Indianapolis Power & Light Company

Demand-Side Management Potential Forecast

For 2018-2034

October 31, 2014

IPL engaged Applied Energy Group ("AEG") to complete a Demand-Side Management ("DSM") Potential Forecast for 2018-2034 for inclusion in the Company's 2014 Integrated Resource Plan.

IPL notes:

- AEG's forecast represents the market potential from a 2014 viewpoint
- IPL's future DSM filings and results will likely vary from the forecast
- Legislation and public policy will help shape future DSM
- Customer behavior including additional large customer opt-outs will affect outcomes
- Programs were included in the forecast based on a Total Resource Cost (TRC) threshold result of 1 or greater, while IPL's DSM portfolio offerings typically have an aggregate TRC value greater than 1

AEG's report is provided herein.

INDIANAPOLIS POWER & LIGHT
DEMAND-SIDE MANAGEMENT POTENTIAL FORECAST
FOR 2015-2034

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CONTENTS

LIST OF FIGURES

LIST OF TABLES

Introduction

This study represents an update to the prior report "Energy Efficiency Market Potential Study and Action Plan" dated December 21, 2012 (2012 MPS).[1] This report focuses on the work we did to update that analysis for Indianapolis Power & Light (IPL) to create forecasts of demand-side management (DSM) potential from 2015 to 2034 as part of the development of their integrated resource plan (IRP). For a detailed description of the analysis approach for the DSM potential forecasts, please refer to the 2012 MPS. In Chapter 2, Analysis Approach, we focus primarily on updates and revisions to the previous study.

The updated analysis Applied Energy Group (AEG) presents in this report identifies achievable potential based on cost-effectiveness criteria provided by IPL. It also delivers estimates of program costs, energy savings, and demand savings associated with the DSM programs and measures. Further, these estimates are calibrated to align with the DSM Action Plan (2015-2017) that were developed separately for IPL by AEG. IPL is using the Action Plan in its DSM filing to seek approval of DSM programs for 2015-2016.

Definitions of Potential

Unless otherwise noted, the DSM savings estimates provided in this report represent net savings[2] developed into three types of potential: technical potential, economic potential, and achievable potential. Technical and economic potential are both theoretical limits to efficiency savings. Achievable potential embodies a set of assumptions about the decisions consumers make regarding the efficiency of the equipment they purchase, the maintenance activities they undertake, the controls they use for energy-consuming equipment, and the elements of building construction. The various levels are described below.

- **Technical potential** is defined as the theoretical upper limit of DSM potential. It assumes that customers adopt all feasible measures regardless of their cost. At the time of existing equipment failure, customers replace their equipment with the most efficient option available. In new construction, customers and developers also choose the most efficient equipment option. Technical potential also assumes the adoption of every other available measure, where applicable. For example, it includes installation of high-efficiency windows in all new construction opportunities and furnace maintenance in all existing buildings with furnace systems. These retrofit measures are phased in over a number of years, which is longer for higher-cost and complex measures.
- **Economic potential** represents the adoption of all ***cost-effective*** DSM measures. In this analysis, the cost effectiveness is measured by the total resource cost (TRC) test, which compares lifetime energy and capacity benefits to the incremental cost of the measure. If the benefits outweigh the costs (that is, if the TRC ratio is greater than 1.0), a given measure is considered in the economic potential. Customers are then assumed to purchase the most cost-effective option applicable to them at any decision juncture.
- **Realistic Achievable potential** estimates customer adoption of economic measures when delivered through DSM programs under typical market, implementation, and customer preference conditions. The delivery environment in this analysis projects the current state of

[1] The 2012 report was completed by EnerNOC Utility Solutions Consulting Group, which has since been acquired by Applied Energy Group. The same team members completed the analysis in both studies.

[2] Savings in "net" terms instead of "gross" means that the savings do not include program "free riders" and that the baseline forecast includes naturally occurring efficiency. In other words, the baseline assumes that natural early adopters continue to make purchases of equipment and measures at efficiency levels higher than the minimum standard.

the DSM market in IPL's service territory and projects typical levels of expansion and increased awareness over time.

Abbreviations and Acronyms

Throughout the report we use several abbreviations and acronyms. Table 1-1 shows the abbreviation or acronym, along with an explanation.

Table 1-1 Explanation of Abbreviations and Acronyms

Acronym	Explanation
ACS	American Community Survey
AEO	Annual Energy Outlook forecast developed annually by EIA
AHAM	Association of Home Appliance Manufacturers
B/C Ratio	Benefit to cost ratio
BEST	AEG's Building Energy Simulation Tool
CAC	Central air conditioning
C&I	Commercial and industrial
CFL	Compact fluorescent lamp
DEEM	AEG's Database of Energy Efficiency Measures
DEER	State of California Database for Energy-Efficient Resources
DSM	Demand side management
EE	Energy efficiency
EIA	Energy Information Administration
EISA	Energy Efficiency and Security Act of 2007
EPACT	Energy Policy Act of 2005
EPRI	Electric Power Research Institute
EUEA	Efficient Use of Energy Act
EUI	Energy-use index
HH	Household
HID	High intensity discharge lamps
HPWH	Heat pump water heater
IURC	Indiana Utility Regulatory Commission
LED	Light emitting diode lamp
LoadMAP	AEG's Load Management Analysis and Planning™ tool
OUCC	Indiana Office of Utility Consumer Counselor
RAP	Realistic Achievable Potential
RTU	Roof top unit
Sq. ft.	Square feet
TRC	Total resource cost
UEC	Unit energy consumption

Analysis Approach

In this section, we summarize our analysis approach and modeling tool, focusing on updates made to the original analysis from the 2012 MPS.

Overview of Analysis Approach

To develop the DSM potential forecasts, AEG used a bottom-up analysis approach following the major steps listed below. Following this, we describe our modeling tool and then focus briefly on each step, describing the areas where updates or revisions were applied. For a more detailed description of the analysis approach, please refer to the 2012 MPS.

1. Performed a market characterization to describe sector-level electricity use for the residential, commercial, and industrial sectors for the base year, 2011 within IPL's service territory. This included existing information contained in prior Indiana studies, specific updates to the IPL customer database since the 2012 MPS, AEG's own databases and tools, and other secondary data sources such as the American Community Survey (ACS) and the Energy Information Administration (EIA).
2. Developed a baseline projection of energy consumption and peak demand by sector, segment, and end use for 2011 through 2034. This 20-year timeframe was a requirement for the IPL integrated resource plan, and had not been developed in the 2012 MPS or previous Action Plans, which only focused on years through 2017.
3. Defined and characterized several hundred DSM measures to be applied to all sectors, segments, and end uses.
4. Estimated the Technical, Economic, and Realistic Achievable potential from the efficiency measures. This involved a step to calibrate the participation, savings, and spending levels of Realistic Achievable potential to align with those filed in IPL's 2015-2017 DSM Action Plan.

LoadMAP Model

For the DSM potential analysis, we used AEG's Load Management Analysis and Planning tool (LoadMAP™) version 3.0 to develop both the baseline projection and the estimates of potential. AEG developed LoadMAP in 2007 and has enhanced it over time through application to numerous national, regional, and utility-specific forecasting and potential studies. Built in Excel, the LoadMAP framework is both accessible and transparent and has the following key features.

- Embodies the basic principles of rigorous end-use models (such as EPRI's REEPS and COMMEND) but in a more simplified, accessible form.
- Includes stock-accounting algorithms that treat older, less efficient appliance/equipment stock separately from newer, more efficient equipment. Equipment is replaced according to the measure life and appliance vintage distributions defined by the user.
- Balances the competing needs of simplicity and robustness by incorporating important modeling details related to equipment saturations, efficiencies, vintage, and the like, where market data are available, and treats end uses separately to account for varying importance and availability of data resources.
- Isolates new construction from existing equipment and buildings and treats purchase decisions for new construction and existing buildings separately.
- Uses a simple logic for appliance and equipment decisions. Other models available for this purpose embody complex decision choice algorithms or diffusion assumptions, and the model

parameters tend to be difficult to estimate or observe and sometimes produce anomalous results that require calibration or even overriding. The LoadMAP approach allows the user to drive the appliance and equipment choices year by year directly in the model. This flexible approach allows users to import the results from diffusion models or to input individual assumptions. The framework also facilitates sensitivity analysis.

- Includes appliance and equipment models customized by end use. For example, the logic for lighting is distinct from refrigerators and freezers.
- Can accommodate various levels of segmentation. Analysis can be performed at the sector level (e.g., total residential) or for customized segments within sectors (e.g., housing type or income level).

Consistent with the segmentation scheme and the market profiles we describe below, the LoadMAP model provides forecasts of baseline energy use by sector, segment, end use, and technology for existing and new buildings. It also provides forecasts of total energy use and DSM savings associated with the various types of potential.

Market Characterization

AEG used the market characterization from the 2012 MPS for this study as a starting point. It describes electricity consumption for IPL's residential, commercial, and industrial sectors for the base year of 2011, which was developed using prior Indiana studies, in AEG's own databases and tools, and in other secondary data sources such as the American Community Survey (ACS) and the Energy Information Administration (EIA).

To update the market characterization within the LoadMAP files, IPL provided the following data updates that had been completed since the publication of the prior report:

- Historical billing data of customer counts by sector
- Historical billing data of annual energy consumption and system peak demand by sector
- Updates to NAICS codes on the billing system

As a result of these additional data, particularly NAICS codes, we refined the split between commercial and industrial customers. Using the IPL system peak data together with AEG's end-use load shape library, we developed estimates of peak demand by sector, segment and end use. We calibrated the values to IPL's system peak.

Baseline Projection

AEG used the existing LoadMAP model from the 2012 MPS and applied updates we made to the market characterization as the basis for a projection of baseline electricity use by sector, segment, and end use beginning in the base year of 2011 and ending in 2034. AEG applied the latest data sources regarding codes and standards, market conditions, and customer purchase decisions that had evolved since the 2012 MPS. The model was calibrated to exactly match IPL's actual sales for 2012 and 2013, and then compared and aligned to the official IPL load forecast through 2034. Similar to the 2012 MPS and most of the potential studies we conduct, the LoadMAP forecast does not exactly match IPL's official load forecast in every year, but is within a small, acceptable range that does not materially affect the results of the study.

This current study also developed a baseline end-use projection for peak demand by applying the end-use peak factors to the annual projection by segment and end use. The summary of the peak demand forecast is presented in Chapter 4.

DSM Measure Characterization

AEG used the measure characterization from the 2012 MPS and updated assumptions that have evolved in the marketplace since the completion of the previous work, primarily the projected cost and performance of LED lighting. Additionally, changes were made to the television market baseline to reflect that more efficient LCD and LED televisions have become available and are

being purchased. Similarly, set-top-boxes have undergone a transformation through a manufacturer agreement and those savings are included in the baseline projection in 2017 and beyond.

We also added measures to represent the residential peer comparison program and air conditioning direct load control programs.

Estimate DSM Potential

AEG used the LoadMAP model as described above to estimate three levels of DSM potential: Technical, Economic, and Realistic Achievable. The DSM potential estimates incorporated updated avoided cost data and discount rates as provided by IPL.

For this analysis, we excluded potential savings associated with the large commercial and industrial (C&I) customers that have chosen to opt out of DSM programs. This was done by calibrating the participation and savings levels in the DSM potential forecast for the years 2015 through 2017 to the latest DSM Action Plan filed by IPL. In the 2015-2017 Action Plan, participation and savings levels exclude 25% of C&I customers based on current opt-out rates.

Calibration to IPL's 2015-2017 DSM Action Plan

AEG calibrated savings and costs in the first three years of the Achievable Potential forecast to align with the savings and costs in the 2015-2017 DSM Action Plan. This process involved adjusting participation rates by a constant so that measure savings matched the levels of the DSM Action Plan for 2015-2017. Due to variance in market segmentation, measure bundling, naming conventions, and other factors, the specific measures present in the LoadMAP models do not exactly match those in the 2015-2017 DSM Action Plan. As a result, the alignment and calibration of costs and savings do not produce an exact match in every year, but it is within an acceptable range that does not materially affect the results of the study. This process is described in more detail in Appendix A.

Market Characterization

This section summarizes how customers in the IPL service territory use electricity in the base year of the study, 2011. It begins with a high-level summary of energy use by sector and then delves into each sector in detail.

Overall Energy Use

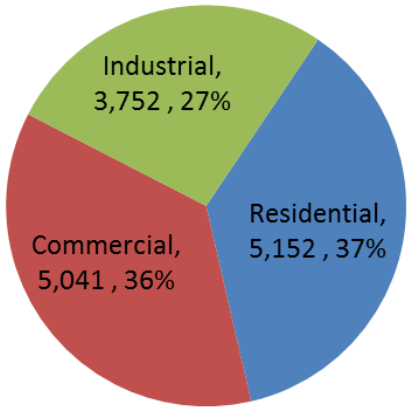
Total electricity use for the residential, commercial and industrial sectors for IPL in 2011 was 13,946 GWh. As shown in Table 3-1 and Figure 3-1, the largest sector is residential, which accounts for 37% of load at 5,152 GWh. Commercial accounts for 36% of the load at 5,041 GWh. The remaining use is in the industrial sector, at 3,752 GWh.

In this study, we used enhanced customer information and updates to NAICS codes in the IPL billing system to reclassify commercial and industrial accounts. This results in a different allocation of energy use to the commercial and industrial sectors. The current analysis shows that the commercial sector, at 36% of total use, is higher than the industrial, with 27% of total use.

Table 3-1 Sector-Level Electricity Use, 2011

Segment	Annual Use (GWh)	% of Sales
Residential	5,152	37%
Commercial	5,041	36%
Industrial	3,752	27%
Total	**13,946**	**100%**

Figure 3-1 Sector-Level Electricity Use, 2011



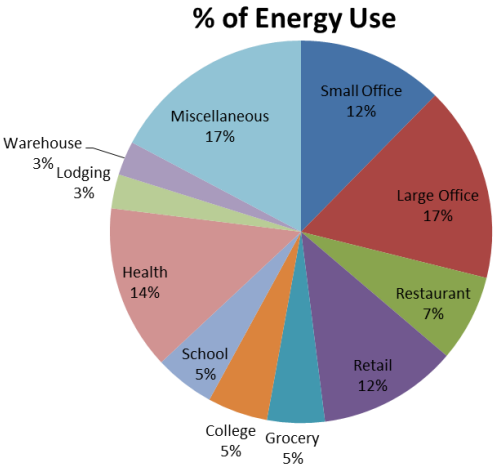
Commercial Sector Use by Building Type

In addition to revised sector-level control totals for the commercial and industrial sectors, the additional IPL data were used to develop refined energy use estimates for the eleven building-type identified for the analysis: Small Office, Large Office, Restaurant, Retail, Grocery, College, School, Health, Lodging, Warehouse, and Miscellaneous.

The values are shown in Table 3-2 below.

Table 3-2 Commercial Electricity Use by End Use and Segment (2011)

Segment	Electricity Use (GWh)	Intensity (kWh/SqFt)	Floor Space (million SqFt)
Small Office	624	15.2	41
Large Office	832	18.0	46
Restaurant	370	38.7	10
Retail	594	13.9	43
Grocery	245	48.9	5
College	257	11.5	22
School	257	8.0	32
Health	701	24.6	29
Lodging	145	13.7	11
Warehouse	145	6.4	23
Miscellaneous	870	7.6	114
Total	5,041	13.5	375

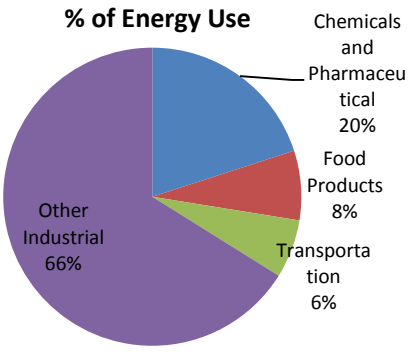


Industrial Sector Use by Industry

Similar to the commercial sector, we used the additional IPL data to develop refined energy use estimates for the four industries identified for the analysis: Chemical and Pharmaceutical (considered as one segment due to similarities in energy use and production methods), Transportation, and Food – with the remaining customers classified as Other Industrial. The values are shown in Table 3-3 below.

Table 3-3 Industrial Electricity Use by End Use and Segment (2011)

Segment	Electricity Use (GWh)	Number of Employees
Chemical and Pharmaceutical	751	3,079
Food Products	283	3,592
Transportation	238	4,054
Other Industrial	2,481	90,634
Total	**3,752**	**101,358**



Baseline Projection

Prior to developing estimates of DSM potential, we developed a baseline end-use projection to quantify what consumption is likely to be in the future in absence of new DSM programs. The baseline projection serves as the metric against which DSM potentials are measured. This chapter presents the baseline forecast for electricity for each sector. As mentioned above, we used the models from the 2012 MPS with a base year of 2011. To calibrate and exactly match the actual sales data from 2012 and 2013 that had become available since the 2012 study, we adjusted for actual weather, trends in exogenous forecast variables, and miscellaneous usage. The remainder of the forecast years, 2014 through 2034, were projected by the LoadMAP forecasting engine.

Residential Sector

The baseline projection incorporates assumptions about economic growth, electricity prices, equipment standards, building codes and naturally occurring energy efficiency.

Table 4-1 and Figure 4-1 present the baseline projection for electricity consumption for select years at the end-use level for the residential sector as a whole. Overall, residential use increases slightly from 5,152 GWh in 2011 to 6,266 GWh in 2034, an increase of 21.6%, or an average growth rate of 0.9% per year. This reflects the impact of the EISA lighting standard, additional appliance standards adopted in 2011, and modest customer growth. Fluctuations in the early years illustrate the calibration process to actual load data that was available for 2011 to 2013.

Table 4-1 Residential Electricity Baseline Projection by End Use (GWh)

End Use	2011	2015	2016	2017	2020
Cooling	785	804	813	820	843
Heating	978	1,021	1,037	1,049	1,084
Water Heating	462	465	466	463	452
Interior Lighting	653	577	543	537	517
Exterior Lighting	95	71	65	65	58
Appliances	1,107	1,004	987	971	941
Electronics	606	695	719	730	771
Miscellaneous	466	627	697	730	834
Total	**5,152**	**5,263**	**5,326**	**5,365**	**5,500**

End Use	2025	2029	2034	% Change 2011-2034	Avg. Growth Rate 2011-2034
Cooling	886	907	931	19%	0.7%
Heating	1,137	1,160	1,189	22%	0.8%
Water Heating	435	420	420	-9%	-0.4%
Interior Lighting	473	486	502	-23%	-1.1%
Exterior Lighting	42	42	43	-55%	-3.5%
Appliances	934	943	963	-13%	-0.6%
Electronics	841	856	876	45%	1.6%
Miscellaneous	997	1,153	1,343	188%	4.6%
Total	**5,744**	**5,966**	**6,266**	**21.6%**	**0.9%**

Figure 4-1 Residential Electricity Baseline Projection by End Use (MWh)

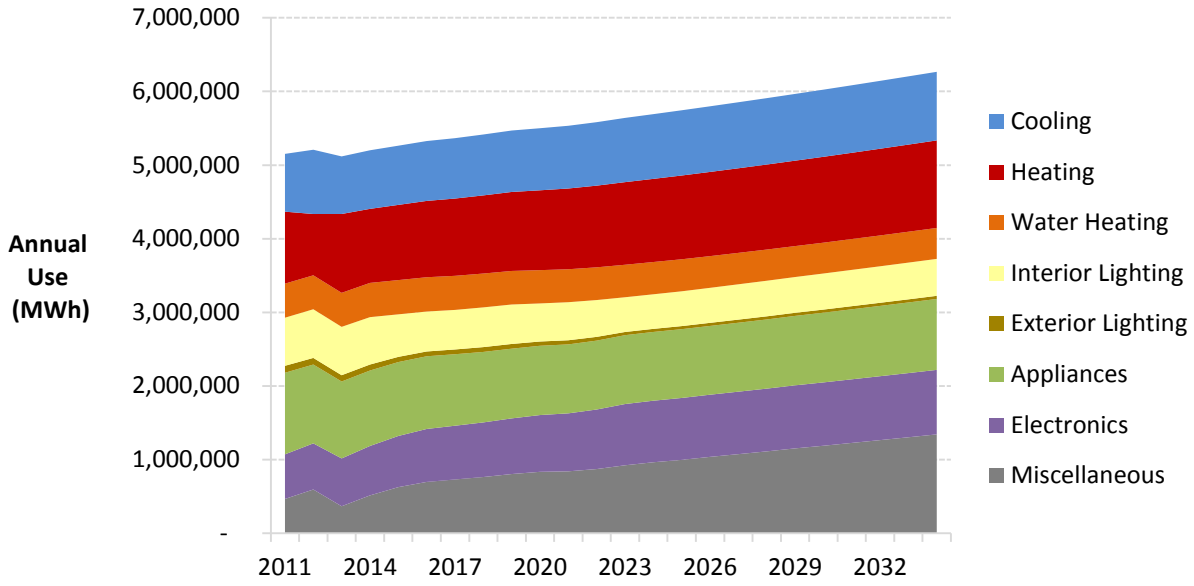


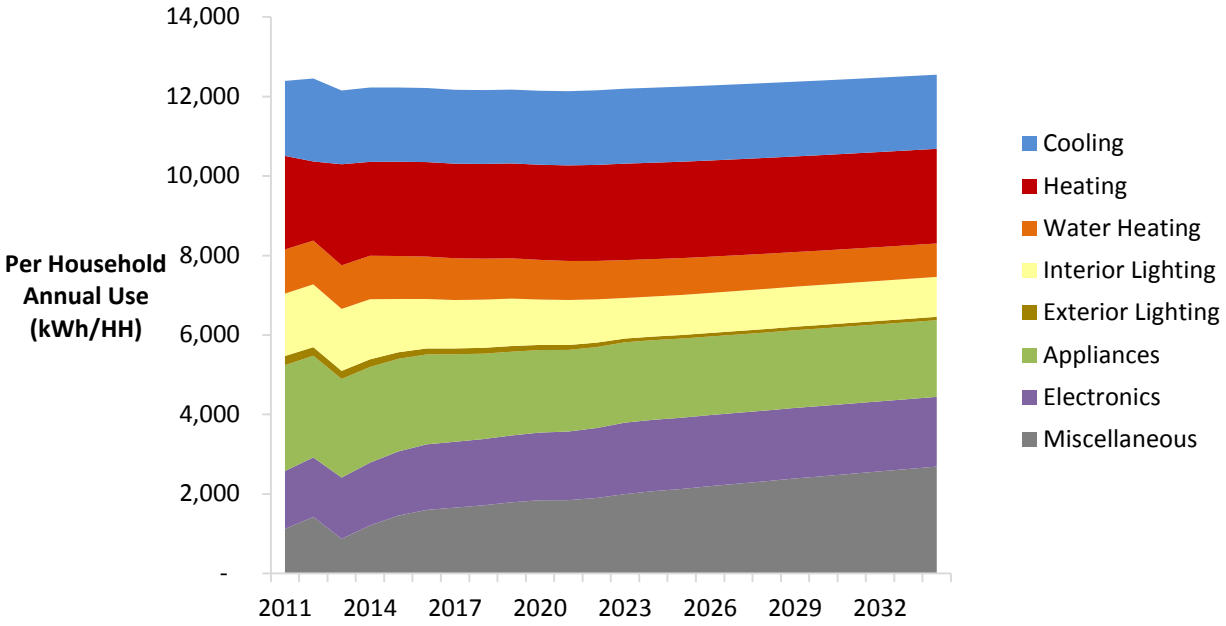
Table 4-2 and Figure 4-2 presents the forecast of use per household for select years. Most noticeable is that lighting use decreases significantly throughout the time period as the lighting efficiency standards from EISA come into effect.

Table 4-2 Residential Electricity Use per Household by End Use (kWh per HH)

End Use	2011	2015	2016	2017	2020
Cooling	1,887	1,868	1,864	1,859	1,861
Heating	2,351	2,371	2,377	2,380	2,394
Water Heating	1,112	1,081	1,068	1,050	997
Interior Lighting	1,571	1,341	1,244	1,218	1,142
Exterior Lighting	228	164	149	147	128
Appliances	2,664	2,331	2,263	2,201	2,077
Electronics	1,458	1,614	1,649	1,656	1,702
Miscellaneous	1,121	1,455	1,599	1,657	1,842
Total	**12,392**	**12,226**	**12,213**	**12,169**	**12,145**

End Use	2025	2029	2034	% Change 2011-2034	Avg. Growth Rate 2011-2034
Cooling	1,889	1,880	1,865	-1%	-0.1%
Heating	2,425	2,405	2,380	1%	0.1%
Water Heating	927	871	841	-24%	-1.2%
Interior Lighting	1,008	1,007	1,004	-36%	-1.9%
Exterior Lighting	89	87	85	-63%	-4.3%
Appliances	1,992	1,955	1,929	-28%	-1.4%
Electronics	1,793	1,775	1,754	20%	0.8%
Miscellaneous	2,125	2,390	2,689	140%	3.8%
Total	**12,248**	**12,372**	**12,549**	**1%**	**0.1%**

Figure 4-2 Residential Electricity Use per Household by End Use (kWh per HH)



Commercial Sector

The commercial baseline projection also incorporates assumptions about economic growth, electricity prices, equipment standards, building codes and naturally occurring efficiency.

Figure 4-3 and Table 4-3 present the baseline forecast for electricity for select years at the end-use level for the commercial sector as a whole. Overall, commercial use increases slightly from 5,041 GWh in 2011 to 5,722 GWh in 2034, an increase of 14%, or an average growth rate of 0.6% per year.

Figure 4-3 Commercial Electricity Baseline Forecast by End Use

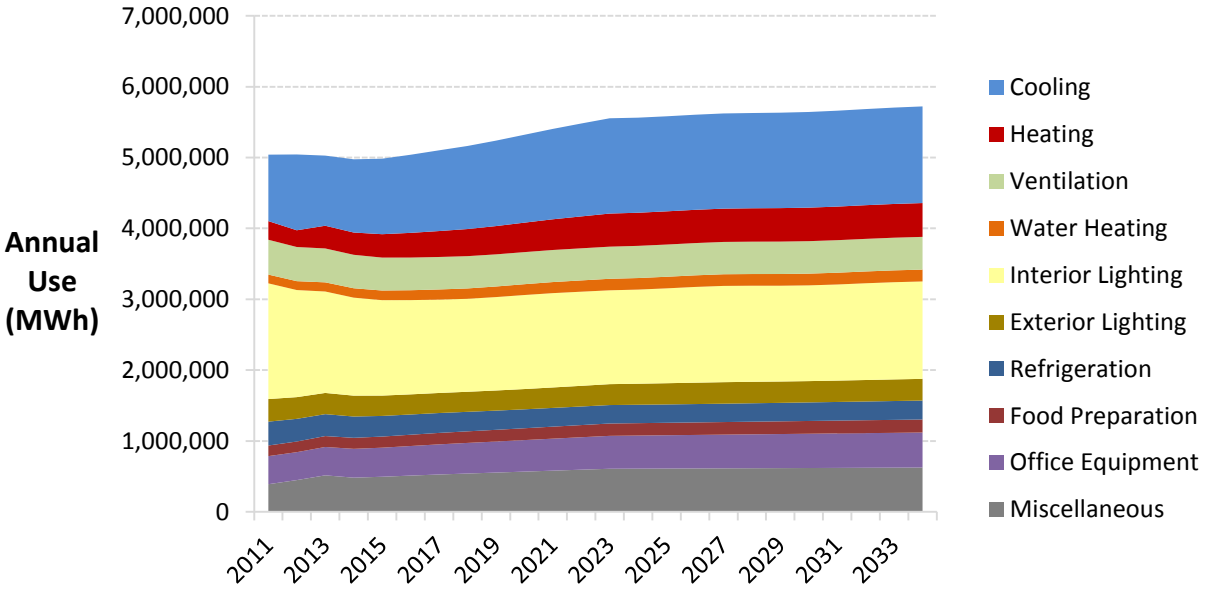


Table 4-3 Commercial Electricity Consumption by End Use (GWh)

End Use	2011	2015	2016	2017	2020
Cooling	938	1,066	1,102	1,139	1,240
Heating	263	330	348	366	416
Ventilation	492	465	461	459	453
Water Heating	123	136	140	143	153
Interior Lighting	1,633	1,347	1,330	1,318	1,327
Exterior Lighting	319	287	284	283	286
Refrigeration	337	292	286	281	267
Food Preparation	150	157	159	161	167
Office Equipment	396	410	418	425	445
Miscellaneous	390	495	511	527	568
Total	**5,041**	**4,984**	**5,040**	**5,102**	**5,322**

End Use	2025	2029	2034	% Change 2011-2034	Avg. Growth Rate 2011-2034
Cooling	1,341	1,347	1,364	45%	1.6%
Heating	469	472	477	81%	2.6%
Ventilation	455	458	462	-6%	-0.3%
Water Heating	163	165	168	36%	1.3%
Interior Lighting	1,339	1,352	1,375	-16%	-0.7%
Exterior Lighting	299	301	306	-4%	-0.2%
Refrigeration	259	261	267	-21%	-1.0%
Food Preparation	176	179	184	23%	0.9%
Office Equipment	470	481	494	25%	1.0%
Miscellaneous	611	617	625	60%	2.1%
Total	**5,582**	**5,634**	**5,722**	**14%**	**0.6%**

Industrial Sector

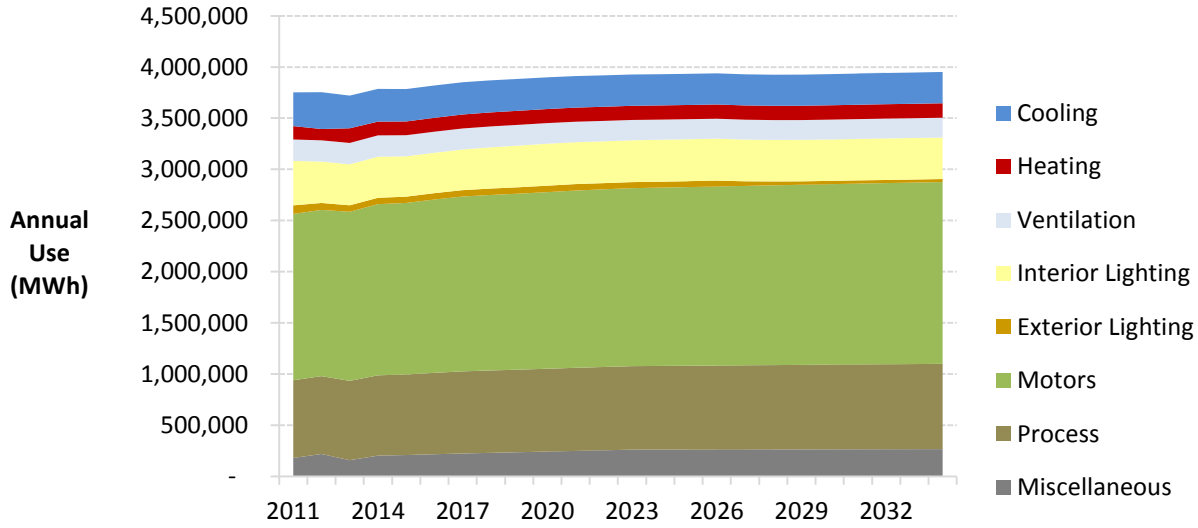
The baseline forecast incorporates assumptions about economic growth, electricity prices, equipment standards, building codes and naturally occurring energy efficiency. Table 4-4 and Figure 4-4 present the baseline forecast for electricity for select years at the end-use level for the industrial sector as a whole. Overall, industrial use increases slightly from 3,752 GWh in 2011 to 3,952 GWh in 2034, an increase of 5%, or an average growth rate of 0.2% per year.

Table 4-4 Industrial Electricity Consumption by End Use (GWh)

End Use	2011	2015	2016	2017	2020
Cooling	330	317	316	315	310
Heating	130	134	136	137	138
Ventilation	210	206	206	205	201
Interior Lighting	434	394	395	397	410
Exterior Lighting	83	61	62	62	63
Motors	1,626	1,676	1,694	1,709	1,726
Process	759	787	795	802	809
Miscellaneous	180	208	216	223	242
Total	**3,752**	**3,785**	**3,820**	**3,851**	**3,899**

End Use	2025	2029	2034	% Change 2011-2034	Avg. Growth Rate 2011-2034
Cooling	304	304	306	-7%	-0.3%
Heating	139	140	141	8%	0.3%
Ventilation	196	193	194	-7%	-0.3%
Interior Lighting	410	406	405	-7%	-0.3%
Exterior Lighting	58	33	29	-65%	-4.5%
Motors	1,746	1,760	1,777	9%	0.4%
Process	819	825	833	10%	0.4%
Miscellaneous	262	264	266	48%	1.7%
Total	**3,934**	**3,926**	**3,952**	**5%**	**0.2%**

Figure 4-4 Industrial Electricity Baseline Forecast by End Use



Baseline Projection Summary

Table 4-5 and Figure 4-5 provide a summary of the baseline forecast for electricity by sector for the entire IPL service territory. Overall, the forecast shows a 14.3% increase from 2011 to 2034 with an average annual growth rate of 0.6%. Most of the increase is attributed to the residential sector, followed by commercial, and then industrial. Table 4-6 and Figure 4-6 show the peak demand forecast for each sector.

Table 4-5 Electricity Projection by Sector (GWh)

Sector	2011	2015	2016	2017	2020
Residential	5,152	5,263	5,326	5,365	5,500
Commercial	5,041	4,984	5,040	5,102	5,322
Industrial	3,752	3,785	3,820	3,851	3,899
Total	**13,946**	**14,033**	**14,186**	**14,319**	**14,722**
Sector	2025	2029	2034	% Change 2011-2034	Avg. Growth Rate 2011-2034
Residential	5,744	5,966	6,266	21.6%	0.9%
Commercial	5,582	5,634	5,722	13.5%	0.6%
Industrial	3,934	3,926	3,952	5.3%	0.2%
Total	**15,260**	**15,526**	**15,940**	**14.3%**	**0.6%**

Figure 4-5 Electricity Baseline Projection Summary (GWh)

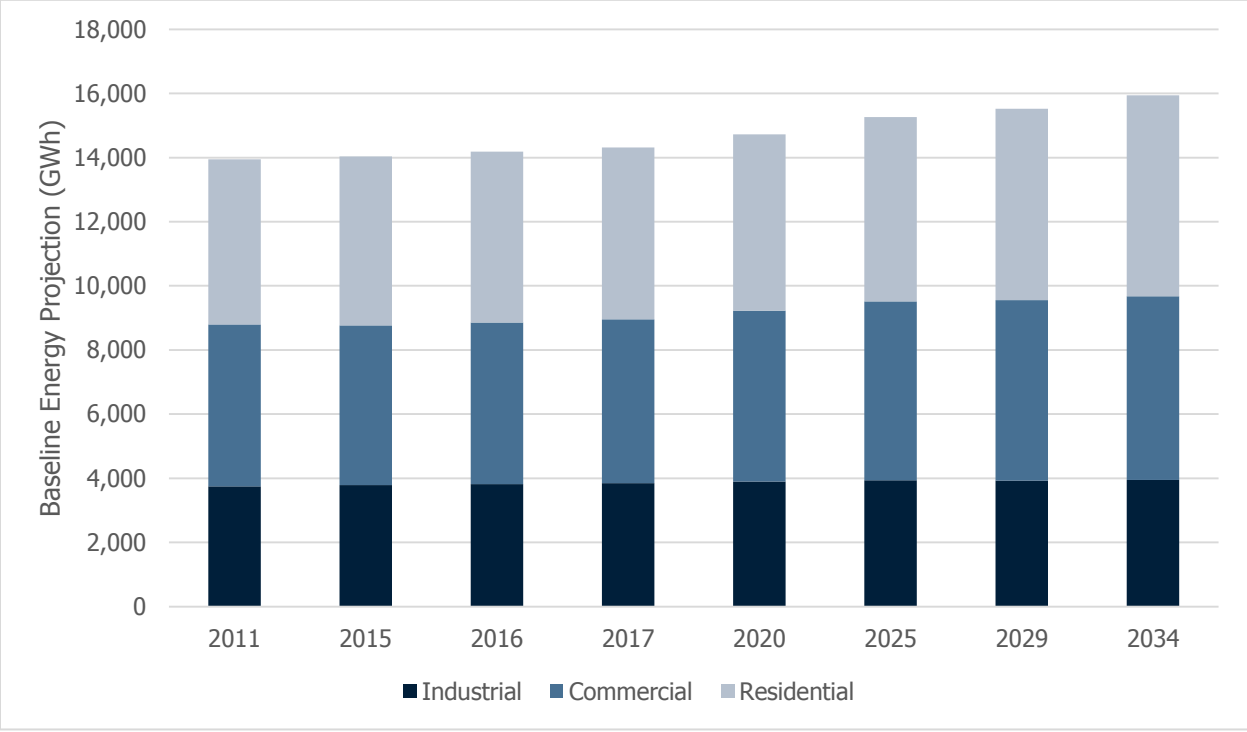
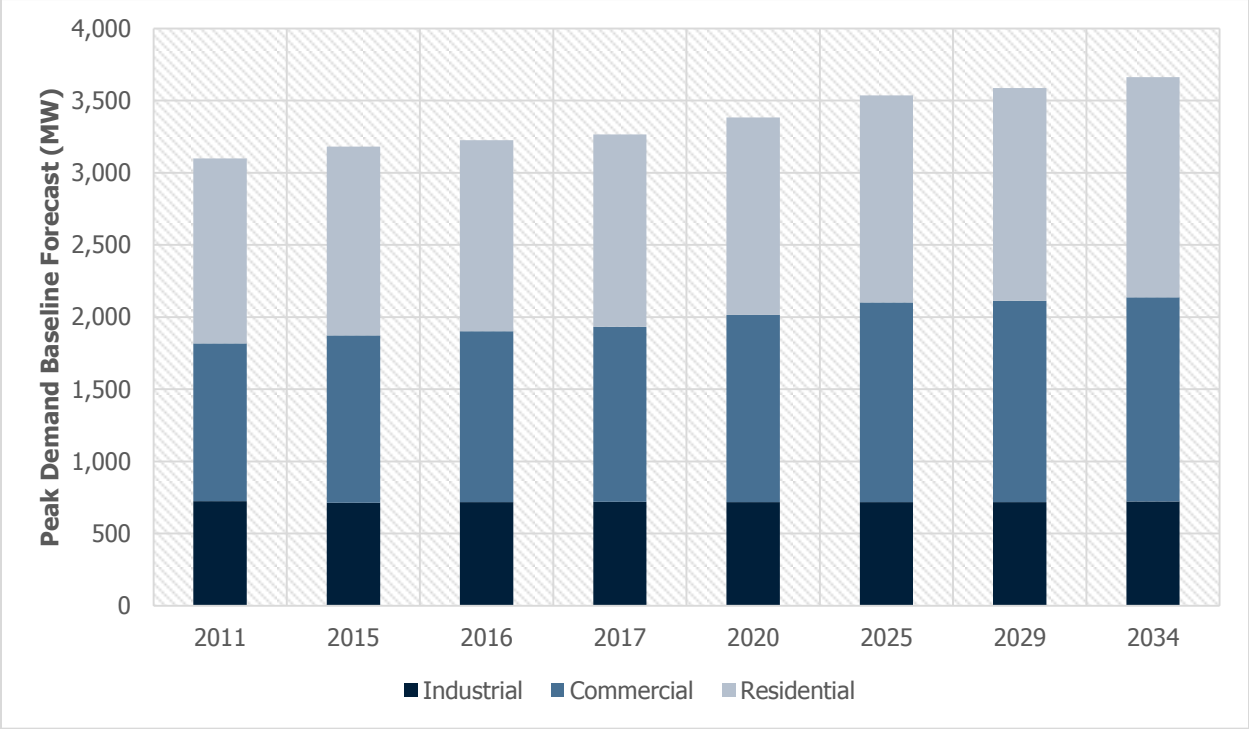


Table 4-6 and Figure 4-6 show the peak demand forecast for each sector.

Table 4-6 Peak Demand Consumption by Sector (MW)

Sector	2011	2015	2016	2017	2020
Residential	1,282	1,309	1,323	1,333	1,368
Commercial	1,094	1,158	1,185	1,213	1,297
Industrial	724	714	717	719	718
Total	**3,100**	**3,181**	**3,225**	**3,265**	**3,383**
Sector	2025	2029	2034	% Change 2011-2034	Avg. Growth Rate 2011-2034
Residential	1,434	1,474	1,525	19.0%	0.8%
Commercial	1,385	1,394	1,414	29.2%	1.1%
Industrial	717	718	723	-0.2%	0.0%
Total	**3,535**	**3,586**	**3,662**	**18.1%**	**0.7%**

Figure 4-6 Peak Demand Baseline Forecast Summary (MW)



DSM Potential – Overall Results

Table 5-1 and Figure 5-1 summarize the DSM savings for the different levels of potential relative to the baseline projection. Figure 5-2 displays the DSM potential forecasts in a line graph representing electricity consumption under the various analysis cases considered here. Potential forecasts in the model begin in 2013, but results here focus on the 2015-2017 time frame that corresponds to the latest IPL Action Plan, as well as milestone years through 2034, which represents the final year of consideration in IPL's IRP development.

By 2034, the cumulative energy savings under the Realistic Achievable Potential case are 10.4% of the baseline projection, or 1,665 net GWh.

Table 5-1 Summary of Overall DSM Potential

	2015	2016	2017	2020	2025	2029	2034
Baseline Forecast (GWh)	14,033	14,186	14,319	14,722	15,260	15,526	15,940
Cumulative Savings (GWh)							
Realistic Achievable	234	320	412	706	1,125	1,378	1,665
Economic Potential	1,163	1,323	1,495	2,057	2,914	3,438	3,911
Technical Potential	1,509	1,770	2,034	2,877	4,030	4,681	5,172
Energy Savings (% of Baseline)							
Realistic Achievable	1.7%	2.3%	2.9%	4.8%	7.4%	8.9%	10.4%
Economic Potential	8.3%	9.3%	10.4%	14.0%	19.1%	22.1%	24.5%
Technical Potential	10.8%	12.5%	14.2%	19.5%	26.4%	30.2%	32.4%

Figure 5-1 Summary of Energy Savings

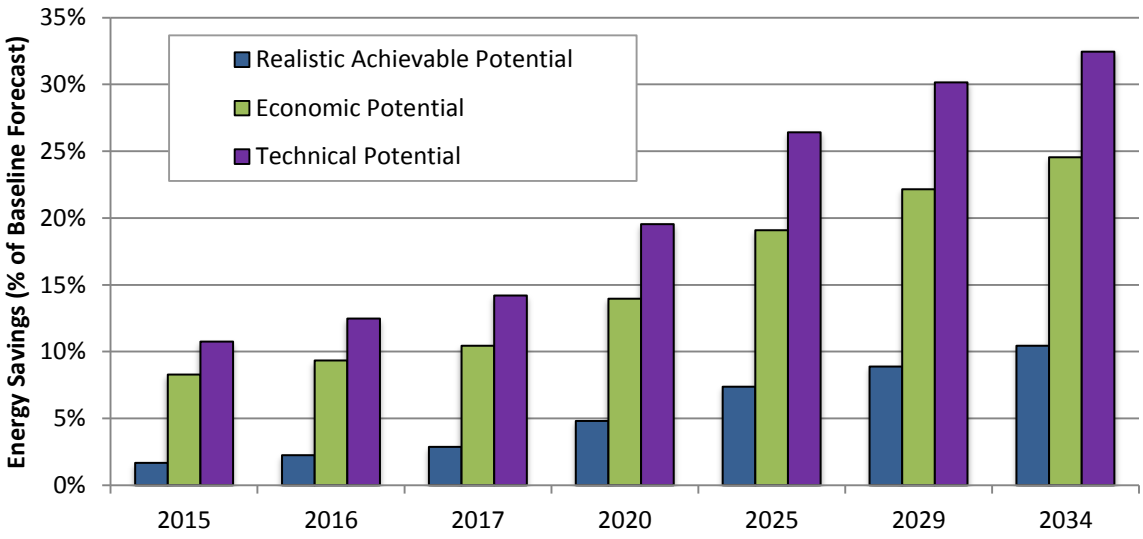


Figure 5-2 Forecasts of Potential (GWh)

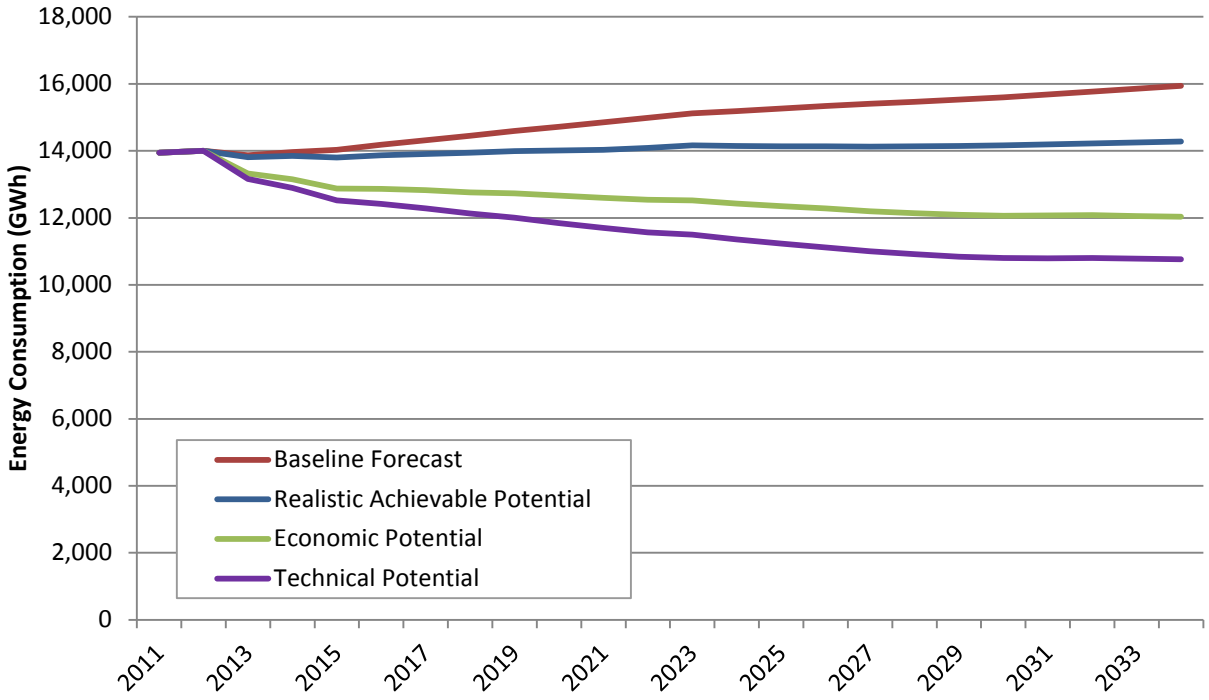
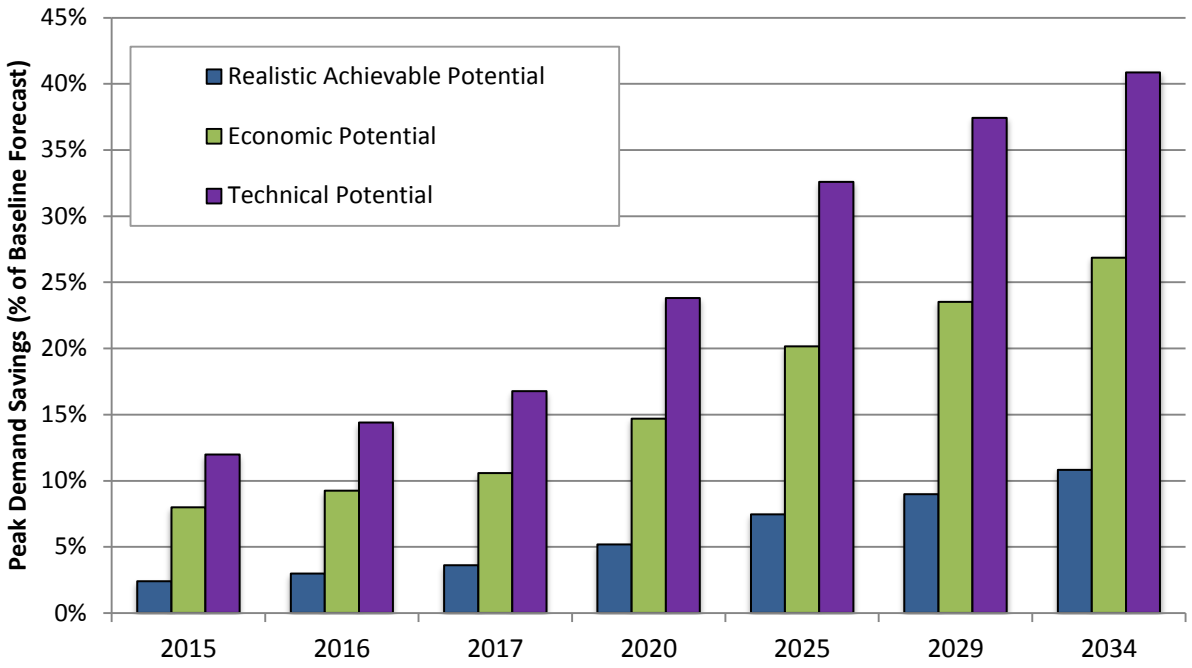


Table 5-2 and Figure 5-3 summarize the electric peak demand savings for the different levels of potential relative to the baseline forecast. By 2034, the cumulative peak demand savings under the Realistic Achievable Potential case are 10.8% of the baseline projection, or 396 net MW.

Table 5-2 Summary of Peak Demand Potential

	2015	2016	2017	2020	2025	2029	2034
Baseline Forecast (MW)	3,181	3,225	3,265	3,383	3,535	3,586	3,662
Cumulative Savings (MW)							
Realistic Achievable	76	96	117	175	263	322	396
Economic Potential	254	298	345	497	712	843	983
Technical Potential	381	464	547	805	1,152	1,342	1,495
Energy Savings (% of Baseline)							
Realistic Achievable	2.4%	3.0%	3.6%	5.2%	7.5%	9.0%	10.8%
Economic Potential	8.0%	9.2%	10.6%	14.7%	20.1%	23.5%	26.8%
Technical Potential	12.0%	14.4%	16.8%	23.8%	32.6%	37.4%	40.8%

Figure 5-3 Summary of Electric Peak Demand Savings



Overview of DSM Potential by Sector

Table 5-3 and Figure 5-4 summarize the realistic achievable electric energy savings potential by sector. The commercial sector accounts for the largest portion of the savings, followed by residential, and then industrial.

Table 5-3 Realistic Achievable Energy Savings by Sector (GWh)

	2015	2016	2017	2020	2025	2029	2034
Realistic Achievable Savings (GWh)							
Residential	95.5	122.6	141.3	223.2	291.7	368.9	472.5
Commercial	101.2	140.9	187.3	333.1	582.5	724.0	870.4
Industrial	37.2	56.3	83.2	149.8	250.5	285.2	322.0
Total	**234.0**	**319.8**	**411.9**	**706.2**	**1,124.8**	**1,378.1**	**1,664.9**

Figure 5-4 Realistic Achievable Energy Savings Potential by Sector (GWh)

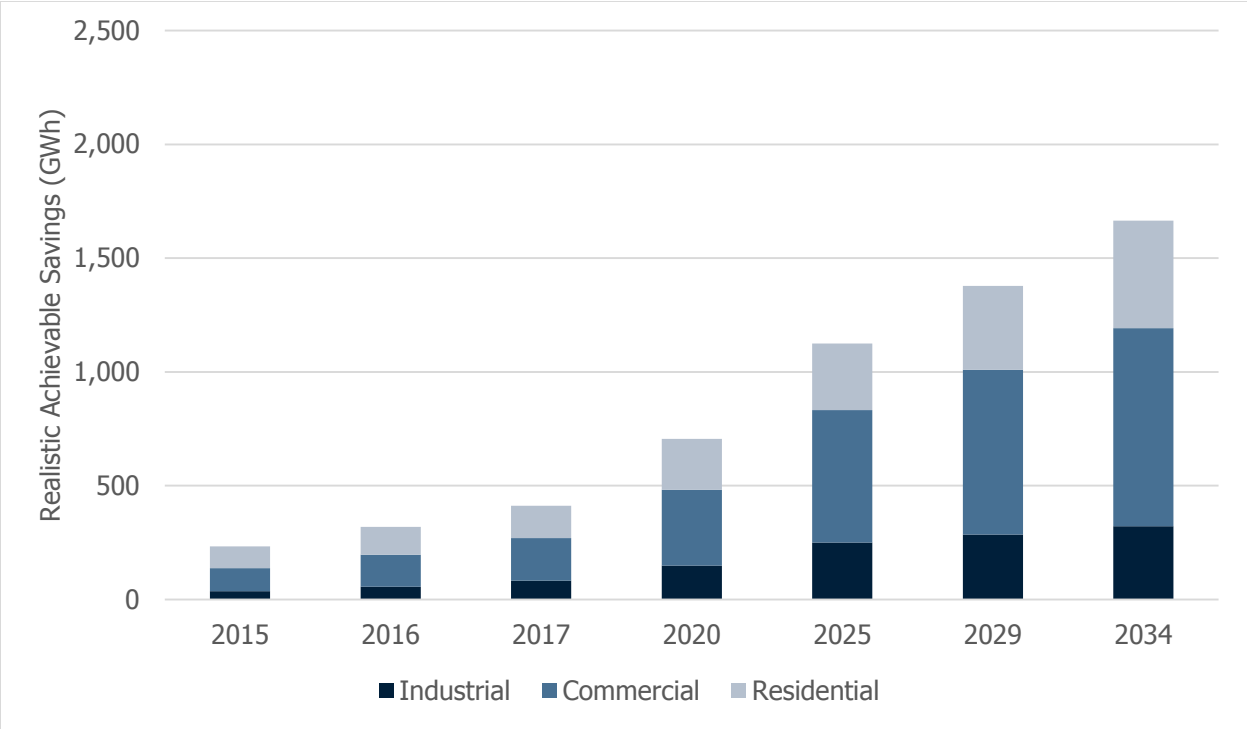
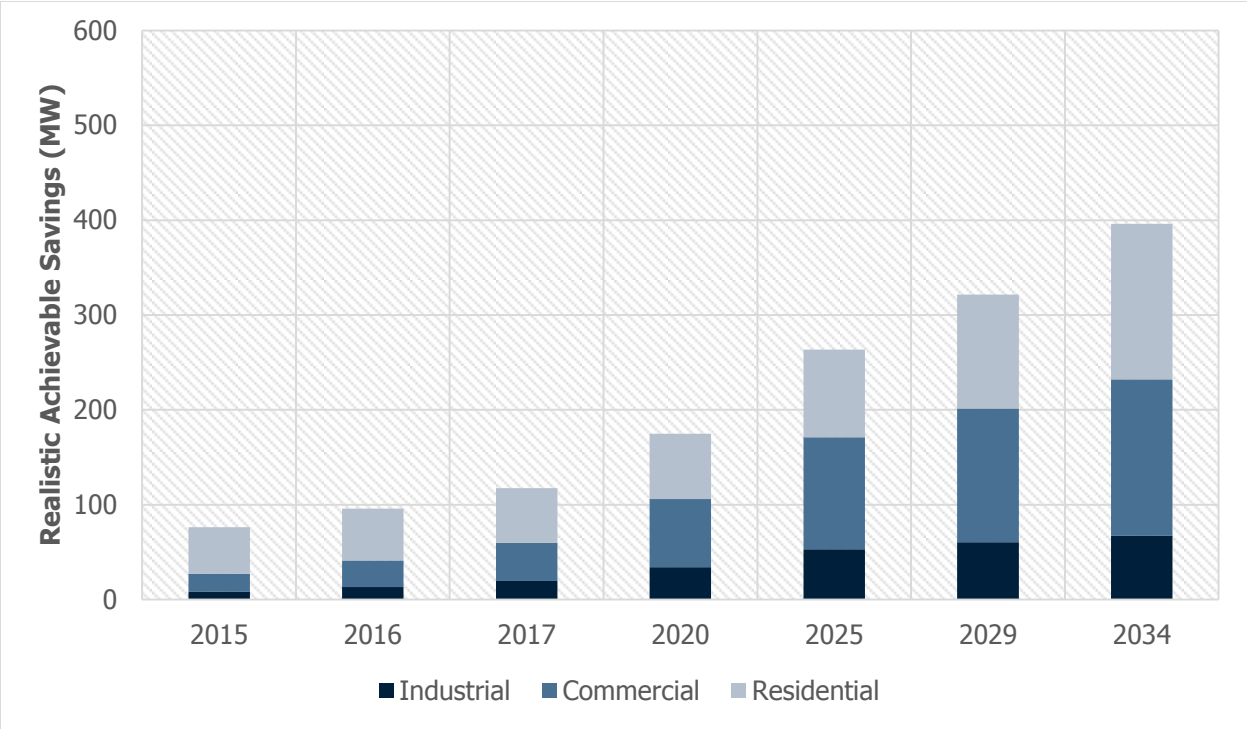


Table 5-4 and Figure 5-5 summarize the realistic achievable electric peak demand potential by sector. The commercial and residential sectors account for the largest portion of the savings, followed by industrial.

Table 5-4 Realistic Achievable Peak Demand Savings by Sector (MW)

	2015	2016	2017	2020	2029	2034
Realistic Achievable Savings (MW)						
Residential	49.4	54.8	57.8	68.9	120.3	163.9
Commercial	18.7	28.0	40.0	71.8	140.9	165.1
Industrial	8.3	13.1	19.7	34.1	60.4	67.1
Total	**76.4**	**95.9**	**117.5**	**174.8**	**321.6**	**396.1**

Figure 5-5 Realistic Achievable Peak Demand Savings Potential by Sector (MW)



Detailed potential results for each sector are presented in the following chapter.

DSM Potential By Sector

This chapter presents the results of the DSM potential analysis at the sector level. First, the residential potential is presented, followed by the commercial and industrial.

Residential Electricity Potential

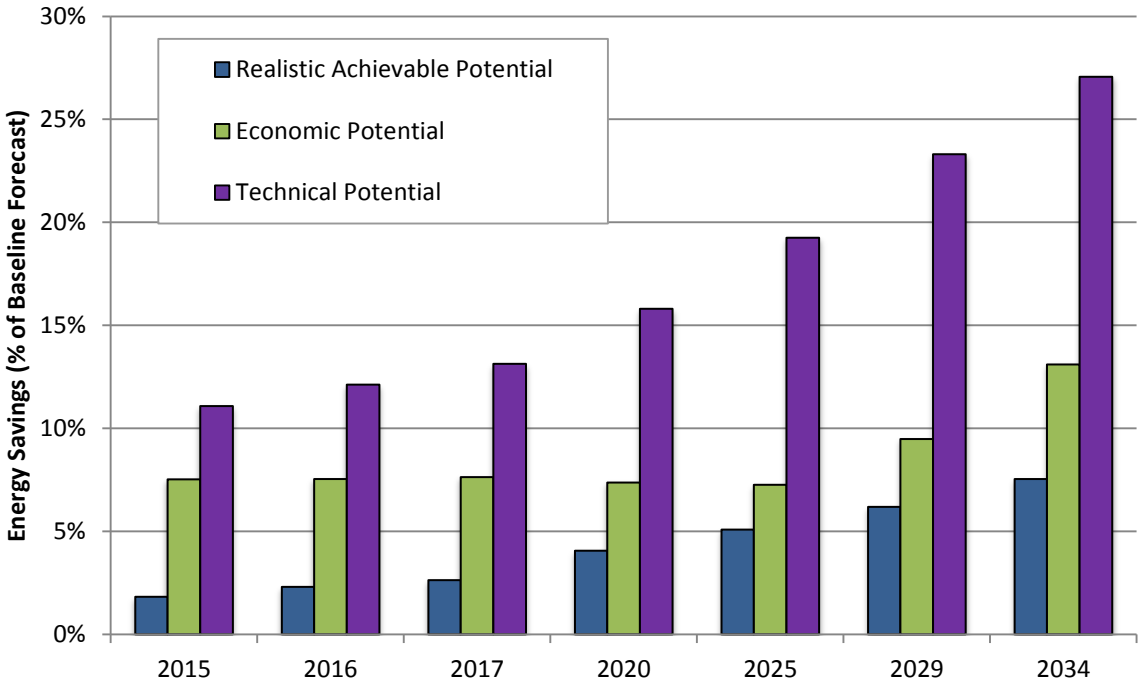
Table 6-1 presents estimates for the three types of energy savings potential for the residential electricity sector. Figure 6-1 depicts these potential energy savings estimates graphically.

- **Realistic Achievable potential** projects 473 GWh of energy savings in 2034, or 7.5% of the baseline forecast at that time.
- **Economic potential,** which reflects a theoretical limit to savings when all cost-effective measures are taken, is 820 GWh in 2034, representing 13.1% of the baseline energy forecast.
- **Technical potential,** which reflects the adoption of all DSM measures regardless of cost, is a theoretical upper bound on savings. By 2034, technical potential reaches 1,695 GWh, 27.1% of the baseline energy forecast.

Table 6-1 DSM Energy Savings Potential for the Residential Sector

	2015	2016	2017	2020	2025	2029	2034
Baseline Forecast (GWh)	5,263	5,326	5,365	5,500	5,744	5,966	6,266
Cumulative Savings (GWh)							
Realistic Achievable	96	123	141	223	292	369	473
Economic Potential	396	401	410	405	417	565	820
Technical Potential	583	645	704	869	1,106	1,391	1,695
Energy Savings (% of Baseline)							
Realistic Achievable	1.8%	2.3%	2.6%	4.1%	5.1%	6.2%	7.5%
Economic Potential	7.5%	7.5%	7.6%	7.4%	7.3%	9.5%	13.1%
Technical Potential	11.1%	12.1%	13.1%	15.8%	19.2%	23.3%	27.1%

Figure 6-1 Residential DSM Energy Savings Potential



Residential Electric Potential by End Use

Figure 6-2 focuses on the end-use break out for residential energy savings in 2034 under the Realistic Achievable Potential case. Lighting equipment replacements account for the highest portion of the energy savings, while cooling, heating, and water heating measures also make substantial contributions. Figure 6-3 shows the residential Realistic Achievable peak demand potential in 2034 by end use. It shows how cooling contributes the lion's share of savings because it is most peak coincident. Figure 6-4 and Figure 6-5 show how the cumulative energy and peak demand potential evolve by end use over time.

The key measures comprising the potential are listed below:

- Lighting: CFL lamps and specialty bulbs in the near term, but LED lamps going forward. While LED technologies are just becoming cost-effective, historic and forward-looking research indicates that performance and cost trends will continue to improve dramatically. We have incorporated these trends in our modeling and show that lighting opportunities will become dominated by LED lamps over the next 20 years.
- Demand Response: Direct load control of central air conditioning equipment is a prominent measure in the portfolio of peak demand savings.
- Removal of second refrigerator
- HVAC: efficient air conditioners, ducting repair/sealing, insulation, behavioral programs and programmable thermostats
- Water heating: efficient water heaters, low-flow showerheads, and faucet aerators.

Figure 6-2 Residential Realistic Achievable Potential by End Use in 2034 (Energy Savings)

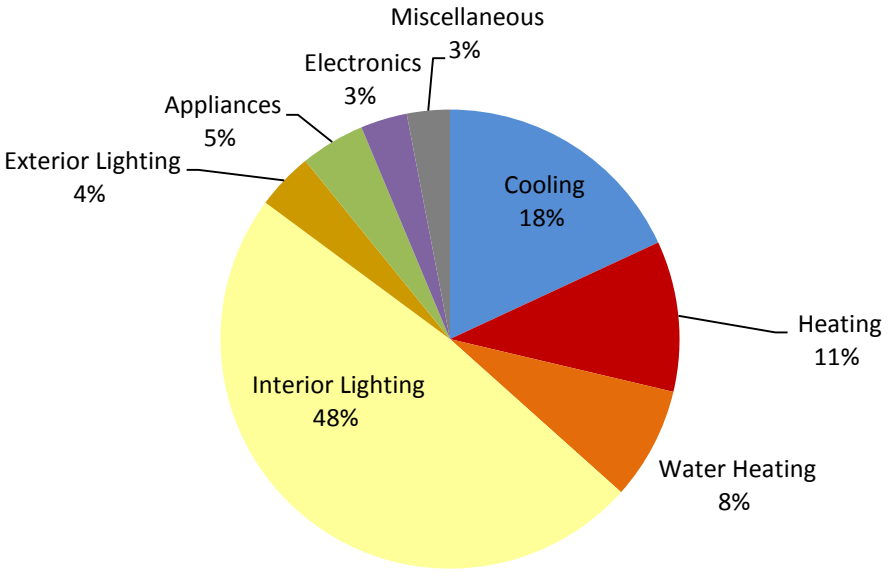


Figure 6-3 Residential Realistic Achievable Potential by End Use in 2034 (Peak Savings)

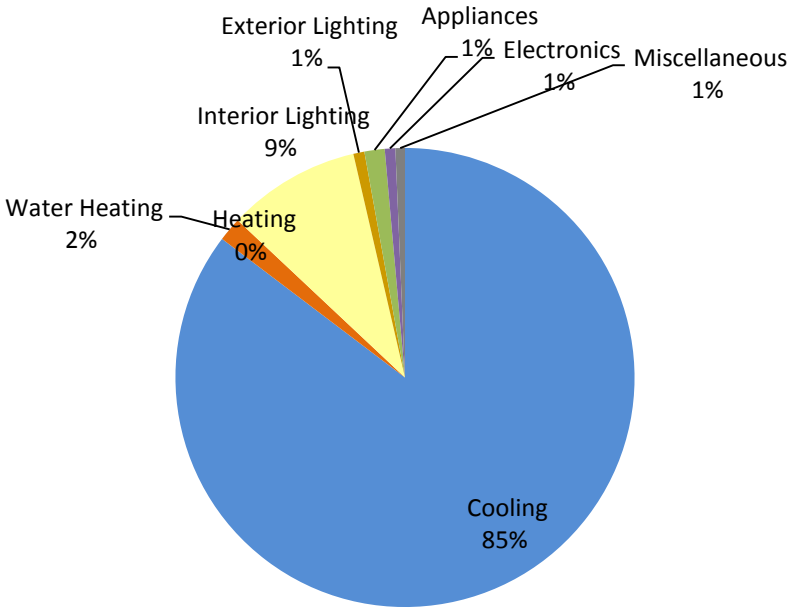


Figure 6-4 Residential % of Cumulative Achievable Energy Savings Potential by End Use Over Time

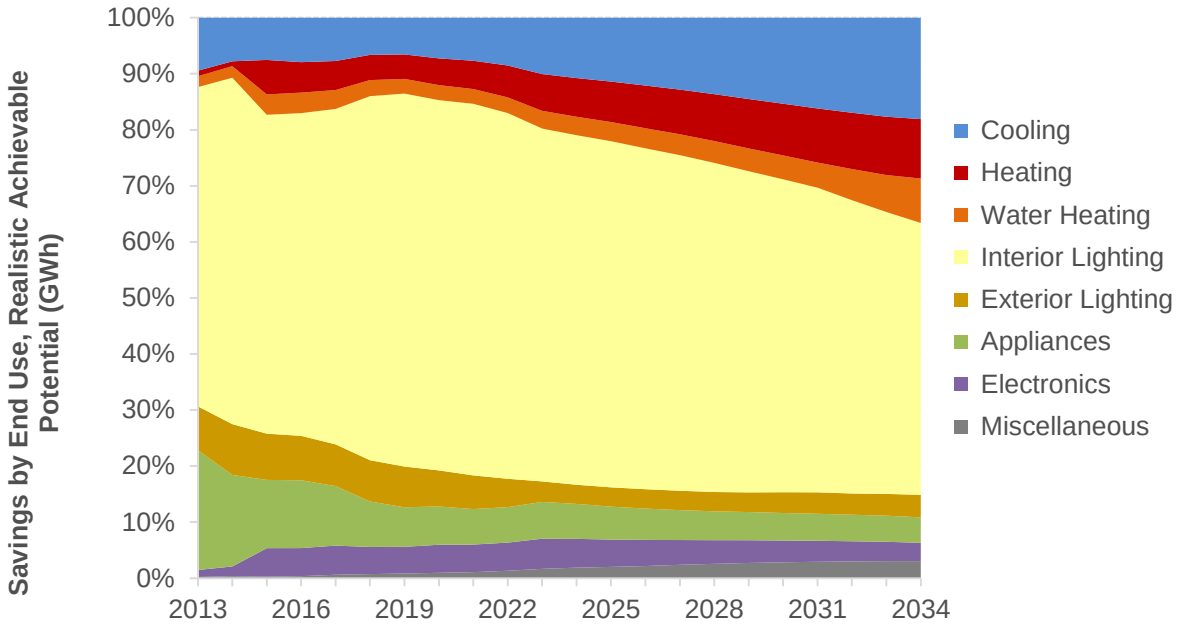
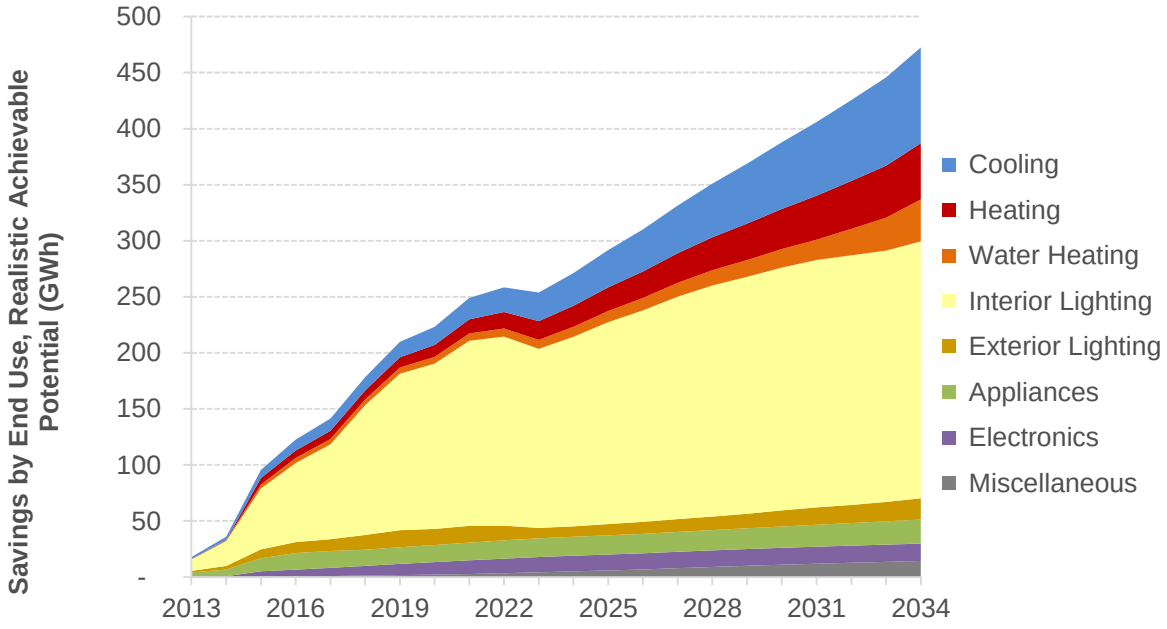


Figure 6-5 Residential Cumulative Achievable Energy Savings Potential by End Use Over Time (GWh)



Commercial DSM Potential

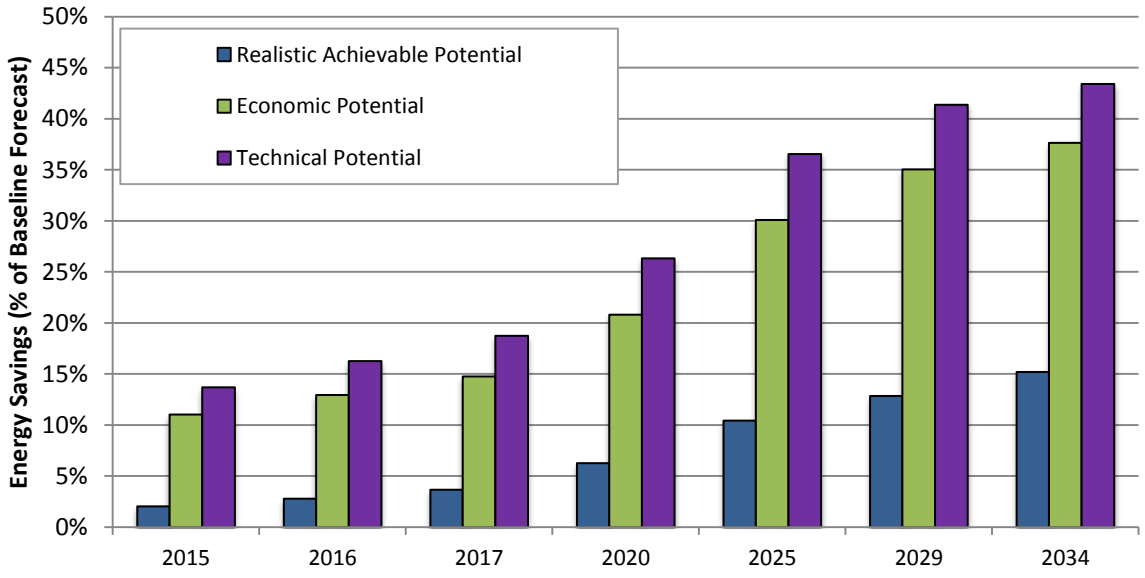
The commercial sector accounts for 36% of energy consumption, making for prime efficiency opportunities. Table 6-2 presents estimates for the three types of potential for the commercial electricity sector. Figure 6-6 depicts these potential energy savings estimates graphically.

- **Realistic Achievable potential** projects 870 GWh of energy savings in 2034, or 15.2% of the baseline forecast at that time.
- **Economic potential,** which reflects a theoretical limit to savings when all cost-effective measures are taken, is 2,154 GWh in 2034, representing 37.6% of the baseline energy forecast.
- **Technical potential,** which reflects the adoption of all DSM measures regardless of cost, is a theoretical upper bound on savings. By 2034, technical potential reaches 2,484 GWh, 43.4% of the baseline energy forecast.

Table 6-2 DSM Energy Savings Potential for the Commercial Sector

	2015	2016	2017	2020	2025	2029	2034
Baseline Forecast (GWh)	4,984	5,040	5,102	5,322	5,582	5,634	5,722
Cumulative Savings (GWh)							
Realistic Achievable	101	141	187	333	583	724	870
Economic Potential	550	652	752	1,107	1,679	1,973	2,154
Technical Potential	682	820	956	1,400	2,040	2,330	2,484
Energy Savings (% of Baseline)							
Realistic Achievable	2.0%	2.8%	3.7%	6.3%	10.4%	12.9%	15.2%
Economic Potential	11.0%	12.9%	14.7%	20.8%	30.1%	35.0%	37.6%
Technical Potential	13.7%	16.3%	18.7%	26.3%	36.5%	41.4%	43.4%

Figure 6-6 Commercial DSM Energy Savings Potential



Commercial Potential by End Use

Figure 6-7 focuses on achievable potential savings by end use. Not surprisingly, interior lighting delivers the highest achievable savings throughout the study period. In 2034, exterior lighting is

second, and cooling is third. Figure 6-8 shows the peak demand potential in 2034. Cooling and lighting end uses hold the largest shares of peak coincident demand savings. Figure 6-9 and Figure 6-10 show how cumulative energy and peak demand potential evolves by end use over time.

The key measures comprising the potential are listed below:

- Lighting – LED lamps in screw-in, linear fluorescent, and high-bay style applications. While LED technologies are just becoming cost-effective, historic and forward-looking research indicates that performance and cost trends will continue to improve. We have incorporated these trends in our modeling and show that lighting opportunities will become dominated by LED lamps over the next 20 years.
- Cooling, HVAC, and Ventilation equipment replacements and controls/optimizations (e.g. variable speed controls)
- Energy management systems
- Refrigeration – efficient equipment, control systems, decommissioning

Figure 6-7 Commercial Realistic Achievable Potential by End Use in 2034 (Energy Savings)

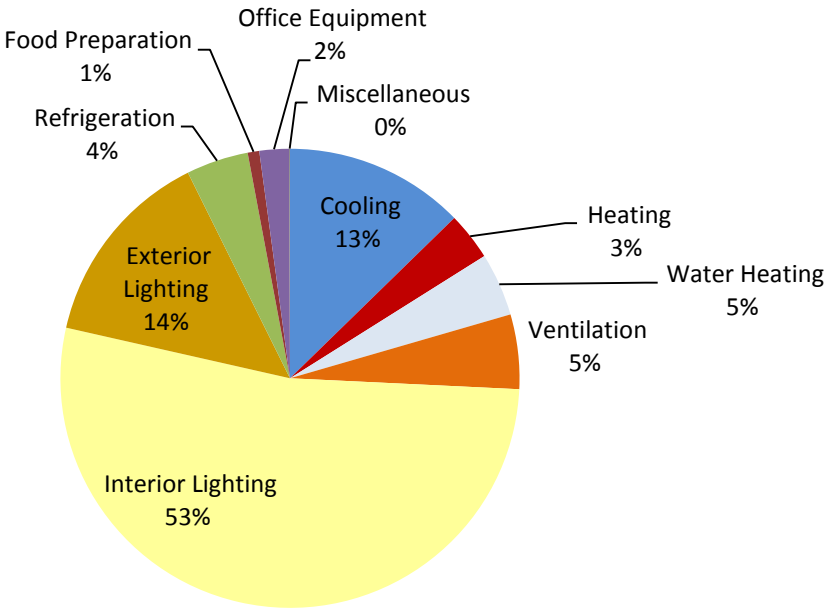


Figure 6-8 Commercial Realistic Achievable Potential by End Use in 2034 (Peak Savings)

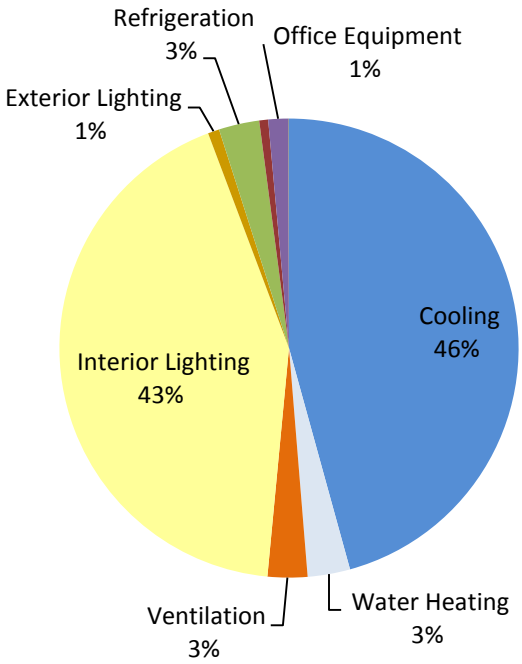


Figure 6-9 Commercial % of Cumulative Achievable Energy Savings Potential by End Use in 2034

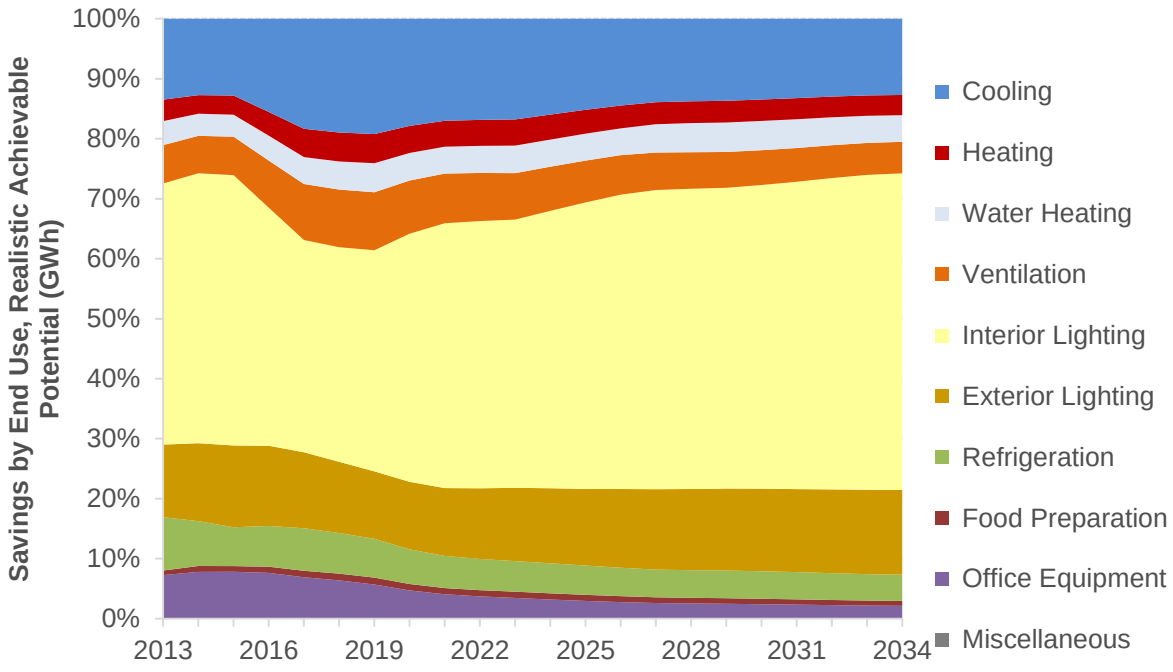
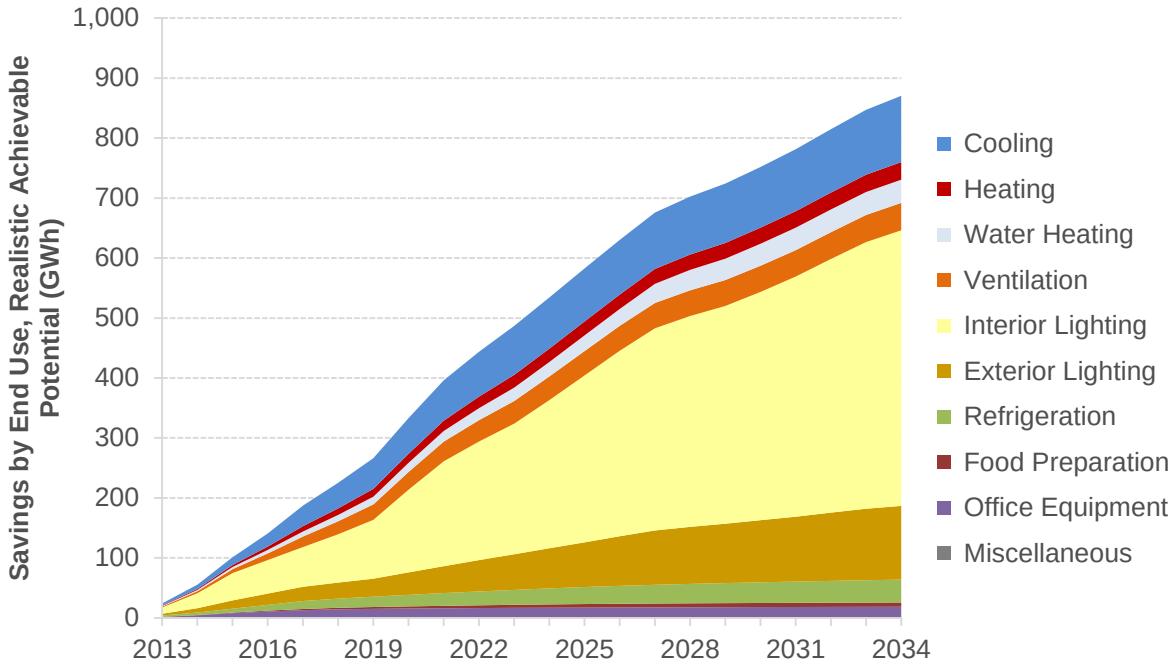


Figure 6-10 Commercial Cumulative Achievable Energy Savings Potential by End Use in 2034 (GWh)



Industrial Electricity Potential

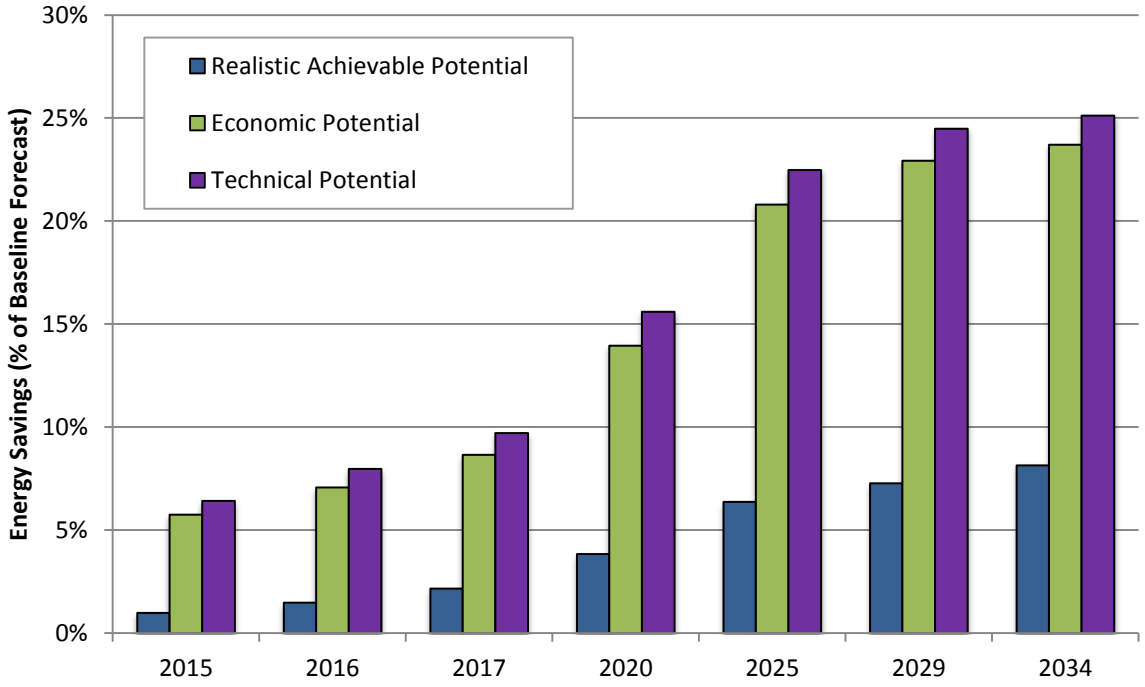
The IPL industrial sector accounts for 27% of total energy consumption. Table 6-3 and Figure 6-11 present the savings for the various types of potential considered in this study.

- **Realistic Achievable potential** projects 322 GWh of energy savings in 2034, or 8.1% of the baseline forecast at that time.
- **Economic potential,** which reflects a theoretical limit to savings when all cost-effective measures are taken, is 937 GWh in 2034, representing 23.7% of the baseline energy forecast.
- **Technical potential,** which reflects the adoption of all DSM measures regardless of cost, is a theoretical upper bound on savings. By 2034, technical potential reaches 993 GWh, 25.1% of the baseline energy forecast.

Table 6-3 DSM Energy Savings Potential for the Industrial Sector

	2015	2016	2017	2020	2025	2029	2034
Baseline Forecast (GWh)	3,785	3,820	3,851	3,899	3,934	3,926	3,952
Cumulative Savings (GWh)							
Realistic Achievable	37	56	83	150	251	285	322
Economic Potential	217	270	333	544	818	900	937
Technical Potential	243	305	374	608	884	961	993
Energy Savings (% of Baseline)							
Realistic Achievable	1.0%	1.5%	2.2%	3.8%	6.4%	7.3%	8.1%
Economic Potential	5.7%	7.1%	8.7%	13.9%	20.8%	22.9%	23.7%
Technical Potential	6.4%	8.0%	9.7%	15.6%	22.5%	24.5%	25.1%

Figure 6-11 Industrial DSM Energy Savings Potential



Industrial Potential by End Use

Figure 6-12 illustrates the achievable potential savings by electric end use in 2034 for the industrial sector. The largest shares of savings opportunities are in lighting and motors. For fluorescent lighting, efficient T5s and T8s transition to LEDs as the study progresses. For motors, potential savings for equipment replacements at end-of-life have been effectively eliminated due to the National Electrical Manufacturer's Association (NEMA) standards, which now mandate premium efficiency motors as the baseline efficiency unit. As a result, potential savings are incrementally small to upgrade to even more efficient levels. Many of the savings opportunities in this end use come from controls, timers, and variable speed drives, which improve system efficiencies where motors are utilized. Figure 6-13 shows the peak coincident end uses with the majority in cooling, followed by lighting and motors. Figure 6-14 and Figure 6-15 show how cumulative energy and peak demand potential evolve by end use over time.

The key measures comprising the potential are listed below:

- Efficient lighting technologies, primarily LED, for screw-in, fluorescent-style, high-bay, and HID applications
- Motor drives and controls, optimization
- Process timers and controls
- Application of optimization and controls for fans, pumps, compressed air
- Energy management systems & programmable thermostats

Figure 6-12 Industrial Realistic Achievable Potential by End Use in 2034 (Energy Savings)

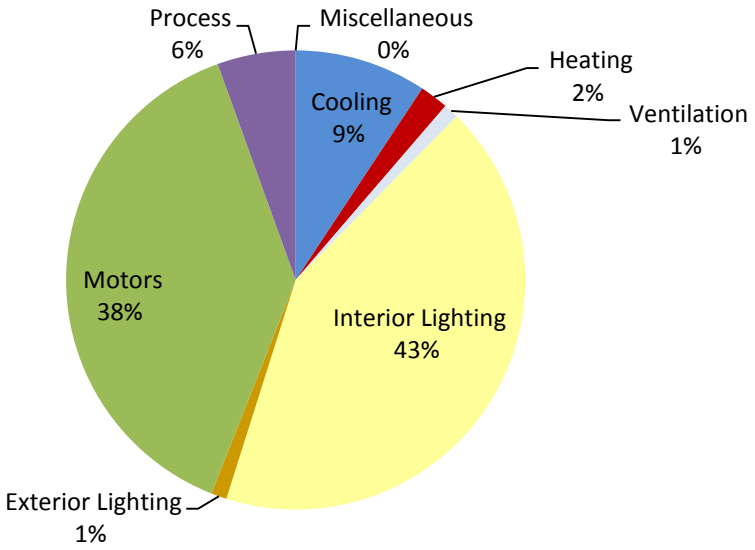


Figure 6-13 Industrial Realistic Achievable Potential by End Use in 2034 (Peak Savings)

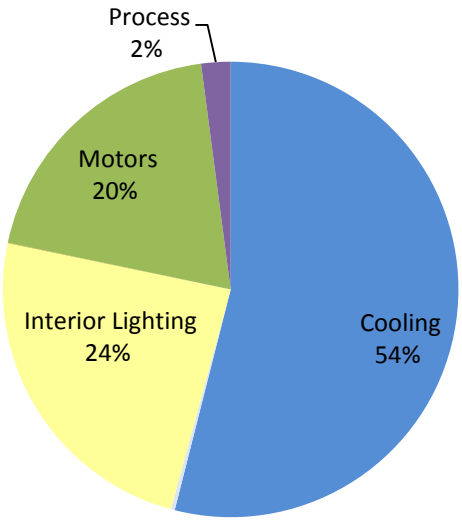


Figure 6-14 Industrial % of Cumulative Achievable Energy Savings Potential by End Use in 2034

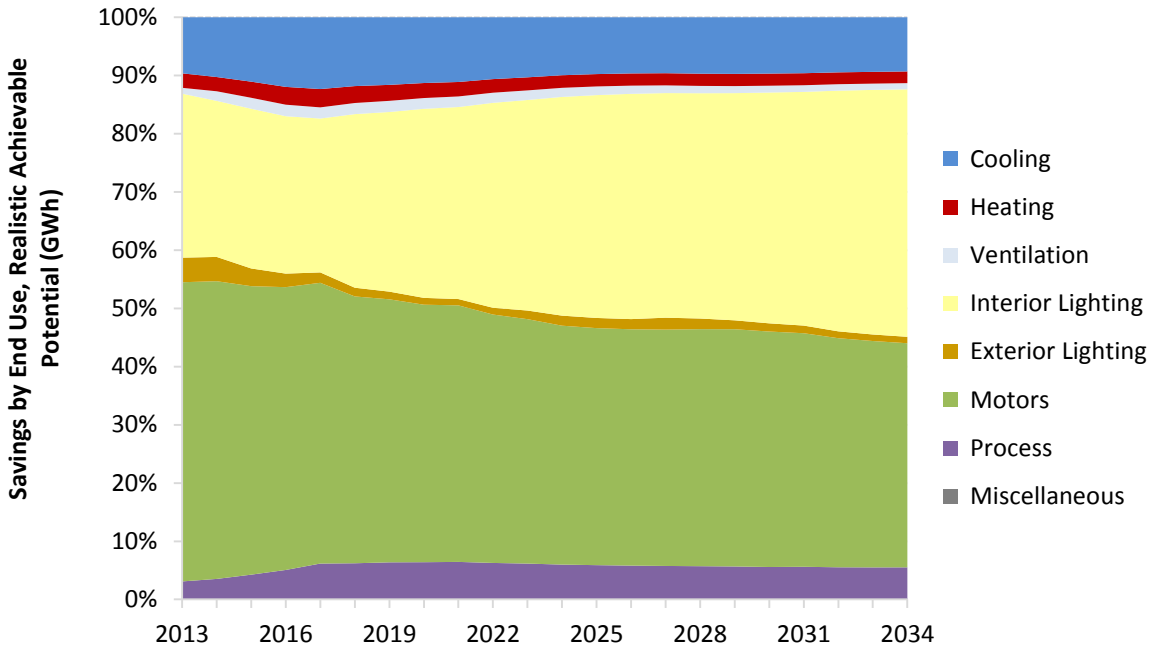
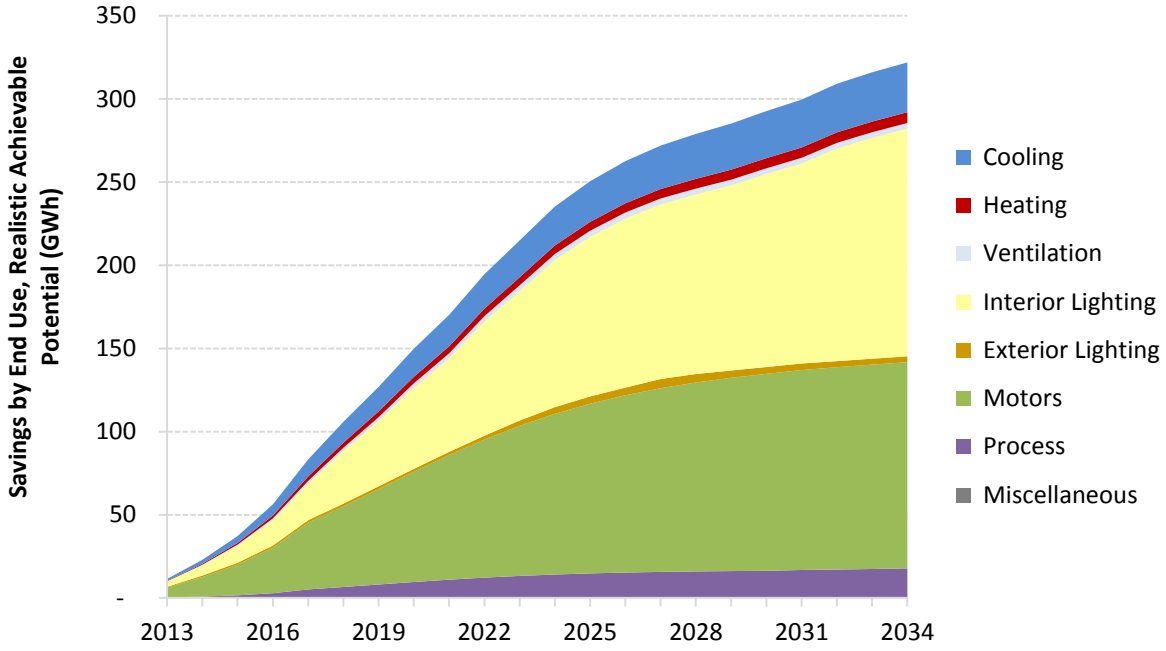


Figure 6-15 Industrial Cumulative Achievable Energy Savings Potential by End Use in 2034 (GWh)



Calibration to Filed 2015-2017 IPL DSM Action Plan

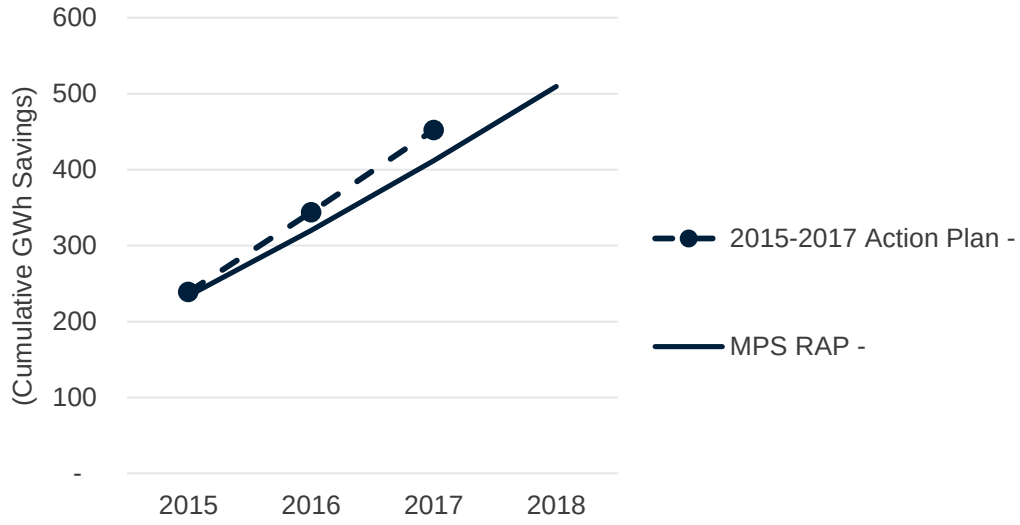
As mentioned in Chapter 2, this analysis also included a step to calibrate participation, savings, and spending levels to those filed in IPL's 2015-2017 Action Plan[3]. The 2015-2017 DSM Action Plan is based on the best available information from IPL programs currently in the field, as well as appropriate benchmarking information for comparable utility DSM programs. The implication is that we adjusted the participation rates, incentive amounts, and administrative cost assumptions that were in the 2012 MPS to be more specifically aligned with IPL past efforts and projected activity.

Another result of this calibration is that this analysis implicitly includes current opt-out levels of large commercial and industrial customers. In the 2015-2017 Action Plan, the planned levels for C&I programs were reduced relative to planned levels of Residential program activity in order to match current levels of program activity and reflect the amount of C&I customer load that had chosen to opt out of DSM programs. Aligning to the Action Plan means that these participation assumptions are incorporated into the DSM potential forecasts as they continue beyond 2017. This appendix shows the results of the calibration process.

The calibration was conducted on the separate but interconnected variables of energy savings, peak demand savings, and program budget; all of which underwent changes to their bottom-up composition in the modeling as described in previous sections, so an exact match with the 2015-2017 DSM Action Plan was neither obtainable nor required.

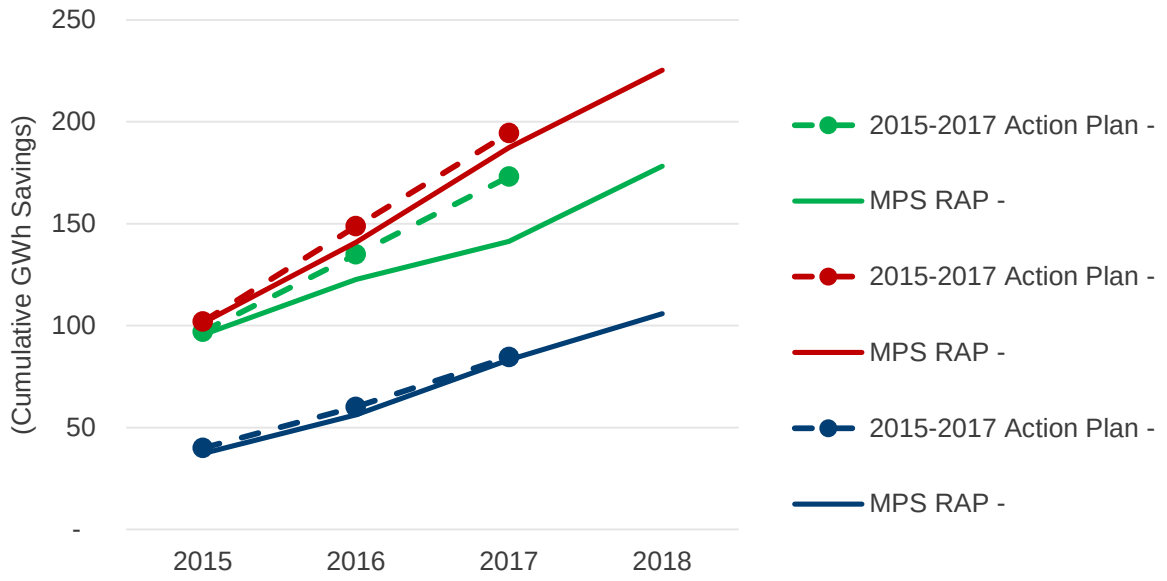
As shown in Figure A-1 and Figure A-2 below, the DSM Potential Forecasts of energy from the current analysis are a close match to the dotted line of the Action Plan for overlapping years. The first figure illustrates the calibration at the overall portfolio level, while the second shows the sector breakdown. The alignment was obtained by applying a constant scalar factor to participation levels in all years such that all measures within a given sector would align with the Action Plan. We then projected these trends into the future to 2034, which is the timeframe required for support of IPL's integrated resource planning process.

Figure A-1 Comparison of DSM Potential Forecast (RAP) and 2015-2017 Action Plan – Energy



[3] See Petitioners Exhibit ZE-2, Cause No. 44497 as filed on May 30, 2014.

Figure A-2 Comparison of DSM Potential Forecast (RAP) and 2015-2017 Action Plan - Energy by Sector



As shown in Figure A-3 and Figure A-4 below, the DSM Potential Forecasts for peak MW from the current study are a close match to the dotted lines of the Action Plan for overlapping years. We then projected these trends into the future to 2034, which is the timeframe required for support of IPL's integrated resource planning process. The first figure illustrates the calibration at the overall portfolio level, while the second shows the sector breakdown.

Figure A-3 Comparison of DSM Potential Forecast (RAP) and 2015-2017 Action Plan – Peak Demand

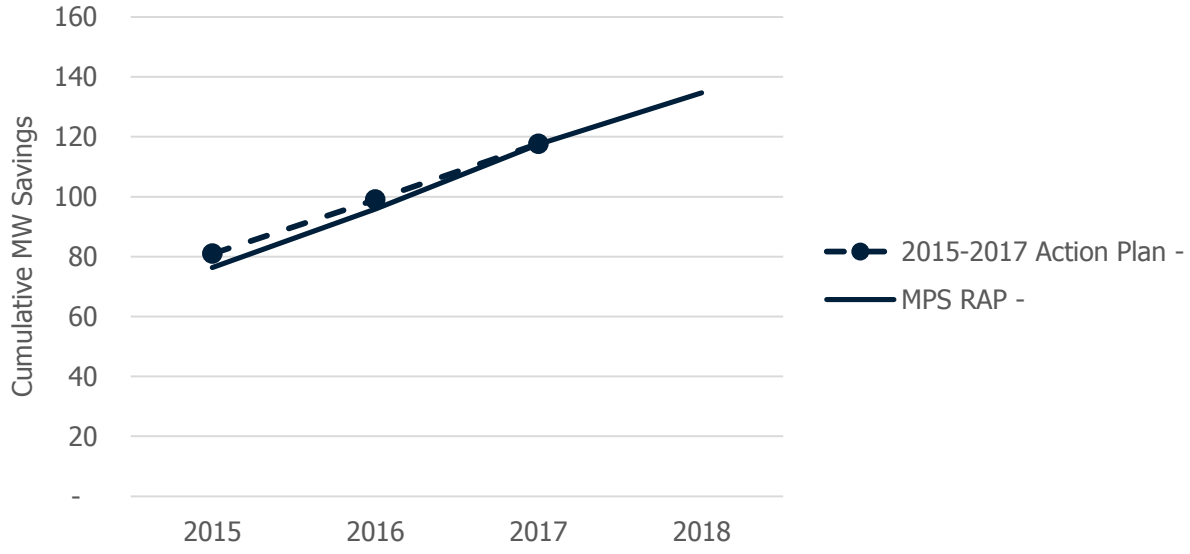
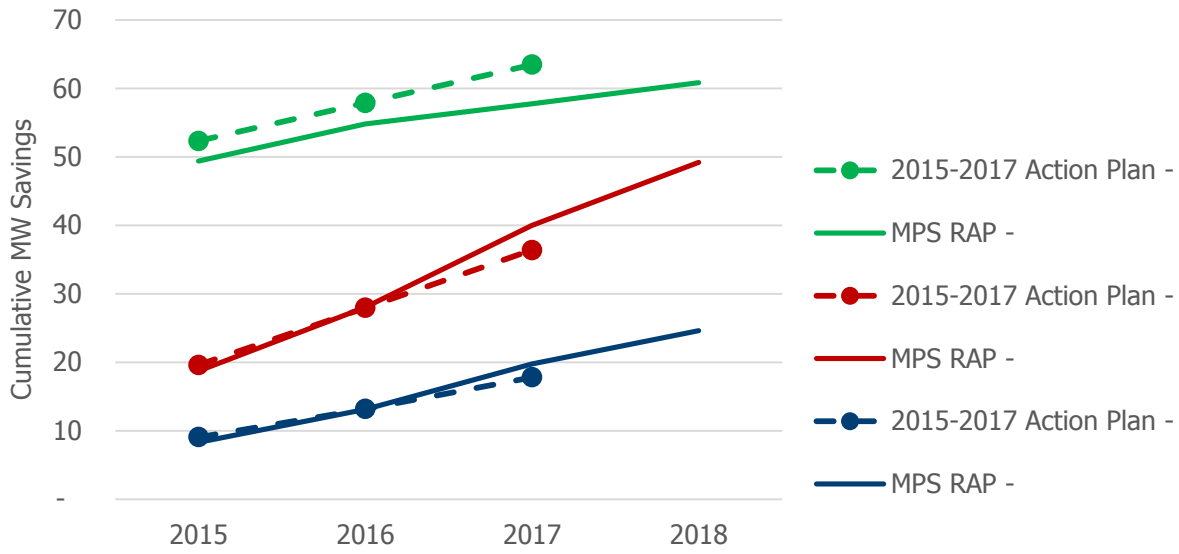


Figure A-4 Comparison of DSM Potential Forecast (RAP) and 2015-2017 Action Plan – Peak Demand by Sector



Finally, as shown in Figure A-5 and Figure A-6 below, utility budgets for the current study are also a close match to the Action Plan for overlapping years. We then project these trends into the future. The first figure illustrates the calibration at the overall portfolio level, while the second shows the sector breakdown. The figures represents a three-year moving average for spending to smooth some of the spikes introduced as an artifact of the modeling process. Dollar figures are given in real terms as of the study base year (2011).

Figure A-5 Comparison of DSM Potential Forecast (RAP) and 2015-2017 Action Plan – Utility Budget

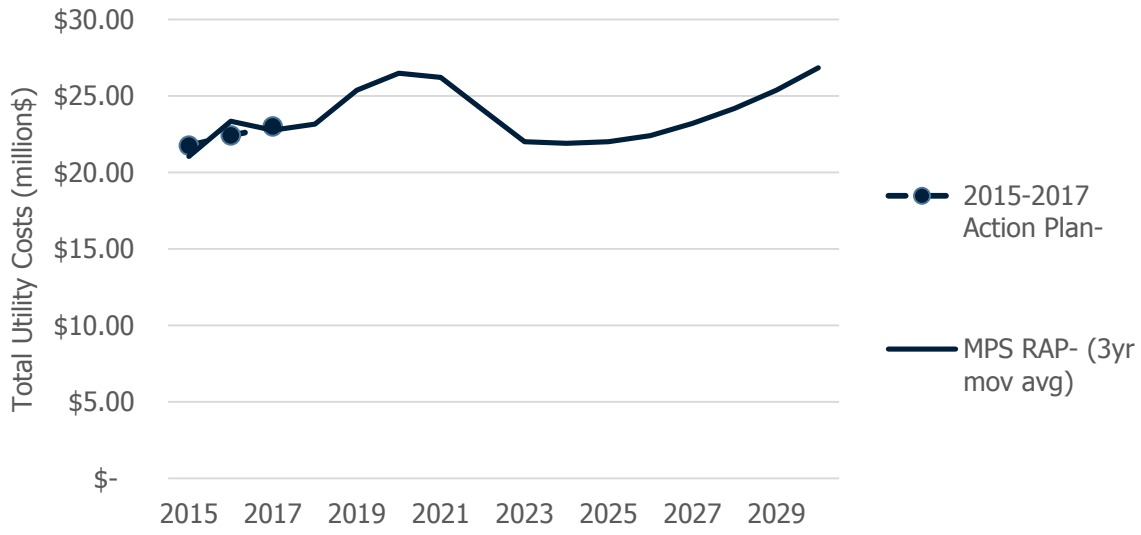


Figure A-6 Comparison of DSM Potential Forecast (RAP) and 2015-2017 Action Plan – Utility Budget by Sector

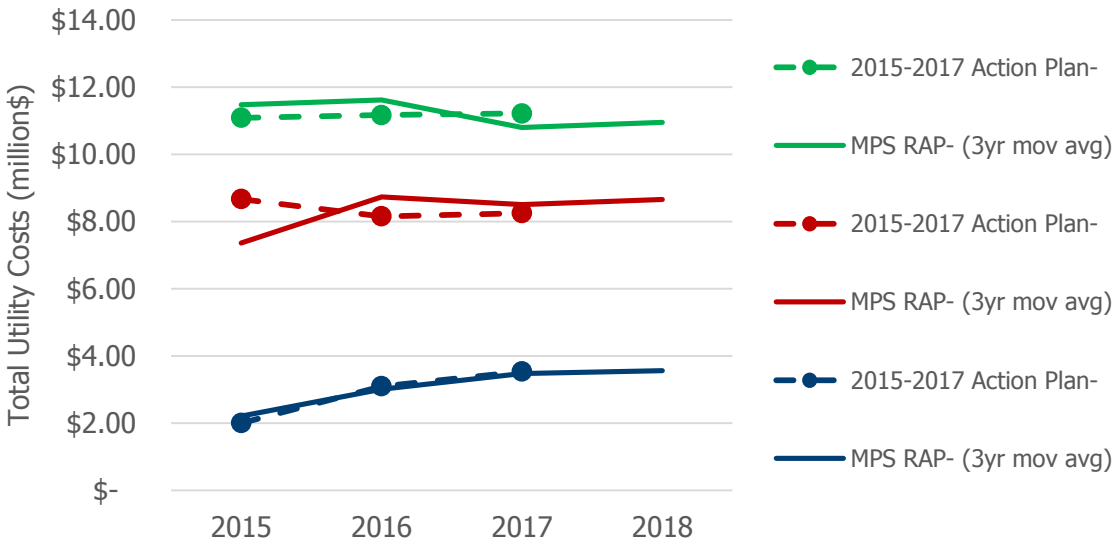
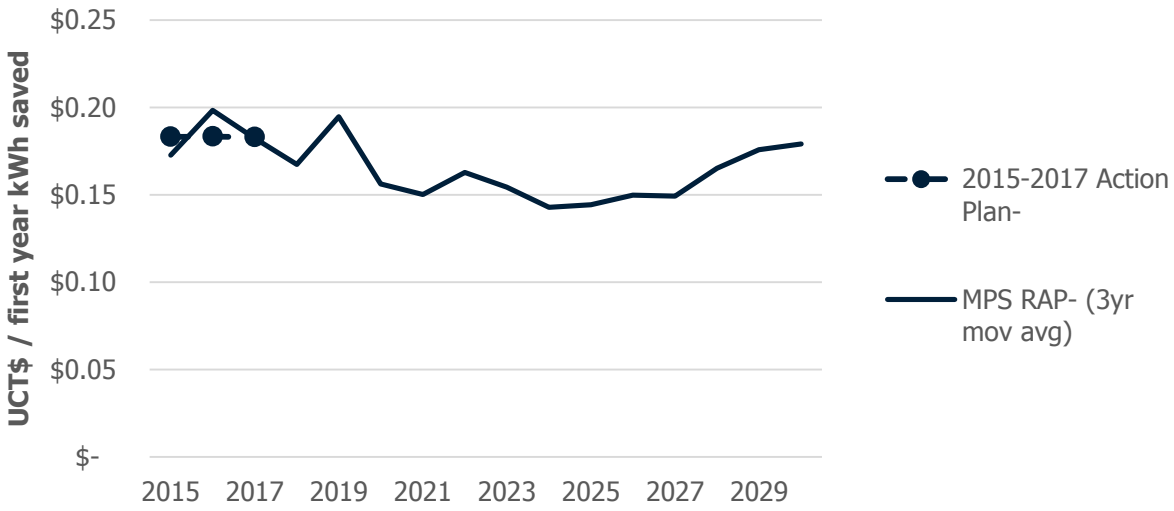


Figure A-7 below provides a view of the utility spending on a per-unit basis, where the unit is the number of kWh savings in the first year from newly installed measures. The utility budget consists of all program spending, including incentives and non-incentive or administrative costs. The data below represents a 3-year moving average of Utility Cost per first-year kWh saved, again to smooth some of the spikes introduced as an artifact of the modeling process. Dollar figures are given in real terms as of the study base year (2011).

Figure A-7 Comparison of DSM Potential Forecast (RAP) and 2015-2017 Action Plan – Utility Budget per First Year kWh Saved



Interpretation of this metric ($/first-year-kWh-saved) is subject to the following caveats: This metric includes programs with both short lives (like behavioral programs at 1 year) and long lives (like building shell or LED measures at 15+ years), so lifetime effects are difficult to gauge from first-year spending alone. Also, this metric includes spending on demand response programs, whose productivity is aimed at peak kW reductions rather than kWh energy reductions. It is an imperfect metric, but we note that the overall projections represent a rate and productivity of spending that is relatively stable over the 20 year time horizon.

Annual Forecast Savings and Program Budgets

Table B-1 below shows the annual values for net cumulative energy savings, net cumulative peak demand savings, and the total utility program costs. Program costs are given in real terms as of the study base year (2011) on a 3-year moving average basis as explained in Appendix A above.

Table BB-1 Annual Forecast Savings and Program Budgets

	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
Net Cumulative Energy Savings (GWh)																						
Residential	18	36	96	123	141	178	210	223	249	258	254	271	292	310	331	351	369	388	406	426	446	473
Commercial	24	56	101	141	187	225	266	333	396	444	487	534	583	630	676	702	724	752	781	815	847	870
Industrial	11	23	37	56	83	106	127	150	170	195	215	235	251	263	272	279	285	293	300	309	316	322
TOTAL	**53**	**114**	**234**	**320**	**412**	**509**	**603**	**706**	**815**	**897**	**955**	**1,041**	**1,125**	**1,203**	**1,279**	**1,332**	**1,378**	**1,432**	**1,487**	**1,549**	**1,609**	**1,665**
Net Cumulative Peak Demand Savings (MW)																						
Residential	4	6	49	55	58	61	66	69	74	78	82	87	92	98	105	113	120	128	137	145	154	164
Commercial	5	10	19	28	40	49	59	72	84	94	103	110	118	125	132	137	141	146	150	156	161	165
Industrial	2	5	8	13	20	25	29	34	38	43	47	50	53	55	57	59	60	62	63	65	66	67
TOTAL	**10**	**21**	**76**	**96**	**117**	**135**	**154**	**175**	**197**	**215**	**231**	**248**	**263**	**279**	**295**	**308**	**322**	**336**	**350**	**366**	**382**	**396**
Total Utility Program Cost ($Millions, 3-year moving average)[4]																						
Residential	*N/A*	*N/A*	$11.48	$11.61	$10.80	$10.95	$12.74	$12.63	$11.86	$10.65	$9.52	$9.54	$9.71	$9.99	$10.80	$11.67	$12.97	$13.80	$14.80	$16.10	$18.13	$19.42
Commercial	*N/A*	*N/A*	$7.36	$8.73	$8.51	$8.66	$9.29	$10.54	$10.83	$9.90	$8.88	$8.95	$9.02	$9.15	$9.16	$9.25	$9.32	$9.82	$10.60	$11.62	$12.34	$12.80
Industrial	*N/A*	*N/A*	$2.21	$3.01	$3.47	$3.56	$3.36	$3.33	$3.54	$3.55	$3.60	$3.42	$3.29	$3.28	$3.25	$3.28	$3.09	$3.23	$3.50	$4.05	$4.38	$4.59
TOTAL	***N/A***	***N/A***	**$21.05**	**$23.36**	**$22.78**	**$23.17**	**$25.39**	**$26.50**	**$26.23**	**$24.11**	**$22.01**	**$21.92**	**$22.02**	**$22.42**	**$23.20**	**$24.20**	**$25.39**	**$26.85**	**$28.90**	**$31.78**	**$34.85**	**$36.81**

[4] Dollars are in real terms as of the study base year (2011).

About Applied Energy Group (AEG)

Founded in 1982, AEG is a multi-disciplinary technical, economic and management consulting firm that offers a comprehensive suite of demand-side management (DSM) services designed to address the evolving needs of utilities, government bodies, and grid operators worldwide. Hundreds of such clients have leveraged our people, our technology, and our proven processes to make their energy efficiency (EE), demand response (DR), and distributed generation (DG) initiatives a success. Clients trust AEG to work with them at every stage of the DSM program lifecycle – assessing market potential, designing effective programs, supporting the implementation of the programs, and evaluating program results.

The AEG team has decades of combined experience in the utility DSM industry. We provide expertise, insight and analysis to support a broad range of utility DSM activities, including: potential assessments; end-use forecasts; integrated resource planning; EE, DR, DG, and smart grid pilot and program design and administration; load research; technology assessments and demonstrations; project reviews; program evaluations; and regulatory support.

Our consulting engagements are managed and delivered by a seasoned, interdisciplinary team comprised of analysts, engineers, economists, business planners, project managers, market researchers, load research professionals, and statisticians. Clients view AEG's experts as trusted advisors, and we work together collaboratively to make any DSM initiative a success.

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