**	**7,941**	**7,915**

Utility-Owned RPS-eligible Resources:

	[list resource by plant or unit]	Fuel type	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
12a	Aqueduct	Small Hydroelectric	145	92	64	64	64	64	64	64	64	64	64	64	64	64
12b	Aqueduct_PP_Improvement_65	Small Hydroelectric	0	0	0	0	0	0	9	9	9	9	9	9	9	9
12c	Castaic_Improvements	Small Hydroelectric	24	24	24	24	24	24	24	24	24	24	24	24	24	24
12d	NHollywood	Small Hydroelectric	1	1	1	1	1	1	1	1	1	1	1	1	1	1
12e	Owens Gorge	Small Hydroelectric	109	109	109	109	109	109	109	109	109	109	109	109	109	109
12f	Owens Valley	Small Hydroelectric	27	17	12	12	12	12	12	12	12	12	12	12	12	12
12g	Sepulveda	Small Hydroelectric	9	9	9	9	9	9	9	0	0	0	0	0	0	0
12h	Solar_DWP_Adelanto	Solar PV	5	5	5	5	0	0	5	5	5	5	5	5	5	4
12i	Solar_DWP_PineTree	Solar PV	4	4	4	4	0	0	4	4	4	4	4	4	4	4
12j	Solar_Owens	Solar PV	0	0	0	0	0	0	0	32	64	96	122	127	124	123
12k	Wind_PineTree	Wind	18	0	1	3	13	30	28	1	1	3	13	28	0	1
12l	WSHydro_65	Small Hydroelectric	0	0	0	7	7	7	7	7	7	7	7	7	7	7

Long-Term Contracts (RPS-eligible):

	[list contracts by name]	Fuel type	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
12m	Geo_DonCamb	Geothermal	13	13	13	13	13	13	13	13	13	13	13	13	13	13
12n	Geo_DonCamb2	Geothermal	15	15	15	15	15	15	15	15	15	15	15	15	15	15
12o	Geo_Herber1	Geothermal	29	29	34	34	34	34	34	34	34	3	0	0	0	0
12p	Geo_Hudson_Ranch_65	Geothermal	52	52	52	52	44	0	0	0	0	0	0	0	0	0
12q	SB859_Biomass_PPA_2018	Biofuels	0	12	12	12	12	12	0	0	0	0	0	0	0	0
12r	Solar_Community	Solar PV	0	1	2	3	2	2	2	3	3	3	2	2	3	3
12s	Solar_DWP_Basin_E	Solar PV	2	2	2	2	0	2	2	2	2	2	0	2	2	2
12t	Solar_DWP_Basin_P	Solar PV	3	7	9	11	13	15	16	15	15	15	15	15	15	15
12u	Solar_FIT_150	Solar PV	37	63	100	101	97	97	97	100	99	101	98	97	100	101
12v	Solar_FIT_150_Exp	Solar PV	0	0	26	76	123	147	147	153	151	153	147	145	148	149
12w	Solar_FIT_400_Exp_2035	Solar PV	0	0	0	0	0	0	0	0	0	41	79	118	162	204
12x	Solar_FIT_E_65	Solar PV	0	0	0	45	47	0	39	0	39	0	40	40	40	40
12y	Solar_PPA_Beacon_1	Solar PV	34	41	4	38	38	40	40	4	25	37	37	39	39	4
12z	Solar_PPA_Beacon_25	Solar PV	16	65	7	59	60	63	62	7	39	57	58	61	61	6
12aa	Solar_PPA_Beacon_3	Solar PV	44	41	4	38	38	40	40	4	25	37	37	39	39	4
12ab	Solar_PPA_Beacon_4	Solar PV	40	37	4	34	34	36	35	4	22	32	33	34	35	4
12ac	Solar_PPA_CopperMountain	Solar PV	131	123	123	125	121	123	125	123	125	125	121	125	123	123
12ad	Solar_PPA_KMoapa_65	Solar PV	118	148	143	144	146	138	122	143	151	143	146	122	148	143
12ae	Solar_PPA_RecurrentBR_65	Solar PV	56	57	55	56	52	56	56	54	55	54	51	55	54	52
12af	Solar_PPA_Springbok_65	Solar PV	88	85	17	80	78	82	81	17	22	78	76	79	81	16
12ag	Solar_PPA_Springbok2_65	Solar PV	122	125	25	118	115	121	119	25	32	115	112	117	119	24
12ah	Solar_PPA_Springbok3_65	Solar PV	0	0	15	68	67	69	69	14	19	66	65	67	69	14
12ai	Wind_Linden	Wind	24	25	25	25	25	25	25	25	25	25	25	25	25	25
12aj	Wind_Milford1	Wind	28	3	117	7	115	50	27	115	75	7	115	27	3	117
12ak	Wind_Milford2	Wind	15	2	41	2	43	18	15	41	13	2	43	15	2	41
12al	Wind_PebbleSprings	Wind	28	33	33	33	33	33	33	33	33	33	0	0	0	0
12am	Wind_PPMWyoming	Wind	17	16	6	0	0	0	0	0	0	0	0	0	0	0
12an	Wind_WillowCrk	Wind	25	34	34	34	34	34	34	0	0	0	0	0	0	0
12ao	Wind_WindyPoint	Wind	102	118	118	118	118	118	118	118	118	118	118	118	118	118
12	**Total peak dependable capacity of existing and planned RPS-eligible resources (sum of 12a...12t)**		**1,380**	**1,408**	**1,265**	**1,581**	**1,756**	**1,639**	**1,638**	**1,330**	**1,450**	**1,609**	**1,815**	**1,758**	**1,773**	**1,590**
13	**Total peak dependable capacity of existing and planned supply resources (11+12)**		**8,968**	**9,033**	**8,999**	**9,370**	**9,569**	**9,592**	**9,542**	**9,193**	**9,129**	**9,213**	**9,594**	**9,566**	**9,714**	**9,505**

GENERIC ADDITIONS

NON-RPS ELIGIBLE RESOURCES:

	[list resource by name or description]	Fuel type	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
14a	DC Loss Payback	Unspecified/System Power	18	18	18	14	14	18	18	18	14	14	14	18	18	18
14b																
14c																
14d																
14e																
14f																
14g																
14h																
14i																
14j																
14k																
14l																
14m																
14n																
14	**Total peak dependable capacity of generic supply resources (not RPS-eligible)**		**18**	**18**	**18**	**14**	**14**	**18**	**18**	**18**	**14**	**14**	**14**	**18**	**18**	**18**

RPS-ELIGIBLE RESOURCES:

	[list resource by name or description]	Fuel type	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
15a	Geo_PPA_2017_OR	Geothermal	3	29	29	28	29	29	29	28	29	29	29	28	29	29
15b	Geo_PPA_2018_NNV	Geothermal	0	32	54	54	116	120	142	142	142	142	142	143	142	142
15c	Wind_Ext_65	Wind	34	41	4	38	38	40	40	4	25	37	37	39	39	4
15d	New Geothermal	Geothermal	0	0	0	0	0	18	24	64	79	114	124	132	157	157
15e	New Solar	Solar PV	0	0	0	0	286	644	650	636	646	644	616	650	646	634
15f	New Wind	Wind	0	0	0	0	0	0	0	0	0	0	0	0	45	151
15	**Total peak dependable capacity of generic RPS-eligible resources**		**37**	**102**	**87**	**120**	**469**	**851**	**885**	**874**	**921**	**966**	**948**	**992**	**1,058**	**1,117**
16	**Total peak dependable capacity of generic supply resources (14+15)**		**55**	**120**	**105**	**134**	**483**	**869**	**903**	**892**	**935**	**980**	**962**	**1,010**	**1,076**	**1,135**

CAPACITY BALANCE SUMMARY

		2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
17	**Total peak procurement requirement (from line 10)**	**7,311**	**7,483**	**7,660**	**7,658**	**7,611**	**7,579**	**7,529**	**7,437**	**7,281**	**7,164**	**7,141**	**7,293**	**7,282**	**7,370**
18	**Total peak dependable capacity of existing and planned supply resources (from line 13)**	**8,968**	**9,033**	**8,999**	**9,370**	**9,569**	**9,592**	**9,542**	**9,193**	**9,129**	**9,213**	**9,594**	**9,566**	**9,714**	**9,505**
19	**Current capacity surplus (shortfall) (18-17)**	**1,657**	**1,550**	**1,339**	**1,712**	**1,958**	**2,013**	**2,013**	**1,756**	**1,848**	**2,049**	**2,453**	**2,273**	**2,432**	**2,135**
20	**Total peak dependable capacity of generic supply resources (from line 16)**	**55**	**120**	**105**	**134**	**483**	**869**	**903**	**892**	**935**	**980**	**962**	**1,010**	**1,076**	**1,135**
21	**Planned capacity surplus/shortfall (shortfalls assumed to be met with short-term capacity purchases) (19+20)**	**1,712**	**1,670**	**1,444**	**1,846**	**2,441**	**2,882**	**2,916**	**2,648**	**2,783**	**3,029**	**3,415**	**3,283**	**3,509**	**3,270**

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

Scenario Name:

Units = MWh

Yellow fill relates to an application for confidentiality.

Historical Data

NET ENERGY FOR LOAD CALCULATIONS

		2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
1	Retail sales to end-use customers			24,190,091	24,656,192	24,972,209	25,437,817	25,928,100	26,503,770	26,946,445	27,428,711	27,864,118	28,355,677	28,681,479	29,075,270
2	Other loads			400,410	443,330	832,820	1,014,110	1,018,940	1,183,770	1,177,500	1,156,520	1,268,470	1,206,080	1,110,740	1,547,590
3	Net energy for load			**27,488,740**	**28,018,400**	**28,377,510**	**28,906,610**	**29,463,750**	**30,117,920**	**30,620,960**	**31,168,990**	**31,663,770**	**32,222,360**	**32,592,590**	**33,040,080**
4	Retail sales to end-use customers (accounting for AAEE impacts)	20,597,662	20,927,014	21,287,280	21,697,449	21,975,544	22,385,279	22,816,728	23,323,317	23,712,871	24,137,266	24,520,423	24,952,996	25,239,702	25,586,238
5	Net energy for load (accounting for AAEE impacts)	26,269,340	26,297,510	26,525,130	26,668,820	26,960,050	27,164,420	27,225,510	27,546,600	27,541,370	27,564,250	27,673,030	28,140,400	28,390,050	29,246,010
6	Firm Sales Obligations	479,900	479,900	479,900	479,900	479,900	480,910	479,900	479,900	479,900	480,910	479,900	479,900	479,900	480,910
7	**Total net energy for load (accounting for AAEE impacts) (5+6)**	**26,749,240**	**26,777,410**	**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**
8	[Customer-side solar generation]														
9	[Light Duty PEV electricity consumption/procurement requirement]														
10	[Other transportation electricity consumption/procurement requirement]														
11	[Other electrification/fuel substitution; consumption/procurement requirement]														

EXISTING AND PLANNED GENERATION RESOURCES

Utility-Owned Generation Resources (not RPS-eligible):

	[list resource by name]	Fuel type	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
12a	Castaic	Pump Storage	505,800	538,880	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
12b	Harbor	Natural Gas	47,040	96,420	119,660	151,210	62,120	44,930	45,930	38,470	35,380	17,650	3,650	4,050	9,830	354,090
12c	Haynes (New Units)	Natural Gas	170,480	108,560	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
12d	Haynes (Existing Units)	Natural Gas	3,834,010	3,273,240	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
12e	Palo Verde 1	Nuclear	599,410	653,070	599,410	601,240	653,070	599,410	599,410	654,890	599,410	599,410	653,070	601,240	599,410	653,070
12f	Palo Verde 2	Nuclear	609,070	607,300	661,660	609,220	607,300	661,660	607,300	609,150	661,660	607,300	607,300	663,510	607,300	607,300
12g	Palo Verde 3	Nuclear	653,070	599,410	599,410	654,890	599,410	599,410	653,070	601,240	599,410	653,070	599,490	601,240	653,070	599,490
12h	Scattergood (New Units)	Natural Gas	1,920,510	2,194,580	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
12i	Scattergood (Existing Units)	Natural Gas	8,720	0	0	6,600	0	0	0	0	0	0	0	0	0	0
12j	Valley	Natural Gas	771,370	757,600	658,910	789,950	508,780	399,890	381,630	364,050	412,080	285,500	182,710	157,430	100,690	83,610

Long-Term Contracts (not RPS-eligible):

	[list contracts by name]	Fuel type	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
12aj	APEX_X	Natural Gas	38,180	36,850	29,210	21,650	13,980	11,050	9,720	9,040	1,880	270	370	0	20	0
12ak	**APEX1P1**	Natural Gas	1,357,990	1,392,670	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
12al	APEX2P1	Natural Gas	1,218,530	1,219,160	935,370	804,290	555,130	356,960	374,210	305,560	87,030	16,770	17,120	2,570	2,960	0
12am	Battery_Storage_2Hour	Battery Storage	0	0	0	23,350	26,140	27,260	27,250	26,960	24,580	24,400	25,260	29,460	30,610	26,290
12an	Battery_Storage_4Hour	Battery Storage	0	0	116,530	115,630	126,930	121,530	153,080	185,480	222,270	222,630	212,700	216,590	220,020	220,030
12ao	Battery_Storage_Customer	Battery Storage	0	0	0	3,130	3,280	3,620	3,610	3,590	3,620	3,650	3,570	3,970	4,100	3,690
12ap	Battery_Storage_Hhour	Battery Storage	4,920	14,190	16,620	16,310	16,610	20,570	20,470	19,550	20,970	22,880	19,750	22,460	23,780	19,480
12aq	CAES	Storage	0	0	0	0	0	605,840	599,740	612,170	612,050	607,120	612,260	593,350	597,860	615,950
12ar	Cogen	Natural Gas	169,940	169,940	169,940	170,410	169,940	169,940	169,940	170,410	169,940	169,940	169,940	170,410	169,940	169,940
12as	Hoover	Large	564,180	564,010	564,240	564,250	564,310	564,270	563,990	564,000	564,240	564,250	564,280	564,250	564,210	564,350
12at	IPP1	Coal	2,835,850	2,486,200	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
12au	IPP2	Coal	2,296,930	2,166,110	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
12av	PV SCPPA 1	Nuclear	426,120	464,280	426,120	427,390	464,280	426,120	426,120	465,550	426,120	426,120	464,280	427,390	426,120	464,280
12aw	PV SCPPA 2	Nuclear	427,390	426,120	464,280	427,390	426,120	464,280	426,120	427,390	464,280	426,120	426,120	465,550	426,120	426,120
12ax	PV SCPPA 3	Nuclear	464,280	426,120	426,120	465,550	426,120	426,120	464,280	427,390	426,120	464,280	426,120	427,390	464,280	426,120
12ay	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	375,000	375,000
12az	Solar_CNM_nonRPS_P_760_MLS	Solar PV	184,090	230,680	279,550	326,140	372,730	421,590	468,180	517,050	613,640	660,230	706,820	753,410	801,140	847,730
12ba	Utah CC	Natural Gas	0	0	0	0	0	0	0	0	1,538,440	2,229,620	2,530,430	2,282,590	1,409,060	1,503,370
12	**Total energy from existing and planned supply resources (not RPS-eligible) (sum of 12a…12n)**		**19,482,880**	**18,800,390**	**18,584,870**	**18,602,650**	**17,220,750**	**17,169,590**	**17,131,780**	**16,852,010**	**16,778,040**	**16,438,670**	**16,534,270**	**16,816,480**	**16,522,200**	**16,834,280**

Utility-Owned RPS-eligible Generation Resources:

	[list resource by plant or unit]	Fuel type	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
13a	Aqueduct	Small	509,300	322,730	225,210	225,210	225,210	225,210	225,210	225,210	225,210	225,210	225,210	225,210	225,210	225,210
13b	Aqueduct_PP_Improvement_65	Small	0	0	0	0	0	0	18,870	30,000	30,000	30,000	30,000	30,000	30,000	30,000
13c	Castaic_Improvements	Small	94,750	94,940	95,090	95,210	96,580	97,390	97,580	97,580	95,880	96,360	97,700	97,100	97,970	94,870
13d	NHollywood	Small	3,000	4,360	4,350	4,370	4,380	4,370	4,370	4,350	4,360	4,370	4,380	4,370	4,360	4,350
13e	Owens Gorge	Small	426,320	306,190	213,660	213,660	213,660	213,660	213,660	213,660	213,660	213,660	213,660	213,660	213,660	213,660
13f	Owens Valley	Small	88,500	56,080	39,130	39,130	39,130	39,130	39,130	39,130	39,130	39,130	39,130	39,130	39,130	39,130
13g	Sepulveda	Small	13,000	31,740	31,700	31,710	31,750	31,790	31,780	0	0	0	0	0	0	0
13h	Solar_DWP_Adelanto	Solar PV	19,000	20,000	19,000	19,000	19,000	19,000	19,000	19,000	19,000	19,000	19,000	19,000	18,000	18,000
13i	Solar_DWP_PineTree	Solar PV	17,000	18,000	17,000	17,000	17,000	17,000	17,000	17,000	17,000	17,000	17,000	17,000	17,000	17,000
13j	Solar_Owens	Solar PV	0	0	0	0	0	0	0	132,000	262,000	393,000	522,000	519,000	517,000	514,000
13k	Wind_PineTree	Wind	245,000	382,000	381,000	382,000	381,000	382,000	382,000	382,000	382,000	382,000	382,000	382,000	382,000	382,000
13l	WSHydro_65	Small	0	0	0	13,830	22,000	22,000	22,000	22,000	22,000	22,000	22,000	22,000	22,000	22,000
13m																
13n																

Long-Term Contracts (RPS-eligible):

	[list contracts by name]	Fuel type	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
13o	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	114,000	114,000
13p	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	135,000	135,000
13q	Geo_Herber1	Geothermal	258,000	258,000	300,000	300,000	300,000	300,000	300,000	300,000	300,000	25,000	0	0	0	0
13r	Geo_Hudson_Ranch_65	Geothermal	458,000	458,000	458,000	458,000	383,000	0	0	0	0	0	0	0	0	0
13s	SB859_Biomass_PPA_2018	Biofuels	0	52,550	104,240	104,530	104,240	104,240	51,690	0	0	0	0	0	0	0
13t	Solar_Community	Solar PV	0	1,000	3,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000
13u	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	6,000	6,000
13v	Solar_DWP_Basin_P	Solar PV	12,000	27,000	36,000	45,000	53,000	64,000	64,000	63,000	63,000	63,000	62,000	62,000	62,000	61,000
13w	Solar_FIT_150	Solar PV	73,860	122,730	196,590	196,590	196,590	196,590	196,590	196,590	196,590	196,590	196,590	196,590	196,590	196,590
13x	Solar_FIT_150_Exp	Solar PV	0	0	50,000	148,860	248,860	298,860	298,860	298,860	298,860	296,590	295,450	294,320	292,050	290,910
13y	Solar_FIT_400_Exp_2035	Solar PV	0	0	0	0	0	0	0	0	0	79,550	159,090	238,640	318,180	397,730
13z	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	71,590	71,590
13aa	Solar_PPA_Beacon_1	Solar PV	114,000	138,000	137,000	137,000	136,000	135,000	135,000	134,000	133,000	133,000	132,000	131,000	131,000	130,000
13ab	Solar_PPA_Beacon_25	Solar PV	54,000	217,000	216,000	215,000	214,000	213,000	212,000	211,000	210,000	208,000	207,000	206,000	205,000	204,000
13ac	Solar_PPA_Beacon_3	Solar PV	151,000	138,000	137,000	137,000	136,000	135,000	135,000	134,000	133,000	133,000	132,000	131,000	131,000	130,000
13ad	Solar_PPA_Beacon_4	Solar PV	135,000	123,000	122,000	122,000	121,000	121,000	120,000	119,000	119,000	118,000	118,000	117,000	116,000	116,000
13ae	Solar_PPA_CopperMountain	Solar PV	539,000	515,000	515,000	515,000	515,000	515,000	515,000	515,000	515,000	515,000	515,000	515,000	515,000	515,000
13af	Solar_PPA_KMoapa_65	Solar PV	597,000	618,000	618,000	618,000	618,000	618,000	618,000	618,000	618,000	618,000	618,000	618,000	618,000	618,000
13ag	Solar_PPA_RecurrentBR_65	Solar PV	177,000	181,000	180,000	179,000	178,000	177,000	177,000	176,000	175,000	174,000	173,000	172,000	171,000	170,000
13ah	Solar_PPA_Springbok_65	Solar PV	300,000	283,000	281,000	280,000	279,000	277,000	276,000	274,000	273,000	272,000	270,000	269,000	268,000	266,000
13ai	Solar_PPA_Springbok2_65	Solar PV	414,000	417,000	415,000	413,000	411,000	409,000	407,000	405,000	403,000	401,000	399,000	397,000	395,000	393,000
13aj	Solar_PPA_Springbok3_65	Solar PV	0	0	240,000	239,000	238,000	236,000	235,000	234,000	233,000	232,000	231,000	229,000	228,000	227,000
13ak	Wind_Linden	Wind	139,000	145,000	145,000	145,000	145,000	145,000	145,000	145,000	145,000	145,000	145,000	145,000	145,000	145,000
13al	Wind_Milford1	Wind	449,000	434,000	434,000	434,000	434,000	434,000	434,000	434,000	434,000	434,000	434,000	434,000	434,000	434,000
13am	Wind_Milford2	Wind	232,000	231,000	231,000	231,000	231,000	231,000	231,000	231,000	231,000	231,000	231,000	231,000	231,000	231,000
13an	Wind_PebbleSprings	Wind	162,000	193,000	193,000	193,000	193,000	193,000	193,000	193,000	193,000	193,000	16,000	0	0	0
13ao	Wind_PPMWyoming	Wind	208,000	171,000	171,000	171,000	171,000	86,000	0	0	0	0	0	0	0	0
13ap	Wind_WillowCrk	Wind	145,000	197,000	197,000	197,000	197,000	197,000	197,000	0	0	0	0	0	0	0
13aq	Wind_WindyPoint	Wind	598,000	694,000	694,000	694,000	694,000	694,000	694,000	694,000	694,000	694,000	694,000	694,000	694,000	694,000
13	**Total energy from RPS-eligible resources (sum of 13a…13t)**		**6,958,320**	**7,176,910**	**7,426,560**	**7,545,690**	**7,577,990**	**7,162,830**	**7,037,330**	**6,888,970**	**7,009,280**	**6,935,050**	**6,931,800**	**6,980,610**	**7,048,740**	**7,111,040**
13z	**Undelivered RPS energy**		**30,790**	**39,430**	**44,210**	**39,230**	**151,780**	**186,020**	**216,780**	**202,840**	**369,060**	**245,850**	**308,390**	**272,810**	**267,150**	**262,720**
14	**Total energy from existing and planned supply resources (12+13)**		**26,441,200**	**25,977,300**	**26,011,430**	**26,148,340**	**24,798,740**	**24,332,420**	**24,169,110**	**23,740,980**	**23,787,320**	**23,373,720**	**23,466,070**	**23,797,090**	**23,570,940**	**23,945,320**

GENERIC ADDITIONS

NON-RPS ELIGIBLE RESOURCES:

	[list resource by name or description]	Fuel type	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
15a	DC Loss Payback	Unspecified/System Power	409,000	409,000	409,000	409,000	409,000	409,000	409,000	409,000	409,000	409,000	409,000	409,000	409,000	409,000
15b																
15c																
15d																
15e																
15f																
15g																
15h																
15i																
15j																
15k																
15l																
15m																
15n																
15	**Total energy from generic supply resources (not RPS-eligible)**		409,000	409,000	409,000	409,000	409,000	409,000	409,000	409,000	409,000	409,000	409,000	409,000	409,000	409,000

RPS-ELIGIBLE RESOURCES:

	[list resource by name or description]	Fuel type	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
16a	Geo_PPA_2017_OR	Geothermal	0	0	250,000	250,000	250,000	250,000	250,000	250,000	250,000	250,000	250000	250000	250000	250000
16b	Geo_PPA_2018_NNV	Geothermal	0	0	474,000	477,000	1,015,000	1,049,000	1,248,000	1,248,000	1,248,000	1,248,000	1248000	1252000	1248000	1248000
16c	Wind_Ext_65	Wind	0	0	0	0	0	0	0	390,000	390,000	390,000	390000	390000	390000	390000
16d	New Geothermal	Geothermal	0	0	0	0	0	158,000	208,000	566,000	691,000	1,003,000	1090000	1165000	1375000	1375000
16e	New Solar	Solar PV	0	0	0	0	1,216,000	2,336,000	2,336,000	2,336,000	2,336,000	2,336,000	2336000	2336000	2336000	2336000
16f	New Wind	Wind	0	0	0	0	0	0	0	0	0	0	0	0	263000	757000
16	**Total energy from generic RPS-eligible resources**		**0**	**0**	**724,000**	**727,000**	**2,481,000**	**3,793,000**	**4,042,000**	**4,790,000**	**4,915,000**	**5,227,000**	**5,314,000**	**5,393,000**	**5,862,000**	**6,356,000**
17	**Total energy from generic supply resources (15+16)**		**409,000**	**409,000**	**1,133,000**	**1,136,000**	**2,890,000**	**4,202,000**	**4,451,000**	**5,199,000**	**5,324,000**	**5,636,000**	**5,723,000**	**5,802,000**	**6,271,000**	**6,765,000**
17z	**Total energy from RPS-eligible short-term contracts**															

ENERGY FROM SHORT-TERM PURCHASES

		2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
18	**Short term and spot market purchases:**														
18a	**Short term and spot market sales (only report sales of energy from resources already included in the EBT):**														

ENERGY BALANCE SUMMARY

		2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
19	**Total energy from supply resources (14+17+17z)**	**26,850,200**	**26,386,300**	**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**
19a	**Undelivered RPS energy (from 13z)**	**30,790**	**39,430**	**44,210**	**39,230**	**151,780**	**186,020**	**216,780**	**202,840**	**369,060**	**245,850**	**308,390**	**272,810**	**267,150**	**262,720**
20	**Net Short term and spot market purchases (18 - 18a)**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
21	**Total delivered energy (19-19a+20)**	**26,819,410**	**26,346,870**	**27,100,220**	**27,245,110**	**27,536,960**	**28,348,400**	**28,403,330**	**28,737,140**	**28,742,260**	**28,763,870**	**28,880,680**	**29,326,280**	**29,574,790**	**30,447,600**
22	**Total net energy for load (from 7)**	**26,749,240**	**26,777,410**	**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**
23	**Surplus/Shortfall (21-22)**	**70,170**	**(430,540)**	**95,190**	**96,390**	**97,010**	**703,070**	**697,920**	**710,640**	**720,990**	**718,710**	**727,750**	**705,980**	**704,840**	**720,680**

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

Scenario Name:

Yellow fill relates to an application for confidentiality.

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

GHG EMISSIONS FROM EXISTING AND PLANNED SUPPLY RESOURCES

Utility-Owned Generation (not RPS-eligible):

	[list resource by name]	Emissions Intensity	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
1a	Castaic	0.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1b	Harbor	0.48	24,894	50,633	62,814	79,397	32,629	23,599	24,110	20,198	18,589	9,265	1,926	2,126	4,883	140,059
1c	Haynes (New Units)	0.42	95,473	60,768	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
1d	Haynes (Existing Units)	0.41	1,568,254	1,340,087	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
1e	Palo Verde 1	0.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1f	Palo Verde 2	0.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1g	Palo Verde 3	0.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1h	Scattergood (New Units)	0.40	765,298	874,438	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
1i	Scattergood (Existing Units)	0.73	6,380	0	0	4,733	0	0	0	0	0	0	0	0	0	0
1j	Valley	0.42	325,837	319,792	277,677	337,270	216,851	168,789	161,153	153,580	174,301	121,536	78,436	67,409	43,450	36,482

Long-Term Contracts (not RPS-eligible):

	[list contracts by name]	Emissions Intensity	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
1aj	APEX_X	0.37	14,279	13,782	10,925	8,097	5,229	4,133	3,635	3,381	703	101	138	0	7	0
1ak	APEX1P1	0.37	507,888	520,859	422,022	376,771	257,914	150,546	158,049	136,985	39,248	5,969	6,586	864	1,459	0
1al	**APEX2P1**	0.37	455,730	455,966	349,828	300,804	207,619	133,503	139,955	114,279	32,549	6,272	6,403	961	1,107	0
1am	Battery_Storage_2Hour	0.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1an	Battery_Storage_4Hour	0.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1ao	Battery_Storage_Customer	0.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1ap	Battery_Storage_Hhour	0.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1aq	CAES	0.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1ar	Cogen	0.43	72,734	72,734	72,734	72,935	72,734	72,734	72,734	72,935	72,734	72,734	72,734	72,935	72,734	72,734
1as	Hoover	0.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1at	IPP1	0.92	2,598,773	2,278,354	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
1au	IPP2	0.92	2,104,907	1,985,023	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
1av	PV SCPPA 1	0.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1aw	PV SCPPA 2	0.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1ax	PV SCPPA 3	0.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1ay	Solar_CNM_nonRPS	0.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1az	Solar_CNM_nonRPS_P_760_MLS	0.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1ba	Utah CC	0.37	0	0	0	0	0	0	0	0	575,377	833,878	946,381	853,689	526,988	562,260
1	**Total GHG emissions of existing and planned supply resources (not RPS-eligible) (sum of 1a…1n)**		**8,540,447**	**7,972,436**	**7,766,953**	**7,814,005**	**7,023,796**	**6,665,951**	**6,573,013**	**6,343,469**	**4,930,566**	**3,917,055**	**3,889,774**	**4,005,800**	**3,848,576**	**3,826,160**

Utility-Owned RPS-eligible Generation Resources:

	[list resource by plant or unit]	Emissions Intensity	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
2a	Aqueduct	0.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2b	Aqueduct_PP_Improvement_65	0.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2c	Castaic_Improvements	0.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2d	NHollywood	0.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2e	Owens Gorge	0.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2f	Owens Valley	0.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2g	Sepulveda	0.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2h	Solar_DWP_Adelanto	0.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2i	Solar_DWP_PineTree	0.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2j	Solar_Owens	0.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2k	Wind_PineTree	0.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2l	WSHydro_65	0.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2m																
2n																

Long-Term Contracts (RPS-eligible):

	[list contracts by name]	Emissions Intensity	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
2o	Geo_DonCamb	0.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2p	Geo_DonCamb2	0.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
sq	Geo_Herber1	0.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2r	Geo_Hudson_Ranch_65	0.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2s	SB859_Biomass_PPA_2018	0.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2t	Solar_Community	0.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2u	Solar_DWP_Basin_E	0.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2v	Solar_DWP_Basin_P	0.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2w	Solar_FIT_150	0.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2x	Solar_FIT_150_Exp	0.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2y	Solar_FIT_400_Exp_2035	0.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2z	Solar_FIT_E_65	0.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2aa	Solar_PPA_Beacon_1	0.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2ab	Solar_PPA_Beacon_25	0.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2ac	Solar_PPA_Beacon_3	0.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2ad	Solar_PPA_Beacon_4	0.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2ae	Solar_PPA_CopperMountain	0.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2af	Solar_PPA_KMoapa_65	0.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2ag	Solar_PPA_RecurrentBR_65	0.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2ah	Solar_PPA_Springbok_65	0.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2ai	Solar_PPA_Springbok2_65	0.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2aj	Solar_PPA_Springbok3_65	0.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2ak	Wind_Linden	0.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2al	Wind_Milford1	0.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2am	Wind_Milford2	0.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2an	Wind_PebbleSprings	0.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2ao	Wind_PPMWyoming	0.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2ap	Wind_WillowCrk	0.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2aq	Wind_WindyPoint	0.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	**Total GHG emissions from RPS-eligible resources (sum of 2a…2t)**		**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
3	**Total GHG emissions from existing and planned supply resources (1+2)**		**8,540,447**	**7,972,436**	**7,766,953**	**7,814,005**	**7,023,796**	**6,665,951**	**6,573,013**	**6,343,469**	**4,930,566**	**3,917,055**	**3,889,774**	**4,005,800**	**3,848,576**	**3,826,160**

EMISSIONS FROM GENERIC ADDITIONS

NON-RPS ELIGIBLE RESOURCES:

	[list resource by name or description]	Emissions Intensity	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
4a	DC Loss Payback	0.428	175,052	175,052	175,052	175,052	175,052	175,052	175,052	175,052	175,052	175,052	175,052	175,052	175,052	175,052
4b																
4c																
4d																
4e																
4f																
4g																
4h																
4i																
4j																
4k																
4l																
4m																
4n																
4	**Total GHG emissions from generic supply resources (not RPS-eligible)**		**175,052**	**175,052**	**175,052**	**175,052**	**175,052**	**175,052**	**175,052**	**175,052**	**175,052**	**175,052**	**175,052**	**175,052**	**175,052**	**175,052**

RPS-ELIGIBLE RESOURCES:

	[list resource by name or description]	Emissions Intensity	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
5a	Geo_PPA_2017_OR	0.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5b	Geo_PPA_2018_NNV	0.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5c	Wind_Ext_65	0.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5d	New Geothermal	0.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5e	New Solar	0.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5f	New Wind	0.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5	**Total GHG emissions from generic RPS-eligible resources**		**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
6	**Total GHG emissions from generic supply resources (4+5)**		175,052	175,052	175,052	175,052	175,052	175,052	175,052	175,052	175,052	175,052	175,052	175,052	175,052	175052

GHG EMISSIONS OF SHORT TERM PURCHASES

		Emissions Intensity	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
7	**Net spot market/short-term purchases:**	0.428	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

TOTAL GHG EMISSIONS

		2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
8	**Total GHG emissions to meet net energy for load (3+6+7)**	**8,715,499**	**8,147,488**	**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**

EMISSIONS ADJUSTMENTS

		2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
8a	**Undelivered RPS energy (MWh from EBT)**	30,790	39,430	44,210	39,230	151,780	186,020	216,780	202,840	369,060	245,850	308,390	272,810	267,150	262,720
8b	**Firm Sales Obligations (MWh from EBT)**	479,900	479,900	479,900	479,900	479,900	480,910	479,900	479,900	479,900	480,910	479,900	479,900	479,900	480,910
8c	**Total energy for emissions adjustment (8a+8b)**	510,690	519,330	524,110	519,130	631,680	666,930	696,680	682,740	848,960	726,760	788,290	752,710	747,050	743,630
8d	**Emissions intensity (portfolio gas/short-term and spot market purchases)**	0.428	0.428	0.428	0.428	0.428	0.428	0.428	0.428	0.428	0.428	0.428	0.428	0.428	0.428
8e	**Emissions adjustment (8Cx8D)**	218,575	222,273	224,319	222,188	270,359	285,446	298,179	292,213	363,355	311,053	337,388	322,160	319,737	318,274

PORTFOLIO GHG EMISSIONS

8f	**Adjusted Portfolio emissions (8-8e)**	8,496,924	7,925,215	7,717,686	7,766,869	6,928,489	6,555,557	6,449,886	6,226,308	4,742,263	3,781,054	3,727,438	3,858,692	3,703,891	3,682,938

GHG EMISSIONS IMPACT OF TRANSPORTATION ELECTRIFICATION

		2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
9	**GHG emissions reduction due to gasoline vehicle displacement by LD PEVs**	**0.000**	**0.161**	**0.213**	**0.272**	**0.337**	**0.407**	**0.481**	**0.558**	**0.636**	**0.715**	**0.795**	**0.874**	**0.952**	**1.030**
10	**GHG emissions increase due to LD PEV electricity loads**	**0.000**	**0.077**	**0.100**	**0.128**	**0.146**	**0.166**	**0.195**	**0.214**	**0.192**	**0.166**	**0.181**	**0.204**	**0.203**	**0.215**
11	**GHG emissions reduction due to fuel displacement - other transportation electrification**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**
12	**GHG emissions increase due to increased electricity loads - other transportation electrification**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**

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

Scenario Name:

Beginning balances Start of 2017 **Units = MWh**

		Compliance Period 3					Compliance Period 4					Compliance Period 5				Compliance Period 6			
	RPS ENERGY REQUIREMENT CALCULATIONS	**2017**	**2018**	**2019**	**2020**		**2021**	**2022**	**2023**	**2024**		**2025**	**2026**	**2027**		**2028**	**2029**	**2030**	
1	Annual Retail sales to end-use customers (accounting for AAEE impacts) (From EBT)	20,597,662	20,927,014	21,287,280	21,697,449		21,975,544	22,385,279	22,816,728	23,323,317		23,712,871	24,137,266	24,520,423		24,952,996	25,239,702	25,586,238	
2	Green pricing program Exclusion, (may include other exclusions like self generation exclusion)																		
3	Soft target (%)	27.00%	29.00%	31.00%	33.00%		34.75%	36.50%	38.25%	40.00%		41.67%	43.33%	45.00%		46.67%	48.33%	50.00%	
4	Required procurement for compliance period	25,389,418					33863854					31,374,021				36,637,030			
	Category 0, 1 and 2 Resources (bundled with RECs)																		
5	Excess balance at beginning/end of compliance period					5,169,062					15,078,329				20,036,438				22,150,797
6	RPS-eligible energy procured (copied from EBT)	6,958,320	7,176,910	8,150,560	8,272,690		10,058,990	10,955,830	11,079,330	11,678,970		11,924,280	12,162,050	12,245,800		12,373,610	12,910,740	13,467,040	
6A	Amount of energy applied to procurement obligation	5,561,369	6,068,834	6,599,057	7,160,158		7,636,502	8,170,627	8,727,398	9,329,327		9,881,153	10,458,677	11,034,190		11,645,563	12,198,348	12,793,119	
7	Net purchases of Category 0, 1 and 2 RECs																		
7A	Excess balance and REC purchases applied to procurement obligation																		
8	Net change in balance/carryover (RECs and RPS-eligible energy) (6+7-6A-7A)	1,396,951	1,108,076	1,551,503	1,112,532		2,422,488	2,785,203	2,351,932	2,349,643		2,043,127	1,703,373	1,211,610		728,047	712,392	673,921	
	Category 3 Resources (unbundled RECs)																		
9	Excess balance at beginning/end of compliance period					0					0				0				0
10	Net purchases of Category 3 RECs																		
11	Excess balance and REC purchases applied to procurement obligation																		
12	Net change in REC balance	0	0	0	0		0	0	0	0		0	0	0		0	0	0	
13	Total generation plus RECs (all Categories) applied to procurement requirement (6A + 7A + 11)	25,389,418					33,863,854					31,374,021				36,637,030			
14	Over/under procurement for compliance period (13 - 4)	0					0					0				0			

Footnote	Table	Line	Description
1	EBT	2	Comprised of pumping loads for pumped storage and charging loads for other storage assets. Pumping and charging is using energy from the grid, which may or may not include renewable resources. No double counting of renewable credits exist. Charging loads are not represented in the total net energy for load; GHG associated with energy storage is accounted for at the generating unit source (i.e. thermal combined cycle unit) to not
2	EBT	12a	Generation only. Pumped storage facility receive inflow of water from California Department of Water Resources in addition to water from pumping. Pumping load is included in footnote 1 above.
3	EBT	12am-12aq	Generation only. Charging loads included in footnote 1 above. All storage assets are charged using the marginal resource at the time of charging.
4	EBT	18 - 18a	Short-term and spot market purchases or sales are not relied on to serve load; instead, market transactions are made for economic reasons in actual operations. LADWP's modeling does not include the market.
5	EBT	23	Energy shortfall in 2018 due to outages from older generating units that have not yet been repowered

APPENDIX A

CITY OF LOS ANGELES

DEPARTMENT

OF

WATER AND POWER

2017 RETAIL ELECTRIC SALES AND DEMAND FORECAST

David H. Wright
General Manager

Neil M. Guglielmo
Chief Financial Officer

Andrew C. Kendall
Senior Assistant General Manager -
Power System
Construction, Maintenance, and Operations

Reiko A. Kerr
Senior Assistant General Manager -
Power System
Engineering, Planning, and Technical Services

September 15, 2017
Load Forecasting, Room 956
Financial Services Organization

Table of Contents

2017 Retail Electric Sales and Demand Forecast

Overview

The 2017 Retail Electric Sales and Demand Forecast (Forecast) supersedes the 2016 Retail Electric Sales and Demand Forecast as the City of Los Angeles Department of Water and Power's (LADWP) official Power System Forecast. The Forecast is the basis for LADWP Power System planning activities including but not limited to Financial Planning, Power Integrated Resource Planning (IRP), Transmission and Distribution Planning and Wholesale Marketing.

The Forecast is a public document. Only publically available information is used in the Forecast development. (This practice has become a standard among California electric utilities.) Being public data means all data sources are auditable. LADWP Planners developing alternative scenarios using their own proprietary data should adjust the Forecast accordingly. The Load Forecast Group (LFG) is available for consultation on making adjustments to the Forecast. The Forecast includes unpublished working papers to aid Planners in developing alternative scenarios.

Data Sources

1. Historical Sales reconciled to the Customer Care & Billing (CCB) Consumption and Earnings Report through December 2016.
2. Historical NEL, Peak Demand and Losses reconciled to the Wholesale Energy Resource Management website (WERM) database maintained by the Energy Reconciliation Group.
3. Historical weather data is provided by the National Weather Service and Los Angeles Pierce College.
4. Historical Los Angeles County employment data is provided by the State of California Economic Development Division using the March 2016 Benchmark.
5. Historical population estimates and projections are provided by the State of California Department of Finance Demographic Unit.
6. The long-term Los Angeles County economic forecast with quarterly short-run updates is provided by UCLA Anderson Forecast.
7. The construction activity forecast is provided by Dodge Data and Analytics.
8. The Electric Vehicle forecast is consistent with the 2016 IRP.
9. The LADWP program energy efficiency forecast is based on the AB 2021 goals adopted by Board Resolution and is consistent with 2016 IRP. Historical installations are provided by the Efficiency Solutions Group.
10. The forecasted impacts of the Energy Independence Security Act (EISA) and the Huffman Bill on residential lighting rely on the Energy Efficiency Potential Study prepared in 2014 by Nexant.
11. Projected solar rooftop installations are consistent with the 2016 IRP. Historical installations are provided by the Solar Energy Development Group.
12. Electric prices are based on FYE 2017 Power System Case 4 developed by Financial Services Organization.

Five-Year Sales Forecast

The Forecast represents total sales that will be realized at the meter incorporating future savings from known energy efficiency technologies and future loads expected to be served by distributed generation. The Forecast does not include changes in sales that may result from emerging technologies. Private enterprise and government are both currently funding new research mainly in the pursuit to slow man-made climate change. For example, the State of California has adopted an ambitious Energy Action Plan that includes four “Big Bold Strategies” for significant energy savings. The Energy Action Plan requires all new residential construction to be zero net energy by 2020; all new commercial construction to be zero net energy by 2030; Heating, Venting and Air Conditioning (HVAC) industry to be re-shaped to deliver maximum performance HVAC systems; and all eligible low-income customers be provided with all cost-effective energy efficiency measures in their residences by 2020.

The historical accumulated energy efficiency and solar savings reported in the Forecast are from 1999 forward. The 2016 Forecast only included savings from Codes and Standards from 2012 forward; in the 2017 Forecast, historical Codes and Standards savings for the years 1999 through 2011 based on California Energy Commission (CEC) analysis are included. True accumulated energy efficiency would more likely be dated back to 1974 when the Warren-Alquist Act passed in California but accurate records are not available. In the Forecast, projected energy efficiency and solar savings are expected to occur uniformly throughout the year as a simplifying assumption.

The LADWP billing system underwent a conversion in September 2013. It is the opinion of the Load Forecast Group that sales in FYE 2014 and 2015 are under-reported.

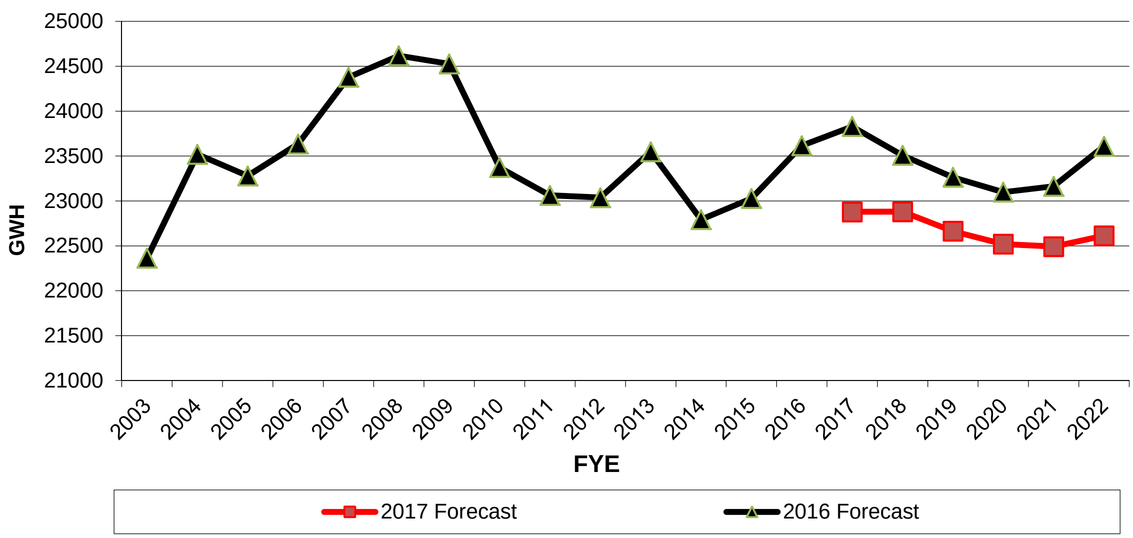
Estimated sales for FYE 2017 are 255 GWH or 1.1 percent below recorded sales in FYE 2016, and the compounded growth rate for sales is estimated to be -0.4 percent over the five-year budget period. This result is mainly attributed to accelerated incremental savings from LADWP’s energy efficiency and solar distributed generation programs, and expected increases in real electric rates. In the Forecast, electric rate increases are lagged one year to allow for customer behavior to change.

Historical and future retail sales would be significantly higher absent LADWP energy efficiency and solar distributed generation programs. Based on installed savings, sales have been reduced by 2679 GWH since FYE 2000 through LADWP-sponsored programs. LADWP is accelerating these savings programs and retail sales are expected to be reduced by another 2244 GWH over the next five years.

Short-Run Growth

Fiscal Year Ending June 30	Retail Sales (GWH)	YOY Growth Rate	Accumulated EE & Solar Savings (GWH)	Estimated Sales wo Programs & Standards (GWH)	YOY Growth Rate
2016-17	22878		2679	25557	
Forecast					
2017-18	22880	0.0%	3260	26141	2.3%
2018-19	22663	-0.9%	3854	26517	1.4%
2019-20	22520	-0.6%	4366	26886	1.4%
2020-21	22492	-0.1%	4724	27216	1.2%
2021-22	22613	0.5%	4923	27536	1.2%

Retail Sales Net of Energy Efficiency and Distributed Generation



Peak Demand Forecast

Growth in annual peak demand over the next ten years is 0.4 percent.

Long-Run Growth

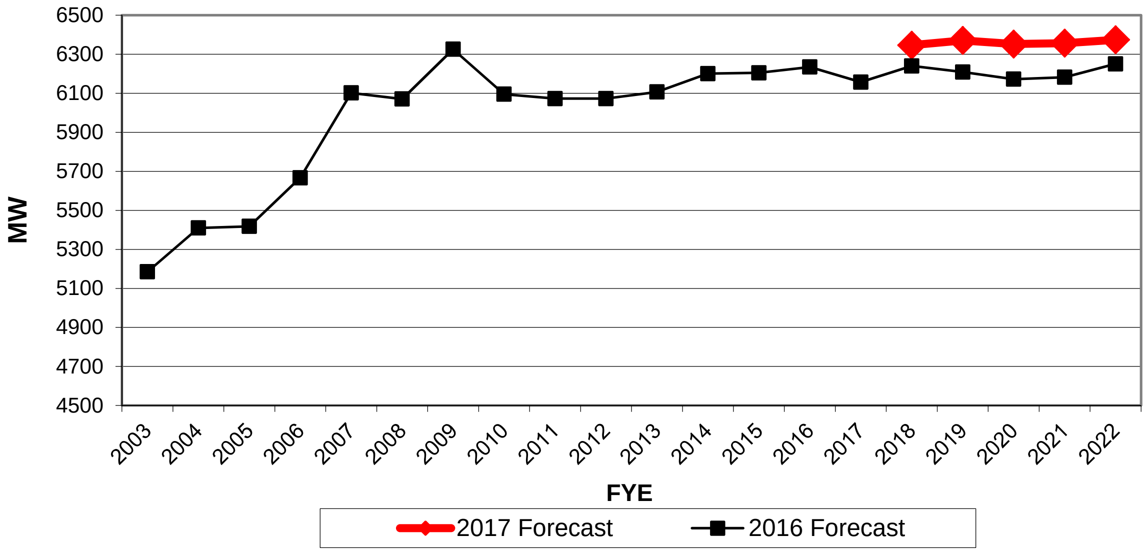
Fiscal Year End June 30	Base Case Peak Demand (MW)	Growth Rate Base Year 2016-17	One-in-Ten Peak Demand (MW)
2016-17	5733[1]		6235
2017-18	5854[1]		6347
Forecast[2]			
2021-22	5889	0.5%	6423
2026-27	6129	0.7%	6640
2036-37	6716	0.8%	7288
2040-41	6998	0.8%	7600

[1]Weather-normalized. Actual peak was 5762 MW in 2016-17 and 6432 MW in 2017-18.
[2]Forecast has been modified to include all-time high occurred on August 31, 2017.

The System set its all-time high peak at 6432 MW on August 31, 2017, a 1-in-12.6 weather event. The weather-adjusted One-in-Two peak for 2017 is 5854 MW. The previous System all-time high peak at 6343 MW was set on September 16, 2014, a 1-in-10.4 weather event. Included in the weather-adjusted peak are normalized DC line losses from the Nevada-Oregon border (NOB). NOB DC line losses at the peak hour on August 31, 2017 were 224 MW, which is higher than the average loss of 173 MW used in the peak weather-normalization calculation.

The following graph of the One-in-Ten Peak Demand Forecast is used for the Integrated Resource Plan (IRP). Peak demand growth generally has been diverging from sales growth. In the last 15 years, annual percentage change for Total Sales was 0.1%, compared to 1.2% for Peak Demand. To incorporate this, in the 2017 Forecast, LADWP used a slightly reduced System load factor while keeping its assumption of future peak being a constant load factor relative to NEL. Adjustments are also made for the Huffman Bill, energy efficiency, electric vehicles and solar distributed generation.

One-in-Ten Peak Demand Forecast Comparisons



In general, system load factors are trending down. Given a constant energy production, a lower load factor means a higher peak. Three considerations are generally thought to be contributing to the lower load factor: 1) customers are making greater efforts to conserve energy but during extreme weather events safety and comfort predominate over conservation causing the peak to spike; 2) the majority of the historical and forecasted energy efficiency effort is oriented toward reducing consumption rather than peak; and 3) solar distributed generation production peak is non-coincident with system peak.

In contrast to the trend listed above, future load factor may increase if LADWP sees greater demand forward use of electric vehicles.

Summer system peak appears to be shifting toward later hours primarily due to the growth of distributed solar generation and electric vehicles. Three of the last five annual peaks occurred at Hour Ending (HE) 1700. LADWP models the peak to occur at Hour Ending 1600. Planners need to be mindful of the potential load shift.

The impacts from Demand Response programs including XRT Rates and Summer Shift are not included in this Forecast.

The Peak Demand Forecast is primarily used in the following areas:

1. Integrated Resource Planning
2. Wholesale Energy Marketing
3. Distribution Planning
4. Transmission Planning

For most planning, LADWP uses the One-in-Ten Case Peak Demand forecast rather than the Base Case forecast. LADWP's policy is to ensure reliability in times of volatility by controlling its own generation capacity. Planning at the One-in-Ten level has proven over the years to be an effective tool in ensuring system reliability. The One-in-Ten case is based on historical peak day weather events.

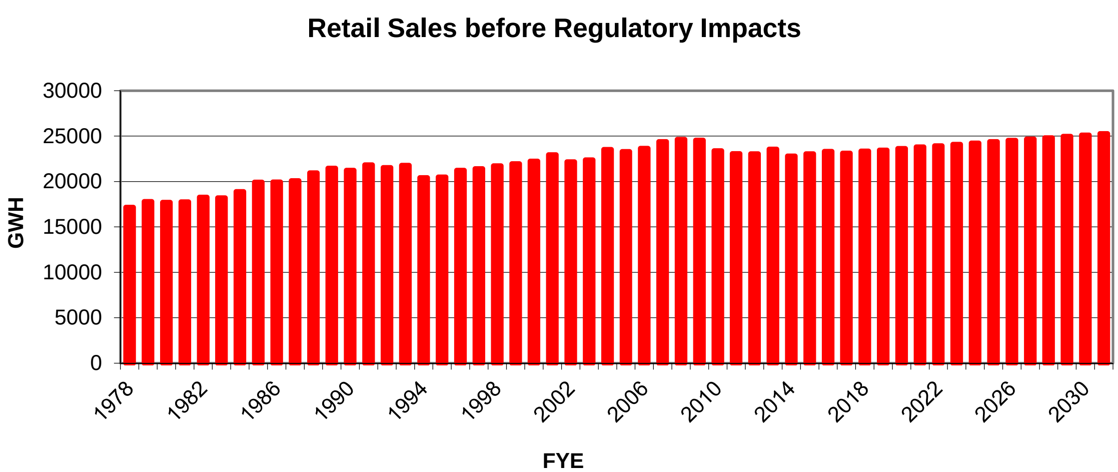
Plausibility

To measure plausibility of our sales forecast, LADWP assumes that growth in energy efficiency, distributed generation and electric vehicle consumption, negative or positive, is in a steady state and then compares the 2017 Forecast prior to adjustments to historical periods. The forecast prior to adjustments for program initiatives is called the unmitigated forecast. In the unmitigated forecast, the change variables are employment, personal income, construction activity and retail electric prices.

The 2008 recession coupled with historically ambitious energy efficiency and distributed generation programs implemented between 2000 and 2016 lowered the trajectory of electric sales significantly. Without the growth in electric vehicles, based solely on the economic variables in the Forecast and assuming energy efficiency Codes and Standards remain in a steady-state; sales will not reach 2008 levels until 2022.

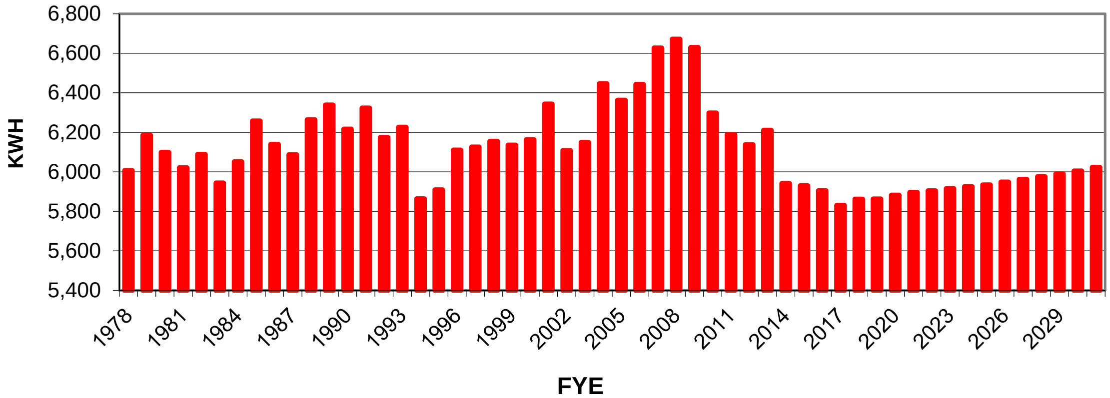
Sales in FYE 2014 declined unexpectedly given a strong underlying local economy. In the 2016 Forecast much of this decline was attributed to the change in billing systems. It was understood that some bills were deferred as the new billing system was being fine-tuned; therefore the 2016 Forecast models included variables to quantify the billing system change effect. Subsequent research suggests that these billing system change variables were correlated with other factors and might have overstated the impact due to the change in billing systems. For example, contemporaneously to the change in billing systems, a large cogeneration customer stopped wheeling its power generation which also lowered sales. Also the billing change variable might have been picking up effects from rate changes and other effects from energy efficiency and distributed generation. In the 2017 Forecast, all the billing change variables have been removed.

The following table shows the long-term perspective.



An alternative way to look at historical and forecasted sales is on a per capita basis. Sales on a per capita basis peaked in FYE 2008 at 6671 KWH per capita. On a per capita basis, sales will be well below this level at the end of the forecast period.

Per Capita Sales before Regulatory Impacts



On a per capita sales basis, very low numbers were recorded in FYE 2014 through 2016 compared to what was recorded in the three years previous. The lower per capita sales are probably a combination of billing changes and lower sales due to distributed generation, energy efficiency, conservation and higher electric rates. In general, higher electric rates encourage increased distributed generation, energy efficiency and conservation.

The economic outlook is fundamentally changed in the 2017 Forecast. On the Federal level, the current Administration's proposed budget is calling for higher deficit spending in the near term through tax cuts as a part of tax reform bill coupled with higher spending on military and infrastructure. The details of all these proposals have yet to be written into law and in the end the final law will inevitably differ from the proposal. Even if we do not see all these increases on the Federal level, California, on the state level, has made a commitment to increasing infrastructure spending through its increased gas tax mechanism.

As we write, the current expansion is into its 96th month versus the average historical expansion of 60 months. The longest expansion since World War II has been 120 months. Full employment is sustainable for a long period but the next recession is likely now somewhere on the horizon. Faster growth would require positive growth in net migration as the large cohort of baby boomers are nearing the stage when they are most likely to retire and leave the labor force rather than continue working.

In 2016, net migration was a negative 15,000 people in Los Angeles County. The last positive year for net migration in Los Angeles County was 2011. Population growth has been due to natural increase (the difference between the number of live births and the number of deaths).

Variables in the Forecast

Population: The 2010 United States Census reported 3,792,621 residents in the City of Los Angeles. This number was well below the previous 4,094,764 estimated by State of California Department of Finance Demographic Unit at the time. The State relies on birth-death records and driver license data to estimate population between censuses. The

2000 United States Census reported a population of 3,694,742 for the city of Los Angeles. The population growth rate was only 0.26 percent per annum in the first decade of the 21st century. Since the 2010 census, Department of Finance has estimated an increase in population for the City of Los Angeles of 238,283 people or 1.0 percent a year. In the same time period, LADWP has added 38,598 residential accounts or 0.5 percent per annum. As these differences show, the estimate of population can be problematic between censuses. Additionally, two issues may be affecting the count the number of residential accounts. The Billing System is counting billing adjustments differently since the changeover to CCB. Also LADWP may no longer be individually metering all the units in large apartment buildings especially if the buildings include solar distributed generation.

Retail Electric Prices: Retail Electric prices in this Forecast are based on Power System FYE 2017 Financial Plan Case 4. Some costs are recovered through pass-through rates which vary over time and are a potential source for variance in the Forecast. Nominal price changes are deflated using the Consumer Price Index and the Gross State Product Deflator forecasted by UCLA Anderson Forecast. Price elasticities are statistically derived from the sales models based on historical interactions within the LADWP service area. The derived price elasticities are at the upper bounds of national and international historical research. Elasticities may be overstated since they are highly correlated with LADWP energy savings programs and LADWP's billing system changeover.

Sector	Price Elasticity (%)
Residential	-.35
Commercial	-.29
Industrial	-.70

Customer Care & Billing System: The Customer Care & Billing System (CCB) replaced the TRES system in September 2013. From a forecasting perspective, the reported data was inconsistent and erratic as adjustments were made to the billings. In the 2016 Forecast LADWP used smoothing techniques in its modeling of data to account for the changeover since in the Load Forecast Group's opinion the sales data was normalizing. The smoothing techniques once again led to sales underperforming the Forecast so that the techniques were not included in the 2017 Forecast.

Sustainable Communities and Climate Protection Act (SB 375): SB 375 layers statewide guidelines onto local planning decisions. The goal is to reduce vehicle miles traveled thereby reducing emissions, and to encourage more compact, complete, and efficient communities for the future. SB 375 favors redevelopment areas near transportation centers over new development. In LADWP service territory, many apartment complexes are being built in downtown and vacant industrial land has been replaced with residential and commercial buildings. In 2017, workshops are being held to evaluate whether or not targets are being met. New policies could arise out of these workshops.

Zero Net Energy Policy: Current state law states that all new residential building will be zero net energy by 2020 and all new commercial buildings will be zero net energy by 2030.

Emission Allowances: AB 32 program seeks to reduce greenhouse gas emissions to 1990 levels using a cap-and-trade approach. In 2016, AB 32 was replaced by SB 32. SB 32 sets new targets for the State of California to reduce greenhouse emissions to 40 percent below 1990 levels. Workshops are being held in 2017 to revise policies and programs to meet this new goal. SB 32 impacts the Forecast mainly through the retail price forecast and the increase in electricity consumed by electric vehicles. Potential changes in SB 32 policy and program design add an element of uncertainty to the Forecast.

Large Construction Projects: Most construction activity currently is concentrated in large projects and this trend is forecasted to continue. The last of the small developers left the market during the 2008 recession, ending a trend that began in the 1990s. Having development concentrated in larger projects could potentially lead to faster and bigger swings in construction activity since each project is a larger percentage of overall construction activity. During the last recession, many large projects were deferred or abandoned.

Uncertainty in Economic Forecast: This Forecast uses the UCLA Anderson long-term economic forecast. This Forecast was based on a continuation of Obama-era economic policies. The new Administration has very different view of fiscal policy. Tax cuts, tax reform, military spending, infrastructure spending and immigration policy could all change the trajectory of the economy. As this Forecast is being written, there are many proposals on the table and outcomes are unclear.

Electric Vehicles: Electric vehicles are a key strategic initiative for LADWP. The Forecast adopts the numbers approved in the 2016 IRP.

The 2017 Forecast uses the same load shape that was first revised in the 2016 Forecast. In the 2016 Forecast, load was shifted to daytime and evening hours from nighttime. The load shape shift increases the peak demand in the Forecast.

Energy Efficiency: The Forecast uses the AB 2021 Energy Efficiency goals adopted by the Board on August 5, 2014.

Title 24 Building and Appliance standards are included in the AB 2021 goal of reducing electric consumption by fifteen percent by year 2020. This action aligns LADWP's policy with the California's investor-owned utilities.

In a change from the 2016 Forecast, the 2017 Forecast includes all the energy efficiency savings adopted in 2016 Integrated Resource Plan (IRP). In previous Forecasts, energy efficiency savings were only included through the five-year program window. Final decisions on energy efficiency savings are made in the Integrated Resource planning process.

One finding from the Energy Efficiency Potential Study is that energy efficiency in the LADWP service area is more effective in reducing energy consumption and less effective in reducing coincident peak demand.

Demand Response: LADWP is experimenting with several different Demand Response programs. The goal is to obtain 200 MW by 2020 and 500 MW by 2026. LADWP has had a voluntary load curtailment program in place for many years however it has not been consistently used on the peak days because capacity has not been constrained.

In summer 2016, LADWP adopted a Summer Shift program which reduced peak demands in July, August and September by an estimated 100 MW. LADWP plans to continue the Summer Shift program in 2017.

As in previous forecasting cycles, Demand Response effects are accounted for in the IRP instead of the Forecast. As such, to the extent Demand Response programs are employed in the future, some of the forecasted demand will not be realized at the meter.

Distributed Solar Generation: In a change from the 2016 Forecast, impacts to future sales from the installation of distributed solar are modeled over the entire forecast period based on 2016 IRP. Previous forecasts only forecast the change in sales and peaks though the Budget program years.

A unique characteristic of LADWP's residential sector is that over half the population are renters living in large apartment complexes containing five or more units. Because of this fact, LADWP does not have the technical and market potential for behind the meter solar installation when compared to other utilities in the State. Solar panels installed behind the meter reduce LADWP energy sales but not consumption.

The alternative for LADWP is to have solar panels directly connected to the grid using the feed-in tariff mechanism. When solar panels are connected to the grid it becomes wholesale energy and neither retail sales nor consumption are affected. Details of LADWP's solar strategy are included in the IRP.

Smart Grid Investment Program: LADWP is conducting a smart grid demonstration project. Outcomes are yet to be determined. All future impacts from the project are detailed in the IRP. Smart Grid is an integrated strategy which will affect future LADWP policy regarding Demand Response, Electric Vehicle, Customer Behavior and Cyber Security.

Recent characteristics of Residential Sector: The LADWP service area has the lowest rate of owner-occupied housing in the United States at 38 percent. The Millennial Generation throughout the United States and Los Angeles has delayed forming traditional households when compared to previous generations. There is growing concern that the scarcity of affordable housing will continue to keep the owner-occupied rate down in Los Angeles. The California Department of Finance has vacancy rate in LADWP service area is moderately on the high side at 5.9 percent. The 25-year low for vacancy rate was 4.6 percent in 1994. However there are private surveys that show that vacancy is as low as 2.8% in the apartment rental markets. The private surveys may be only covering the large apartment complexes which would partially explain the difference. Los Angeles residents spent 50 percent of their income on rent in 2016 compared to the 28 percent that they spent in 2000. This is the highest ratios of rent to income for any city in the United States according to Zillow. The fair market rent in Los Angeles for a standard two-bedroom apartment increased by 3.7% between 2016 and 2017, and the median house price increased by $23,000 according to California Association of Realtors.

Recent Characteristics of the Commercial Sector: In the retail sector, the combination of the growth in big box retailer and buying over the internet is hurting the B and C graded malls. The Grade A or "high-end" malls are still viable but they are changing their retail mix to become more of a destination type experience by adding theaters and restaurants. Vacancy rates in commercial office space are improving but are still high when compared to historical averages. There is an argument that current vacant office space is not configured for the higher density offices that employers favor today, which is an indication that this space is not vacant but instead should be torn down or remodeled. There is some anecdotal evidence that subleasing activity is up. High rates of office subleasing often occur close to the top of a market.

Port of Los Angeles: In 2016, the Port set a new record when cargo volumes reached 8.8 million TEUs, marking the busiest year ever for a Western Hemisphere Port. With the opening of newly expanded Panama Canal in June 2016, there will be increased competition for cargo wharfage and increased pressure on the Port of Los Angeles. Ultimate impacts on electric sales are unknown. At this point in the business cycle, the Port of Los Angeles does not expect a large slowdown due to the Panama Canal expansion. If there is a recession, the eastern ports in combination with the Panama Canal might compete for a larger share of a potentially smaller market. Los Angeles leads in total dollar value of shipments through its ports while Gulf of Mexico and Eastern seaports lead in tonnage. The most obvious reason for this difference is the transportation of oil and other fuels.

In June 2017, the Mayor announced that the Port of Los Angeles will strive to become a zero greenhouse emission facility. Targets and timelines for achieving this goal will be announced in November 2017. Incremental electric sales that may result are not included in this Forecast.

Losses in NEL: The loss factor used to calculate NEL after FYE 2017 is 12 percent. For a two-year period after the change in billing systems in FYE 2014 and FYE 2015, rolling twelve-month losses reached as high as 15.2 percent. In our opinion, sales were being under-reported in this time frame due to the conversion of CCB. For FYE 2016 and 2017, losses are still high at 12.6% and 12.5% respectively.

Although the Load Forecast includes a loss factor of 12%, the IRP Group has found in a preliminary study that future generation mix may lower the loss factor to 11%.

A separate initiative within LADWP seeks to find additional ways to lower system losses. This initiative is not included in the Forecast.

NEL Accounting: Preliminary analysis indicates that the energy received assumption from Distributed Generation and the Feed-in Tariff programs might have overstated annual NEL by approximately 146 GWH in calendar year 2015 and 70 GWH in 2016. Annual Peak Demand in 2015 would be an estimated 6215 MW instead of the reported 6234 MW. Calendar peak in 2016 would be an estimated 6042 MW instead 6052 MW.

2017 ENERGY AND DEMAND FORECAST

NET ELECTRICITY SALES BY CUSTOMER CLASS AND SYSTEM PEAK DEMAND WITH REGULATORY IMPACTS

	Page 17	Page 18	Page 19			Page 16				Page 15			Page 13		
	SECTOR SALES					Total Sales to Ultimate Customers	LOSSES			Net Energy for Load	Customer Self-Generation	Service Area Load	Peak Demand	Customer Self-Generation Peak	Service Area Peak
Fiscal Year	Residential (GWh)	Commercial (GWh)	Industrial (GWh)	Miscellaneous* (GWh)	Electric Vehicles (GWh)	(GWh)	Total (GWh)	Percentage (%)	DC Line (GWh)	(GWh)	(GWh)	(GWh)	(MW)	(MW)	(MW)
2000-01	7,542	12,248	2,754	389	0	22,934	2,753	10.7%	407	25,688	1,294	26,982	5,299	184	5,483
2001-02	7,282	11,979	2,496	391	0	22,149	2,755	11.1%	350	24,903	1,059	25,962	4,805	181	4,986
2002-03	7,358	12,230	2,383	392	0	22,363	3,006	11.8%	444	25,370	1,069	26,439	5,185	184	5,369
2003-04	8,061	12,559	2,485	414	0	23,520	3,181	11.9%	239	26,701	1,081	27,782	5,410	187	5,597
2004-05	7,907	12,502	2,447	423	0	23,279	3,059	11.6%	216	26,338	1,081	27,420	5,418	187	5,605
2005-06	8,051	12,699	2,451	432	0	23,634	3,194	11.9%	482	26,828	1,083	27,911	5,667	187	5,854
2006-07	8,495	13,130	2,332	421	0	24,378	3,125	11.7%	377	27,502	1,084	28,586	6,102	188	6,290
2007-08	8,540	13,269	2,366	441	0	24,617	3,311	11.9%	425	27,928	1,086	29,014	6,071	188	6,260
2008-09	8,578	13,210	2,303	434	0	24,526	2,921	10.6%	350	27,447	1,089	28,536	5,647	189	5,836
2009-10	8,300	12,582	2,073	417	0	23,373	3,153	11.9%	262	26,526	1,096	27,622	5,709	191	5,899
2010-11	8,068	12,429	2,189	376	0	23,062	3,191	12.2%	598	26,252	1,111	27,364	6,142	194	6,336
2011-12	8,162	12,601	1,924	349	0	23,037	3,515	13.2%	886	26,552	1,137	27,689	5,907	201	6,108
2012-13	8,442	12,845	1,947	314	0	23,548	3,606	13.3%	888	27,154	1,181	28,335	5,782	219	6,000
2013-14	7,957	12,740	1,827	269	0	22,793	3,963	14.8%	836	26,756	1,266	28,022	5,862	230	6,092
2014-15	8,131	12,938	1,720	239	0	23,028	3,664	13.7%	506	26,692	1,307	27,999	6,343	240	6,583
2015-16	8,291	13,109	1,630	262	0	23,292	3,364	12.6%	615	26,657	1,358	28,015	6,234	253	6,487
2016-17	8,060	12,869	1,689	255	6	22,878	3,302	12.6%	574	26,180	1,440	27,620	5,762	273	6,035
2017-18	8,017	12,689	1,804	267	103	22,880	3,130	12.0%	574	26,010	1,542	27,552	6,432	298	6,730
2018-19	8,017	12,404	1,792	268	182	22,663	3,109	12.1%	574	25,772	1,593	27,366	5,881	311	6,192
2019-20	8,008	12,179	1,799	268	265	22,520	3,165	12.3%	574	25,684	1,636	27,320	5,866	322	6,188
2020-21	8,013	12,059	1,806	269	345	22,492	3,093	12.1%	574	25,585	1,677	27,262	5,872	332	6,204
2021-22	8,046	12,056	1,813	270	428	22,613	3,091	12.0%	574	25,703	1,719	27,422	5,889	342	6,231
2022-23	8,088	12,118	1,818	271	508	22,802	3,118	12.0%	574	25,919	1,761	27,681	5,933	353	6,286
2023-24	8,140	12,215	1,820	271	587	23,033	3,212	12.2%	574	26,245	1,803	28,048	5,976	363	6,339
2024-25	8,201	12,339	1,823	272	650	23,286	3,174	12.0%	574	26,459	1,852	28,311	6,029	375	6,405
2025-26	8,258	12,462	1,828	273	716	23,537	3,211	12.0%	574	26,748	1,925	28,673	6,076	393	6,469
2026-27	8,327	12,602	1,833	273	771	23,807	3,246	12.0%	574	27,053	1,971	29,023	6,129	405	6,534
2027-28	8,399	12,742	1,838	274	826	24,078	3,350	12.2%	574	27,428	2,012	29,440	6,182	415	6,597
2028-29	8,472	12,881	1,842	275	872	24,341	3,320	12.0%	574	27,662	2,053	29,715	6,239	425	6,665
2029-30	8,546	13,015	1,847	275	925	24,609	3,352	12.0%	574	27,961	2,095	30,055	6,291	435	6,727
2030-31	8,619	13,146	1,852	276	973	24,867	3,393	12.0%	574	28,260	2,136	30,396	6,348	446	6,794
2031-32	8,694	13,281	1,857	277	1,025	25,135	3,497	12.2%	574	28,631	2,177	30,809	6,400	456	6,856
2032-33	8,771	13,431	1,862	278	1,073	25,415	3,468	12.0%	574	28,883	2,218	31,101	6,473	466	6,940
2033-34	8,851	13,592	1,868	278	1,125	25,714	3,504	12.0%	574	29,218	2,260	31,477	6,514	476	6,990
2034-35	8,931	13,755	1,873	279	1,177	26,015	3,547	12.0%	574	29,561	2,301	31,862	6,576	487	7,062
2035-36	9,011	13,922	1,878	280	1,229	26,320	3,661	12.2%	574	29,981	2,336	32,317	6,633	495	7,128
2036-37	9,100	14,110	1,883	281	1,281	26,654	3,632	12.0%	574	30,286	2,341	32,627	6,716	496	7,212
2037-38	9,190	14,300	1,888	281	1,333	26,993	3,677	12.0%	574	30,669	2,341	33,010	6,769	496	7,266
2038-39	9,281	14,490	1,893	282	1,385	27,331	3,724	12.0%	574	31,055	2,341	33,395	6,841	496	7,338
2039-40	9,372	14,678	1,899	283	1,437	27,668	3,841	12.2%	574	31,509	2,341	33,849	6,911	496	7,407

Table updated through December 2016

Electric Vehicle Sales before December 2016 included in Residential and Commercial Sales

Intradepartmental sales, historically included in Miscellaneous, are now included in Commercial sector

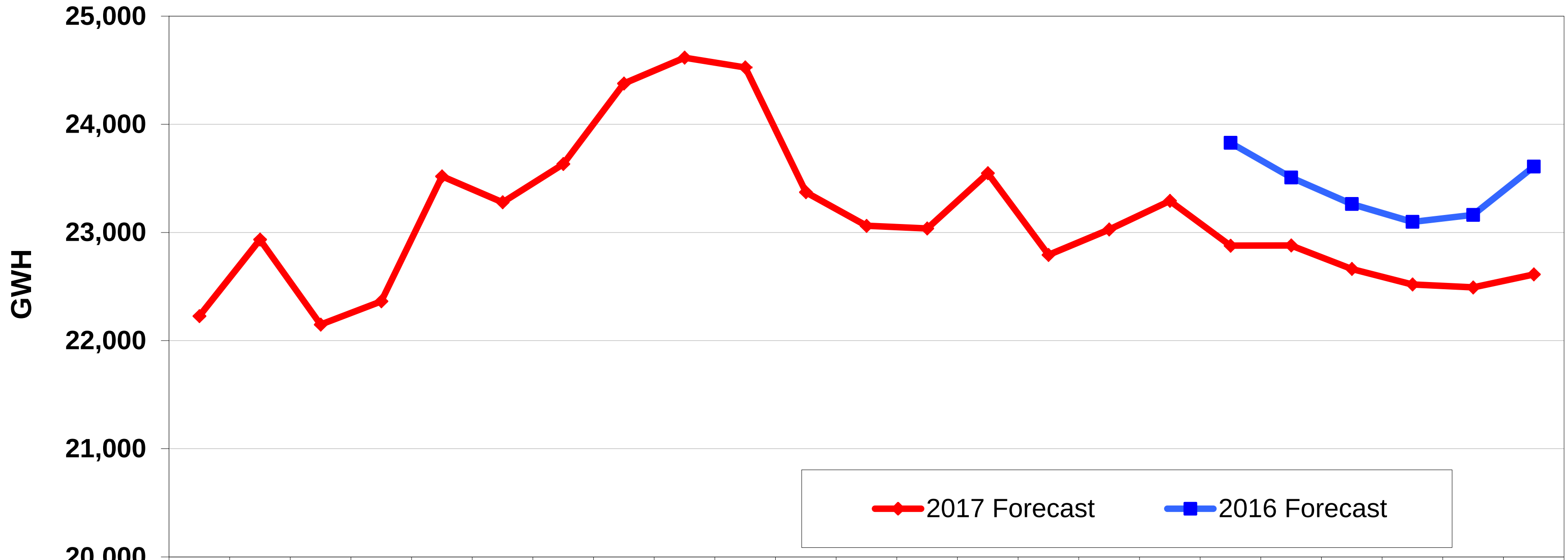
Annual Percent Change

	Residential	Commercial	Industrial	Miscellaneous*	Electric Vehicles	Total Sales to Ultimate Customers	Losses Total	Percentage	DC Line	Net Energy for Load	Customer Self-Generation	Service Area Load	Peak Demand	Customer Self-Generation Peak	Service Area Peak
1993-2003	0.46%	0.44%	-1.17%	0.85%		0.27%				0.37%		0.34%	-0.18%		-0.11%
2001-16	0.68%	0.49%	-3.68%	-2.78%		0.11%				0.26%		0.27%	1.17%		1.21%
2016-22	-0.50%	-1.39%	1.80%	0.46%		-0.49%				-0.61%		-0.36%	-0.95%		-0.67%
2016-26	-0.04%	-0.51%	1.16%	0.38%		0.10%				0.03%		0.23%	-0.26%		-0.03%
2016-36	0.42%	0.30%	0.71%	0.32%		0.61%				0.59%		0.72%	0.31%		0.47%
2016-40	0.49%	0.45%	0.61%	0.30%		0.69%				0.67%		0.76%	0.41%		0.53%

***'Miscellaneous' includes Streetlighting, Owens Valley.

Total Sales to Ultimate Customers

- Based on Financial Plan Case 4 of 2017. Energy Efficiency, PHEV, distributed generation targets as approved in 2016 IRP.
- Major Causes of Lower Forecasted Sales:
  - Removed CCB billing adjustments that were included in 2016 Load Forecast.
  - Energy Efficiency Savings and Solar Distributed Generation.
  - Declining Average Sales per Customer for both residential and commercial customers.

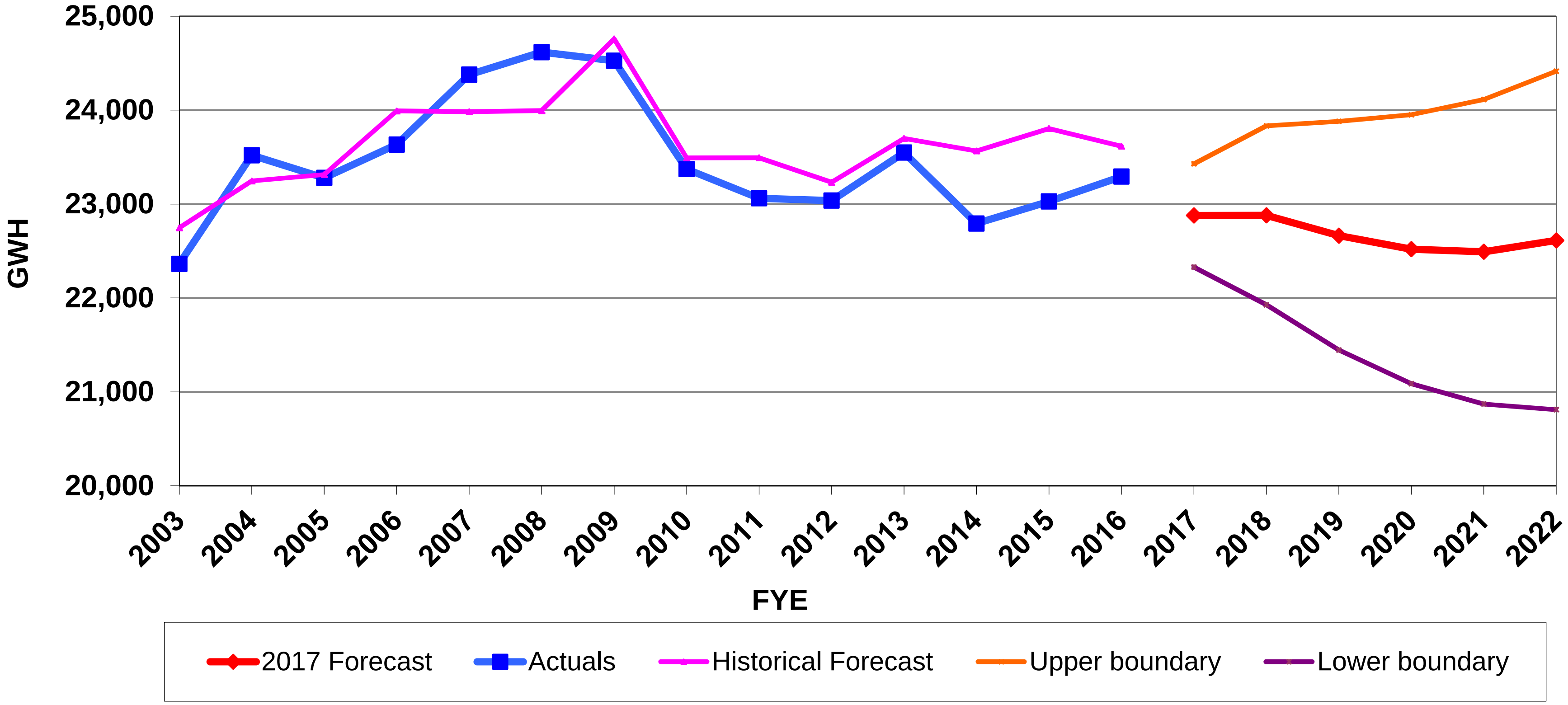


	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
2017 Forecast	22,227	22,934	22,149	22,363	23,520	23,279	23,634	24,378	24,617	24,526	23,373	23,062	23,037	23,548	22,793	23,028	23,292	22,878	22,880	22,663	22,520	22,492	22,613
2016 Forecast																		23,829	23,508	23,264	23,098	23,163	23,609

FYE

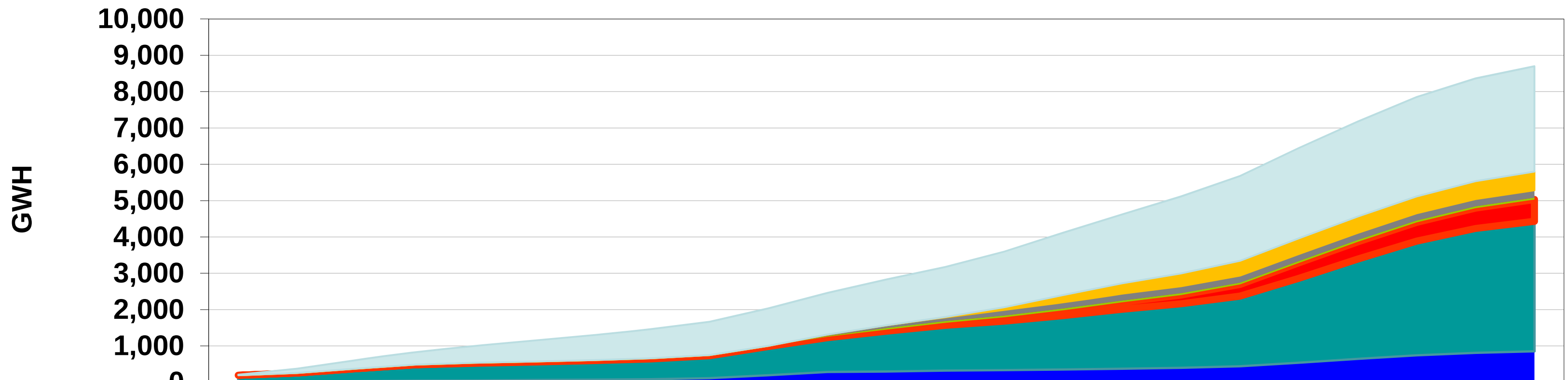
Retail Sales

- Historical average forecast variance is 0.8% with a 1.7% deviation.
- Historical variation is based on demographics, economics and weather.
- Expect larger variation in accuracy
  - Utility program targets tend to be aspirational.



Historical and Forecasted Accumulated Savings Energy Efficiency and Solar Rooftops

- Building and Appliance Standards now incorporated into LADWP's EE goals.
- EE and Distributed Generation savings in 2016 IRP continued throughout entire Forecast timespan.

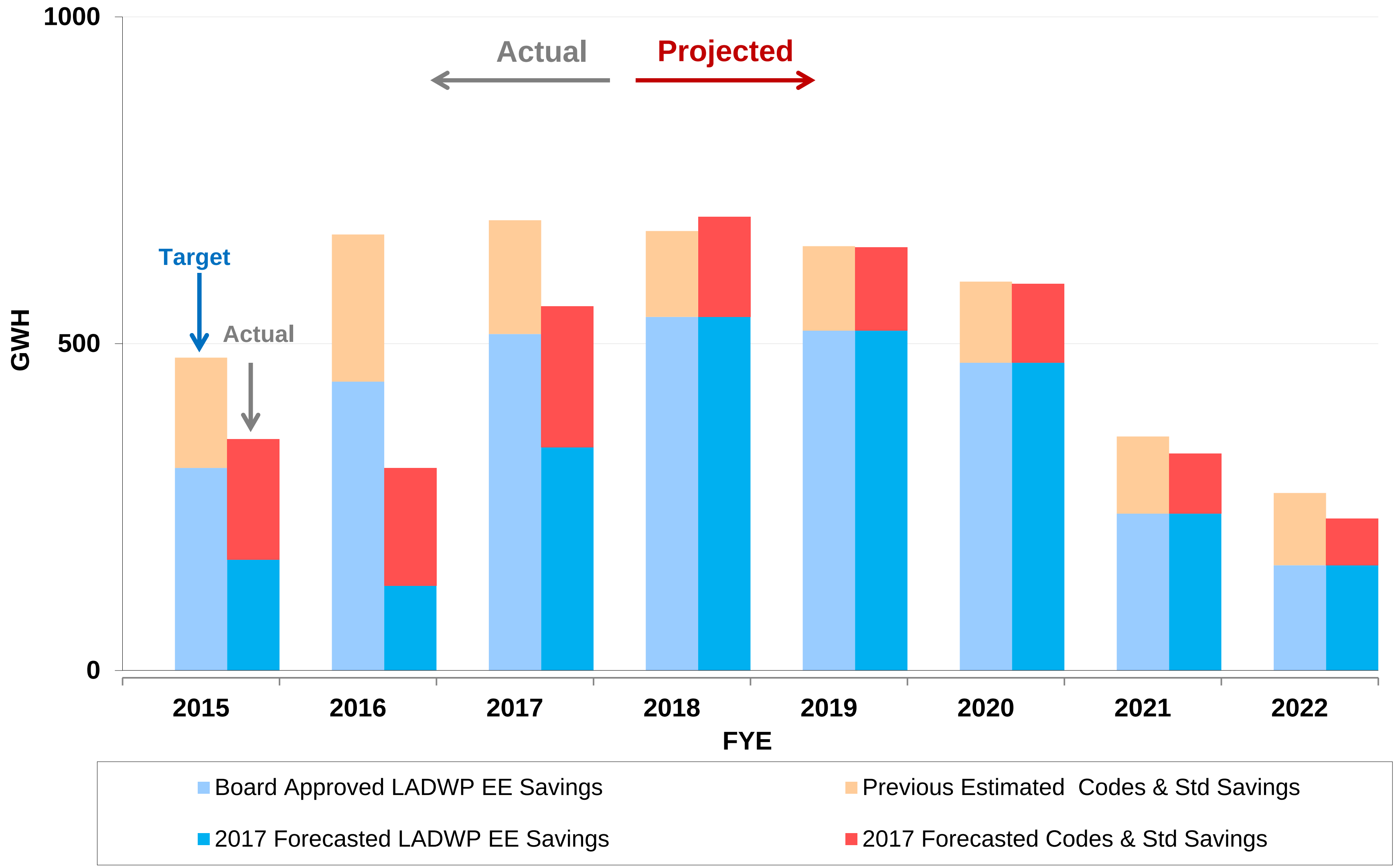


	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Building and Appliance Standards	17	118	232	347	461	575	689	804	918	1,032	1,146	1,261	1,375	1,533	1,717	1,897	2,120	2,335	2,489	2,616	2,736	2,828	2,900
Light Bulb Replacement per Huffman Bill	0	0	0	0	0	0	0	0	0	0	0	0	9	77	201	287	354	408	431	448	466	494	518
LADWP Street Light	0	0	0	0	0	0	0	0	0	0	41	78	105	150	168	188	190	192	194	196	198	200	202
LADWP Traffic Light	0	0	0	0	0	0	0	0	0	0	20	42	50	50	50	50	50	50	50	50	50	50	50
LADWP Rooftop Solar	0	0	1	5	12	12	14	15	17	20	27	42	68	104	147	189	240	321	423	475	517	559	600
LADWP Commercial	179	238	343	436	472	498	525	559	618	790	946	1,112	1,246	1,349	1,483	1,639	1,763	1,932	2,324	2,748	3,143	3,421	3,579
LADWP Residential	15	21	34	45	53	62	71	86	115	195	283	297	322	337	354	374	400	441	539	645	744	814	853

FYE

- LADWP Residential
- LADWP Commercial
- LADWP Rooftop Solar
- LADWP Traffic Light
- LADWP Street Light
- Light Bulb Replacement per Huffman Bill
- Building and Appliance Standards

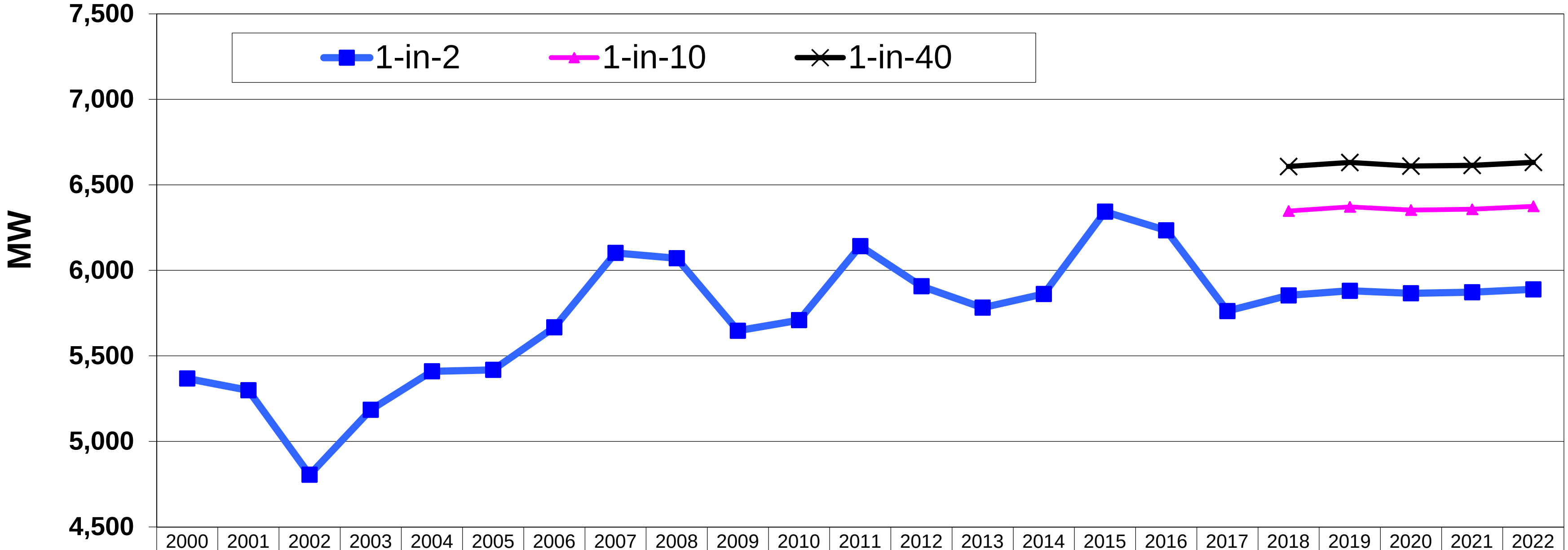
Total Installed EE Savings



Peak Demand

Cases

– Based on the recent climate change finding that more extreme weather events of longer duration will occur in the future, it is now expected that the System will approach its potential more frequently so the difference between the 1-in-10 and 1-in-40 forecasts is compressed.



	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
1-in-2	5,368	5,299	4,805	5,185	5,410	5,418	5,667	6,102	6,071	5,647	5,709	6,142	5,907	5,782	5,862	6,343	6,234	5,762	5,854	5,881	5,866	5,872	5,889
1-in-10																			6,347	6,371	6,353	6,357	6,374
1-in-40																			6,608	6,631	6,610	6,614	6,631

FYE

Peak Demand

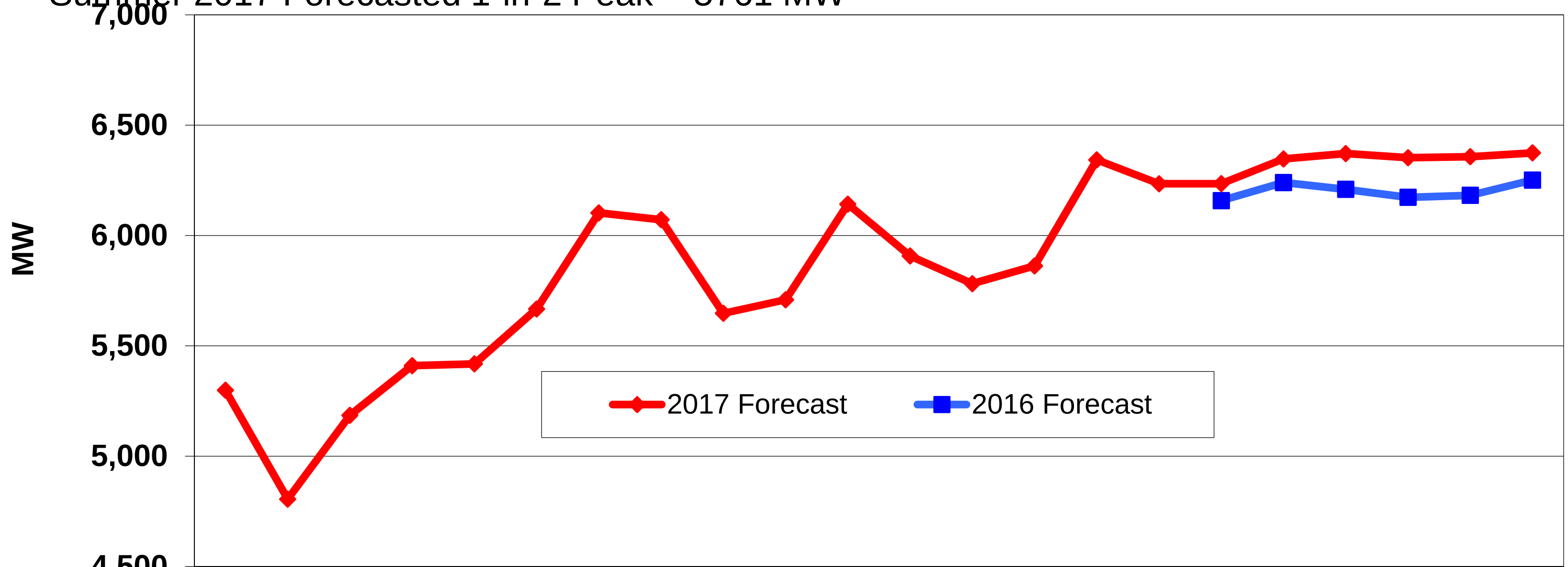
- Annual peak demand is dependent on the severity of the heat storms that are encountered during the year.
- The cases are built on the probability of a weather event occurring in a given year.

NEL (MW) Fiscal Year Annual Peak Demand

Fiscal Year	Base Case	1 in 5	1 in 10	1 in 40 Hot
2017-18	5854	6178	6347	6608
2018-19	5881	6203	6371	6631
2019-00	5866	6186	6353	6610
2020-21	5872	6191	6357	6614
2021-22	5889	6208	6374	6631
2022-23	5933	6255	6423	6682
2023-24	5976	6300	6469	6731
2024-25	6029	6357	6529	6793
2025-26	6076	6407	6580	6847
2026-27	6129	6464	6640	6910
2027-28	6182	6521	6698	6971
2028-29	6239	6582	6761	7038
2029-30	6291	6638	6819	7098
2030-31	6348	6698	6882	7164
2031-32	6400	6753	6938	7223

1-in-10 Peak Demand

- **Summer 2017 Actual Peak = 6432 MW (1-in-15.1 peak occurred on a 1-in-12.6 weather day)**
- **Weather Normalized Peaks for Summer 2017:**
  - Summer 2017 1-in-10 Peak = 6347 MW
  - Summer 2017 1-in-2 Peak = 5854 MW
  - Summer 2017 Forecasted 1-in-2 Peak = 5761 MW



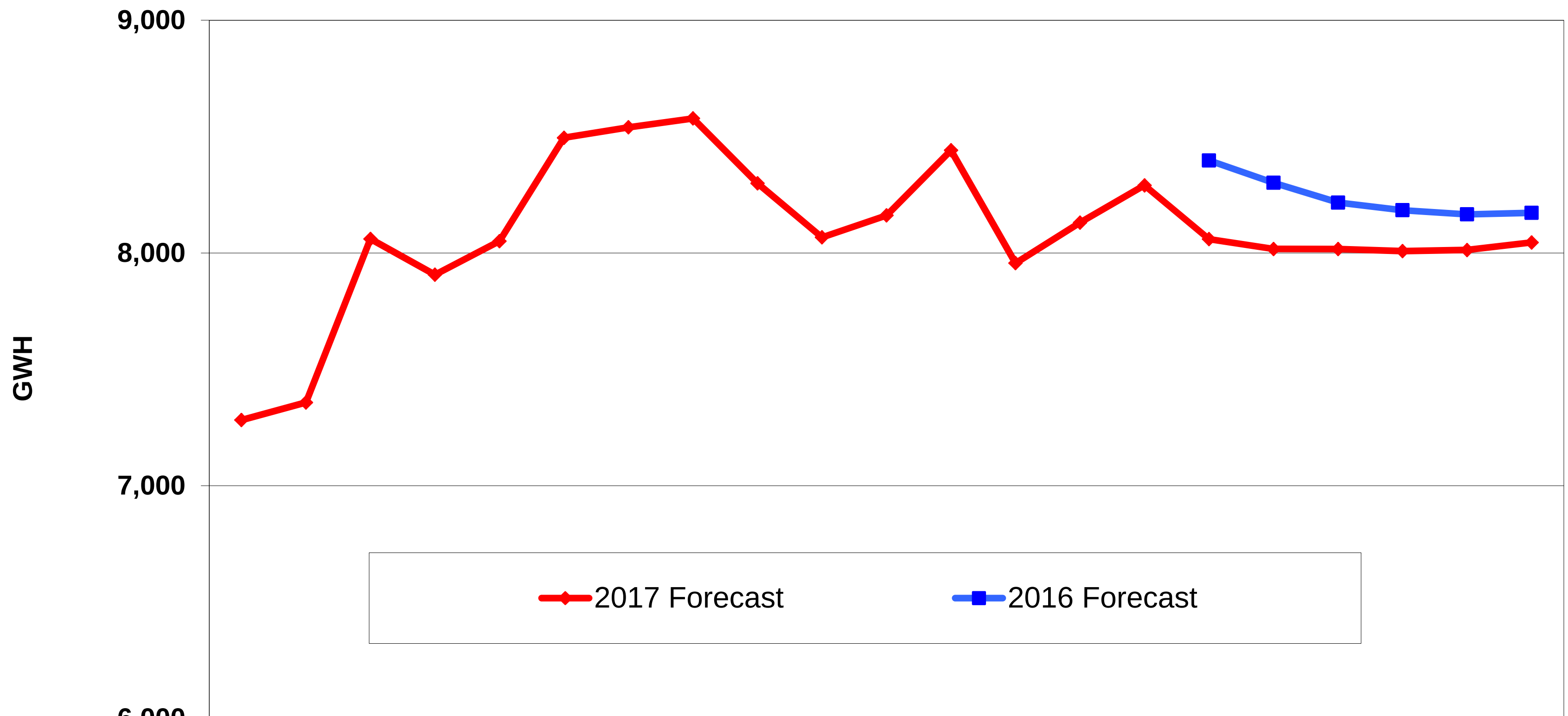
	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
2017 Forecast	5,299	4,805	5,185	5,410	5,418	5,667	6,102	6,071	5,647	5,709	6,142
2016 Forecast											

	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
2017 Forecast	5,907	5,782	5,862	6,343	6,234	6235	6347	6371	6353	6357	6374
2016 Forecast						6,158	6,240	6,209	6,173	6,182	6,251

FYE

Residential Sales

- Incorporates electric rate increases from Financial Plan Case 4 with a 1-year lag.

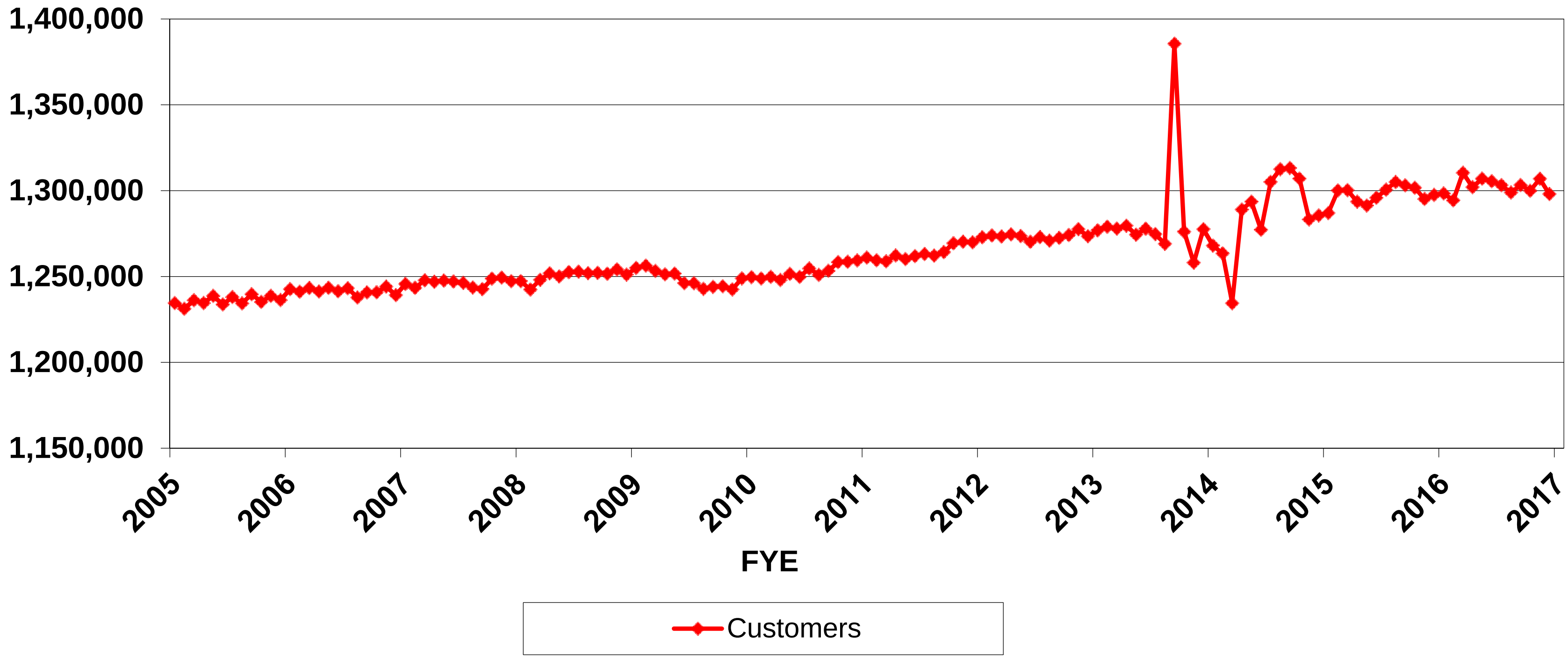


FYE	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
2017 Forecast	7,282	7,358	8,061	7,907	8,051	8,495	8,540	8,578	8,300	8,068	8,162	8,442	7,957	8,131	8,291	8,060	8,017	8,017	8,008	8,013	8,046
2016 Forecast																8,398	8,302	8,217	8,184	8,166	8,173

FYE

Residential Energy Sales
Number of Residential Customers

- Peak-to-Trough – 13,532 customers lost between February 2009 and August 2009.
- 55,000 (4.3%) customers added since August 2009.
- Total Customers = 2 * Bimonthly Bills + 1 * Monthly Bills
- The majority of residential customers are renters and live in multi-family units.

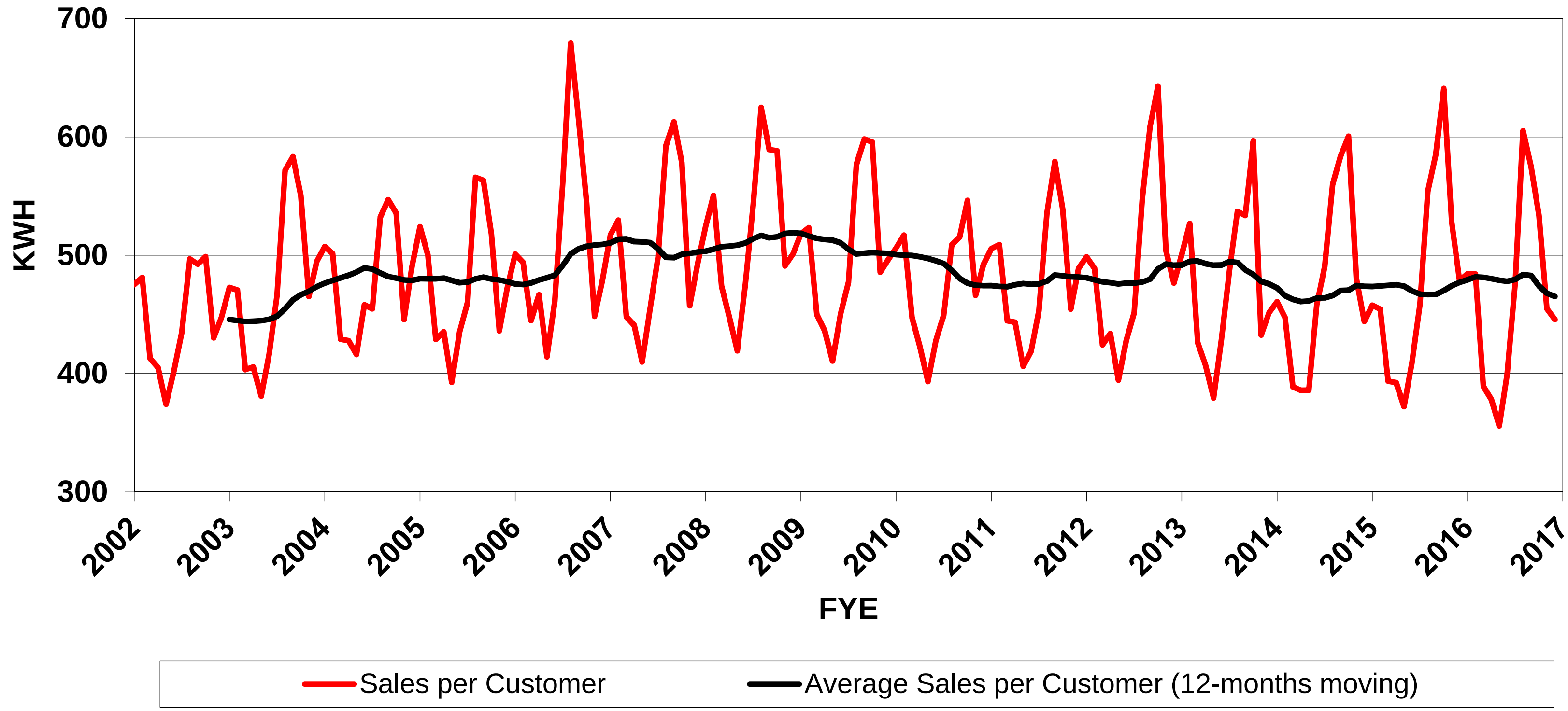


Residential Sales

Average Sales per Customer

Recent Evidence

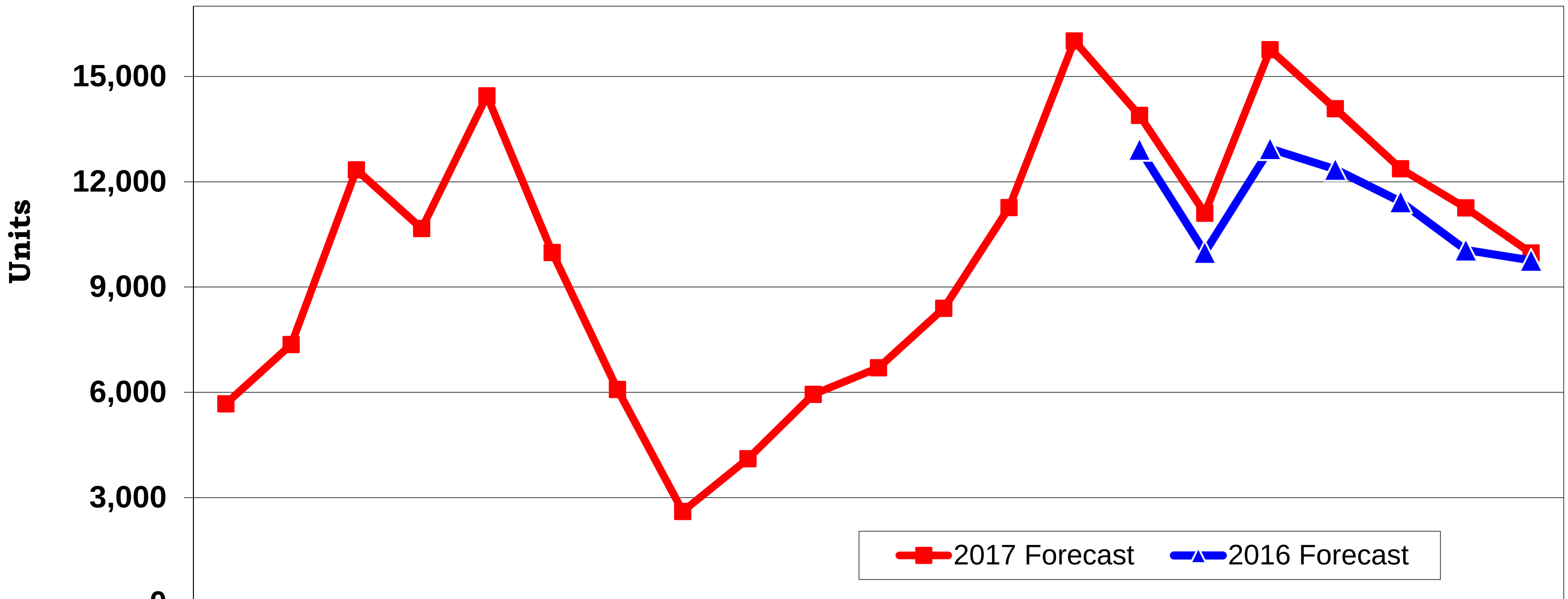
- Moving average monthly sales per customer reached an all-time high of 519 KWH per month in December 2008.
- The December 2016 moving average is 465 KWH per Month.



Residential Energy Sales

New Residential Building Units

- New units are 15% Single-Family and 85% Multi-family which lowers future average consumption per household.
- Absorption changed from positive to negative in 2015.
- Model sensitive to number of households.



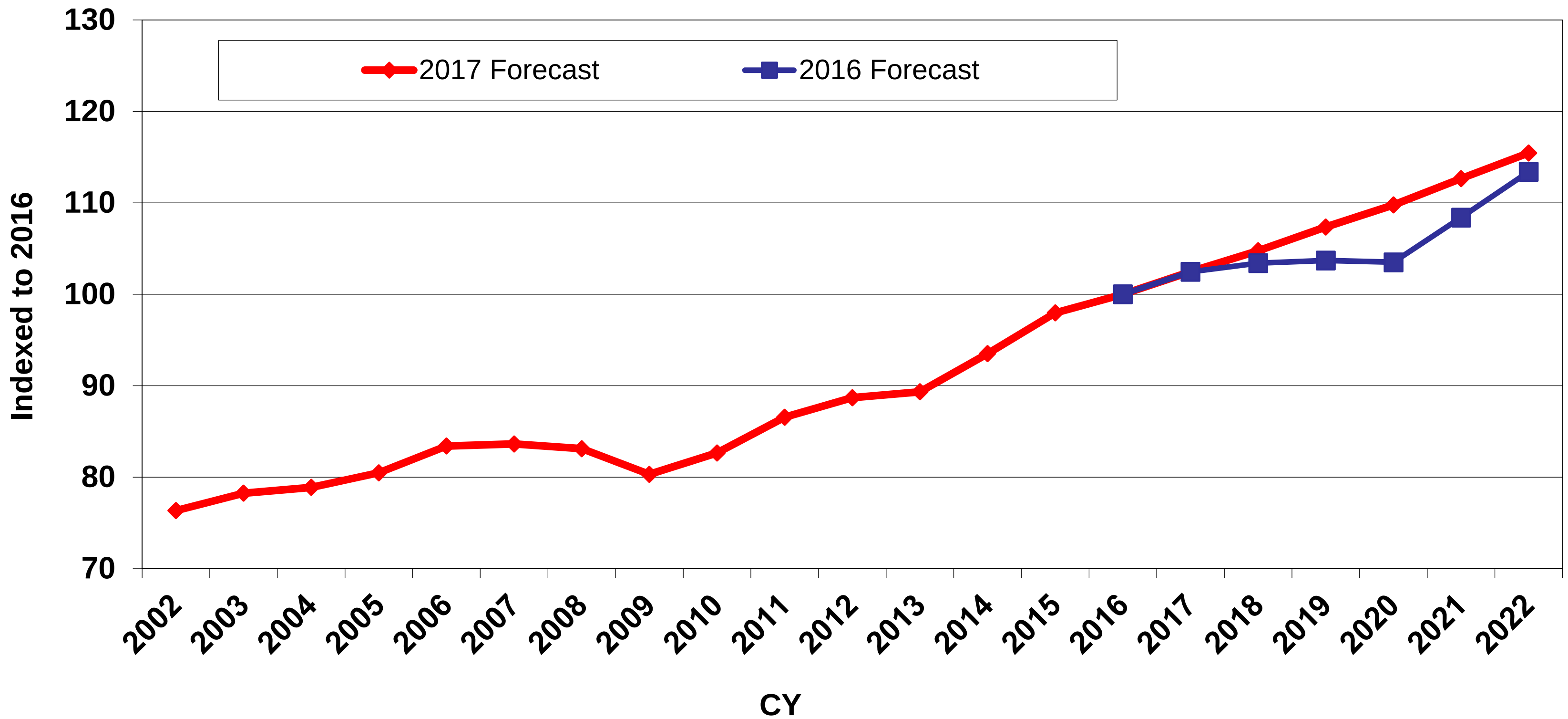
	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
2017 Forecast	5,673	7,361	12,34	10,66	14,44	9,985	6,080	2,607	4,109	5,940	6,700	8,392	11,26	16,01	13,89	11,10	15,76	14,08	12,37	11,25	9,970
2016 Forecast															12,92	9,990	12,94	12,35	11,43	10,05	9,761

FYE

Residential Energy Sales
Recent Economic Impact

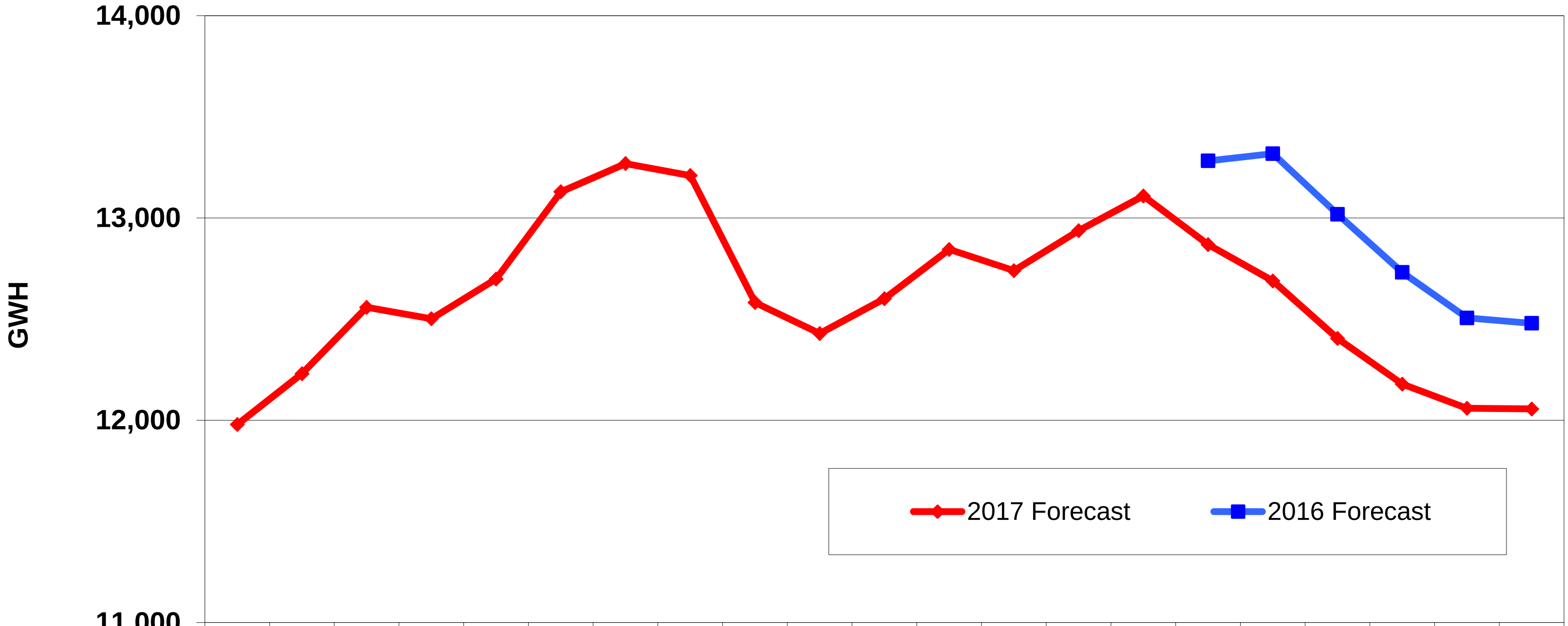
Real Personal Income:

- Change due to new fiscal policy proposed by the current Administration.
- Model sensitive to growth in Personal Income.



Commercial Sales

- Intradepartmental Sales included in Commercial due to CCB reclassification.
- Sectors experiencing positive growth: Education & Health, Professional Services, and Information.
- Open office trend means more employees per square foot.



	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
2017 Forecast	11,979	12,230	12,559	12,502	12,699	13,130	13,269	13,210	12,582	12,429	12,601	12,845	12,740	12,938	13,109	12,869	12,689	12,404	12,179	12,059	12,056
2016 Forecast																13,283	13,318	13,019	12,731	12,506	12,480

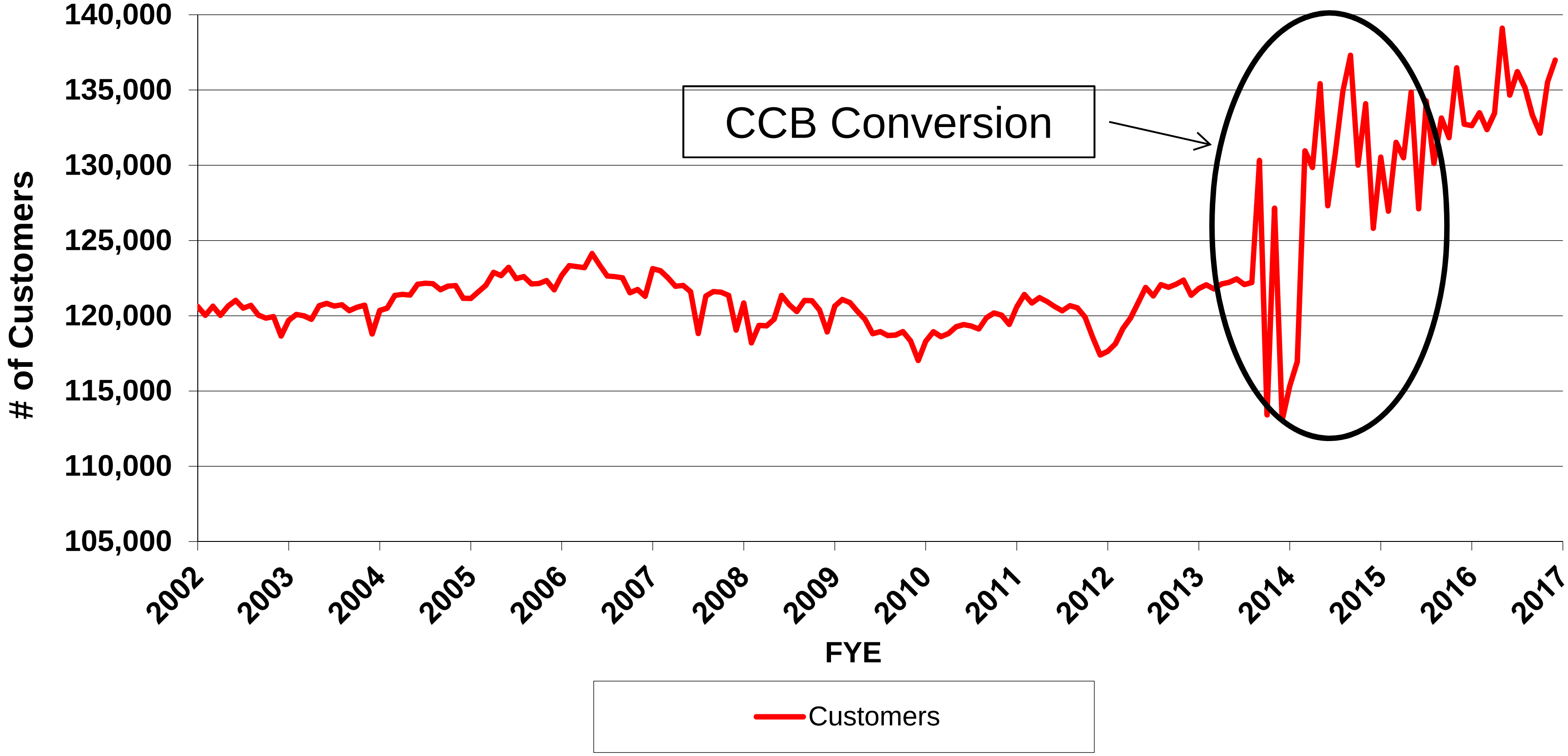
FYE

Commercial Energy Sales

Commercial Customers Count

Recent Evidence

- Pre-CISCONN average ~124,000
- Last 12 months average is ~134,588



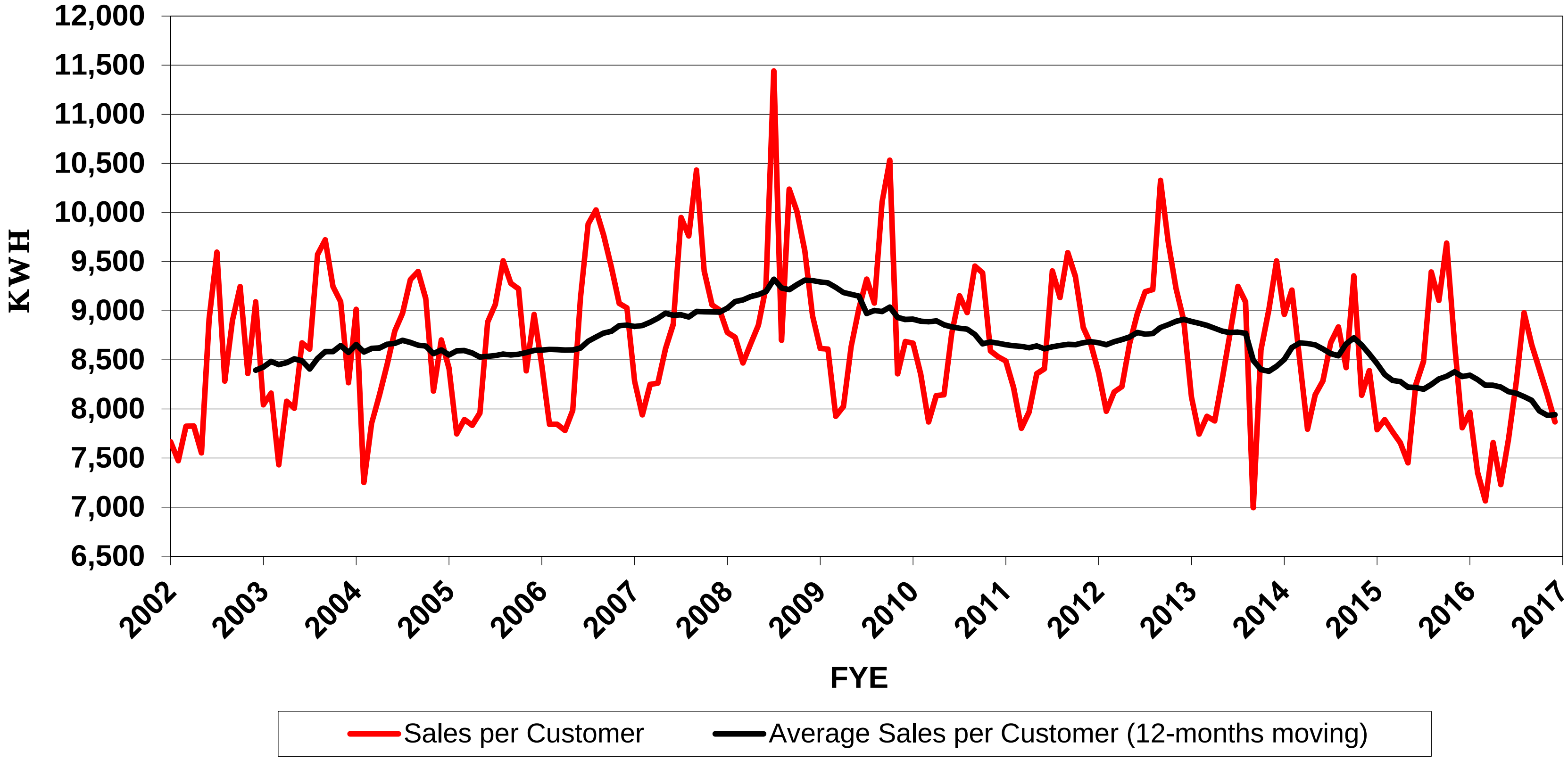
Commercial Energy Sales

Twelve-Month Moving Average Sales per Customer

Recent Evidence

– Moving average of sales per customer per month peaked in July 2008 at 9320 KWH per month.

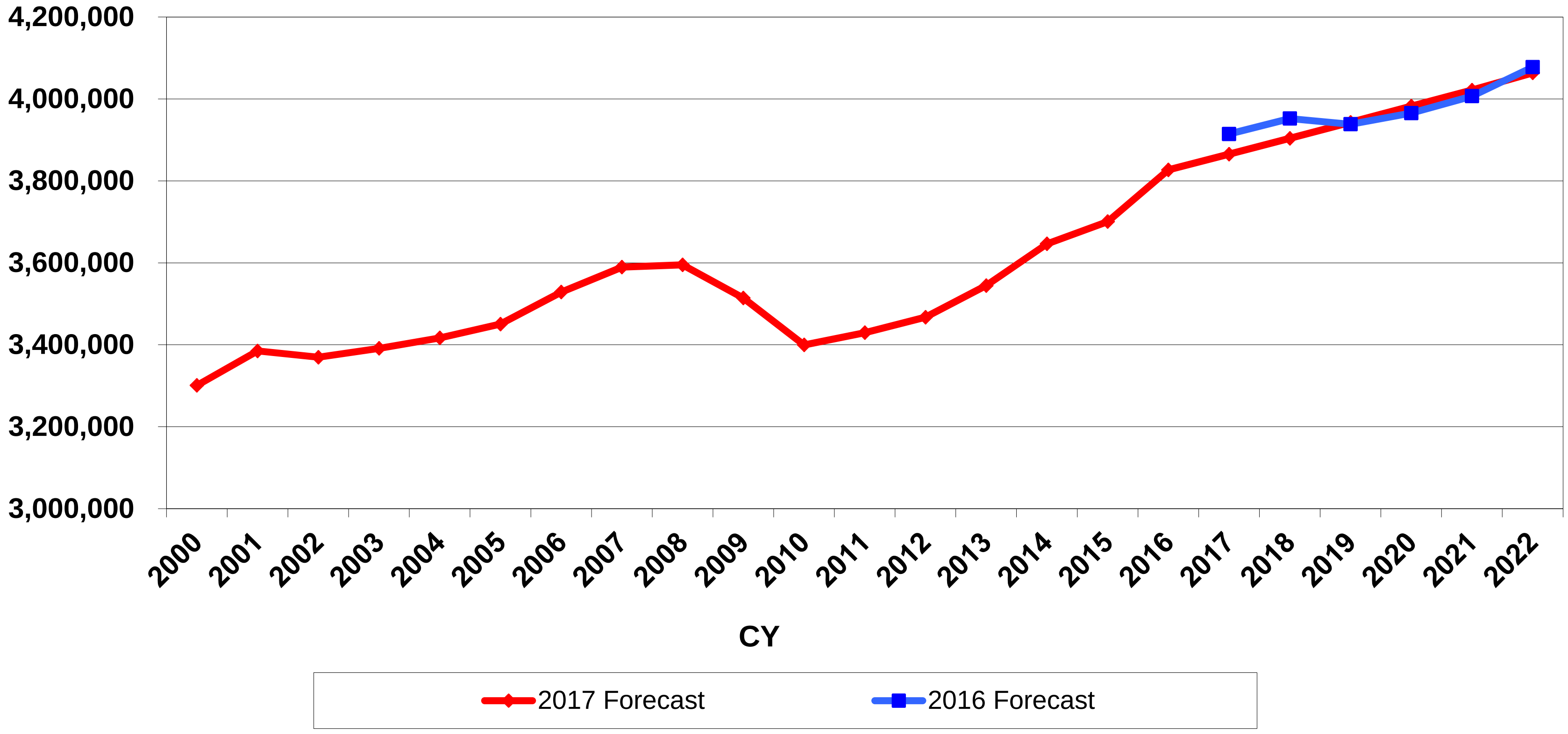
– Currently sales per customer per month are 7941 KWH.



Commercial Energy Sales
Local Employment in Services Sector

LA County Commercial Services Employment

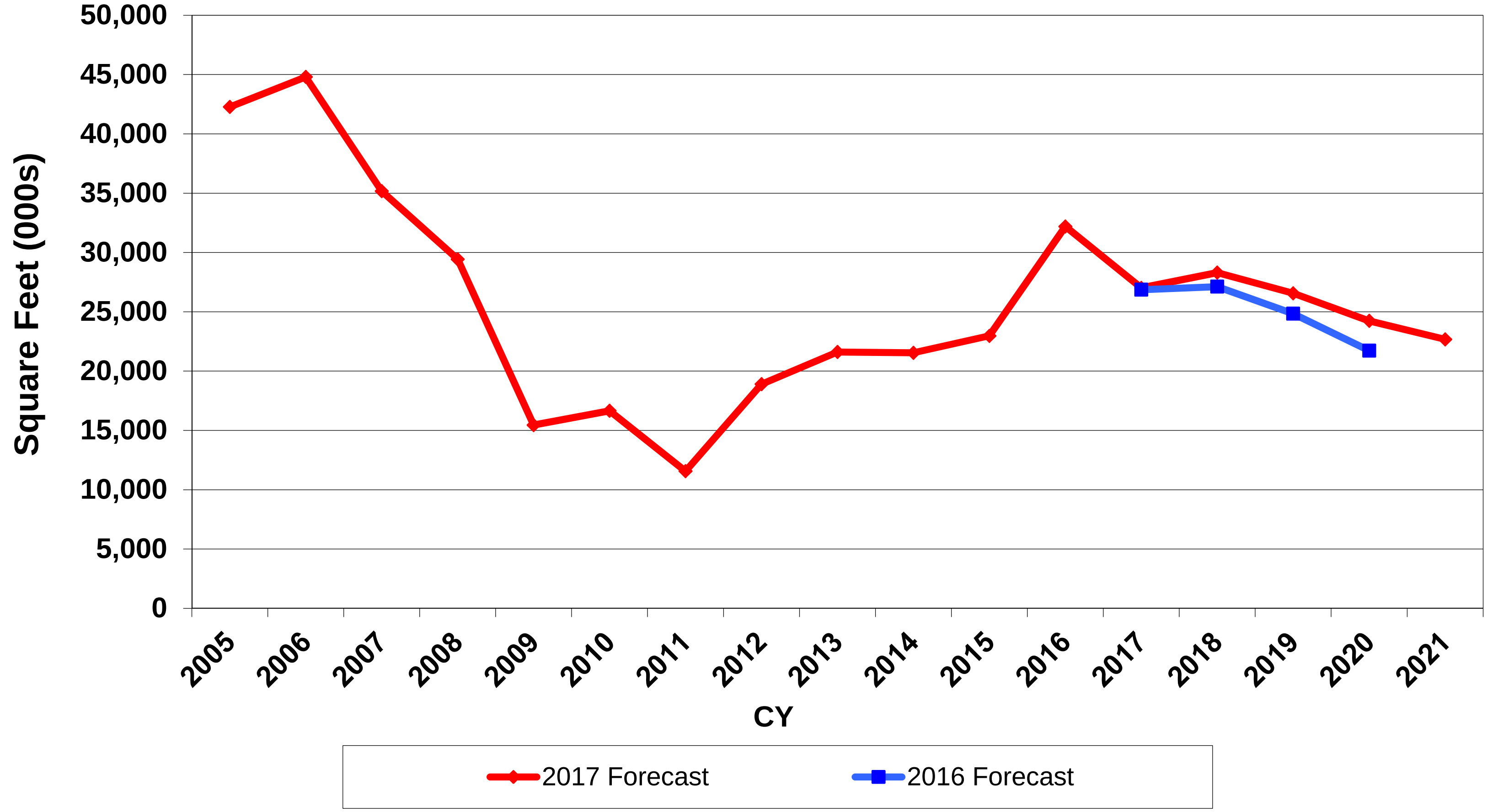
- Indexed to the March 2016 benchmark.
- Model sensitive to slopes of these curves



Commercial Energy Sales
Dodge Data & Analytics Forecast

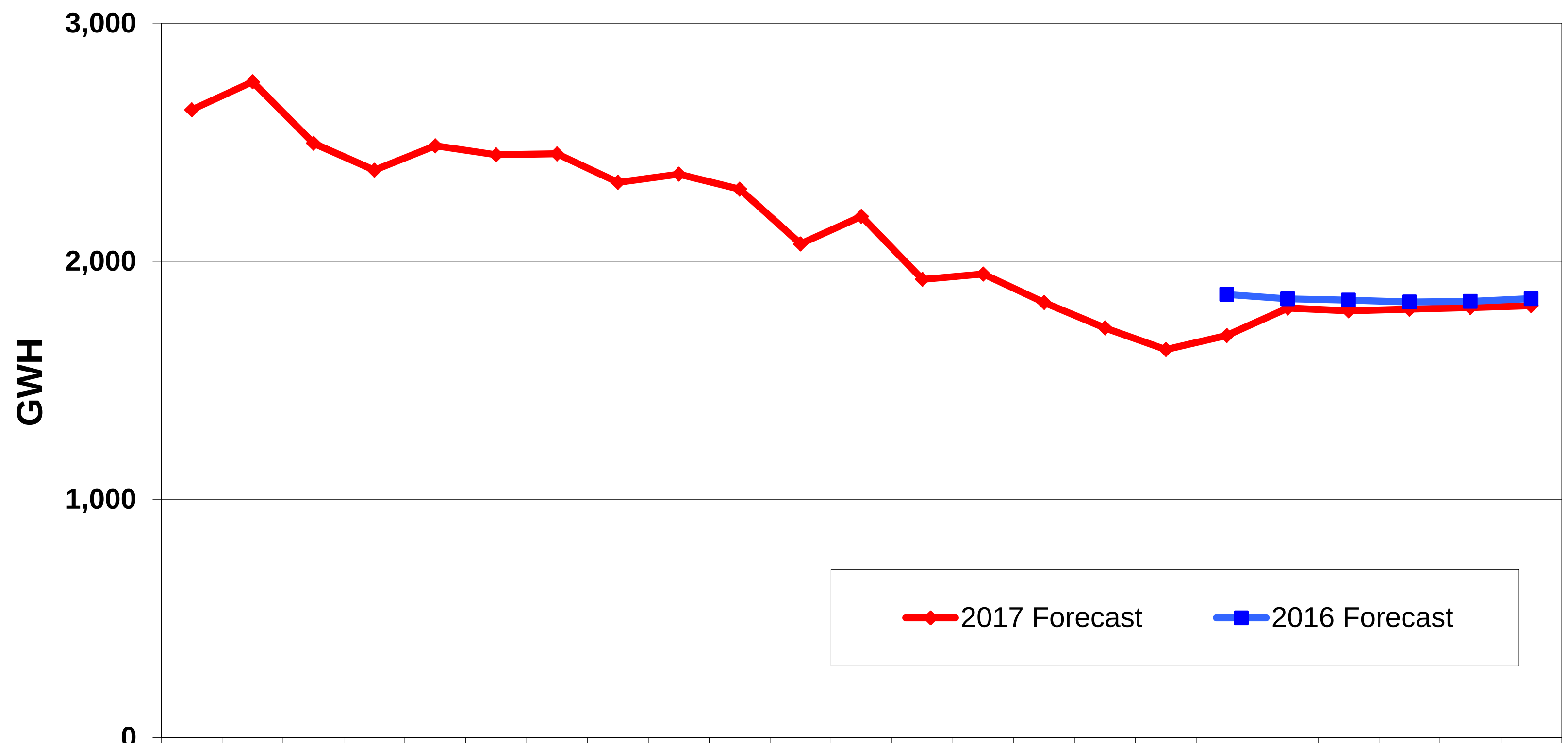
Commercial Floorspace Additions

– Model sensitive to floorspace square footage.



Industrial Sales

- No EE or rooftop solar in the Industrial Forecast. All EE and solar assigned to Residential, Commercial and Streetlight sectors.



	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
2017 Forecast	2,637	2,754	2,496	2,383	2,485	2,447	2,451	2,332	2,366	2,303	2,073	2,189	1,924	1,947	1,827	1,720	1,630	1,689	1,804	1,792	1,799	1,806	1,813
2016 Forecast																		1,861	1,843	1,837	1,829	1,832	1,843

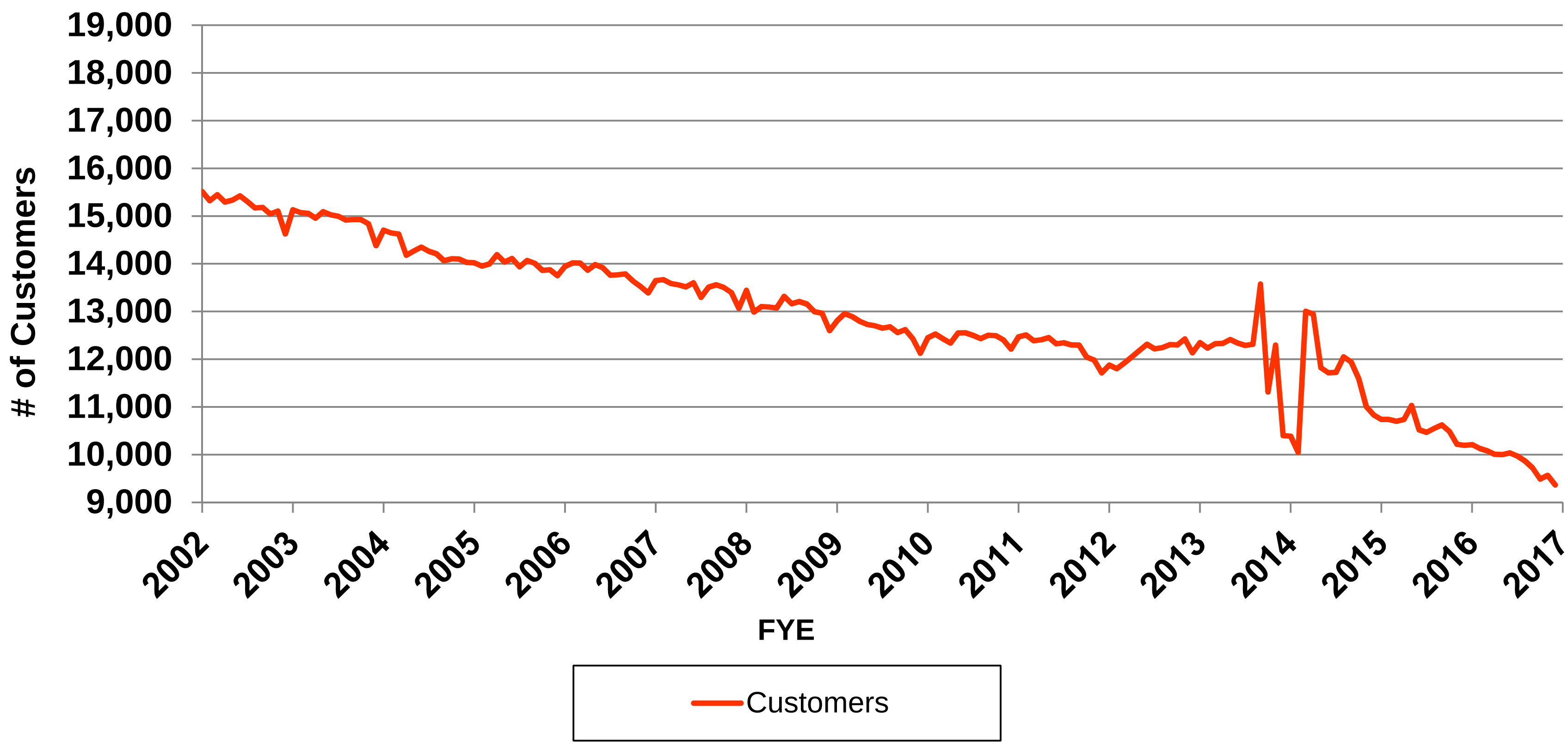
FYE

Industrial Energy Sales

Number of Customers

Recent Evidence

– The forecast is for the heavy process industries (refineries and breweries) to remain but no new heavy industry will emerge. Assembly industry customers and jobs are disappearing.

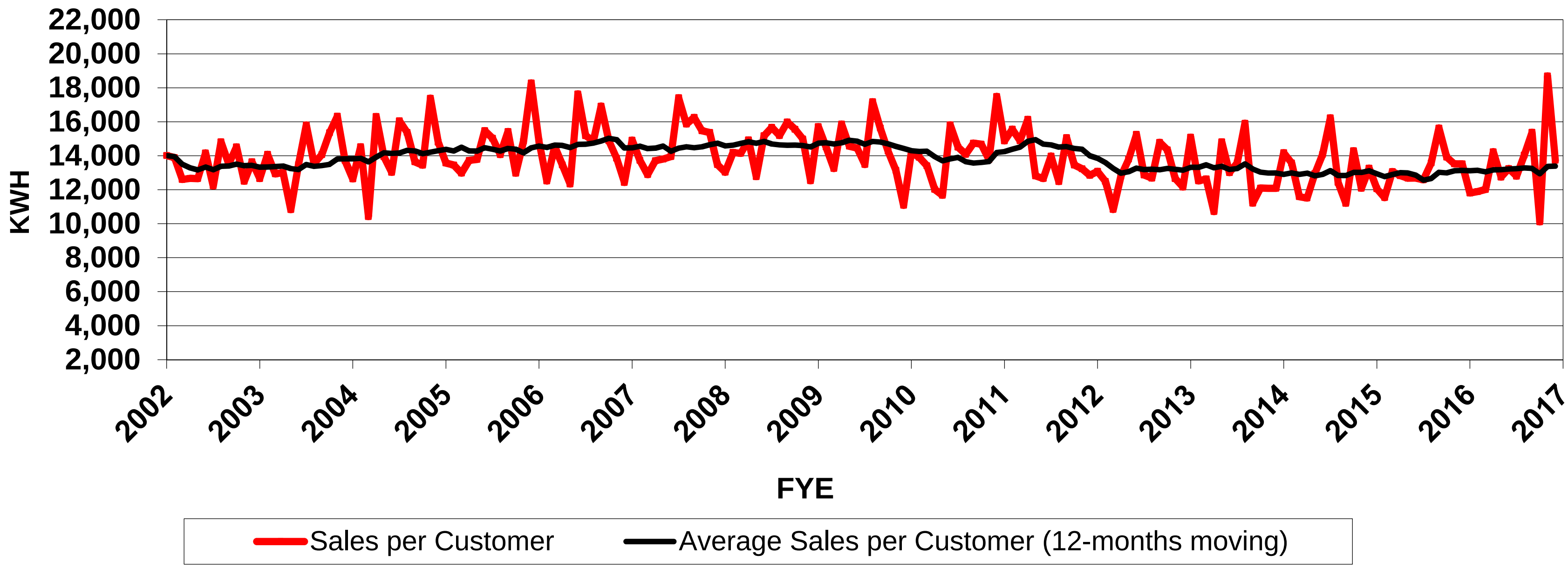


Industrial Sales

Twelve-Month Moving Average Sales per Customer

Recent Evidence

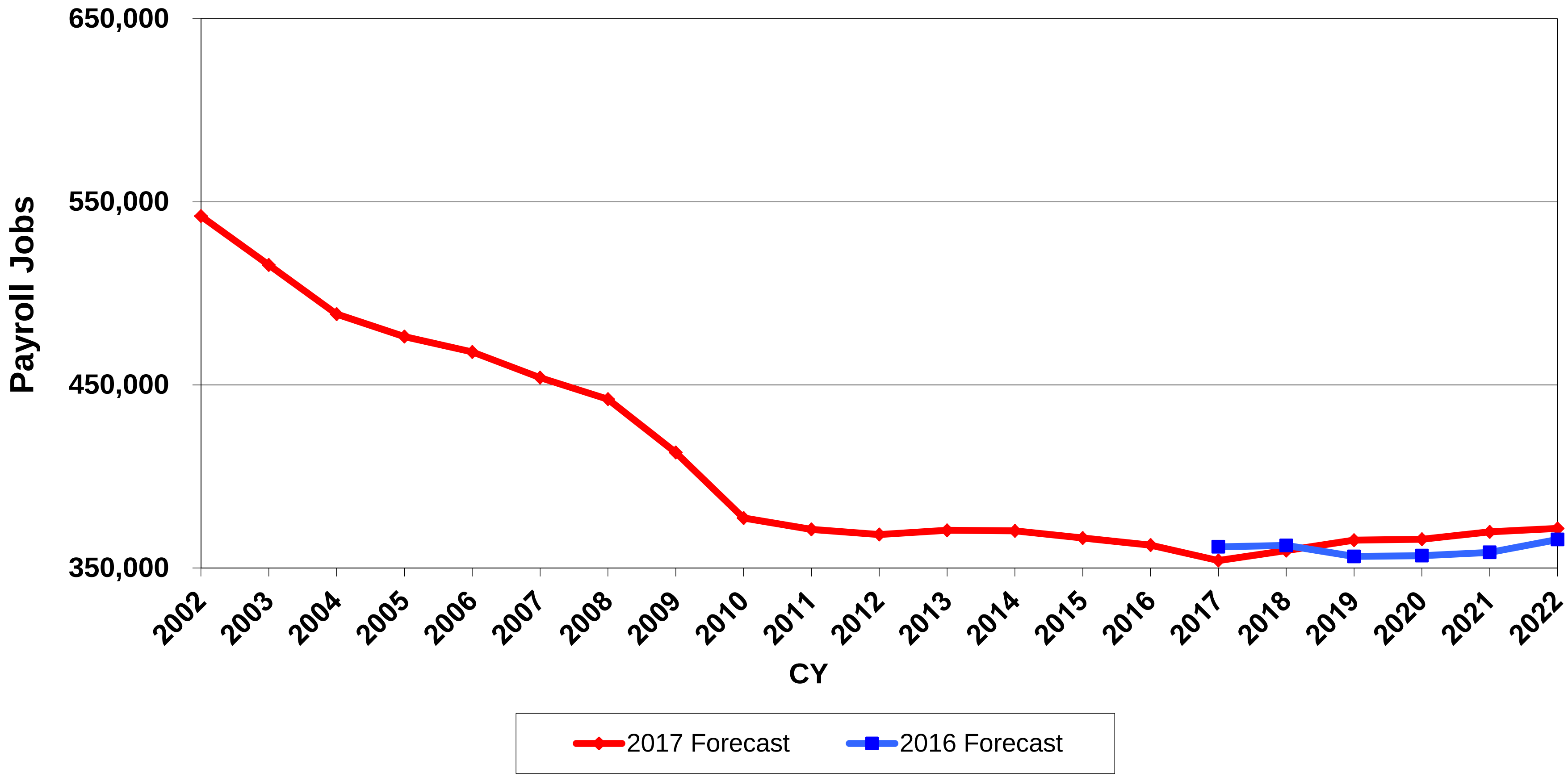
- Sales per customer per month peaked in October 2006 at 15,026 KWH per month. High consumption partially attributed to a large self-generation unit being off-line at a refinery.
- Currently sales per customer per month are 13,390 KWH.



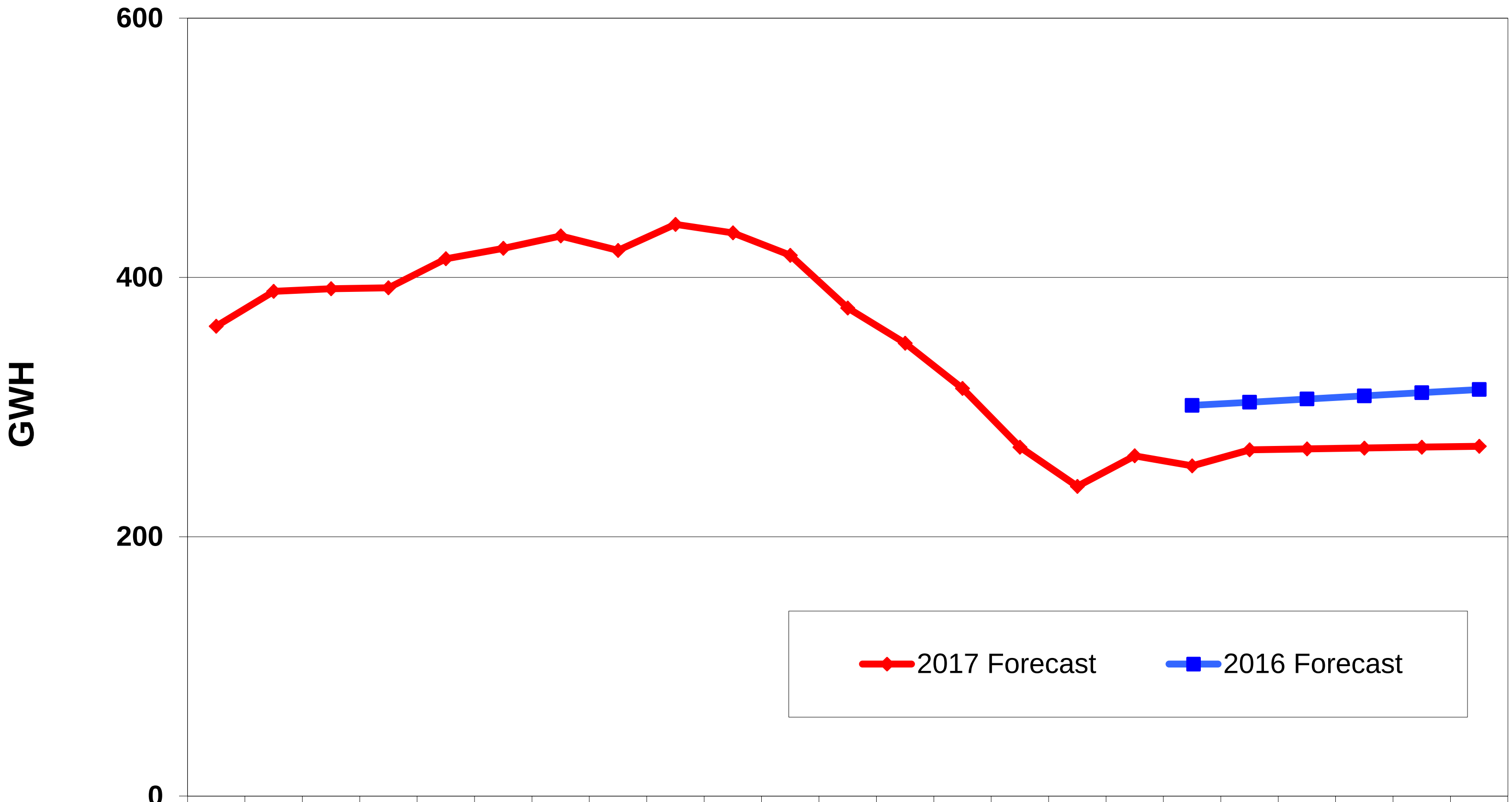
Industrial Sales
Employment Outlook

LA County Manufacturing Employment

- Model sensitive to absolute number of jobs.



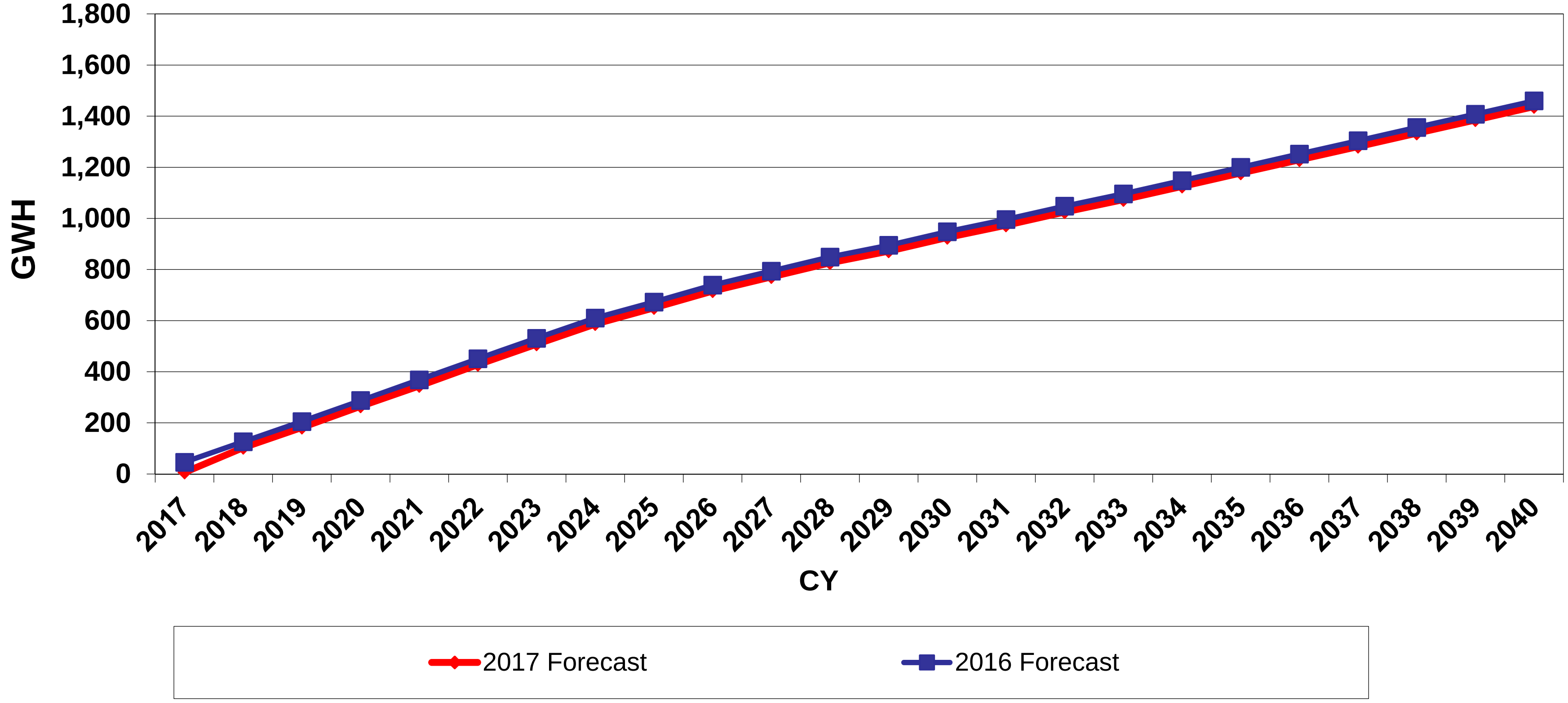
Miscellaneous Sales



	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
2017 Forecast	362	389	391	392	414	423	432	421	441	434	417	376	349	314	269	239	262	255	267	268	268	269	270
2016 Forecast																		301	304	306	309	311	314

Electric Vehicles
Load Growth

- Using 2016 IRP EV forecast.
- Historical LADWP sales embedded in sector sales.
- Estimated Coincident Load Factor is 93%.



WHEREAS, State Senate Bill 350 (SB 350) became law on October 7, 2015, amending Senate Bill 2(1X) and increasing the Renewable Portfolio Standard (RPS) targets from 33 percent by 2020 to 50 percent by 2030; and

WHEREAS, SB 350 further establishes the goal of doubling energy efficiency of buildings and conservation of electricity and natural gas end uses by 2030; and

WHEREAS, by January 1, 2019, SB 350 requires Publicly Owned Utilities (POUs) with an average load of greater than 700 gigawatt-hours to adopt an Integrated Resource Plan (IRP) by its Board and submit the IRP to the California Energy Commission (CEC) with an update once every five years; and

WHEREAS, the Los Angeles Department of Water and Power's (LADWP) Strategic Long-Term Resource Plan (SLTRP) was approved by the General Manager on May 2, 2018; and

WHEREAS, the 2017 IRP is based on the approved 2017 SLTRP recommended case scenario, which incorporates 55 percent RPS by 2030, doubling of energy efficiency through 2027, and doubling of transportation electrification goals; and

WHEREAS, LADWP is required to file and submit to the CEC its 2017 IRP by April 30, 2019.

NOW, THEREFORE, BE IT RESOLVED that the Board of Water and Power Commissioners (Board) of the City of Los Angeles hereby adopts the 2017 IRP, pursuant to SB 350.

BE IT FURTHER RESOLVED that the Board of Water and Power Commissioners has determined that that adoption of the 2017 IRP is exempt from the California Environmental Quality Act (CEQA) pursuant to CEQA Section 15061(b)(3).

BE IT FURTHER RESOLVED that LADWP shall file its 2017 IRP to the CEC by April 30, 2019.

BE IT FURTHER RESOLVED that LADWP shall report back to this Board in 2022, for the Board to reevaluate and approve the next IRP update for CEC submittal.

I HEREBY CERTIFY that the foregoing is a full, true, and correct copy of a resolution adopted by the Board of Water and Power Commissioners of the City of Los Angeles at its meeting held on NOV 2 7 2018

Barbara E. Moschos

Secretary

APPROVED AS TO FORM AND LEGALITY
MICHAEL N. FEUER, CITY ATTORNEY

AUG 1 0 2018

BY

WILLIAM R. KYSELLA, JR.
DEPUTY CITY ATTORNEY