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LOS ANGELES DEPARTMENT OF WATER AND POWER

ELECTRICITY DEMAND FORECAST FORMS 4 AND 6

CALIFORNIA ENERGY COMMISSION

2019 INTEGRATED ENERGY POLICY REPORT

DOCKET NUMBER 19-IEPR-03

APRIL 15, 2019

Los Angeles Department of Water & Power

CUSTOMERS FIRST

FORM 4

DEMAND FORECAST METHOD AND MODELS

2019 INTEGRATED ENERGY POLICY REPORT

DOCKET NUMBER 19-IEPR-03

LADWP Load Forecast Methodology

Electric Demand and Sales Forecast

LOAD FORECASTING GROUP

Contents

Overview

The Retail Sales and Demand Forecast (Forecast) is a long-run projection of electrical energy consumption, peak demands and energy production in the City of Los Angeles and Owens Valley.

Signature Authority

The General Manager, the Chief Operating Officer, Power System and the Chief Financial Officer have final signature authority on the Retail Sales and Peak Demand Forecast (Forecast).

Schedule

The signed Forecast is typically published once a year in the Spring. It includes actual data through December of the previous calendar year. Management reserves the right to revise and publish a new signed Forecast at any time. Forecasts are subject to the phenomenon of displacement. A displacement is an external shock to a system pushing the System off its current trends and establishing new relationships among variables. Two historic displacements for LADWP were the Northridge earthquake and the California Energy Crisis. Displacements can also be policy-driven. The adoption of a new Energy Efficiency strategy is an example of a policy-driven displacement. After a displacement, Management may request the development a new Forecast.

Peer Review

The Load Forecasting group has developed a forecast peer review group based on previous audit recommendations. The Peer Review Group includes the principal users of the Forecast within LADWP. The main goal of the Peer Review Process is to evaluate the Forecast inputs and outputs for accuracy and usefulness. The Forecasting Group presents its assumptions before a subject matter expert panel and builds consensus for the assumptions. The other major objective to the Peer Review Process is to review the reasonableness of the Forecast. End users make good reviewers because they understand how change in the forecast can affect their perspective areas of operations. Criticism of the Forecast can be communicated either directly to the Load Forecast group or through management channels. Out of the Peer Review Process evolves the final forecast for senior management to review and sign.

End Users

The signed Forecast is distributed throughout LADWP and the Power System. Primary internal users include:

- Financial Planning & Scenario Development – Revenue forecast and Fuel Budget
- Integrated Resource Planning
- Distribution Planning
- Transmission Planning
- Environment and Efficiency
- Wholesale Marketing and Planning

Externally, the forecast is required to be sent either annually or biannually to:

- Energy Information Agency
- California Energy Commission
- Western Electric Coordinating Council

Population Forecast

Data Sources

Primary

State of California, Department of Finance

Background

- US Census
- US Census American Community Survey
- UCLA Anderson Forecast
- Southern California Association of Governments
- City of Los Angeles Documents

Methodology

LADWP ties its population projections to the State of California, Department of Finance, Population Projections for California and Its Counties 2010-2060, Sacramento, California, December 2014 commonly known as the P-1 report.

The P-1 report is at the County level and LADWP needs to make adjustments to capture the service area which City of Los Angeles only. The methodology used to make the adjustments is ratio analysis. To estimate the ratios LADWP uses the State of California, Department of Finance, E-5 Population and Housing Estimates for Cities, Counties and the State, 2011-2013, with 2010 Benchmark, Sacramento, California, May 2014 commonly known as the E-5 report.

Historically, it is noted that the ratio between Los Angeles City and Los Angeles County population is not constant and at different times the ratio is either decreasing or increasing. Two simplifying assumptions are made to create the forecast. First assumption is that current change rate in ratio will persist sometime into the future. Second assumption is that in the long-run City population will grow at the same rate as County or that the ratio between the two will be a constant.

Economic Forecast

Data Sources

Primary

- UCLA Anderson Forecast
- State of California, Economic Development Department, Labor Market Information
- State of California, Department of Finance, Demographic Unit
- McGraw-Hill Construction Forecast

Background

- US Census American Community Survey
- Los Angeles Economic Development Council (LAEDC)
- Real Estate Research Council
- Barrons, BusinessWeek, The Economist and other Business Journals

City of Los Angeles - Los Angeles County Data

Economic data is commonly aggregated at the Metropolitan Statistical Area (MSA). The current local MSA includes both Los Angeles and Orange counties. Before 2004, the MSA included only Los Angeles County. Fortunately, Los Angeles County is a large enough entity that numbers are still being reported at the County level.

The LADWP service includes only the City of Los Angeles and Owens Valley. Since Owens Valley is a slow growth area, LADWP forecasts Owens Valley as a separate sales class. The problem then is to apportion economic growth between City of Los Angeles and the rest of Los Angeles County.

The basic technique is to trend a ratio of an economic or demographic variable between city and county.

The naïve approach is to assume that the City and County are growing at the same rates. This is the constant trend approach. In the absence of better information this is the assumption used.

Employment Forecast

The basis for the forecast is the UCLA Anderson Forecast Los Angeles County Forecast. For employment, LADWP assumes a constant share of Los Angeles County employment. We have attempted to forecast City employment only but found the time series to be too erratic to make definitive conclusions. UCLA Anderson's employment forecast is seasonally adjusted. However in the LADWP sales forecast we want to capture seasonal effects. Therefore we use non-seasonally adjusted data historical data from the EDD and preserve the seasonally influences by using UCLA Anderson YOY employment growth rates rather than the actual forecast itself.

Higher detail data is available if needed but employment forecasts are developed for the following industry sector 2-digit NAICS codes:

- Natural Resources
- Construction
- Manufacturing
- Trade, Retail and Utilities
- Information
- Finance
- Professional
- Education & Health
- Leisure & Hospitality
- Other
- Government

Real Personal Income Forecast

The basis for the forecast is the UCLA Anderson Forecast. LADWP assumes that Real Personal Income in the service areas will grow as a constant share of Los Angeles County personal income. We acknowledge that incomes within the City are below that of the County.

Housing Forecast

The State of California Demographic Unit E-5 report is used to benchmark the time series. The data is available annually. To convert it to months, we use linear extrapolation.

To forecast housing supply, City of Los Angeles building permits are trended against the McGraw-Hill Construction history and forecast. These time series trends are developed for both single-family and multi-family. Since 2001, multi-family units are being built at a far faster rate than single family housing at an approximate 3 to 1 rate. The McGraw-Hill forecast is a five-year forecast and is a construction forecast reflecting the supply of new housing coming on-line. Beyond five years, at the long-term average rate.

Commercial Floorspace

To forecast commercial floorspace, City of Los Angeles data is trended against the McGraw-Hill Construction history and forecasts. Time series data is developed for the following sectors:

- Office
- Retail
- Warehouse
- Health
- Hotels
- Education
- Miscellaneous

The McGraw-Hill forecast is a five-year forecast and is a construction forecast reflecting the supply of new commercial floorspace coming on-line. After five years, in the absence of better knowledge such as a school build out plan, we assume that commercial floorspace will grow at its long-term average.

Electric Prices

Data Sources

- Analysis of Consumption & Earnings
- LADWP Financial Planning Unit
- UCLA Anderson Forecast

Methodology

LADWP uses Revenue divided by Retail Sales as its electric prices metric. Economic theory says that customers will react to marginal costs rather than average costs. To establish marginal costs at the macro level is highly difficult so most in the industry use the average cost method. The biggest distortion will lie in the time-of-use rates. Electricity, however, is a derived demand from mostly staple goods so it is considered relatively inelastic. LADWP measures elasticity below 0.25 in all our sectors. The problem is not considered great as real electric price increases are typically modest over time.

The electric price forecast through the budget period is developed by the Financial Planning group. After the budget period, the nominal prices are assumed to grow at the inflation rate. The nominal electric prices are deflated to create real electric prices

The fact that after the budget period LADWP increases nominal prices at the inflation rate means that long-term real electric prices are constant and there is no long-term price elasticity effect in the Forecast. For the residential sector, CPI is used as the deflator. For commercial and industrial, a broader statewide deflator based on Gross State Product is used.

LADWP incorporates the Utility Tax into the electric price for purposes of the modeling. The reason is that the tax is included on what the customer pays. The overall rate of the utility tax for a customer class can change over time. A major change occurred in the Residential sector when 60,000 low-income customers were removed off the low income rate as a result of an audit. Customers qualifying for the low-income rate are forgiven the utility tax. To forecast utility tax rates, LADWP uses long-term trends in the absence of any specific know information.

Weather Normalization and Billing Days

Data Sources

- National Weather Service using Schneider as the consolidator
- Pierce College Weather Station
- Billing Cycle Schedule

Methodology

LADWP collects weather from 6 weather stations – Civic Center, Hawthorne, LAX, Burbank, Van Nuys and Woodland Hills. Woodland Hills is a non-automated station run by Pierce College. We have a long history of Woodland Hill's data that we have manually collected. It is considered more representative of Valley weather since it is closer to the floor of the Valley then either Burbank or Van Nuys.

In 1998, Title 20 divided the City of Los Angeles into three climate zones where previous it had only been two. Typically, LADWP uses Civic Center, Woodland Hills and LAX to represent the three zones.

For customers billed monthly, LADWP reads meters on a 21 meter read day cycle. For bimonthly customers, it is a 42 meter read day cycle. To successfully model sales, you need to measure weather by revenue month. To make this measurement, we sum Cooling Degree Days (CDD) and Heating Degree Days (HDD) for each billing cycle. The CDD and HDD are then summed for all the billing cycles in the revenue month.

The number of days in a revenue month will vary depending on number of work days it takes to do a full 21 day billing cycle. The days in the billing cycle are counted in similar manner to the CDD and HDD. The days in each billing cycle are added to give total billing days in the revenue month.

In some models, LADWP uses average billing rather than total billing days. To find average, you divide by the number of billing cycles (21 for monthly bills and 42 for bimonthly bills).

Electric Sales

Data Sources

- Analysis of Consumption and Earnings RP77
- Banner Report
- Traffic Control Estimate
- Power System Consumption and Earning Monthly Summary
- CCB Reporting

Methodology

Total Sales to Retail Customers is the base unit from which we forecast. Total Sales to Retail Customers is divided into six customer classes:

- Residential
- Commercial
- Industrial
- Intradepartmental Sales
- Streetlight
- Owens Valley

The Forecasted customer classes are slightly different than reported by General Accounting but every month the Forecast Group reconciles its total sales number to the Power System Consumption and Earning (C&E) Monthly Summary report.

In September 2013 LADWP implemented a change in its billing system from a mainframe based system to an Oracle based architecture called Customer Contact & Billing (CCB). The new C&E report (CMR095_RPT) initially made available in February 2015 classifies sales by the following customer categories:

- Residential
- Apartment
- Commercial
- Industrial
- Municipal
- Government

In March 2015, Load Forecasting mapped all the sales to the old classification in order to continue the consistency in the long-term forecast until there is at least five years of sales data available in the new classifications. The largest difference is in common area apartment bills. General Accounting categorizes this load as commercial whereas the load is put into residential for forecasting purposes.

Forecasting also treats Owens Valley sales as separate class although in reality it includes Residential, Commercial, Industrial, Intradepartmental and Streetlight sales. The load is small and not growing very fast so to develop a separate model does not meet a cost benefit test. Sales are reported in revenue month not calendar month.

Net Energy for Load (NEL) and Losses

Data Sources

Power System Wholesale Energy Reconciliation Management Database

Methodology

Hourly NEL data is reported by the Wholesale Energy Reconciliation Documentation group at the Energy Control Center.

Monthly NEL is a calendar month rather than a revenue month.

Losses are defined NEL minus Total Sales to Ultimate Customers.

Losses from the Load Forecasting perspective include not only the engineering losses associated with the transport and transformation of power but also include Purpose of Enterprise Sales, Energy Theft and energy accruals associated with the billing cycle.

Retail Sales Models

Tools

- Metrix ND Software
- Forecast Manager

References

- Forecasting in Business and Economics by C.W.J. Granger
- Statistics for Economists by Ralph E. Beals
- Metrix ND Software Manual

Methodology

The Retail Sales Models are primarily econometric models using Ordinary Least Squares (OLS) Regression techniques. OLS Regression is a common technique. The methodology can be found in many texts.

Load Forecast uses Metrix ND software developed and owned by Itron. . The Metrix ND software was developed with the Power Industry sales forecasting groups as its target market. It performs OLS modeling and has other techniques available such as ARIMA models and Neural Networks. It is fully compatible with Window-type software which makes data manipulation easier. It produces a full set of statistics necessary for validating econometric models. Full documentation on use of the software is available on-line and in on-site user manuals.

Residential Model Specification

Variable	Coef	StdErr	T-Stat	P-Value	Definition
CONST	-281.465	67.477	-4.171	0.01%	Constant term
ForecastVariables.Res_Billing_Days	10.429	0.807	12.925	0.00%	Total Billing Days/Number of Billing Cycles
ForecastVariables.Res_HDD	0.224	0.012	18.632	0.00%	Total Cooling Degree Days/Number of Billing Cycles
ForecastVariables.Res_CDD	0.367	0.011	33.578	0.00%	Total Heating Degree Days/Number of Billing Cycles
NRG_Economics.YPR_LA	0.342	0.094	3.644	0.04%	Real Personal Income in LA County
EPrice2014.EPriceRes96	-781.569	167.061	-4.678	0.00%	Real Average Price - Cents / kWh

Model Statistics	
Iterations	1
Adjusted Observations	164
Deg. of Freedom for Error	158
R-Squared	0.915
Adjusted R-Squared	0.912
AIC	5.705
BIC	5.818
F-Statistic	340.715
Prob (F-Statistic)	0.0000
Log-Likelihood	-694.52
Model Sum of Squares	493,683.79
Sum of Squared Errors	45,787.20
Mean Squared Error	289.79
Std. Error of Regression	17.02
Mean Abs. Dev. (MAD)	13.44
Mean Abs. % Err. (MAPE)	2.65%
Durbin-Watson Statistic	1.965

The dependent variable in this equation is sales per occupied household. To get the sales forecast, multiply predicted sales per occupied household times the forecast for occupied households.

Commercial Model Specification

Variable	Coef	StdErr	T-Stat	P-Value	Definition
CONST	-0.540	0.176	-3.062	0.26%	Constant term
BillingDays.BDays	0.042	0.004	10.159	0.00%	Total Billing Days/Number of Billing Cycles
Weather_Variables.RevHDD	-0.000	0.000	-3.998	0.01%	Total Cooling Degree Days/Number of Billing Cycles
Weather_Variables.RevCDD	0.001	0.000	13.758	0.00%	Total Heating Degree Days/Number of Billing Cycles
EPriceCom_96.EPriceCom96	-1.799	0.415	-4.332	0.00%	Average Price per kWh
NRG_ECON.Ecom1kSqFt	0.199	0.017	11.763	0.00%	Employment in Commercial Services/000 Square Feet of Commercial Buildings

Model Statistics	
Iterations	1
Adjusted Observations	164
Deg. of Freedom for Error	158
R-Squared	0.855
Adjusted R-Squared	0.850
AIC	-5.804
BIC	-5.691
F-Statistic	186.443
Prob (F-Statistic)	0.0000
Log-Likelihood	249.22
Model Sum of Squares	2.71
Sum of Squared Errors	0.46
Mean Squared Error	0.00
Std. Error of Regression	0.05
Mean Abs. Dev. (MAD)	0.04
Mean Abs. % Err. (MAPE)	2.23%
Durbin-Watson Statistic	2.312

The dependent variable in this equation is sales per thousand square feet of commercial buildings floorspace. Other commercial sales (Transportation, Communications, Utilities and National Defense) are included in the commercial sales. To get the sales forecast, we multiply predicted sales per square foot times the forecast for commercial floorspace. HDD has an unexpected negative sign but the variable has minimal effect so it is left in the model for consistency.

Industrial Model Specification

Variable	Coef	StdErr	T-Stat	P-Value	Definition
CONST	107562.856	40439.524	2.660	0.87%	Constant term
BillingDays.BDays	1831.574	1188.102	1.542	12.54%	Total Billing Days/Number of Billing Cycles
Weather_Variables.RevCDD	81.450	17.142	4.751	0.00%	Total Cooling Degree Days/Number of Billing Cycles
Weather_Variables.RevHDD	11.849	19.078	0.621	53.55%	Total Heating Degree Days/Number of Billing Cycles
NRG_ECON.Manufacturing	0.199	0.016	12.435	0.00%	Employment in Manufacturing Sector
October_2013_Model.RPEI_96_MA3	-6316.372	1381.083	-4.573	0.00%	Average Price / kWh
Binary.April2001	91860.760	15534.282	5.913	0.00%	Dummy Variable to account for a billing adjustment
Binary.March2004	-39537.478	15379.746	-2.571	1.12%	Dummy Variable to account for a billing adjustment
Binary.April2004	39267.755	15403.110	2.549	1.18%	Dummy Variable to account for a billing adjustment
Binary.July2004	21721.114	15322.901	1.418	15.85%	Dummy Variable to account for a billing adjustment
Binary.November2003	42182.423	15272.069	2.762	0.65%	Dummy Variable to account for a billing adjustment
Binary.November2004	52625.184	15341.934	3.430	0.08%	Dummy Variable to account for a billing adjustment

Model Statistics	
Iterations	1
Adjusted Observations	156
Deg. of Freedom for Error	144
R-Squared	0.683
Adjusted R-Squared	0.659
AIC	19.332
BIC	19.566
F-Statistic	28.250
Prob (F-Statistic)	0.0000
Log-Likelihood	-1,717.23
Model Sum of Squares	71,785,505,958.11
Sum of Squared Errors	33,265,594,815.76
Mean Squared Error	231,011,075.11
Std. Error of Regression	15,199.05
Mean Abs. Dev. (MAD)	11,133.96
Mean Abs. % Err. (MAPE)	5.88%
Durbin-Watson Statistic	1.923

The independent variable is industrial sales. Many billing adjustments exist in the Industrial time series because of the size of customers and the number of special contracts.

Miscellaneous Sectors

Intradepartmental Model Specification

Variations in Intradepartmental sales are primarily related to amount of water pumping by the Water System. Water pumping is primarily related to rainfall. The Forecast is simply the long-term annual mean usage by the Water System. The long-term mean usage is 89 GWH per year. The annual average is allocated to the months based on historical patterns.

Streetlight Model Specification

Streetlight sales are not metered. The sales are estimated by counting the number of streetlight lamps on the system, using the energy rating of the lamps and assuming a load shape. The forecast is based on a simple time trend. The forecast is adjusted by the installation of LED lamps which is provided by the City of Los Angeles Department of Streetlights.

Owens Valley Model Specification

For forecasting purposes, all Owens Valley sales are rolled into a single class. It is a slow growth area. The forecast is a simple time trend. The sales are allocated to the months based on historical patterns. There was a significant shift upward in sales in 2005 due to a reclassification of load from Purpose of Enterprise consumption to Intradepartmental Sales.

Plug-in Hybrid Electric Vehicles

The Forecast is based on the California Energy Commission statewide forecast.

Energy Efficiency and Solar Roof Program Forecast

Forecasting energy efficiency saving is difficult because of the lack of measurement of historical savings. Historical energy efficiency savings are embedded in the historical sales numbers. When using econometric models to forecast, the implied assumption is that future relationships between endogenous and exogenous variables will be similar to past. In the absence of additional information, the most efficient, cost-effective forecast is the naïve forecast. The naive forecast is that the future period is simply equal to the last period's value. There is a problem applying the naïve forecast to energy efficiency since we know that the time series of energy efficiency installments is not stable. Therefore we modify the naive forecast to say the future period is equal to the average monthly installation of energy efficiency over the study period. For energy efficiency savings from building and appliance standards, technological change and push back, LADWP assumes the future will mirror the past. Thus the savings are implied and captured by the econometric models.

LADWP identified two areas where there is additional information on energy efficiency programs. They include LADWP energy efficiency programs and the impacts of the Huffman Bill.

To include the savings from LADWP programs in the Forecast, the technique is to find the incremental difference of the projected installations and the historical average installed. Projected installations are developed from an Energy Potential Study that is performed every three years. The Forecast only includes the first five years of projected installations which is tied to LADWP's budget cycle. Energy Efficiency installed beyond the budget cycle is considered a resource. The incremental difference is subtracted from the results of the econometric model. If projected energy efficiency installations are lower than average historical energy efficiency savings then sales will actually increase. This result is due to the implied underlying assumption that the energy efficiency savings being installed at the historical average rate. Energy efficiency savings are usually quoted as an annualized number so the annual savings need to be allocated to the months. Also we assume that energy efficiency savings will installed uniformly throughout the year.

The Huffman Bill refers to the new lighting standard that greatly increases the efficiency of light bulbs of disallows the sale of inefficient light bulbs. The Forecast relies on the energy savings estimated to occur due to Huffman from the 2013 Energy Potential Study. The technique for introducing the savings is the same. Actual savings from the Huffman Bill began in 2012. Since the Huffman Bill is a lighting program affecting the residential sector, the monthly allocation is different.

Month	Monthly Allocators
January	9.8%
February	8.8%
March	8.8%
April	8.8%
May	8.0%
June	7.0%
July	7.0%
August	7.0%
September	8.0%
October	8.0%
November	8.8%
December	10.0%

Solar Incentive Program Forecast

The forecast for the Solar Program follows the same technique as the energy efficiency program. Solar PV output is degraded at a 0.5% per year rate. The monthly allocators are as follows:

Month	Monthly Allocators
January	5.8%
February	6.9%
March	8.4%
April	9.8%
May	9.8%
June	9.8%
July	10.8%
August	10.4%
September	9.0%
October	7.6%
November	6.4%
December	5.5%

NEL Forecast

The NEL forecast is a function of the Retail Sales Forecast. In the long-run, the average Loss-to-NEL ratio is 12 percent. The 12 percent ratio is higher than most electric utilities due to the facts that LADWP operates two long range DC transmission lines and that power is transformed to 34.5 KV and 4.7 KV for retail delivery. To forecast annual NEL, we divide the annual Retail sales forecast by .885 to maintain the 11.5 loss ratio. Since sales are based on revenue month and NEL is based on calendar month, the annual NEL is distributed to the months based on historical patterns. The monthly allocators are in the following table. An adjustment is made for leap year.

Month	Monthly Allocators
January	8.1%
February	7.3%
March	8.0%
April	7.7%
May	8.2%
June	8.3%
July	9.5%
August	9.7%
September	8.9%
October	8.4%
November	7.8%
December	8.2%

Annual Peak Demand Forecast

LADWP assumes that the annual Peak Demand will occur on the fourth Thursday of August. Historically, 40 percent of all annual peaks have occurred between August 15 and September 7. The majority of the rest of the peaks have occurred in the summer months June, July and the first half of August. There have been two annual peak outliers - one each in April and in October.

The Peak Demand Forecast is built around a temperature response function. The function is non-linear because as daily temperatures increase the demand for electricity increases at a declining rate. The estimators in ordinary least square (OLS) regression are linear which does not fit with the non-linearity of the temperature response function so the spline method is used to estimate the function. In the spline method, the function is divided into segments. For each segment, we use the linear OLS techniques. The splines are spliced together to create the non-linear curve.

Variable	Coefficient	T-Stat	P-Value	Definition
Capped_Weather_No_humidity2.Weather_75	59.106	11.378	0.00%	Weighted Average Maximum Temperature >= 75 and < 80
Capped_Weather_No_humidity2.Weather_80	60.218	12.512	0.00%	Weighted Average Maximum Temperature >= 80 and < 85
Capped_Weather_No_humidity2.Weather_85	73.672	17.651	0.00%	Weighted Average Maximum Temperature >= 85 and < 90
Capped_Weather_No_humidity2.Weather_90	52.306	10.041	0.00%	Weighted Average Maximum Temperature >= 90 and < 95
Capped_Weather_No_humidity2.Weather_95	81.364	10.331	0.00%	Weighted Average Maximum Temperature >= 95 and < 100
Capped_Weather_No_humidity2.Weather_100	29.049	1.131	25.85%	Weighted Average Maximum Temperature >= 100 and < 105
Capped_Weather_No_humidity2.Weather_105	136.811	3.481	0.05%	Weighted Average Maximum Temperature >= 105 and < 110
Month_Variables.Jun	3364.294	152.368	0.00%	June Binary Weather-Insensitive Load
Month_Variables.Jul	3438.440	132.463	0.00%	July Binary Weather-Insensitive Load
Month_Variables.Aug	3445.980	133.793	0.00%	August Binary Weather-Insensitive Load
Month_Variables.Sep	3408.376	140.354	0.00%	September Binary Weather-Insensitive Load
Year_Variables.Year2002	-48.841	-2.214	2.71%	Economic Trend Adjustment to Weather Sensitive Load
Year_Variables.Year2003	57.460	2.376	1.77%	Economic Trend Adjustment to Weather Sensitive Load
Year_Variables.Year2004	125.974	5.726	0.00%	Economic Trend Adjustment to Weather Sensitive Load
Year_Variables.Year2005	21.307	0.977	32.87%	Economic Trend Adjustment to Weather Sensitive Load
Year_Variables.Year2006	78.191	3.442	0.06%	Economic Trend Adjustment to Weather Sensitive Load
Year_Variables.Year2007	146.691	6.615	0.00%	Economic Trend Adjustment to Weather Sensitive Load
Year_Variables.Year2008	295.827	13.266	0.00%	Economic Trend Adjustment to Weather Sensitive Load
Year_Variables.Year2009	155.423	7.102	0.00%	Economic Trend Adjustment to Weather Sensitive Load
Year_Variables.Year2010	-38.106	-1.731	8.39%	Economic Trend Adjustment to Weather Sensitive Load
Capped_Min_Temp.Min_Temp_60	66.254	18.103	0.00%	Weighted 3-Day Moving Average Minimum Temperature < 65
Capped_Min_Temp.Min_Temp_65	36.596	4.175	0.00%	Weighted 3-Day Moving Average Minimum Temperature >= 65 and <70
Capped_Min_Temp.Min_Temp_70	90.096	3.546	0.04%	Weighted 3-Day Moving Average Minimum Temperature >= 70 and <75

Model Statistics	
Iterations	1
Adjusted Observations	830
Deg. of Freedom for Error	807
R-Squared	0.939
Adjusted R-Squared	0.937
AIC	9.949
BIC	10.080
Log-Likelihood	-5,283.56
Model Sum of Squares	250,999,845.20
Sum of Squared Errors	16,436,460.23
Mean Squared Error	20,367.36
Std. Error of Regression	142.71
Mean Abs. Dev. (MAD)	101.16
Mean Abs. % Err. (MAPE)	2.36%

The temperature variable is a weighted average of Civic Center (50%), Woodland Hills (40%) and LAX (10%).

The dependent variable in the model is weekday peak demand. The maximum weekday daily demand occurs between 1500 and 1600 hours. Splines are created each 5 degrees of the temperature variable. The model only includes data for the months June through September. LADWP does not have a significant winter peak so we only model summer demands. The year variables adjust for sales growth. June and September tend to have lower weather response than July and August.

To find the peak demand, LADWP inputs historical annual peak day weather into the weather response model which gives us 49 observations of peak demand based on current year underlying electricity demand. From the 49 observations, the mean and standard deviation are calculated. The mean is considered to be the weather-normalized peak for the year on which the temperature response model is based. To forecast the peak demand, we input the mean peak day weather into the weather response function. To forecast peak demand, we grow the peak demand at the rate of NEL growth. This technique assumes all load growth will assume the current system shape. However we know that all new energy growth or energy savings is not load following. Therefore we make adjustments for known differences. Currently, these include adjustments for PHEV load growth, Huffman Bill energy efficiency savings and photovoltaic distributed generation growth.

LADWP also uses the weather response function to calculate the weather-sensitivity cases for peak demand. From the 49-year peak day observations, we calculate the mean and standard deviation. We assume the normal distribution based on the Central Tendency Theorem. Knowing the mean and the standard deviation means that we can calculate the expected peak for any probability using the inverse normal function. For example, the 1-in-10 case is where 90% of the time the peaks will fall below the expected peak based on the normal curve.

Monthly Peaks and Minimum Demands

The annual peak demand is forecasted to occur in August of each year. LADWP also forecasts peaks and minimum demands for each calendar month. The method is fairly simplistic. We calculate load factors for each month since 1980. The load factor is calculated separately for the maximum and minimum peak. For the historical load factors, we then calculate the mean load factor for each month for both the maximum and minimum. To calculate the forecasted peaks and minimum demands, we multiply the mean load factors times the forecasted NEL for that month. To check the work, trends are calculated and results are evaluated for reasonableness. Small adjustments may be made based on the analysis.

8760 Hour Forecast

The Energy Production models require that Load Forecast produce an hourly forecast. 8760 hours refers to the number of hours in the year not including leap years.

The LOADFARM algorithm is used to create the forecast. The LOADFARM documentation is available onsite.

There are four inputs into the LOADFARM algorithm:

- Monthly NEL
- Monthly Peak Demand
- Monthly Minimum Demand
- 8760 Load Shape

The load shape is created using a ranked average procedure. The ranked-average procedure preserves the extremities in the data better than would a simple average. We take a historical sample of annual load shapes. Currently the sample is from calendar year 2008 forward. The historical data is permutated so that all the peaks line up on the fourth Thursday in August. We average the NEL across the hours and assign each hour a rank 1 through 8760. This ranking creates an index. Next we rank each year in the study 1 through 8760 and average the NEL across the rankings. The ranked-average NEL is assigned its spot according to the index.

Los Angeles Department of Water & Power

CUSTOMERS FIRST

FORM 6

INCREMENTAL DEMAND-SIDE PROGRAM METHODOLOGY

2019 INTEGRATED ENERGY POLICY REPORT

DOCKET NUMBER 19-IEPR-03

Form 6 Uncommitted Demand-Side Program Methodology

Efficiency Program Costs and Impacts

Assembly Bill 2021 which became law in 2007 requires California Utilities to identify energy efficiency potential and establish annual efficiency targets that would result in the state meeting its energy efficiency goals. As mandated by the bill, LADWP is required to conduct an efficiency potential study every three years in order to establish and continuously update its efficiency goals and projections.

The results of the California Municipal Utilities Association (CMUA) Energy Efficiency Potential Forecasting Study conducted in 2016 by Navigant Consulting, Inc. (Navigant) eventually became the basis for the energy savings and projections as shown in this submittal. ***The same methodology used for the committed programs applies in determining the corresponding amounts of peak demand and energy saving impacts***.

APPENDIX D. LADWP DR POTENTIAL

This appendix presents a high-level, top-down assessment of DR potential in LADWP's service territory. The results presented in this appendix helped identify the program types and customer segments with the greatest DR potential for more detailed consideration in the program design and cost effectiveness efforts described elsewhere in this document. **These potential estimates represent approximate bounds of achievable DR potential before consideration of cost effectiveness, and are refined through more detailed bottom-up analysis presented in Appendix E.**

As part of this potential estimation, Navigant developed high-level estimates of DR program potential among LADWP customers in LADWP's key customer segments, including large CII (including institutional), small-medium CII, and residential. Using its DRSim™ potential model, Navigant estimated:

1. A range of feasible participation rates: for residential customers as a share of customer accounts, and for commercial as a share of peak load;
2. Savings per participant, either as a direct kW estimate or a share of customer peak load; and
3. Scenarios for potential MW of load reduction, both by customer segment and in aggregate.

The results of this analysis are graphically illustrated in the sections below to show the relative potential by segment and growth of DR by year.

In addition to this high-level analysis of all LADWP customers, Navigant also presents a more detailed look at LADWP's Premier Accounts customers and the magnitude of potential peak demand reduction available through DR program deployment targeted at LADWP's largest customers.

The remainder of this appendix contains the following components:

- Discussion of the analysis methodology and key assumptions, including the program categories and scenarios assessed, key input assumptions, and overview of the Premier Accounts analysis.
- Presentation of the analysis findings for both the DRSim potential model and the Premier Accounts analysis.

D.1 METHODOLOGY AND KEY ASSUMPTIONS

Navigant conducted this potential analysis using its Demand Response Simulator (DRSim™) model. This model is designed to identify the critical component variables of peak demand impact and the appropriate population of potential participants. Navigant mirrored the model's approach after the methodology that the Federal Energy Regulatory Commission (FERC) used in its *National Assessment of Demand Response Potential*[14] (NADR), with a number of customizations added to specifically tailor the framework and inputs to LADWP.

Where possible, the analysis used inputs specific to LADWP, gathered through personal communications and interviews with LADWP staff, data request responses from LADWP, and publicly available LADWP resources. Other resources referenced or incorporated included the Global Energy Partners potential study,[15] UCLA Luskin LA EV Market report,[16] EIA-826 data,[17] FERC's 2012 DR survey results,[18] and FERC's NADR.[19] In

[14] Federal Energy Regulatory Commission, *A National Assessment of Demand Response Potential*. Prepared by The Brattle Group, June 2009.

[15] "Los Angeles Department of Water and Power Energy Efficiency and Demand Response Potential Study." Published by Global Energy Partners. February 2011 (Revised September 2011).

[16] UCLA Luskin School of Public Affairs, *Realizing the Potential of the Los Angeles Electric Vehicle Market*, May 2011.

[17] U.S. Department of Energy, Energy Information Administration, "Monthly Electric Utility Sales and Revenue Report with State Distributions," Form EIA-826, Released July 23, 2013.

addition to leveraging NADR to inform the model approach, Navigant also used FERC's study as a benchmark for the model's output and to provide model participation and peak demand reduction.

D.1.1 Program Categories

As noted above, this analysis was intended to indicate which types of DR programs would be most beneficial for LADWP to pursue, with the later selection of specific programs and more detailed program design based on these initial, high-level findings. This potential analysis considered the following broad categories of DR programs, as defined below:[20]

- **Interruptible/curtailable load:** Customers agree to reduce consumption to a pre-specified level, or by a pre-specified amount, in return for an incentive payment. The programs are generally only available for medium and large commercial, institutional, and industrial customers.
- **Direct load control (DLC):** Customer end uses are directly controlled by the utility and are shut down or moved to a lower consumption level during DR events. An air conditioning DLC program is modeled for mass market (residential and small commercial) customers. Direct control of other end uses, such as pool pumps, was not included.
- **Dynamic pricing with manual load control:** Dynamic pricing refers to the family of rates that offer customers time-varying electricity prices on a day-ahead or real-time basis. The rates are dynamic in the sense that prices change in response to events such as high-priced hours, unexpectedly hot days, or reliability conditions. Customers respond to the higher peak prices by manually curtailing various end-uses. Examples of dynamic rates include critical peak pricing, peak time rebates, and real-time pricing. The analysis assumes that advanced metering infrastructure (AMI) must be in place to offer any of these rates.
- **Dynamic pricing with automated load control:** This program is similar to the previously described dynamic pricing program, but customers are also equipped with devices that automatically reduce consumption during high priced hours. For residential and small and medium commercial and industrial customers, the automated technology (known as a programmable communicating thermostat (PCT)) adjusts air conditioning energy use where such devices are determined to be cost-effective. Large commercial and industrial customers are assumed to be equipped with automated demand response (Auto DR) systems, which coordinate reductions at multiple end-uses within the facility.
- **Time of Use (TOU):** Customers on TOU rates pay a different rate for low and high season as well as base, low peak, and high peak periods. TOU rates are considered "static" rates and distinct from dynamic pricing, in that TOU prices are predetermined by the rate schedule and do not change in response to system conditions. This program category represents an extension of LADWP's current TOU rates to mass market customers.
- **EV Service Rider:** This program category represents the potential for growth in LADWP's existing dispatchable DR program for plug-in electric vehicles (EV).

There are also other types of DR programs that are typically offered through third party aggregators and primarily available to medium and large commercial and industrial customers, such as capacity bidding, demand bidding, and other offerings. These other DR programs were not investigated as part of this initial analysis in order to assess the DR potential at LADWP without extensive use of third party aggregators.

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[18] Federal Energy Regulatory Commission, *2012 Survey on Demand Response and Advanced Metering*. Demand Response Survey Data, December 2012.

[19] Federal Energy Regulatory Commission, *A National Assessment of Demand Response Potential*. Prepared by The Brattle Group, June 2009. "National Demand Response Potential Model Guide", prepared for FERC, June 2009.

[20] Definitions for TOU and EV based on LADWP's existing programs. Other definitions based on Federal Energy Regulatory Commission, *A National Assessment of Demand Response Potential*. Prepared by The Brattle Group, June 2009.

D.1.2 Model Scenarios

To capture a range of potential DR impacts, Navigant assumed three scenarios: Basic, Moderate, and High, as follows and described more in Table D-1 below:

- **Basic –** Reflects the most easily achievable DR potential, requiring the fewest changes in LADWP's existing business processes, rates, and system architecture. This suggests a continuation of existing load curtailment rates with little modification and the introduction of a residential air conditioning load control program and a commercial/industrial curtailment incentive for large customers.
- **Moderate –** Increased marketing and incentives, completion of planned AMI rollout, and expansion of DR offerings including optional dynamic pricing.
- **High –** Assumes a full AMI rollout with integration of billing and meter reading, as well as an aggressive internal effort to promote DR with increased marketing and incentives, opt-out dynamic rates, and increased partnerships.

Table D-1: Key Scenario Drivers

Drivers		Basic	Moderate	High
Program Portfolio and Implementation Strategy		Continuation of existing rates, and introduction of simple residential and commercial programs	Increased marketing, education, and outreach for DR programs Moderately higher incentive levels	High priority placed on full-scale DR deployment, with conducive policies in place Accelerated deployment of DR programs
Meter Deployment**	**TOU**	Sufficient TOU deployment to support limited TOU rates	Same as Basic	Conversion of existing TOU meters to AMI
	AMI	Completion of planned AMI rollout, with no additional system integration or AMI installations	Completion of planned AMI rollout, with system integration and no additional AMI installations	Full AMI rollout to all customers, with billing and automated meter reading capabilities
Programs	**Interruptible/ Curtailable Load**	Minor modifications to existing interruptible rates,[21] plus new curtailable load program for medium and large CII customers	Same as Basic, with more significant modifications to existing interruptible rates	Same as Basic, with more significant modifications to existing interruptible rates
	Direct Load Control	New program for residential and small commercial customers with central A/C[22]	Same as Basic	Same as Basic
	Dynamic Pricing w/ manual & automated load control	None	Opt-in program for customers with AMI	Opt-out program for all customers
	Time of Use	No modifications to existing rates	Minor modifications to existing rates	More significant modifications to existing rates
	EV Service Rider	No modifications to existing program	Minor modifications to existing rates or available EV discounts[23]	More significant modifications to existing rates or available EV discounts[23]

** The drivers and program types presented in this table represent likely drivers and program types, based on discussions and data received from LADWP at the time of this analysis. These assumptions do not necessarily reflect the assumptions made in the program design and cost effectiveness analyses.*

*** Only applicable to mass market customers It is assumed that most non-residential customers with demand >30 kW already have an interval meter capable of supporting TOU or dynamic pricing.*

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[21] XRT is included as an interruptible rate for the purposes of this analysis. Later assessment of LADWP's rates suggests this rate has elements of an interruptible rate, but is actually closer to a dynamic pricing tariff (see Task 4).

[22] This analysis focuses on central A/C, although subsequent analysis for the proposed DR portfolio also considers other common load types for direct load control, such as room A/C and pool pumps.

[23] Modifications could include altering either the underlying TOU rate for participants in the EV Service Rider program or the discount offered to customers with EVs who are not on the Rider to increase the attractiveness of the Rider. These recommendations are discussed in more detail in Task 4 (assessment of LADWP's rates).

D.1.3 Input Assumptions

The table below presents the inputs used in the DRSim model to estimate the range of DR potential in LADWP's service territory, with more discussion on the key inputs below Table D-2.

Table D-2: Inputs for DRSim Potential Analysis

Input		Notes/Source
Number of Customers		Number of existing customers by rate class from "Monthly Rate Class Customers1.mdb," provided by LADWP. Customer growth forecast based on LADWP's 2013 Retail Electric Sales and Demand Forecast.
Peak Demand Forecast		System forecast from LADWP's 2013 Retail Electric Sales and Demand Forecast. Demand by rate class based on LADWP's Power System Rates Proposal FY13-14.
Eligibility Requirements *(percentage of customers with end uses or installed equipment required for participation)*	**Central Air Conditioning (CAC)**	**Required for participation in DLC and dynamic pricing with automated load control.**[24] Residential and small commercial CAC penetration (with small commercial based on penetration of CAC for all commercial customers) from Global Energy Partners potential study.
	TOU Meters	**Required for participation in TOU.** Number of existing meters based on interview with LADWP's Smart Grid and AMI group, May 29, 2013. Meter growth forecast based on scenario definitions.
	AMI Meters	**Required for participation in dynamic pricing.** Number of existing meters based on interview with LADWP's Smart Grid and AMI group, May 29, 2013. Meter growth forecast based on scenario definitions.
	Electric Vehicles (EV)	**Required for participation in EV Service Rider.** Based on data request responses provided by LADWP and UCLA Luskin LA EV Market report.
Program Start Year and Ramp Rate		Based on scenario definitions.
Existing DR Program Participation		Based on "Monthly Rate Class Customers1.mdb," data request responses, and other information provided by LADWP.
Maximum DR Program Participation		See below.
Peak Load Reduction Impacts		See below.

[24] This analysis focuses on central A/C, although subsequent analysis for the proposed DR portfolio also considers other common load types for direct load control, such as room A/C and pool pumps.

This analysis considers each input in Table D-2 across the scenarios and program categories discussed above, as well as key customer segments, including:

- Residential – customers on a residential tariff
- Small CII – non-residential customers with <30 kW peak demand
- Medium CII – non-residential customers with 30-200 kW peak demand
- Large CII – non-residential customers with >200 kW peak demand

Eligibility Requirements

As noted above, some program categories require certain types of end uses or installed equipment for customers to participate, which are referred to here as *eligibility requirements*. Examples of this include dynamic pricing, which requires that the customer have an enabled AMI meter to participate, or the load control programs like DLC and dynamic pricing with load control, which require that mass market customers have central air conditioning (CAC) to participate.

As a result, a key driver within the model for residential customer DR contribution is the percentage of residential customers with central A/C, which is assumed to be 47 percent.[25] Other customer end uses, such as heat pumps and pool pumps, are also appropriate for participation in a direct load control program; however, participation with these end uses is less common and was not included in this initial analysis.

Maximum DR Program Participation

Table D-3 below shows the maximum participation assumed for each program, scenario, and customer segment. These assumptions represent the size of each DR program before scaling by the eligibility requirements noted above and adjusting to ensure dual-enrollment in DR programs is not double-counted.[26] For comparison, Table D-5 shows the participation rates used in the model after scaling and adjusting for these factors.

[25] Based on Global Energy Partners, Los Angeles Department of Water and Power Energy Efficiency and Demand Response Potential Study, Volume 1: Energy Efficiency Potential, February 2011 (Revised September 2011).

[26] For the purposes of this analysis, it is assumed that duel-enrollment in DR programs is not allowed. In other words, customers cannot participate in more than one DR program at a time. These maximum DR participation inputs are adjusted to ensure that only eligible customers are considered as participants and that dual-enrollment is not counted in the final participation numbers.

Table D-3: Maximum DR Program Participation Inputs[27]

	Program Category	Resid-ential	Small CII	Medium CII	Large CII	Percentage Basis*
Basic	Interruptible/ Curtailable Load			0.2%	20.2%	% of MW
	Direct Load Control	9.9%	0.6%			% of customers w/CAC
	Dynamic Pricing (manual)					
	Dynamic Pricing (automated)					
	Time of Use	3%	5%	**	**	% of customers[28]
	EV Service Rider	16.6%	1.7%	0.1%	0.0%	% of customers w/EV[29]
Moderate	Interruptible/Curtailable Load			1.7%	20.2%	% of MW
	Direct Load Control	25.0%	1.2%			% of customers w/CAC
	Dynamic Pricing (manual)	5%	5%	5%	5%	% of customers w/AMI
	Dynamic Pricing (automated)					
	Time of Use	10%	15%	**	**	% of customers[28]
	EV Service Rider	24.9%	2.5%	0.2%	0.0%	% of customers w/EV[29]
High	Interruptible/Curtailable Load			1.7%	20.2%	% of MW
	Direct Load Control	25.0%	1.2%			% of customers w/CAC
	Dynamic Pricing (manual)	75%	75%	60%	60%	% of customers w/AMI
	Dynamic Pricing (automated)	42.7%	42.7%	34.2%	34.2%	% of customers w/AMI & CAC***
	Time of Use	33%	33%	**	**	% of customers[28]
	EV Service Rider	33.2%	3.4%	0.3%	0.0%	% of customers w/EV[29]

** All inputs are a percentage of the MW or customers within a given customer segment. Assumed that dual-enrollment in DR programs is not allowed. These values represent the maximum participation of eligible customers before adjusting to ensure dual-enrollment is not counted.*

*** TOU rates for Medium and Large CII customers are already the default rate at LADWP and, thus, are not included in this analysis.*

**** Central air conditioning (CAC) only required for Residential and Small CII customers.*

[27] Source unless otherwise noted: Federal Energy Regulatory Commission, *A National Assessment of Demand Response Potential*. Prepared by The Brattle Group, June 2009.

[28] TOU (Basic and Moderate scenarios): Based on limited increases to participation in LADWP's existing TOU rates, which currently have less than 1 percent of Residential and less than 3 percent of Small CII customers enrolled. TOU (High scenario): Based on Federal Energy Regulatory Commission, *2012 Survey on Demand Response and Advanced Metering*. DR Survey Data for Salt River Project's residential customers on TOU, December 2012.

[29] EV Service Rider (Basic, Moderate, and High scenarios): Assumes 50 percent, 75 percent, and 100 percent of the current participation rate of L.A. EVs in LADWP's EV Service Rider, respectively.

Peak Load Reduction Impacts

The average amount of peak load that a given participant reduces through their participation in each program is shown in

Table D-4. For this preliminary analysis, the peak load reduction impacts are assumed to be the same as FERC's NADR assessment and the same across all scenarios, unless otherwise noted.

Table D-4: Peak Load Reduction Inputs[30]

Program Category	Residential	Small CII	Medium CII	Large CII	Units
Interruptible/Curtailable Load			100%	57%	% of participant's peak kW
Direct Load Control	0.5	2.8			kW/participant
Dynamic Pricing (manual)	35%	1%	17%	15%	% of participant's peak kW
Dynamic Pricing (automated)	48%	15%	14%	14%	% of participant's peak kW
Time of Use	6.7%[31]	1.0%	*	*	% of participant's peak kW
EV Service Rider[32]	0.7	0.7	0.7	0.7	kW/participant

** TOU rates for Medium and Large CII customers are already the default rate at LADWP and, thus, are not included in this analysis.*

D.1.4 Premier Accounts

Using the Premier Accounts database provided by LADWP, Navigant analyzed the monthly peak demand profile from LADWP's premier accounts to understand the quantity, size and type of facilities that are consuming the most power during LADWP's peak demand season. This database contains monthly information, dating back to January 2010, on monthly peak demand, energy consumption, rate class, NAICS industry type, and associated facilities for LADWP's largest customers.

Key steps in the Premier Accounts customer analysis presented in D.2 include:

- **Review of peak demand both by unique customer as well as unique service address** (where a service address is assumed, in most cases, to represent a single site or facility[33]). This dual approach addressed the fact that many premier Customer IDs have multiple (up to several hundred) different Account IDs and service addresses.

[30] Source unless otherwise noted: Federal Energy Regulatory Commission, *A National Assessment of Demand Response Potential*. Prepared by The Brattle Group, June 2009.

[31] TOU (Basic scenario): Conservative estimate of 1% peak reduction based on preliminary analysis of LADWP's existing TOU rate. TOU (Moderate scenario): 6.7% (shown) based on the average reduction reported for LADWP's R1B Residential Time-of-Use program in FERC 2012 AMI/DR survey data. TOU (High scenario): 7.3% average from Electric Power Research Institute, *Understanding Electric Utility Customers – Summary Report*, October 2012.

[32] Sources: LADWP data request response and Brittany Gibson and John Gartner, "Vehicle to Grid Technologies - V2G Applications for Demand Response, Vehicle to Building, Frequency Regulation, and Other Ancillary Services: Market Analysis and Forecasts," Pike Research, 2011.

[33] While it is possible that multiple facilities could exist at a single service address; in the absence of this information being available Navigant assumed that each service address represented a unique facility.

- **Calculation of peak demand at the customer or facility level** by summing the monthly peak demand from all meters within each group during the representative month of August 2012, which had the highest total demand from Premier Account customers out of all the months in 2012. When available, Navigant used the "High Peak kW" value for peak demand and "Base kW" otherwise.

D.2 FINDINGS

The next two sections present the results from the potential analysis Navigant conducted using its DRSim™ model, as well as the results from a more detailed analysis focused on LADWP's Premier Accounts customer data.

D.2.1 DRSim Results

The following figures show the DR potential estimated for LADWP's service territory between 2015 and 2026. Navigant estimates that by 2026, LADWP could achieve roughly 320 MW of peak demand reduction under the conditions presented in the Basic scenario (representing more than 5% of peak demand in 2026), and more than 950 MW of peak demand reduction under the High scenario (representing about 16% of peak demand).

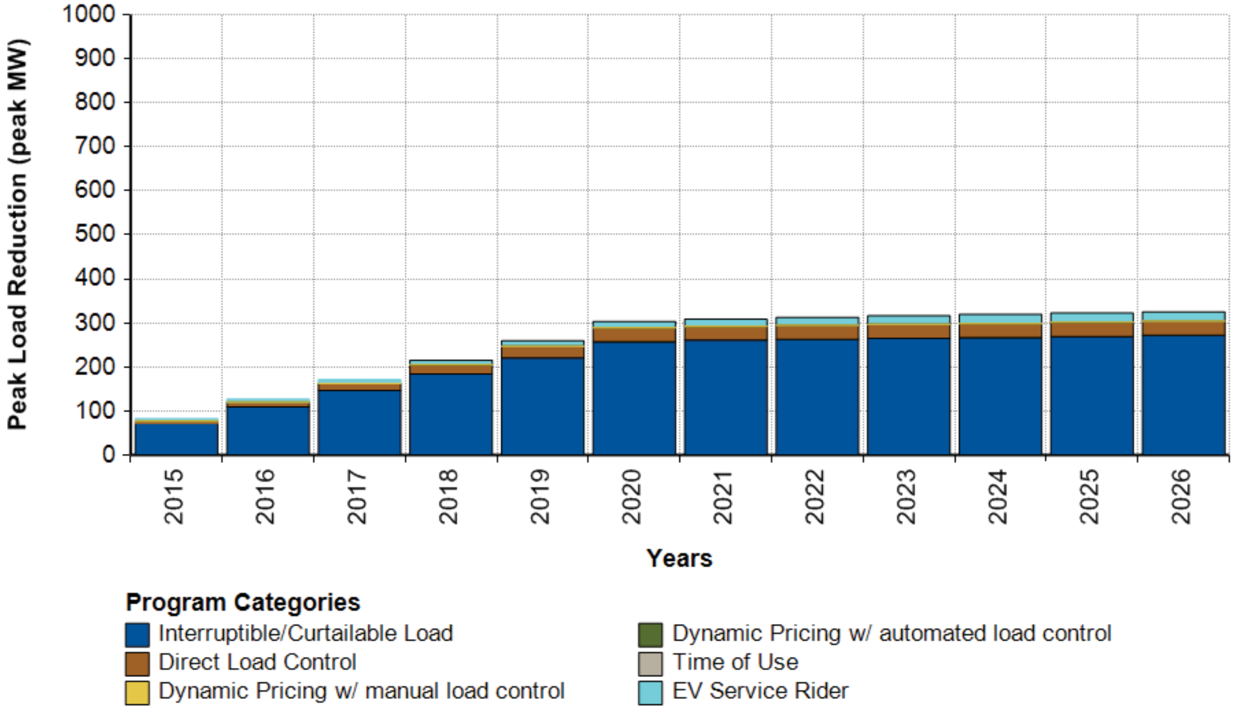
These scenarios are intended to account for a range of variable factors such as participation rates, incentive levels, curtailment as a share of facility peak demand, and level of investment by LADWP. One factor that is worth additional investigation is the participation rate of LADWP's very largest customers and the amount of load that they can shed. While a DR potential analysis must rely on informed estimates based on experience around the country, **a few large customers can significantly alter the achievable megawatts of DR capability.** For this reason, the DRSim™ results are followed by an analysis of the largest Premier Accounts. The potential from these accounts is large but uncertain, and the Customer Services staff may be able to advise Navigant of the nature of these loads and the likelihood of their participation in order to inform the final DR potential estimate.

It is important to note that these potential estimates **have not yet been screened for cost effectiveness** and should be viewed as the high end for potential in each scenario. The results presented here will help identify the program types and customer segments with the greatest DR potential for more detailed consideration in the program design and cost effectiveness efforts performed in Tasks 7 and 9.

Figure D-1 shows the potential estimated under the Basic scenario for each program type. As described in Table D-1 above, this scenario assumes the continuation of LADWP's existing programs, with the addition of a mass market DLC program[34] and a CII curtailable load program. This scenario also assumes a conservative program rollout, as well as conservative customer participation levels. Finally, insufficient AMI is deployed to support dynamic pricing, so limited TOU is the only pricing option for mass market customers.

[34] This preliminary analysis focused on central A/C, although the subsequent updates described in the final proposed portfolio also include other common load types for direct load control, such as room A/C and pool pumps.

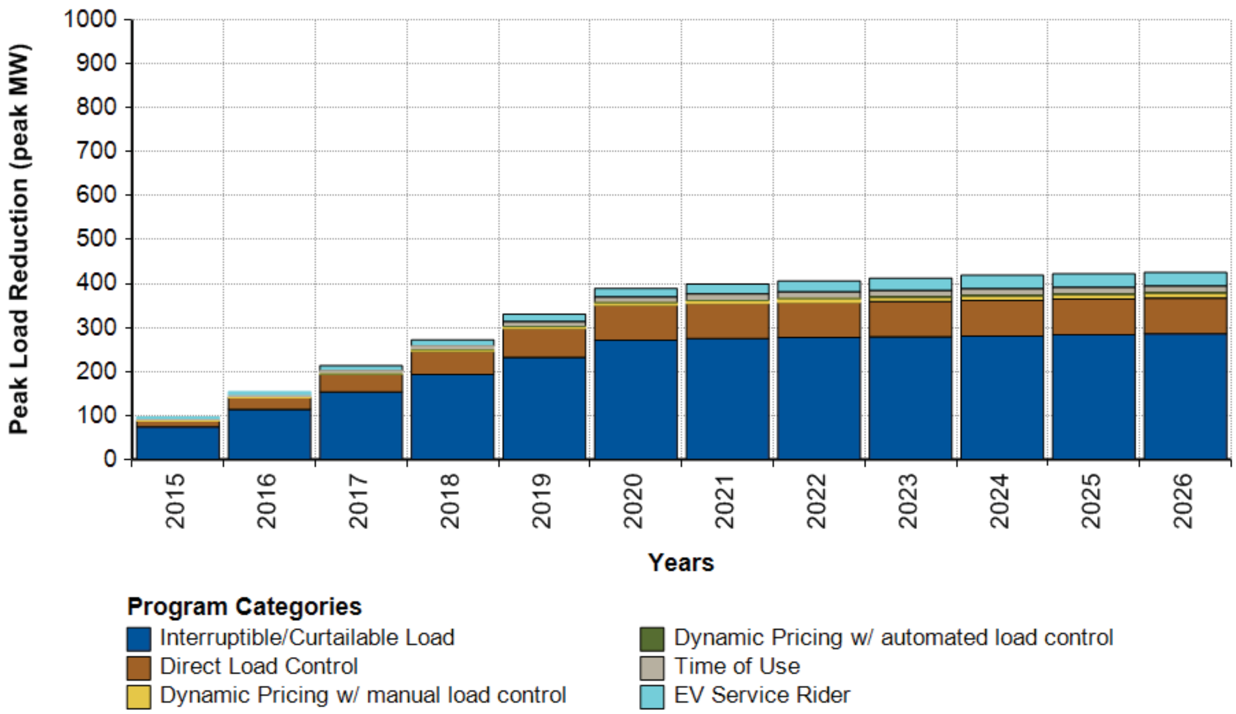
Figure D-1: LADWP Demand Response Potential – Basic Scenario*



** Results shown here represent the relative bounds of achievable DR potential for LADWP, and will be refined through more detailed bottom-up analysis during the program design and cost effectiveness tasks.*

The results for the Moderate scenario are presented below in Figure D-2. This scenario represents a reasonable forecast of DR penetration within LADWP's service territory, with the introduction of limited dynamic pricing rates, greater emphasis on increased direct load control participation, and a similar interruptible/curtailable load program rollout as in the Basic scenario. The total peak load reduction shown in this scenario is close to 430 MW by 2026.

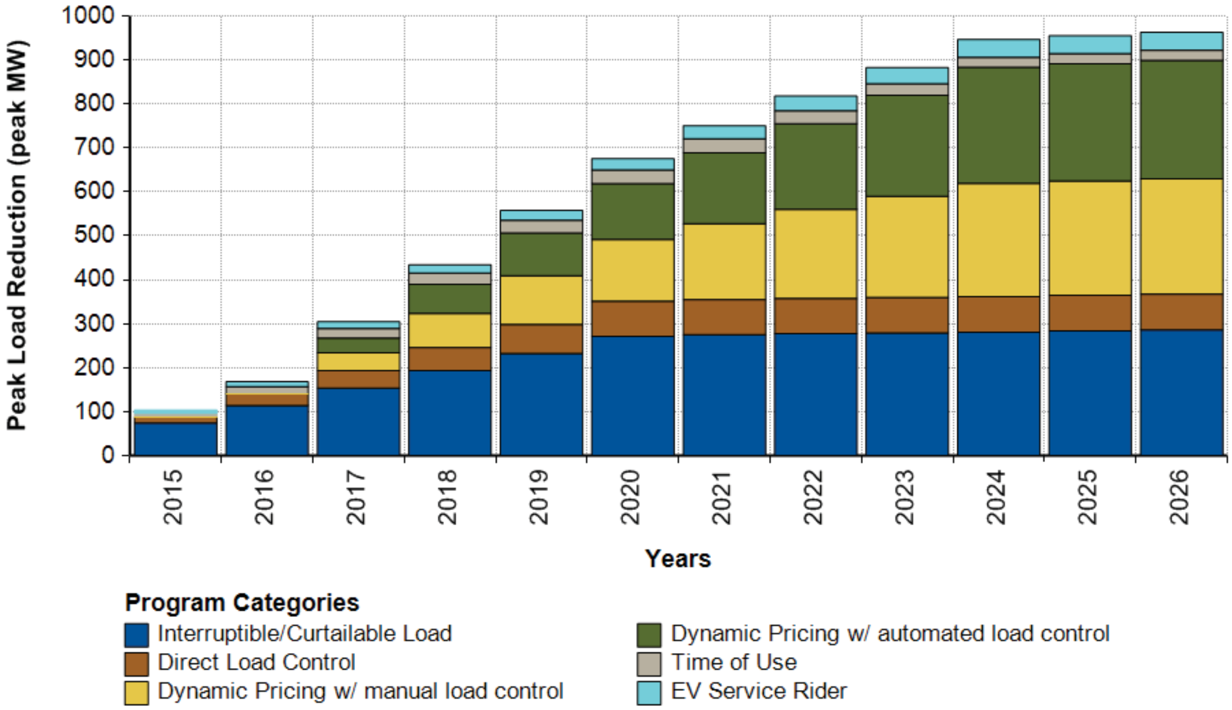
Figure D-2: LADWP Demand Response Potential – Moderate Scenario*



** Results shown here represent the relative bounds of achievable DR potential for LADWP, and will be refined through more detailed bottom-up analysis during the program design and cost effectiveness tasks.*

Figure D-3 shows the potential estimated under the High scenario for each program type. These results reflect a more aggressive DR portfolio with accelerated deployment due to Departmental support for DR, conducive policies for DR program growth, and widespread deployment of AMI meters assumed in this scenario. The drivers assumed in this scenario include higher DLC program participation rates due to higher incentives; opt-out dynamic pricing as the default tariff for all customers; and increased TOU peak reductions through strategic rate changes.

Figure D-3: LADWP Demand Response Potential – High Scenario*



** Results shown here represent the relative bounds of achievable DR potential for LADWP, and will be refined through more detailed bottom-up analysis during the program design and cost effectiveness tasks.*

Table D-5 shows the effective rates of customer participation in 2026 for each program category, scenario, and customer segment after 1) scaling by the eligibility requirements for each program and 2) adjusting to ensure dual-enrollment in DR programs is not counted (see footnote 26). Within the Moderate scenario, close to 25 percent of residential load participates in some type of DR program and roughly 20 percent of the large CII load participates. The estimated peak reduction achieved by these customers in 2026 is shown below in Table D-6.

Table D-5: LADWP Demand Response Program Participation Potential in 2026 (% of MW in each customer segment)

	Program Category	Residential	Small CII	Medium CII	Large CII
Basic	Interruptible/Curtailable Load			0.2%	20.2%
	Direct Load Control	4.7%	0.3%		
	Dynamic Pricing (manual)				
	Dynamic Pricing (automated)				
	Time of Use	2.9%	5.0%		
	EV Service Rider	2.1%	0.2%	0%	0%
	Total	***9.6%***	***5.6%***	***0.2%***	***20.2%***
Moderate	Interruptible/Curtailable Load			1.7%	20.2%
	Direct Load Control	11.8%	0.7%		
	Dynamic Pricing (manual)	1.1%	1.2%	1.2%	1.0%
	Dynamic Pricing (automated)				
	Time of Use	8.7%	14.7%		
	EV Service Rider	3.1%	0.3%	0%	0%
	Total	***24.7%***	***17.0%***	***3.0%***	***21.2%***
High	Interruptible/Curtailable Load			1.7%	20.2%
	Direct Load Control	11.8%	0.7%		
	Dynamic Pricing (manual)	35.7%	34.9%	15.8%	12.8%
	Dynamic Pricing (automated)	16.0%	22.2%	30.3%	24.6%
	Time of Use	12.1%	14.0%		
	EV Service Rider	4.1%	0.4%	0%	0%
	Total	***79.6%***	***72.1%***	***47.8%***	***57.6%***

Table D-6: LADWP Demand Response Potential in 2026 (peak MW)

	Program Category	Residential	Small CII	Medium CII	Large CII
Basic	Interruptible/Curtailable Load			2	270
	Direct Load Control	31	1		
	Dynamic Pricing (manual)				
	Dynamic Pricing (automated)				
	Time of Use	0.4			
	EV Service Rider	21	<1	<1	<1
	Total	***52***	***1***	***2***	***270***
Moderate	Interruptible/Curtailable Load			17	270
	Direct Load Control	78	3		
	Dynamic Pricing (manual)	6	<1	2	3
	Dynamic Pricing (automated)				
	Time of Use	14	2		
	EV Service Rider	31	<1	<1	<1
	Total	***129***	***5***	***19***	***273***
High	Interruptible/Curtailable Load			17	270
	Direct Load Control	78	3		
	Dynamic Pricing (manual)	186	5	27	45
	Dynamic Pricing (automated)	114	34	41	80
	Time of Use	21	2		
	EV Service Rider	41	<1	<1	<1
	Total	***440***	***43***	***85***	***395***

D.2.2 Premier Accounts

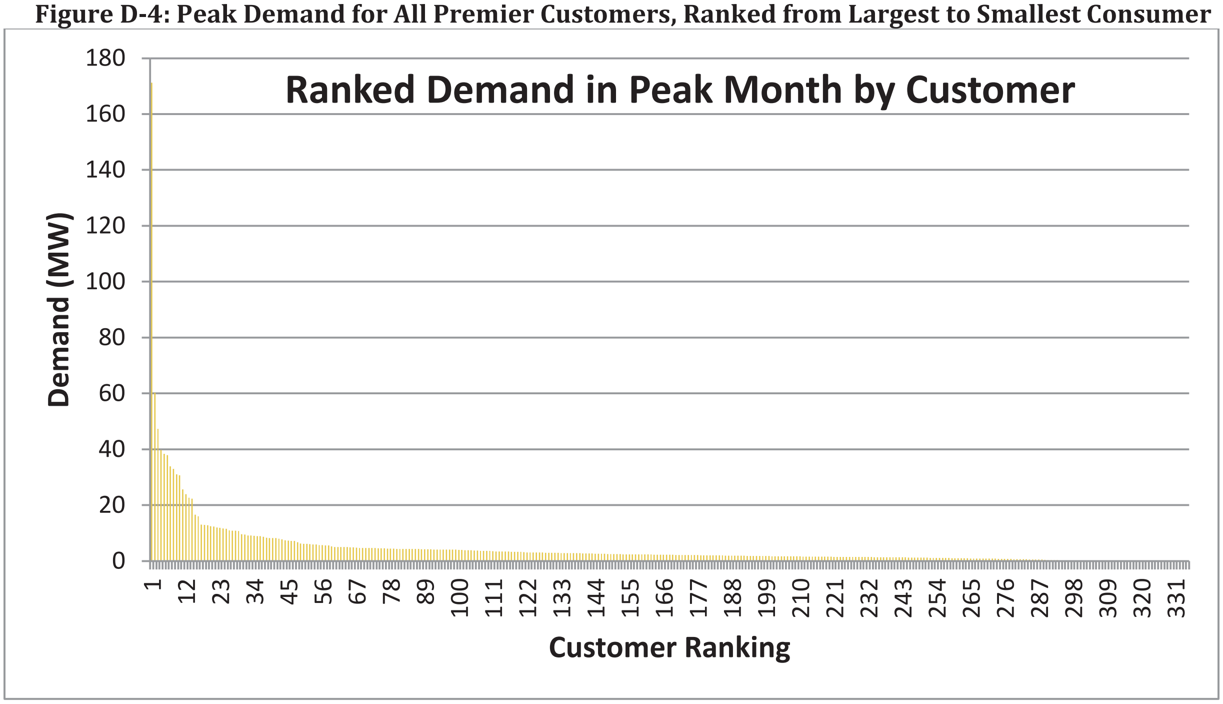
In general, Navigant found that the majority of LADWP's peak demand is consolidated in a relatively small number of customers and facilities, suggesting that targeting DR deployment for just these customers could result in significant peak reduction. In total, LADWP's Premier Accounts represent roughly 350 total premier customers, just over 11,000 total facilities, and almost 1.6 GW of peak demand.[35]

In the sections below, Navigant presents analyses of the largest 20 Premier Accounts customers, the largest facilities of the largest 20 Premier Accounts customers, and the largest 20 Premier Accounts facilities, with comparisons of the relative peak demand usage for each group.

Top 20 Customers

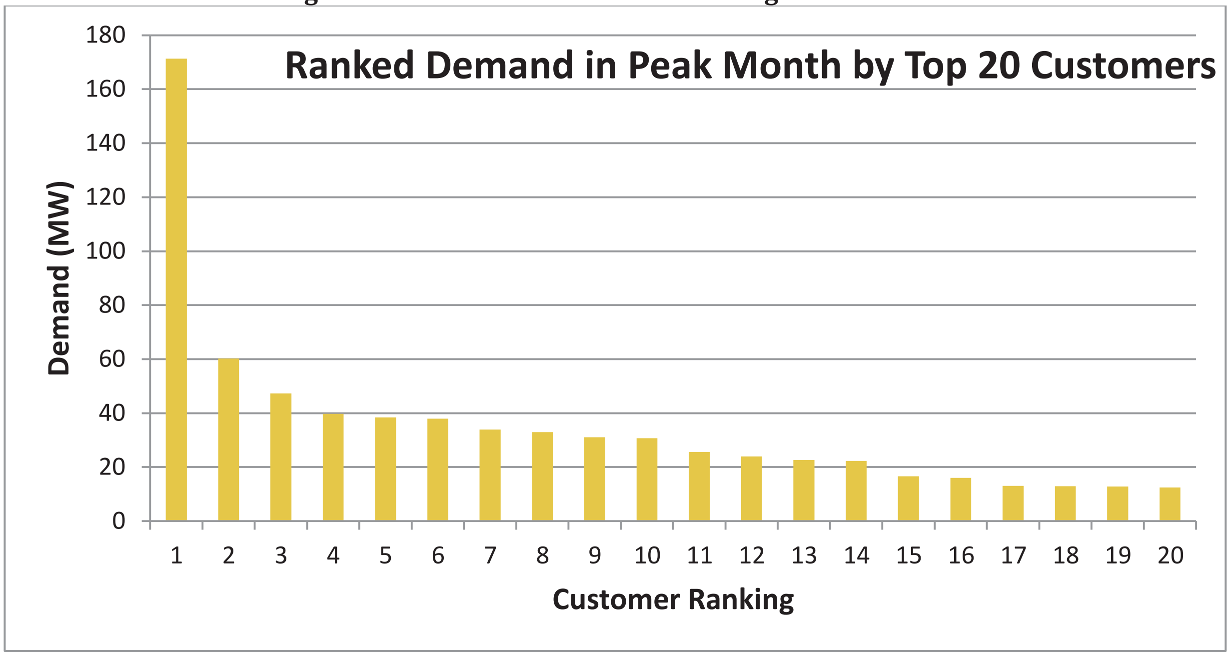
Navigant found that the 20 largest Premier Accounts customers represent less than 6% of the total number of Premier Account customers, but are responsible for roughly 44% of the total peak demand from premier customers. Figure D-4 illustrates that the majority of the total peak demand comes from these largest customers. Figure D-5 zooms in on only the 20 largest customers among all of the premier customers, which constitutes 44% of the total peak demand.

Figure D-4: Peak Demand for All Premier Customers, Ranked from Largest to Smallest Consumer



[35] Number of customers was derived by aggregating by customer number, number of facilities by aggregating by service address (which may contain multiple meters), and peak demand by aggregating all High Peak kW for the representative month of August 2012.

Figure D-5: Peak Demand for the 20 Largest Customers



Facilities for the Top 20 Customers

To better understand what types and sizes of facilities make up the peak demand for the 20 largest consumers, Figure D-5 and Table D-7 show the peak demand and industry type for these facilities. These 20 individual facilities were responsible for 213 MW of LADWP's peak demand. Among these 20 customers, 90% of their total peak demand (640 MW of 708 MW) is from facilities whose peak demand is 200kW or greater and thus are generally large enough to participate in most DR programs. These facilities represent just 18% of the total facilities within this group, indicating that a large portion of LADWP's peak demand is coming from a relatively small number of facilities within the largest accounts.

Figure D-6: Peak demand of the largest 20 facilities among the largest 20 customers

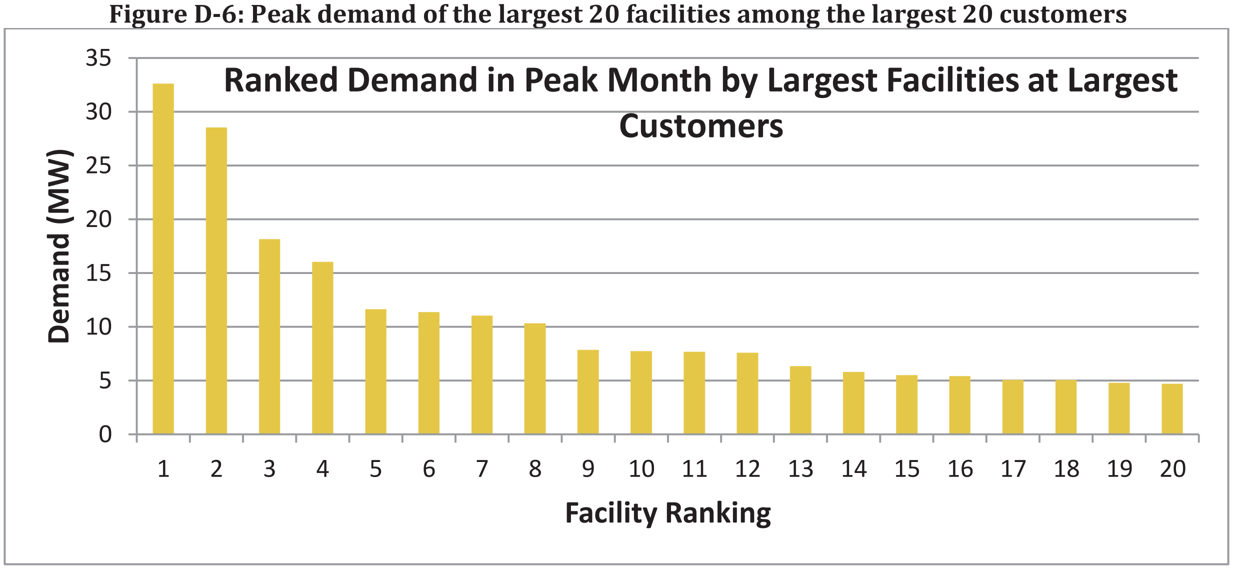


Table D-7: Peak demand and industry type for largest 20 facilities among largest 20 customers[36]

Facility Ranking	Peak Demand (MW)	NAICS Industry Title
1	32.62	*Acid oils made in petroleum refineries*
2	28.52	*Acid oils made in petroleum refineries*
3	18.15	*Children's hospitals, general*
4	16.04	*No Available*
5	11.63	*Compressor, metering and pumping station, gas and oil pipeline, construction*
6	11.36	*Correctional boot camps*
7	11.02	*Agencies, real estate escrow*
8	10.31	*Academies, college or university*
9	7.86	*Academies, college or university*
10	7.73	*No Available*
11	7.67	*No Available*
12	7.59	*Academies, college or university*
13	6.34	*Arena, no promotion of events, rental or leasing*
14	5.80	*Children's hospitals, general*
15	5.50	*Air commuter carriers, scheduled*
16	5.40	*Collection, treatment, and disposal of waste through a sewer system, Enforcement of environmental and pollution control regulations*
17	5.07	*Canal, irrigation*
18	5.06	*Arena, no promotion of events, rental or leasing*
19	4.78	*Acupuncturists' (MDs or DOs) offices (e.g., centers, clinics)*
20	4.70	*Children's hospitals, general*

D.2.3 All Facilities

Navigant also looked at all of the facilities among the premier accounts. Figure D-7, Figure D-8, and Table D-8 below show the peak demand of all facilities. In total, there are over 11,000 facilities in this group. The 20 largest individual facilities consume 13% of the total peak demand, although they represent less than 0.2% of the total number of facilities. Twelve of these facilities are also among the largest facilities of the largest 20 customers shown in Table D-7. For all premier accounts, 88% of the total peak demand (almost 1.4 GW of 1.6 GW) is from facilities with demand greater than or equal to 200 kW. In total, there are 1,355 facilities with a peak demand greater than or equal to 200 kW, out of 11,071 total facilities.

[36] NAICS industry titles for each facility are preliminary mappings and will be verified individually before using for other purposes.

Figure D-7: Peak demand by facility for all premier accounts

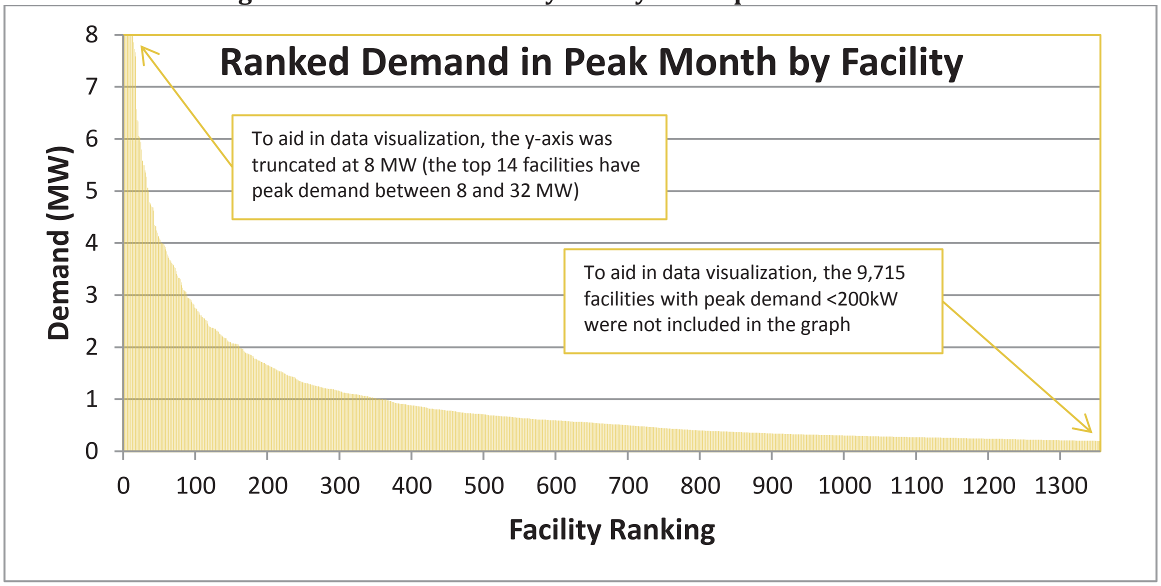


Figure D-8: Peak demand of the 20 largest facilities among all premier accounts

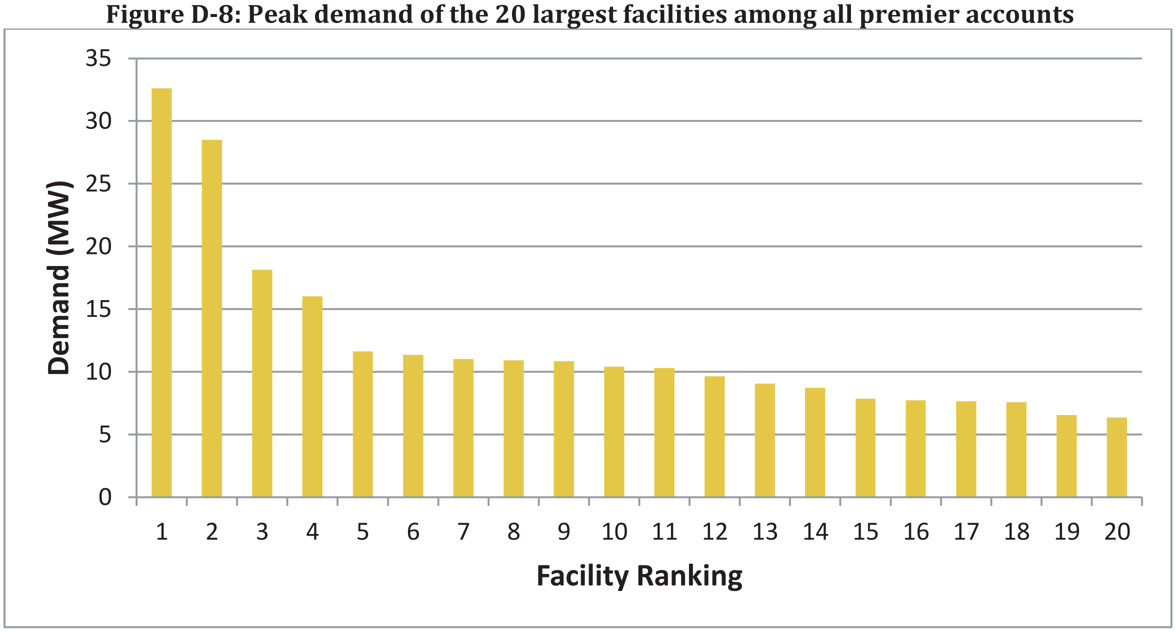


Table D-8: Peak demand and industry type for largest 20 facilities among all premier accounts[37]

Facility Ranking	Peak Demand (MW)	NAICS Industry Title
1	32.62	*Acid oils made in petroleum refineries*
2	28.52	*Acid oils made in petroleum refineries*
3	18.15	*Children's hospitals, general*
4	16.04	*Not Available*
5	11.63	*Compressor, metering and pumping station. gas and oil pipeline, construction*
6	11.36	*Correctional boot camps*
7	11.02	*Agencies, real estate escrow*
8	10.92	*Department stores (except discount department stores). Arena, no promotion of events, rental or leasing*
9	10.84	*Children's hospitals, general, Cancer hospitals*
10	10.40	*Animated cartoon production*
11	10.31	*Academies, college or university*
12	9.64	*Anesthesia apparatus manufacturing*
13	9.06	*Acetylene manufacturing*
14	8.73	*Application hosting. Arena, no promotion of events, rental or leasing*
15	7.86	*Academies, college or university*
16	7.73	*Not Available*
17	7.67	*Not Available*
18	7.59	*Academies, college or university*
19	6.57	*Banking, central*
20	6.36	*Not Available*

[37] NAICS industry titles for each facility are preliminary mappings and will be verified individually before using for other purposes.

Los Angeles Department of Water & Power

Conditions For DR Events

Potential Reasons for Demand Response Events