APPENDIX B
Quantified Savings Metrics within the Local Government Sector

A Technical Appendix to the Local Government Action Plan, a Component of the California Energy Efficiency Strategic Plan

Discussion Draft

October 3, 2014

Prepared for: Energy Division
California Public Utilities Commission

Prepared by: Navigant in collaboration with
Tierra Resource Consultants

Study Contributors

Study Consultant: Navigant
1990 N. California Blvd.
Suite 700
Walnut Creek, CA 94596
925.930.2500

Study Author: Floyd Keneipp (formerly of Navigant)
Tierra Resource Consultants
1200 Mount Diablo Blvd.
Suite 208
Walnut Creek, CA 94596
925.954.7363
Floyd.Keneipp@TierraRC.com

Lead Agency Contact: Energy Division of the California Public Utilities Commission
Jeremy Battis
505 Van Ness Avenue
San Francisco, CA 94110
415.703.3011
jeremy.battis@cpuc.ca.gov

Project Advisor: Joseph Oldham
Local Government EE Best Practices Coordinator
SEEC - Local Government Commission
505 Van Ness Avenue
San Francisco, CA 94110
559.797.6034
joldham@lgc.org

Contents

Project Overview

This technical paper provides a summary of the energy efficiency metrics that Navigant ("the consultant") prepared for the 2013 update to the Strategic Plan Local Government chapter.[1] This paper is the result of research the consultant began in late 2013 when it was asked to develop energy savings metrics using the potential model developed for the 2013 Energy Efficiency Potential and Goals Study (PGT). The consultant engaged various stakeholders to develop a methodological framework, including local governments, utilities, Regional Energy Networks (RENs), associations of local governments, and CPUC staff. Over the course of several months, stakeholders provided input about the methodology and alignment of these metrics with the goals outlined in the Strategic Plan. Where possible, the results presented here incorporate that input.

The consultant developed metrics for Goals 1, 3, and 4 outlined in the Local Government chapter update for the Strategic Plan. The remainder of this memo defines those metrics and provides some context about the values presented here. The consultant did not develop a metric for Goal 2[2] because metrics for that goal did not align with the Potential and Goals Study model used for this effort. Additionally, The consultant reviewed other data sources and literature to assess where potential for energy efficiency savings might exist that was not captured in the 2013 potential model, and is providing information on the nature and magnitude of those savings. It is recognized that there may be additional savings potential not captured in this technical paper that could be addressed through local government efforts.

Summary of Findings

The following provides a summary of key research findings;

- Table 1 provides the forecasted incremental annual EE market potential for Goals 1, 3, and 4. These goals indicate the potential exists to reduce electricity consumption in local government operated buildings by approximately 16% to 20%. This represented an estimated total reduction in annual LG electricity consumption of approximately 9% to 12%.

Table 1. Local Government Strategic Plan Update Incremental Market EE Potential, by Goal (GWh)

Year	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Goal 1	29.6	30.9	29.1	20.9	23.4	27.1	30.6	34.3	37.8	41.4
Goal 3	32.6	56.8	32.1	22	18.3	13	7.1	3.6	1.7	1.1
Goal 4	7.4	7.7	7.3	5.2	5.8	6.8	7.7	8.6	9.4	10.3
Total	69.7	95.4	68.5	48.1	47.5	46.9	45.3	46.4	48.9	52.8

[1] The Strategic Plan Local Government chapter remains a work in progress. Although near completion, it is awaiting finalization of the remaining chapters of the updated Plan. Thus, for 2015 the Energy Division has initiated a Local Government Action Plan document that serves much the same purpose as the chapter, but is expected to be implemented perhaps as much as one year sooner.

[2] Goal 2 reads, "Local governments lead their communities with innovative plans and programs for energy efficiency that fit with broader energy, sustainability, and climate goals."

- The 2013 potential model indicates that the market potential exists to reduce total annual electricity consumed by street lighting by approximately 45% through a blend of technologies including LED and induction lamps, and advanced controls. The value of these savings to local governments depends largely on whether streetlights are owned by the local government or the utility. Table 2 show the distribution of street light ownership by utility territory, based on lamp count, and indicates that LGs who are customers of PG&E and SDG&E stand to gain the most by installing efficient street lighting, while LGs who are customers of SCE do not have as much potential for energy savings because most streetlights are operated by the utility. Overall, the potential exists to reduce annual local government sector electricity consumption by about 7%. This potential is not included in the goals metrics forecast in Table 1.

Table 2. Street Lighting Ownership, by Lamp Count

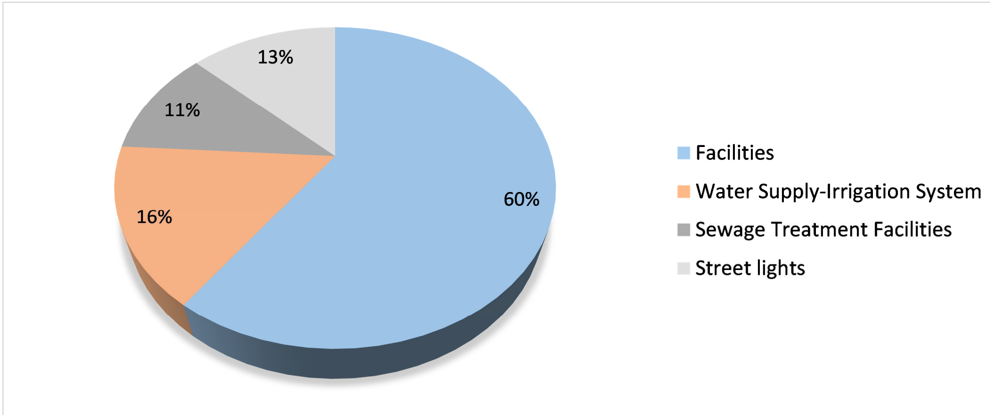
IOU	IOU-Owned	Customer-Owned
Statewide	57.1%	42.9%
PG&E	26.3%	73.7%
SCE	82.4%	17.6%
SDG&E	19.0%	81.0%

- Most drinking/irrigation water supply and waste water treatment facilities[3] are owned and operated by local governments[4]. The potential for municipal water operations was not addressed in the 2013 potential model, however research conducted for this technical paper indicates that nearly 27% of energy consumed by LGs in the PG&E service territory is associated with municipal water operations, as shown in Figure 1. It is likely to be a similar portion of consumption for LGs operating in SCE and SDG&E territories, though data for those utilities was not reviewed to confirm this. The consultant completed a review of secondary literature that indicates that the potential exists to reduce energy consumed for waste water treatment and drinking water supply by about 4.3% through energy efficiency measures, which represents a reduction of 1.2% of total annual LG energy consumption. It is recommended that the long term potential for energy efficiency in municipal water facilities be the subject of further research. This potential is not included in the goals metrics forecast in Table 1.

[3] Drinking/irrigation water supply and waste water treatment facilities are collectively referred to as 'municipal water operations'

[4] About 91% of energy consumed by drinking water supply and waste water treatment facilities in the PG&E service territory are accounts owned by city governments, with the remainder operated by counties.

Figure 1. 2012 PG&E Local Government Electric Energy Sales Distribution by System



Methodology

The following section provides the methodologies used to establish energy efficiency metrics and goals for the update to the local government chapter of the strategic plan and includes the following discussions;

1. Stakeholder Engagement Process
2. Methodology for Estimating LG Baseline Consumption
3. Methodology for Estimating Energy Efficiency Metrics

Stakeholder Engagement Process

Project planning occurred in October 2013 and included defining the method to estimate baseline energy usage for local governments, and the methodology to be used for estimating potential for Goals 1, 2, and 3. Three stakeholder engagements were conducted during November and December 2013, which included the following agenda items and key issues discussed with stakeholders:

1. November 21, 2013 consisted of an in-person meeting at the Pacific Energy Center and covered the following topics;
    - Share preliminary findings from the statewide IOU service territory potential model.
    - Introduce the concept of developing quantitative metrics and energy savings goals for LGs as a subset of the potential defined for the statewide IOU service territory potential model.
    - A review of LG baseline energy usage estimates and a discussion of the method by which this baseline would be used to develop EE potential goals.
    - The relationship of the LG metrics study objectives within the context of the broader Strategic Plan update.
    - Review timeline and next steps.

    Key issues discussed with local government stakeholders included
    - The manner in which the metrics discussion is framed is important. Be clear that the metrics won't quantify all of the activities of the LGs.
    - Savings from LG buildings are only part of the equation. Larger opportunity resides with the constituents' buildings.

- Savings that LGs can achieve may be different than those for which IOUs can claim credit. LGs are interested in representing the full range of savings, not just those for which IOUs can claim credit.
- The manner in which the metrics discussion is framed is important. Be clear that the metrics won't quantify all of the activities of the LGs.
- Reach codes are still on the table in some jurisdictions.
- Enhancing code compliance and enforcement require different mechanisms and has different effects across jurisdictions.

2. December 5 consisted of a teleconference and web-based presentation that included the following agenda items;
    - A review of initial potential estimates for Goals 1, 2, and 3.
    - Review the role of the metrics effort within the LG SP update.
    - Review the key points made during previous meeting.
    - Provide update on use of metrics related to equipment efficiency and enhanced energy management.
    - Share approach and preliminary results for metrics for Goal 3.
    - Gain alignment on metrics for Goals 3 and 4.
    - Gain alignment on approach for Goal 3 and preliminary buy-in on metrics.

    Key issues discussed with local government stakeholders at the second meeting included;
    - Developing metrics will help create legitimacy for the Strategic Plan and efforts of local governments.
    - The metrics developed during this effort are not anticipated to serve as the total energy management goals for the LGP programs.
    - Future studies or pilots may help quantify specific elements of the goals, and the forthcoming action plan can capture those priorities for planning purposes.
3. December 16 was an in person meeting in Los Angeles to review the final metrics estimates for Goals 1, 2, and 3 and included the following agenda items;
    - Review the fit of the metrics effort with the LG Strategic Plan chapter update.
    - Discuss revised approach and results for metrics for Goal 3.
    - Review wording for metrics for Goals 1 and 4.
    - Gain alignment on metrics for Goals 1, 3, and 4.

    Key issues discussed with local government stakeholders at the third meeting included;
    - A revised approach was presented that included a range of potential savings for the to-code compliance metric. These were subsequently dismissed as too speculative.

Methodology for Estimating LG Baseline Consumption

Estimating the potential for energy efficiency for Goal 1 first required that The consultant understand annual energy usage for the LGs within the IOU territories[5]. This annual 'baseline' usage was established through stakeholder discussions and data obtained from IOUs, LGs, municipalities (through CMUA), CEC, and other sources. This baseline effort was limited to estimating only the energy used by facilities owned and/or operated by local governments, and for which local governments are responsible for the utility bill. This does not include constituent energy use (i.e. residents or commercial customers operating within local government territories). This analysis yielded several observations;

- PG&E provided data that disaggregated LG usage by number of service account agreements and associated sales indicating LGs were 6.5% of all commercial service accounts and 4.9% of total commercial sector sales in 2012 as shown in Table 3, including all facilities and municipal water operations. Appendix A1 shows that PG&E LG segment energy sales were distributed over 32 total three NAICS designation. **Error! Reference source not found.** shows that 60% of 2012 electricity sales associated with these NAICs codes are related to facilities operations, while 16% and 11% are associated with waste water and water supply operations. Approximately of 13% of 2012 PG&E electricity sales to local government supported street lighting operations. A similar analysis of PG&E 2012 gas sales data indicates that 73% of gas consumed by local governments was used for power generation, while 27% supported facilities operations, as shown in Figure 3.

Table 3. Distribution of 2012 PG&E Commercial Sector Sales

Commercial Sector Segment	Number of Service Agreements	Percent of Commercial Segment Service Agreements	Total KWH in 2012	Percent of Total 2012 kWh Sales
Non-LG	736,356	93.5%	46,488,170,671	95.1%
LG	51,222	6.5%	2,403,716,667	4.9%
Total	787,578	100.0%	48,891,887,338	100.0%

[5] Adjustments were made to account for differences in the LG and commercial sector activity. This constitutes a minimum achievable target for LG baseline usage by 2025 and will be compared to other estimates, such as revised AB32 goals

Figure 2. 2012 PG&E Local Government Electric Energy Sales Distribution by System

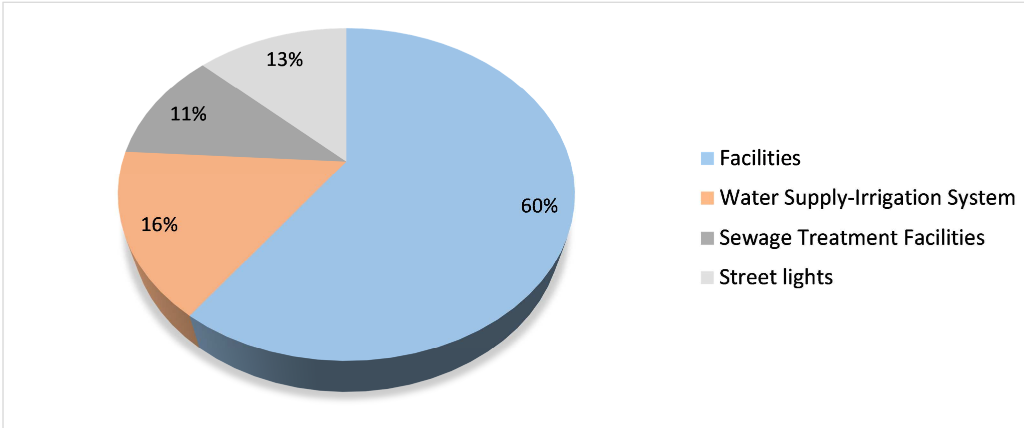
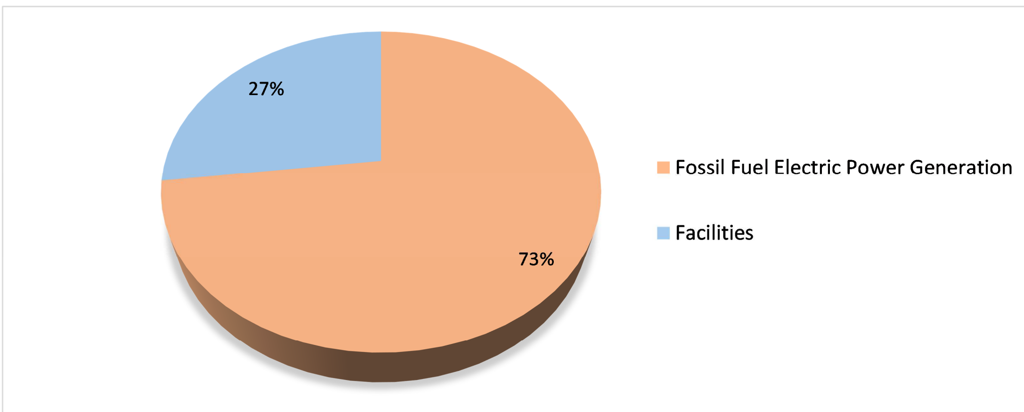


Figure 3. 2012 PG&E Local Government Gas Energy Sales Distribution by System



- SCE provided data that disaggregated LG usage by sector, account owner, and facility type. The data indicated that local government-managed facilities in SCE territory account for 3.4% of 2012 commercial sector sales, and 2.3% of all non-residential sector sales. Table 4 shows that over 95% of energy sales to local government fall into the commercial sectors, with the remaining sales distributed among agricultural and industrial accounts. Table 5 shows that sales are distributed equally among counties and cities. Table 6 shows that 3 types of facilities count for 95% of 2012 SCE LG sales, with the generic label 'All Other Commercial' accounting for nearly 45% of sales.

Table 4. Sectors Included in 2012 SCE Energy Sales (kWh) to Local Governments

Sector	2012 KWh sales	% of 2012 KWh sales
Commercial	1,252,808,563	95.2%
Agricultural	56,220,884	4.3%
Industrial	2,791,586	0.2%
Other	3,513,696	0.3%
Total	1,315,334,729	100%

Table 5. Distribution of 2012 SCE Energy Sales (kWh) to Local Governments by Account Owner

Account Owner	2012 KWh sales	% of 2012 KWh sales
City	635,139,389	51%
County	617,669,174	49%
Total	1,252,808,563	100%

Table 6. SCE 2012 LG Sector Sales by Facility Type

Facility Type	2012 KWh Sales	% of 2012 KWh sales
ALL OTHER COMMERCIAL	559,628,263	44.7%
CORRECTIONAL INSTITUTIONS	147,476,935	11.8%
OFFICE BUILDINGS/LARGE & SMALL	501,387,724	40.0%
Total	1,208,492,922	96.5%

- SDGE did not submit a detailed analysis of LG usage, but responded that LG sales account for 4.8% of commercial sector electric sales and 4.4% of commercial gas sales overall. Removing water supply, and wastewater processing results in LG buildings accounting for 3.4% of commercial sector electric sales and 1.4% of commercial gas sales.
- SCG did not respond to the data request. The consultant estimated that LG buildings in the SCG service territory account for 1.7% of commercial sector gas sales.
- None of the baseline data submitted by the IOU included sales to K-12 schools operations.
- In summary, Table 7 summarizes the local government sales as a percentage of all commercial sector sales. These estimates of LG usage are for buildings and facility operated by local governments, and do not include K-12 schools, street lighting, or waste water and water supply operations.

Table 7. Estimated LG Building Consumption as a Percent of Commercial Consumption

IOU	Fuel Type	LG Building Share of Commercial Sector Consumption*
PG&E	Electric	3.38%
SCE	Electric	3.36%
SDG&E	Electric	3.37%
PG&E	Gas	2.01%
SDG&E	Gas	1.44%
SCG	Gas	1.72%*

Table 8. Distribution of LG Entities by Utility

Utility	Number of LG Entities	Percent of LGs
PG&E	300	56%
SCE	140	26%
SDG&E	100	19%
Total	540	100%

Methodology for Estimating Energy Efficiency Metrics

The following provides a brief outline of the approach used to determine energy savings potential for Goals 1, 3, and 4. No estimate was made for Goal 2 because metrics for that goal did not align with the Potential and Goals Study model used for this effort.

Goal 1 Methodology

The methodology used to estimate metrics for Goal 1, local governments lead by example by reducing their own energy use and greenhouse gas emissions, includes;

- Potential and targets associated with Goal 1 were established by first estimating baseline energy usage for the IOU territory LGs. A ratio was then develop by dividing the LG baseline usage by the full commercial sector usage. This ratio was then used to estimate LG potential as a percent of total commercial market technical, economic, and market potential.
- Goal 1 estimates will be limited to energy used by LG facilities and will not include constituents.

Figure 4 provides the equation for determining annual LG incremental market energy efficiency potential as a percentage of total commercial potential.

Figure 4. Equation for Determining Annual LG Incremental Market Energy Efficiency Potential

$$\frac{\textit{LG Facility Consumption}}{\textit{Commercial Sector Consumption}} \times \textit{Annual Incremental Savings}_{\textit{Comm, IOU, Year}} = \textit{Annual Incremental Savings}_{\textit{LG, IOU, Year}}$$

Goal 3 Methodology

The methodology used to estimate metrics for Goal 3, local governments accelerate the implementation of energy efficiency and greenhouse gas reduction measures through the use of their permitting authority, includes;

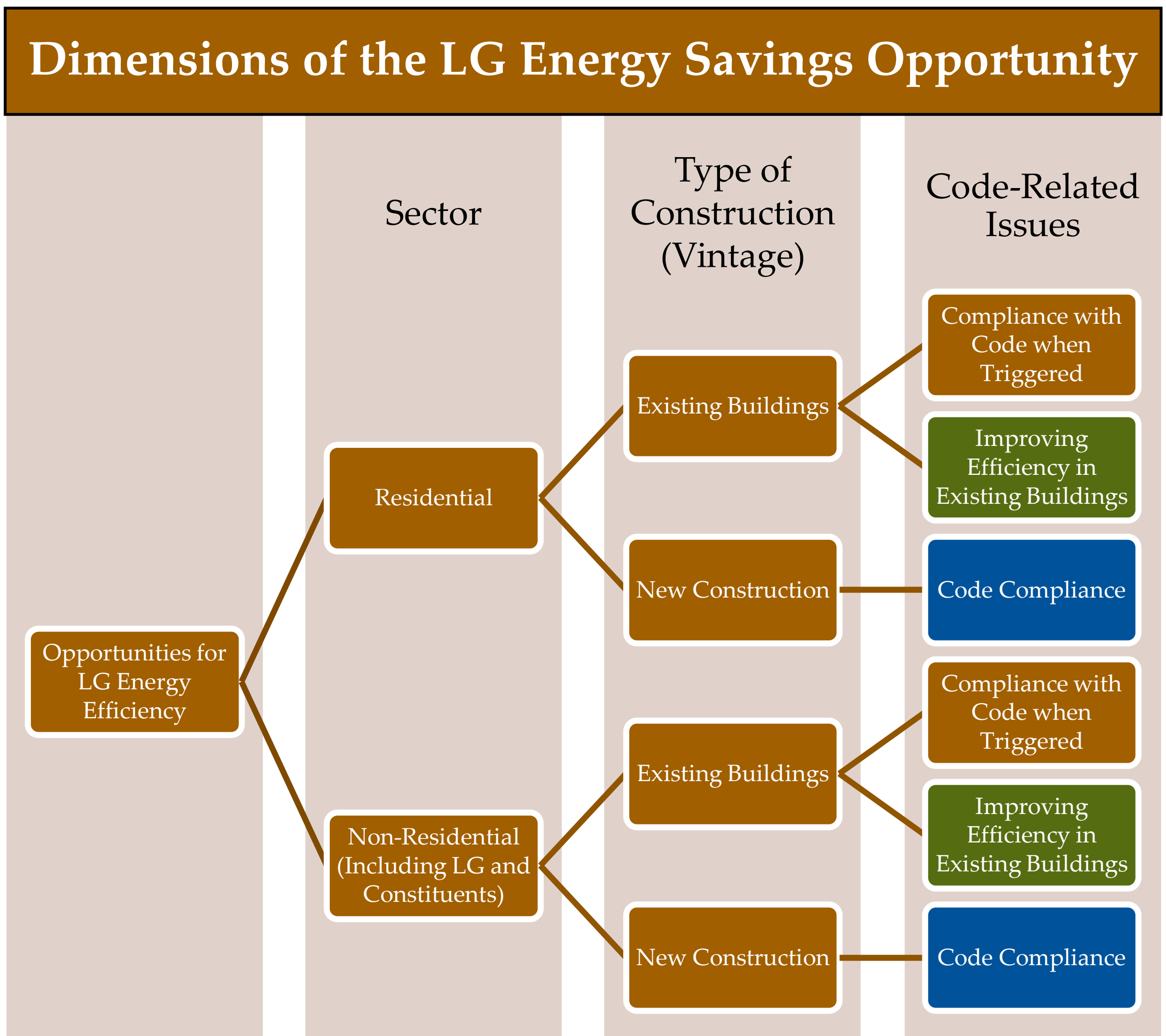
- Potential and targets associated with Goal 3 were established by estimating improvements in code and standard compliance rates attributable to the LG using the Analytica model developed for the 2013 goals and potential study.
- Goal 3 estimates will include LG facilities and constituents.

Table 9 highlights potential issues and Figure 5 outlines the dimension of savings possible for Goal 3.

Table 9. Potential Metrics and Issues for Goal 3

Potential Metric	Potential Issues
Reach Code Adoption. X LGs that represent of Y percent of the state's population adopt reach codes that achieve Z percent more savings than current level of Title 24.	• Challenges in aggregating and analyzing data across different reach codes
Enhanced Compliance Rates. X% of LGs enhance compliance in the first year of new code adoption by Y%.	• Compliance rates vary during course of code cycle. • Requires baseline and update studies on compliance rates.

Figure 5. Facets of the Goal 3 Energy Efficiency Savings Opportunity



Goal 4 Methodology

The methodology used to estimate metrics for Goal 4, local government and community energy efficiency expertise becomes widespread and prevalent, includes;

- Goal 4 assumes that Goal 1 establishes a minimum achievable level of savings that is adjusted upwards to account for additional EE savings potential resulting from implementing the activities targeted in Goals 1, 2, and 3, and resulting in improvements in learning and energy management practices. In combination, these activities will result in higher performing institutions that should be able to exceed the goals established under the 'business as usual' forecast in the 'mid case' scenario used for Goal 1. Improvements in energy management can be achieved through various approaches, but usually include the following five components;
    1. Include a complete analysis of historic usage load sources and load profiles;
    2. Develop a clear and accurate understanding of the potential for energy efficiency based on engineering analysis such as technical potential audits, and covers the full scope of LG operations;
    3. Establish the ability to develop and use guidance documents— such as strategic energy plans—to organize and direct sustained efforts at achieving energy efficiency over a long time horizon;
    4. Organize an effective management structure that includes the ability to transition authority and commitment to a strategic approach to energy management as staff positions evolve and turnover occurs, and
    5. Continuously improves the project delivery process to include increasingly complex projects that include data rich and real-time energy management capability
- The consultant assumes that the aggregate results from Goals 1, 2, and 3, in combination with improvements in overall energy management, will increase the potential for energy efficiency by 25% over the potential model mid case scenario forecast used to forecast Goal 1. As such, the metrics for Goal 4 were estimated by multiplying the mid-case scenario potential provided by Goal 1 by a factor of 1.25.
- Goal 4 estimates will be limited to energy used by LG facilities and will not include constituents.

Summary of Results and Metrics by Strategic Plan Goal

The following provides a summary of results and metrics by strategic plan Goals 1, 3, and 4.

Goal 1 Metrics

The metrics for goal 1 represent energy savings captured in facilities occupied by LGs from implementation of standard efficiency measures delivered through business as usual programs and activities (i.e., measures eligible for IOU rebates). Table 10 provides a summary of goal 1 metrics and factors relevant to Goal 1, while Figure 6 and Figure 7 provide the incremental annual EE market potential for the LG sector by end use for electricity (GWh) and natural gas (MMTherms), respectively.

Table 10. Goal 1 Metrics

Goal 1, Metric 1

Metric	Between 2015 and ~~y~~ 2020, achieve an average annual incremental ex-post gross savings of 27 GWh and 0.2 MM Therms ~~of annual incremental energy savings~~ from the implementation of standard efficiency measures (i.e., measures eligible for IOU rebates) captured in facilities owned and/or occupied by LGs.
Relevant Strategy	Strategy 1-3: Develop capital improvement and infrastructure upgrade plans and annual purchasing budgets that incorporate energy efficiency. Strategy 1-4: Improve access to favorable financing terms for energy efficiency and other demand side management programs. Strategy 1-5: Local governments serve as venues for new technologies and practices to accelerate the State's zero net energy (ZNE) goals.~~Strategy 3-2: Dramatically improve compliance with and enforcement of Title 24, including HVAC permitting and inspection requirements (including peak-load reduction solutions in inland areas).~~
Notes	The electric and gas savings opportunities represented by this metric are already embedded within the Commercial market potential estimates included in the final Energy Efficiency Potential and Goals Study, released in February 2014. The metric for Goal 1 of 27 GWh is equivalent to the electricity required to power 4,308 homes for a period of 1 year; 0.2 MM Therms is equivalent to the natural gas quantity necessary to meet the residential use needs of a community the size of 577 homes for a period of 1 year.
Modeling Approach	Assume baseline code compliance rate increases by 10 percentage points
Scope of Sector Impact	Only impacts energy used by facilities owned and/or operated by local governments, and for which local governments are responsible for the utility bill.

Figure 6. Goal 1 Incremental Annual EE Market Potential for the LG Sector by End Use (GWh)

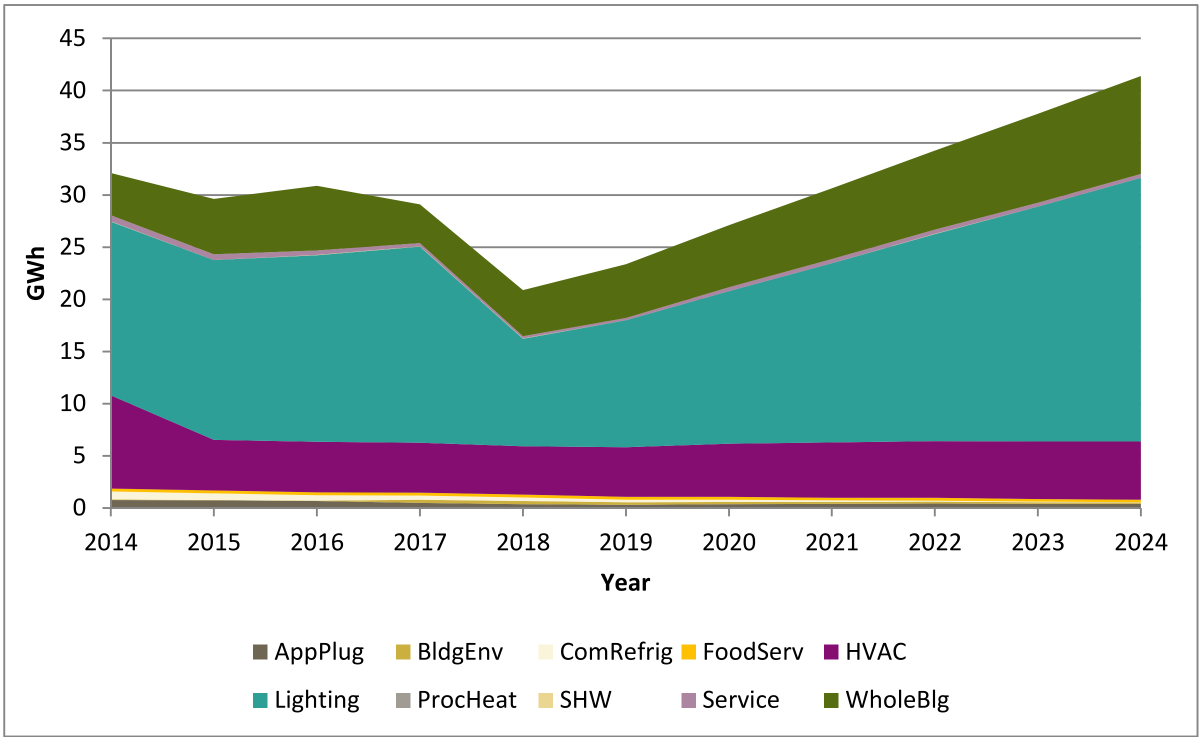
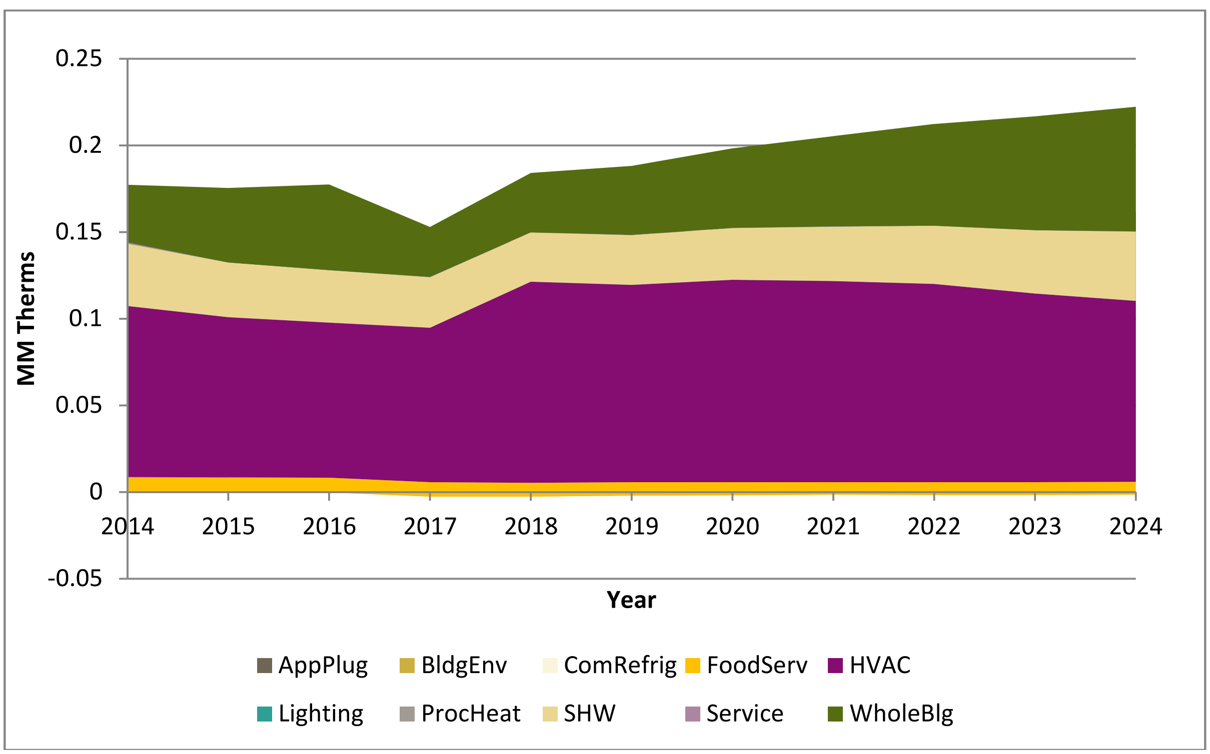


Figure 7. Goal 1 Incremental Annual EE Market Potential for the LG Sector by End Use (MMTherms)



Goal 3 Metrics

The proposed metrics for Goal 3 quantifies the effects of enhanced code compliance for retrofit and new construction. Table 11 provides a summary if the Goal 3 metrics and associated factors. During discussion with stakeholders there was considerable interest expressed in the energy efficiency potential that may exist by updating facilities from existing levels of building energy performance to meet code requirements. These are referred to as 'to code' initiatives. At present, the consultant does not possess the requisite data necessary to reasonably estimate the potential energy savings attributable to updating existing buildings to meet current code requirements. Figure 8 and Figure 9 provide the incremental annual EE market potential by sector for electricity (GWh) and natural gas (MMTherms), respectively.

Table 11. Goal 3 Metrics

Goal 3, Metric 1	
Metric	Between 2015 and 2020, achieve an average annual incremental ex-post gross savings ~~By 2020, achieve~~ of 29~~13~~ GWh and 0.1 MM Therms ~~of incremental annual savings~~ from an increase of 10 percentage points in compliance with existing codes for new construction and renewal/renovation projects. These savings opportunities are based on increasing existing assumptions about code compliance rates (as outlined in the 2006-2008 program evaluations) by 10 percentage points. These opportunities represent an additional savings beyond the estimates of net savings from codes included in the final Energy Efficiency Potential and Goals Study, released in February 2014.
Relevant Strategy	Strategy 3-2: Dramatically improve compliance with and enforcement of Title 24, including HVAC permitting and inspection requirements (including peak-load reduction solutions in inland areas).
Notes	Requires collection of baseline compliance data for 2013 Title 24. Applies to constituent and LG facilities. Attribution of savings from advocacy and code compliance enhancements to be established with affiliated IOU.
Modeling Approach	Assume baseline code compliance rate increases by 10 percentage points

Figure 8. Goal 3 Incremental Annual EE Market Potential by Sector (GWh)

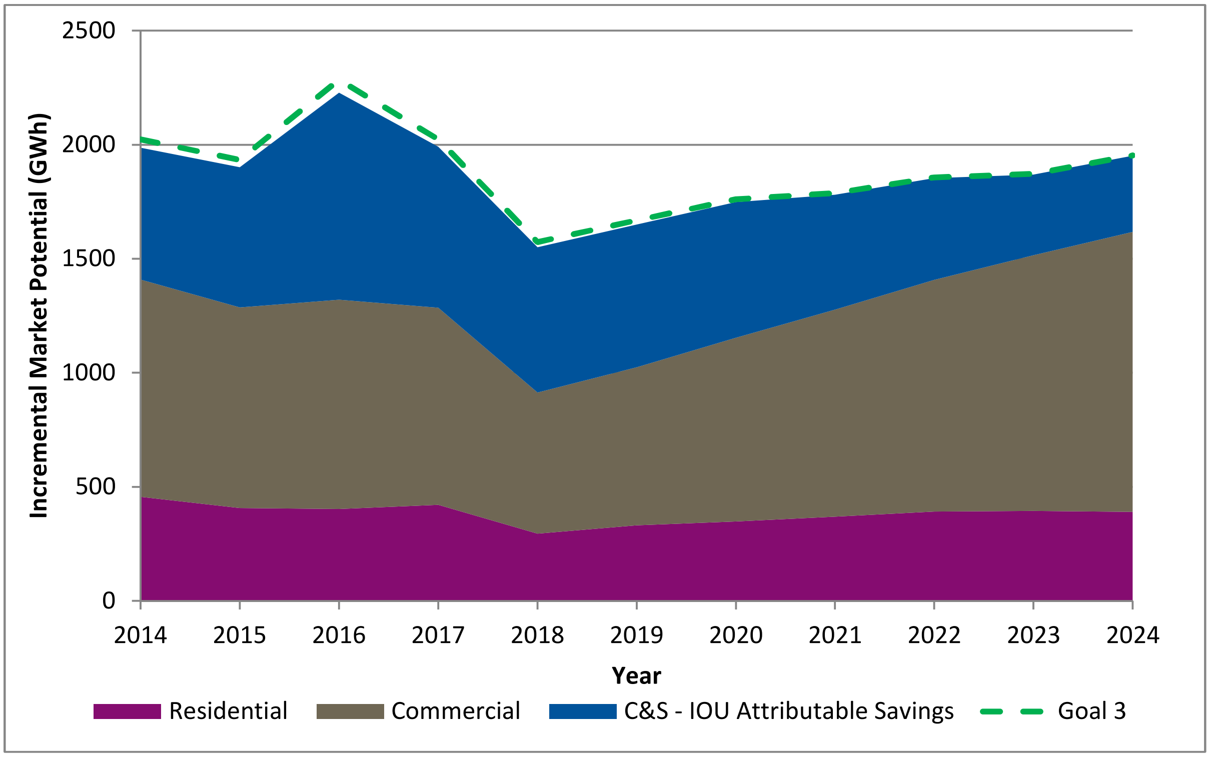
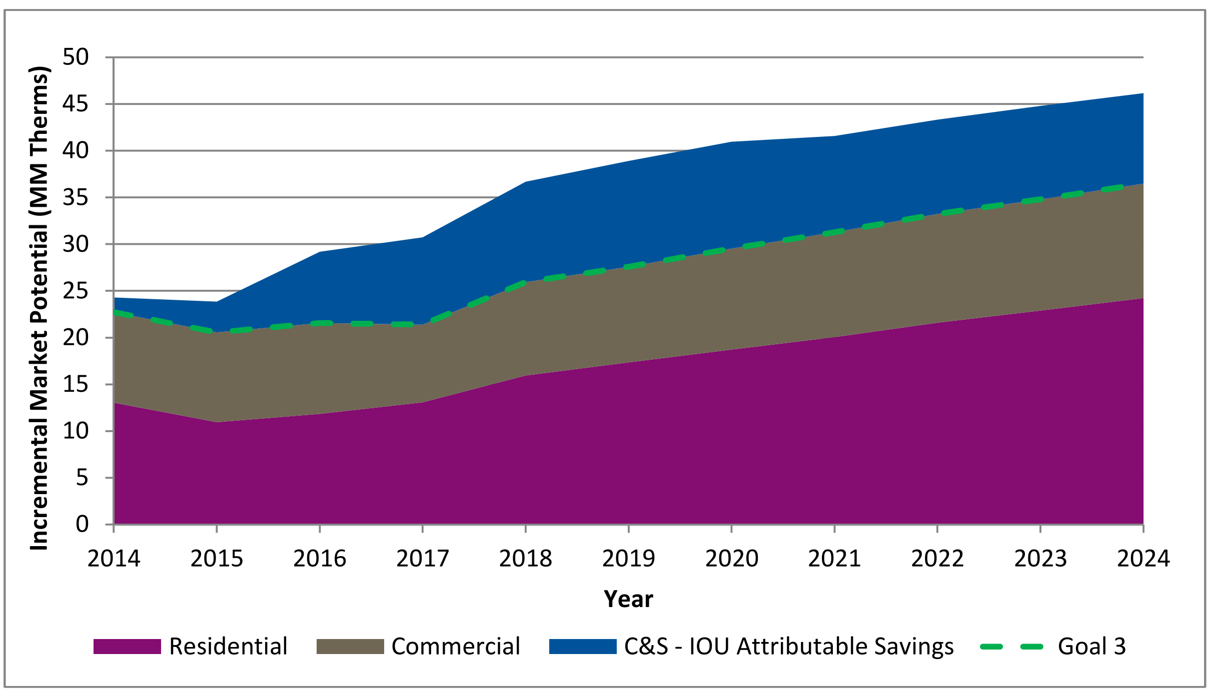


Figure 9. Goal 3 Incremental Annual EE Market Potential by Sector (MMTherms)



Goal 4 Metrics

The proposed metrics for Goal 4 reflect the implementation of enhanced energy management practices. As discussed previously, this includes the additional EE savings potential resulting from implementing the activities targeted in Goals 1, 2, and 3, and corresponding improvements in energy management practices. Table 12 provides a summary of Goal 4 metrics and factors, while Figure 10 and Figure 11 provide the incremental annual EE market potential for the LG sector by end use for electricity (GWh) and natural gas (MMTherms), respectively.

Table 12. Goal 4 Metrics

Goal 4, Metric 1	
Metric	Between 2015 and 2020, achieve an average annual incremental ex-post gross savings By 2020, achieve of 7 GWh and 0.05 MM Therms of annual incremental energy savings in addition to the metrics stated for Goal 1. This additional incremental potential will result from the implementation of enhanced energy management practices captured in facilities owned and/or occupied by LGs.
Relevant Strategy	Strategy 1-3: Develop capital improvement and infrastructure upgrade plans and annual purchasing budgets that incorporate energy efficiency. Strategy 1-4: Improve access to favorable financing terms for energy efficiency and other demand side management programs. Strategy 1-5: Local governments serve as venues for new technologies and practices to accelerate the State's zero net energy (ZNE) goals. Strategy 2-1: Local governments draft and implement long-range plans to advance the State's energy efficiency, zero net energy, and climate change goals within their communities. Strategy 2-2: Tap local government outreach channels and community goodwill to convey the value of energy efficiency and greenhouse gas reduction strategies and programs offered in California. Strategy 2-3: Develop, implement, and market energy efficiency financing programs. Strategy 3-2: Dramatically improve compliance with and enforcement of Title 24, including HVAC permitting and inspection requirements (including peak-load reduction solutions in inland areas). Strategy 3-3: Develop, adopt, and implement model policies and programs focusing on improving the energy efficiency of existing buildings. Strategy 3-4: Develop, adopt, and implement model energy efficiency and zero net energy building energy policies and codes on both a mandatory and voluntary basis. Strategy 3-5: Align local governments' income-eligible programs with energy efficiency standards and programs. Strategy 4-1: Engage elected and appointed officials and other decision makers in energy efficiency policies and programs.

	Strategy 4-2: Engage multiple departments in the planning, implementation, and operation of energy efficiency programs and projects. Strategy 4-3: Support a statewide technical assistance program for local governments, including peer-to-peer expertise exchange. Strategy 4-4: Develop and participate in regional efforts to reduce energy use and encourage ZNE buildings in local government operations and in the community. Regional efforts allow for shared resources and expertise, economies of scale for energy efficiency services and products, and coordination and alignment of goals. Strategy 4-5: Develop public-public partnerships to reduce energy use and greenhouse gas emissions. Strategy 4-6: Develop public-private partnerships to reduce energy use and greenhouse gas emissions and publicly acknowledge positive actions. Strategy 4-7: Develop Local Energy Efficiency Businesses and Workforces.
Notes	The analysis of additional savings from enhanced energy management is based on a comparison of energy consumption by institutional facilities that implemented enhanced energy management practices with comparable facilities that did not implement such strategies. The additional savings opportunities created through enhanced energy management were estimated to be 25% above the estimated savings potential attributable to Goal 1. The estimated savings attributable to Goal 4 represent additional savings beyond the estimates of Commercial market potential included in the final Energy Efficiency Potential and Goals Study, released in February 2014. The goal of 7 GWh is equivalent to the electricity required to power 1,077 homes for a period of one year; 0.05 MM Therms is equivalent to the natural gas quantity necessary to meet the residential use needs of a community the size of 144 homes for a period of one year.
Modeling Approach	Increase Goal 1 metric by 25% for each year.
Scope of Sector Impact	Only impacts energy used by facilities owned and/or operated by local governments, and for which local governments are responsible for the utility bill.

Figure 10. Goal 4 Incremental Annual EE Market Potential for the LG Sector by End Use (GWh)

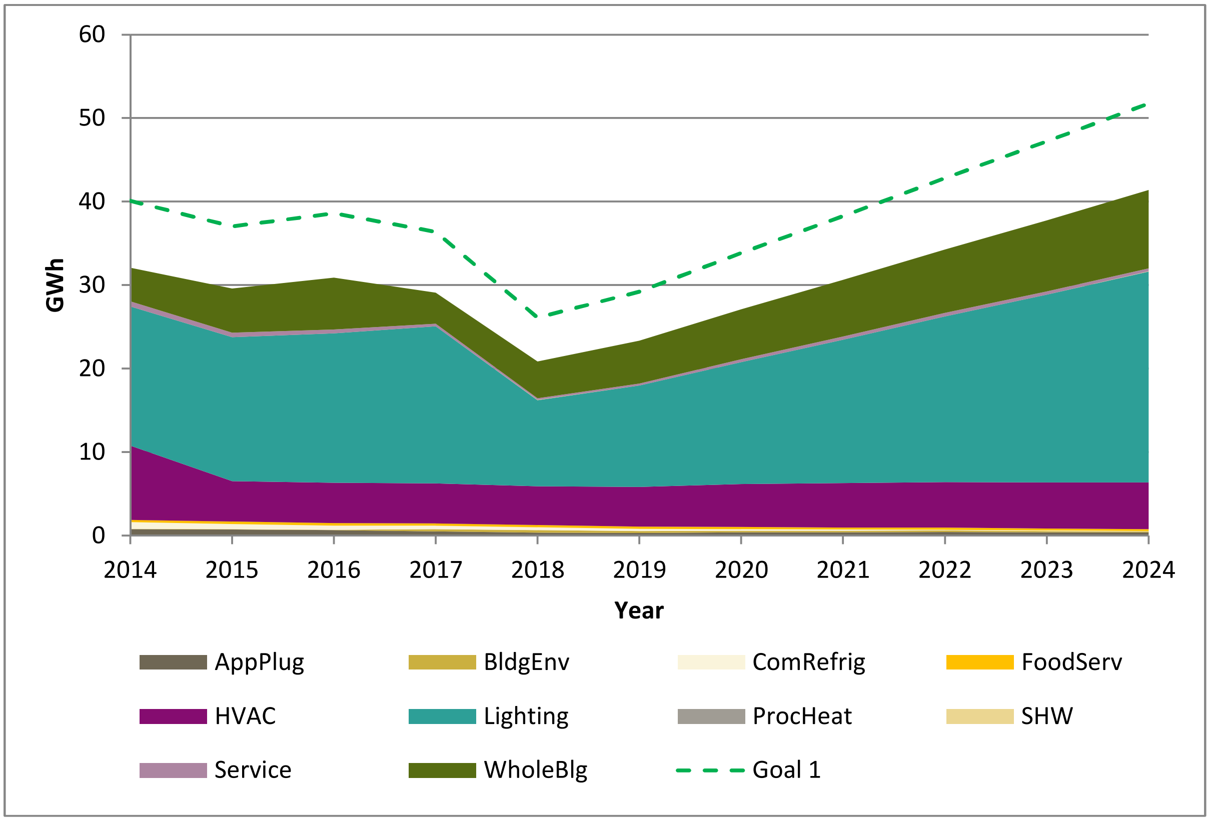
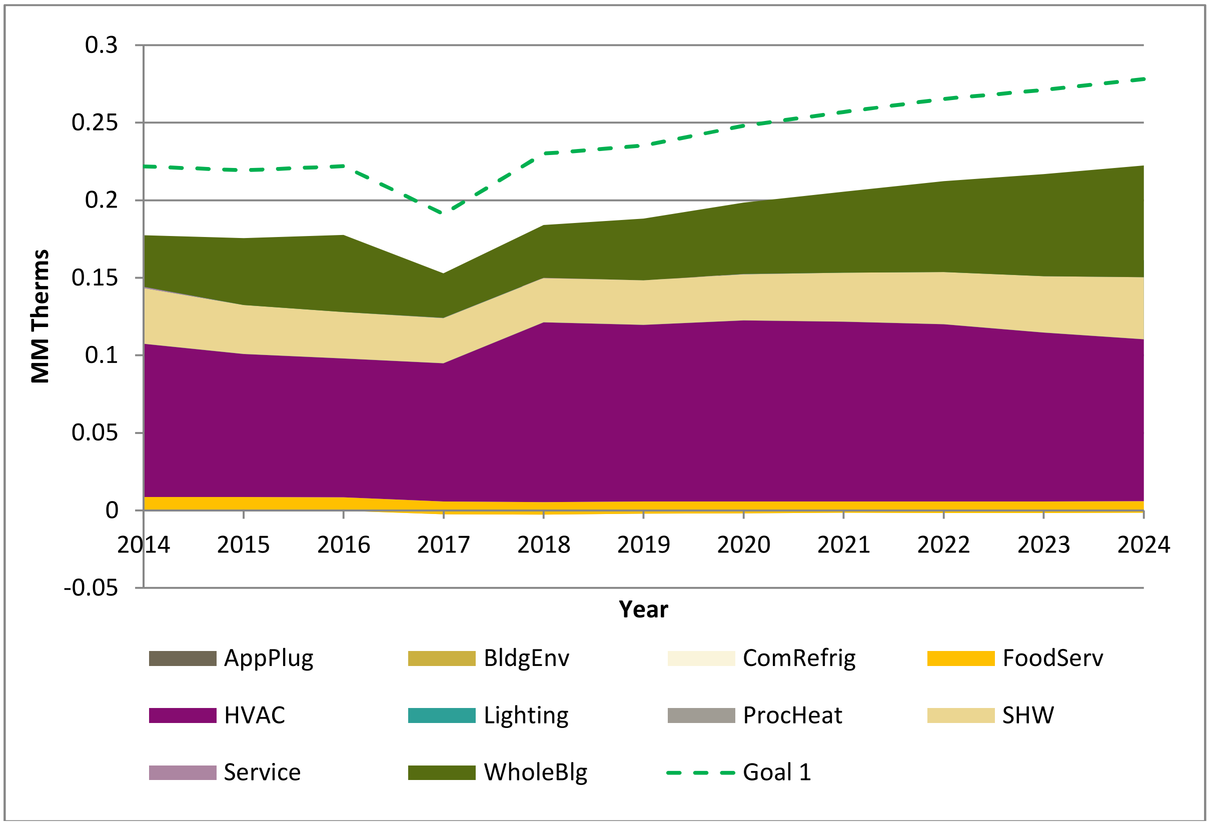


Figure 11. Goal 4 Incremental Annual EE Market Potential for the LG Sector by End Use (MMTherms)



Conclusions

Combined Estimates of Annual Incremental Energy Efficiency Potential

Table 13 provides the incremental annual market (GWh) electric energy efficiency potential by year for Goals 1, 2, and 3. As discussed previously, goals 1 and 4 pertain only to LG-operated facilities. Goal 3 includes the impact to both local government and constituent facilities. These goals indicate the potential exists to reduce electricity consumption in local government operated buildings by approximately 16% to 20%, or a total reduction in annual LG electricity consumption of approximately 9% to 12%. These metrics do not include the potential for energy efficiency from improvements in street lighting or municipal water facilities

Table 13. Local Government Strategic Plan Update Incremental Market EE Potential, by Goal (GWh)

Year	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Goal 1	29.6	30.9	29.1	20.9	23.4	27.1	30.6	34.3	37.8	41.4
Goal 3	32.6	56.8	32.1	22	18.3	13	7.1	3.6	1.7	1.1
Goal 4	7.4	7.7	7.3	5.2	5.8	6.8	7.7	8.6	9.4	10.3

Total	69.7	95.4	68.5	48.1	47.5	46.9	45.3	46.4	48.9	52.8

Historical Context of IOU Local Government Programs and Strategic Plan Goals

In order to provide a context for the annual incremental EE forecast potential shown in Table 13, The consultant reviewed the history of accomplishments for local government programs operated by the California IOUs. This comparison is most valid for Goal 1 because Goal 1 targets only LG facilities under a business as usual context, similar to the 2006 – 2013 programs.

Table 14 provides the savings from local government programs operated by SCE and PG&E from 2006 through 2013, and includes the following observations;

- Table 14 includes both ex-post and ex-ante values as defined below;
    - 2006-2008[6]; annualized ex-ante net planned,
    - 2009; ex-ante gross,
    - 2010-2012; annualized ex-ante gross reported
    - 2013-2014; annualized ex-ante gross filed
- SDG&E is not included because LG program operated by that utility are non-resource and do not report savings.
- SCE savings are from Energy Leader (EL) programs and therefore are based only on energy efficiency accomplishments in facilities owned and/or operated by LGs, per EL program design.
- PG&E reports are for Energy Watch, which is a broader program design that allows savings from constituent participation to be credited to the LG program, in addition to LG facilities.

The SCE LG programs (dba as "Energy Leader Model" programs) may be the best indicator of the types of savings expected to be attributed to local government efforts because the SCE LGP program recognizes EE accomplishment solely within local government-owned and/or -operated facilities. The average ex-post gross savings for these SCE programs from 2009 through 2013 is about 49 GWh per year, indicating the EE forecast potential presented in Table 13 is low by historic LG program savings levels if only Goal 1 is considered. However, if the potential for Goals 1, 3, and 4 are considered, the total forecasted savings appears to be more reasonable. For example, the 2013 (and 2014) savings goal for SCE LG programs is 24 GWh, or 34% of the forecast potential for all IOU strategic plan goals in 2015 presented in Table 13. This is approximately proportionate to the percent of statewide electricity sales associated with SCE LGs.

Table 14. Historic Savings from IOU Based Local Government Partnership Programs (GWh, Ex-post and Ex-ante)

Utility	2006	2007	2008	2009	2010	2011	2012	2013
PG&E	99.6	99.6	99.6	106.7	51.8	51.8	51.8	82.3
SCE	13.9	13.9	13.9	30.8	64.1	64.1	64.1	24.1

[6] Program Projected (Compliance Filing)

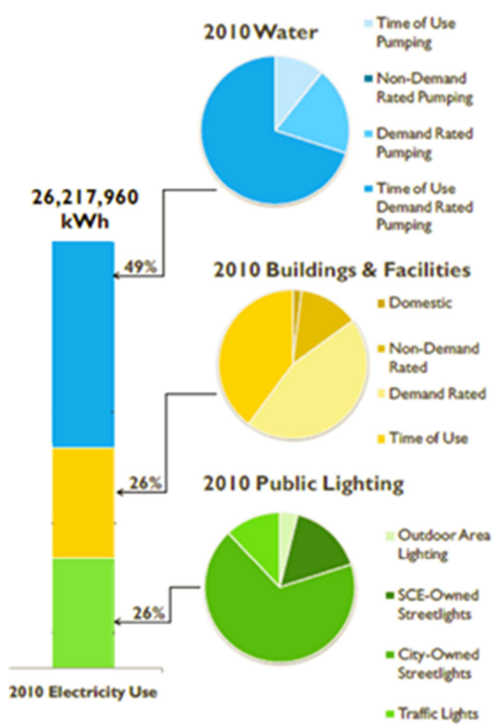
Other Sources of Energy Efficiency Potential for Local Governments

The forecasted potential for Goals 1, 3, and 4 are composed of energy savings potential associated with facilities operated by local governments. However, LG electricity consumption occurs in three primary usage categories;

1. Facilities
2. Street lighting
3. Water systems, including waste water and drinking water operations

The combination of these 3 types of electricity usage varies for each LG, with the largest variation in water systems. All LGs have streetlight and facility uses, but some LGs do not maintain any water systems and so have no significant water related energy expense or potential. For some LGs, water systems are the largest users of electricity. For example, Figure 12 shows that for the City of Goleta, in 2010 approximately 49% of electricity use went to support water operations, 26% for buildings, and 25% for street lights. Appendix A1 provides additional examples of LG energy use distribution. The following sections provide addition information on the potential for energy efficiency savings in both the streetlights and water systems that are not represented in the strategic plan goal metrics forecast in Table 13.

Figure 12. Example of Distribution of Municipal Energy Consumption[7]



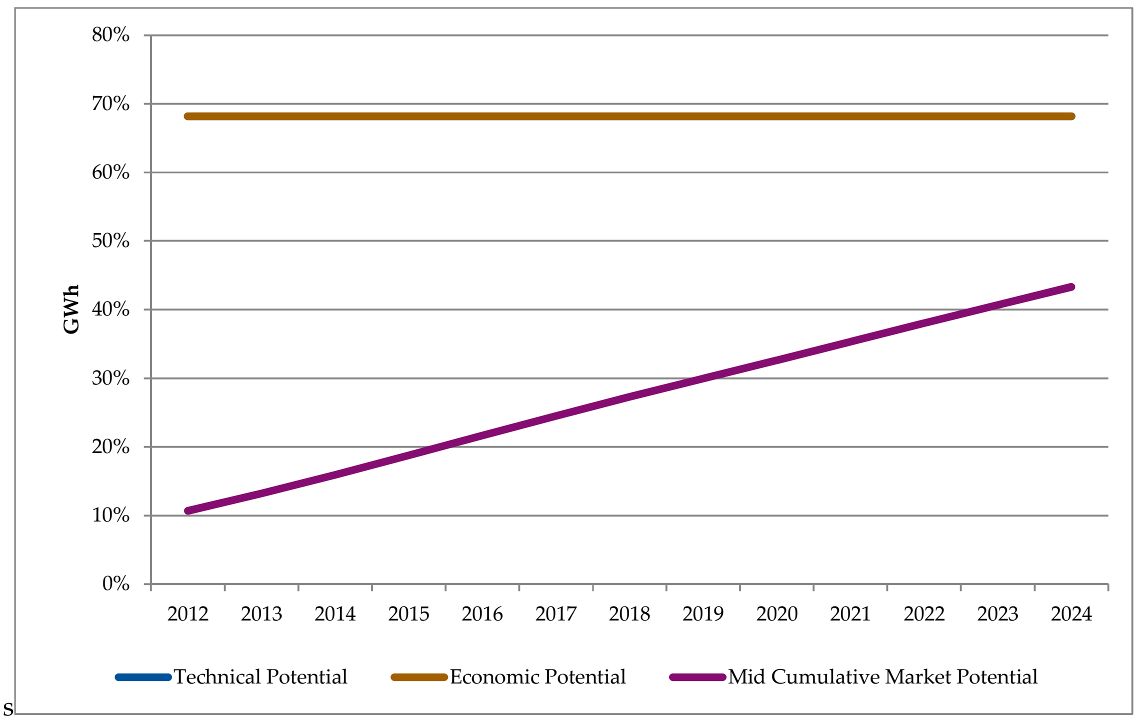
[7] City of Pomona Energy Action Plan November 2012, Figure ES-7: Municipal Electricity Use by Account Type, 2010

Potential for Streetlights Owned and Operated by Local Government

Streetlights usually account for 10% to 40% of electricity costs for Local Governments and there is significant energy savings potential to be had by replacing existing HID streetlights to LED or induction technology lamps and installing advanced controls. Figure 13 shows that there is the potential to reduce by over 40% the CEC forecast electricity consumption for streetlights by 2024. This will have different implications for local governments and IOUs, depending largely on who owns the streetlights. This ownership distribution varies greatly between IOU service territories, as shown in Table 15.

Table 16 provides the forecast for energy savings for local governments in each IOU service territory based on the street lighting potential forecast in the 2013 potential model. Assuming the streetlight are 14% of total annual LG consumption, and the market potential exists to reduce this use by 40% as shown in Figure 13, the potential exists to reduce total annual LG electricity consumption by approximately 7%. Appendix provides additional detail and a summary of the potential model approach to the street lighting sector analysis completed in the 2013 potential and goals study. As described above, this forecast is not included in the strategic plan goals presented in Table 13.

Figure 13. California Street Lighting Savings Potential as a Percent of CEC Street Lighting Forecast (Technical, Economic, and Active Cumulative Market Potential)



S

Table 15. Street Lighting Ownership, by Lamp Count

IOU	IOU-Owned	Customer-Owned
Statewide	57.1%	42.9%
PG&E	26.3%	73.7%
SCE	82.4%	17.6%
SDG&E	19.0%	81.0%

Table 16. Total LG Streetlight Market Potential (GWh)

Year	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
PG&E	11	11	10	9	8	8	7	7	7	6
SCE	3	4	4	4	4	4	4	4	4	4
SDG&E	1	1	1	1	1	1	1	1	1	1
Total	15	15	15	14	13	12	12	12	12	11

Potential for Waste Water and Drinking Water Operations

Municipal water systems generally include two types of service, categorized as drinking water (potable water) or waste water systems (non-potable water). Based on a review of available literature, Table 17 provides a preliminary estimate of savings potential by water service type and end use. This analysis indicates that the potential exists to reduce total LG energy consumption by approximately 4% through energy efficiency measures installed at water facilities operated by local governments. Appendix F1 provides additional insight into the potential for energy efficiency at municipal water systems. As discussed, this analysis is preliminary and intended to demonstrate that the potential for energy efficiency in municipal water systems exists and may be substantial. This potential is not included in the strategic plan goals presented in Table 13.

Table 17. Estimated Savings Potential for Various Potable and Non-Potable Water Systems

Water Service Type	Measure	Upper Bound Savings % of End-Use Consumption	Average Savings % of End-Use Consumption	Market Applicability Factor	End-Use to Sector Adjustment Factor	Applicable Average Savings % of Total Sector Consumption	Total Savings % of Total Sector Consumption
Potable & Non-Potable	Improved Motor Efficiency	6%	4.0%	5.0%	80.0%	0.2%	4.3%
Potable & Non-Potable	Pump System Optimization	20%	12.4%	10.0%		1.0%	
Potable & Non-Potable	VFDs	50%	27.5%	10.0%		2.2%	
Potable & Non-Potable	Supervisory Control and Data Acquisition (SCADA)	20%	15.0%	5.0%		0.6%	
Non-Potable	High Efficiency Aeration Blowers		35.0%	10.0%	8.8%	0.3%	
Potable & Non-Potable	Other		NA		11.2%		
Potable & Non-Potable	Potable & Non-Potable Total				100.0%		

Enhanced Energy Management Context of Strategic Plan Initiatives

As discussed in the Goal 4 methodology, there is an assumption that improved energy management practices would allow local governments to save 25% more than the "business as usual" forecast, defined by Goal 1, based on five general principles for institutional energy management. For guidance, these principles are restated below and include references to specific local government roadmap strategies related within each of the five energy management components.

1. Develop a comprehensive understanding of historic usage patterns, loads, and load profiles.
2. Develop a comprehensive understanding of the potential for energy efficiency that is based on engineering analysis and covers the full scope of LG operations.
    a. Strategy 1-1: Monitor and control municipal energy use.
    b. Strategy 3-1: Statewide monitoring and appraisal of local government code enforcement efforts and appropriate recommendations for improvement and revision.
3. Produce and use guidance documents, such as strategic energy plans, to organize and direct sustained efforts at achieving energy efficiency over a long time horizon.
    a. Strategy 1-3: Develop capital improvement and infrastructure upgrade plans and annual purchasing budgets that incorporate energy efficiency.
    b. Strategy 2-1: Local governments draft and implement long-range plans to advance the State's energy efficiency, zero net energy, and climate change goals within their communities.
4. Implement an effective management structure that includes the ability to transition authority while maintaining a focus and commitment to a strategic approach to energy management.
    a. Strategy 4-1: Engage elected and appointed officials and other decision makers in energy efficiency policies and programs.
    b. Strategy 4-2: Engage multiple departments in the planning, implementation, and operation of energy efficiency programs and projects.
    c. Strategy 4-3: Support a statewide technical assistance program for local governments, including peer-to-peer expertise exchange.
    d. Strategy 4-4: Develop and participate in regional efforts to reduce energy use and encourage ZNE buildings in local government operations and in the community. Regional efforts allow for shared resources and expertise, economies of scale for energy efficiency services and products, and coordination and alignment of goals.
    e. Strategy 4-5: Develop public-public partnerships to reduce energy use and greenhouse gas emissions.
    f. Strategy 4-6: Develop public-private partnerships to reduce energy use and greenhouse gas emissions and publicly acknowledge positive actions.
5. Continuously improve the project delivery process to include increasingly complex projects involving data rich and real-time energy management capability.
    a. Strategy 1-4: Improve access to favorable financing terms for energy efficiency and other demand side management programs.

b. Strategy 1-5: Local governments serve as venues for new technologies and practices to accelerate the State's zero net energy (ZNE) goals.

c. Strategy 2-2: Tap local government outreach channels and community goodwill to convey the value of energy efficiency and greenhouse gas reduction strategies and programs offered in California.

d. Strategy 2-3: Develop, implement, and market energy efficiency financing programs.

e. Strategy 3-2: Dramatically improve compliance with and enforcement of Title 24, including HVAC permitting and inspection requirements (including peak-load reduction solutions in inland areas).

f. Strategy 4-7: Develop Local Energy Efficiency Businesses and Workforces.

g. Strategy 3-3: Develop, adopt, and implement model policies and programs focusing on improving the energy efficiency of existing buildings.

h. Strategy 3-4: Develop, adopt, and implement model energy efficiency and zero net energy building energy policies and codes on both a mandatory and voluntary basis.

i. Strategy 3-5: Align local governments' income-eligible programs with energy efficiency standards and programs.

Limitations of the Analysis

- Since the PGT model was developed for a different purpose than the Strategic Plan metrics, the results provided in this technical paper represent order-of-magnitude, directional opportunities rather than precise estimates of potential for any single local government, end use measure category, or building type.
- The metrics for Goals 1 and 4 are specific for facilities for which local governments either owns the building, or for which they are the utility account holder of record. Many local governments are engaged with their communities to promote energy efficiency and create additional energy efficiency momentum with their constituents. These metrics for Goals 1 and 4 do not include constituent facilities and do not reflect potential for these LG outreach efforts.
- Estimates of energy efficiency potential are limited by the requirements of the Potential, Goals, and Targets (PGT) project. The PGT work is based on all measures that will screen in a TRC cost test, and meet all other criteria for inclusion in IOU incentive type programs. Measures reviewed are cost effective in a utility portfolio setting and at a .85 TRC threshold. Additional potential may be available under different TRC cost effectiveness thresholds or different cost effectiveness tests.
- The analysis of the potential for municipal water operations is preliminary and illustrative in nature, and should be viewed as an order of magnitude estimate only.

Recommendations

The following recommendations are offered with the intent to improve forecast accuracy and completeness of the goals metrics.

1. Further research should be completed through the CPUC potential modelling efforts to refine estimates of energy efficiency potential in water systems operated by local governments.
2. The savings associated with Goal 3 include savings from codes and standards-related activities at LG facilities and their constituents' facilities. A more accurate assessment of this goal could be accomplished by more clearly establishing the relationship between IOU programs and LG activities in the realm of codes and standards. The appropriate allocation of savings due to improvements in rates of code compliance remains somewhat unsettled as to whether to credit the LGs or IOUs. Thus, there remains some uncertainty as to how this goal should be tracked for LGs. Additionally, IOUs receive credit for advancing codes and standards, while LGs who are tasked with enforcing code compliance, lack any incentive-based structure to encourage increased efforts toward compliance.
3. As new program delivery mechanisms that rely on local governments are developed, such as PACE financing and regional energy networks (RENs), it is likely that new sources of savings will be defined, and new methods to develop that potential will be implemented. In order to capture this potential, future revisions to the strategic plan metrics should be considered beyond the definition of potential used in the 2013 potential study, the basis for this technical paper.
4. It is recommended that additional research be completed to further refine estimates of the distribution of energy consumptions by local governments across the following end use categories;
   a Buildings
   b Street lighting
   c Water systems, including wastewater and drinking water operations

   As discussed, the consultant received excellent data from PG&E and was able to gain significant insight based on their response. Additional data from SCE and SDG&E would allow more specific direction on where energy efficiency potential might be clustered at LGs operating in the service territories for these utilities.

   Additionally, most cities and counties have developed energy action plans (EAPs) as part of their carbon action planning process. These EAPs include details on usage for the three categories discussed above. The consultant could not identify a source where all information from these EAPs has been collected and warehoused. Such a database would help further define where potential exists and how it could be most effectively captured.

Appendix A1

Electricity Goals by IOU

Goal	Year	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Goal 1	PG&E	12	13	12	9	10	11	13	15	16	18
	SCE	13	14	13	9	10	12	14	15	17	19
	SDG&E	4	4	3	3	3	3	4	4	4	5
	Total	30	31	29	21	23	27	31	34	38	41
Goal 3	PG&E	14	25	14	10	8	6	3	2	1	0
	SCE	15	26	15	10	8	6	3	2	1	0
	SDG&E	3	6	3	2	2	1	1	0	0	0
	Total	33	57	32	22	18	13	7	4	2	1
Goal 4	PG&E	3	3	3	2	3	3	3	4	4	4
	SCE	3	4	3	2	3	3	4	4	4	5
	SDG&E	1	1	1	1	1	1	1	1	1	1
	Total	7	8	7	5	6	7	8	9	9	10
Total Buildings	PG&E	30	41	30	21	21	20	19	20	21	23
	SCE	32	44	31	22	21	21	21	21	22	24
	SDG&E	8	11	8	6	5	5	5	6	6	6
	Total	70	95	68	48	48	47	45	46	49	53
Street Lights	PG&E	11	11	10	9	8	8	7	7	7	6
	SCE	3	4	4	4	4	4	4	4	4	4
	SDG&E	1	1	1	1	1	1	1	1	1	1
	Total	15	15	15	14	13	12	12	12	12	11
Total Buildings and Street Lights	PG&E	41	51	40	30	28	28	27	27	28	29
	SCE	35	47	35	25	25	25	25	25	26	28
	SDG&E	9	12	9	7	7	6	6	7	7	7
	Total	85	111	83	62	60	59	58	59	61	64

Appendix B1

PG&E 2012 LG Energy Sales Details by NAICS

NAICS Sector (3 Digit NAICS)	Number of Service Agreements	Percent of Service Agreements	Total KWH in 2012	Percent Total KWH in 2012
ACCOMMODATION & FOOD SERVICES	200	0.4%	6,114,310	0.3%
AGRICULTURE, FORESTRY, FISHING	43	0.1%	5,320,325	0.2%
AIR TRANSPORTATION	1	0.0%	12,672	0.0%
ARTS, ENTERTAINMENT, RECREATION	5,221	10.2%	150,944,471	6.3%
BEVERAGE & TOBACCO PRODUCT MFG	1	0.0%	35,160	0.0%
BUSINESS SUPPORT SERVICES	372	0.7%	49,528,196	2.1%
CONSTRUCTION (GENERAL)	12	0.0%	95,263	0.0%
COURIER, WAREHOUSING AND STORAGE	308	0.6%	8,633,000	0.4%
EDUCATIONAL SERVICES	290	0.6%	16,152,506	0.7%
FINANCE AND INSURANCE	15	0.0%	1,360,250	0.1%
FURNITURE-RELATED PRODUCT MFG	1	0.0%	8,414	0.0%
HEALTH CARE & SOCIAL ASSISTANCE	836	1.6%	210,711,827	8.8%
INFORMATION/DATA SERVICES	998	1.9%	64,831,666	2.7%
METAL PRODUCT MANUFACTURING	2	0.0%	32,748	0.0%
NOT ASSIGNED	3,350	6.5%	68,706,235	2.9%
OTHR SVCS (EXCPT PUBLIC ADMIN)	1,516	3.0%	52,324,329	2.2%
PRINTING SERVICES	5	0.0%	1,230,343	0.1%
PUBLIC ADMINISTRATION	24,164	47.2%	897,551,403	37.3%
RAIL TRANSPORTATION	28	0.1%	1,061,685	0.0%
REAL ESTATE & LEASING OFC	379	0.7%	16,371,613	0.7%
RELIGIOUS, CIVIC, PRO ORG	54	0.1%	2,245,520	0.1%
RESIDENTIAL	301	0.6%	3,819,030	0.2%
RETAIL TRADE	52	0.1%	2,035,219	0.1%
SCI-TECH & LEGAL SERVICES	59	0.1%	361,267	0.0%
SPECIAL TRADE CONTRACTORS	141	0.3%	5,140,874	0.2%
SUPPORT ACTVTY FOR TRANSPORTN	618	1.2%	50,909,542	2.1%
TRANSIT-GRND PASSNGR TRANSPRTN	36	0.1%	2,051,004	0.1%
TRANSPORTATION	2	0.0%	45,376	0.0%
TRUCK TRANSPORTATION	1	0.0%	105,280	0.0%
UNCLASSIFIABLE	802	1.6%	19,620,471	0.8%
UTILITIES (ELEC/GAS/WATER)	11,400	22.3%	766,142,814	31.9%
WATER TRANSPORTATION	4	0.0%	140,656	0.0%
WHOLESALE TRADE	6	0.0%	65,514	0.0%
Total	51,218	100.0%	2,403,708,983	100.0%

Appendix C1

SCE 2012 Local Government Sales by Sector and Facility Type

Segment and Sector	2012 KWh sales	% of 2012 KWh Sector Sales	% of 2012 KWh Segment Sales
Agricultural	56,220,884	4.3%	
AGRICULTURE	56,220,884		100.0%
Commercial	1,252,808,563	95.2%	
AGRICULTURE	634,915		0.1%
ALL OTHER COMMERCIAL	559,628,263		44.7%
COLLEGES & UNIVERSITIES	49,661		0.0%
COMMUNICATIONS	8,730,855		0.7%
CORRECTIONAL INSTITUTIONS	147,476,935		11.8%
FOOD STORES/REFRIG WAREHOUSES	153,966		0.0%
HOTELS & MOTELS	24,780,306		2.0%
OFFICE BUILDINGS/LARGE & SMALL	501,387,724		40.0%
OIL & GAS EXTRACT/PIPELINES	1,521,064		0.1%
OTHER WAREHOUSES	1,067,456		0.1%
RESTAURANTS	1,285,445		0.1%
RETAIL STORES/LARGE & SMALL	6,034,033		0.5%
UNCLASSIFIED/YET TO BE CLASSIFIED	57,940		0.0%
Industrial	2,791,586	0.2%	
BUILDERS: RES & COMML	2,417,963		86.6%
OIL & GAS EXTRACT/PIPELINES	373,623		13.4%
Other	3,513,696	0.3%	
OTHER	3,513,696		100.0%
Grand Total	1,315,334,729	100.0%	100.0%

Appendix D1

The following is a review of the distribution of electric energy use across several end use categories based on a review the Energy Action Plans available for various municipalities.

Huntington Beach EAP Summary

GIS Streetlight Audit[8]

Huntington Beach spends over $2 million annually on almost 14,000 streetlights. Street lighting is the single largest item (in both dollars and energy) on the annual power bill. Following the dictum, "what gets measured gets managed", led the city to perform a Geographic Information System (GIS) based inventory of the fixtures. This is not a new trend as many major cities have benefited from this type of inventory. The project creates a spatially accurate inventory of the street poles in a relatively short period of time. City staff, whose efforts are paid for by the federal grant, create a comprehensive streetlight layer in the city's GIS system. This also benefits the city by providing a way to easily update the system as assets are added or removed.

Once the inventory is analyzed, an effective lighting strategy for HB will be developed. Some strategies that have been used by other cities include, (a) turning off some lights, (b) utilizing more efficient lighting sources (induction or LED), or (c) setting timers for lightly used hours. The city of Santa Rosa, for example, with 16,000 streetlights, is reducing fixtures and operating hours and saving 50% of their street lighting budget. As HB develops the long-term street lighting strategy community engagement will be critical to ensure that the public safety, energy and environmental costs and dark sky benefits are understood. The ability to explore these types of options becomes viable as a result of this inventory.

As seen from the GIS streetlight audit activity, street lighting is a significant energy use and expense to the city. Ensuring that HB taxpayers receive appropriate value from these expenditures of energy has led staff to pursue strategic LED street light retrofits. On Main Street, the city was confronted with multiple stakeholder requests that encountered budget and electrical infrastructure constraints. The Business Improvement District (BID) wanted to upgrade the holiday lights and provide auxiliary power for Surf City Nights, yet the existing infrastructure was incapable of supporting these requests. The underground wiring could not provide enough electrical capacity to power both brighter streetlights and holiday lighting simultaneously without digging up the streets to lay new wiring. The Police department needed more and better lighting on Main streets to enhance public safety. Public Works did not have budget to re-work the street lighting circuits and energy costs for street lighting are significant. These constraints led to a solution for wirelessly controlled dimmable LED streetlights that provided increased light quality while consuming less power and providing the ability to adjust light levels depending on the use at any specific time. This solution avoided the need to dig up the streets and reduced energy consumption while satisfying divergent stakeholder needs. The city became one of the first in the nation to implement such a technology to assist in improving

---

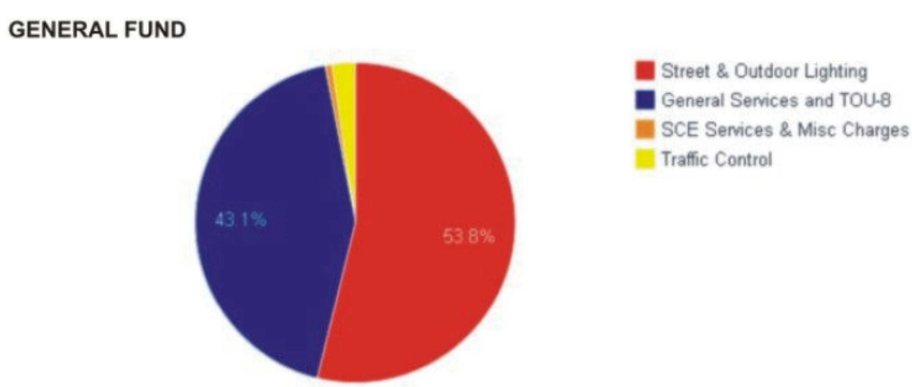
[8] City of Huntington Beach Energy Action Plan

public safety. This solution had several benefits: (a) provided the Police department better light quality at all times, as well as the ability to increase light levels by 30% in emergencies, (b) provided the electrical capacity for the BID to upgrade the holiday lighting, and (c) reduced energy consumption, as well as the ability to increase light quantity by 30% in emergencies. This creative solution was made possible by the involvement of Council members, the BID, staff from multiple departments, and industry partners. As important as these benefits are, longer term it is important to develop next generation lighting solutions because HB spends over $2M annually for street and area lighting.

Another example of using the newer unique features of LED area lighting allows HB to provide energy services (light) to people not things, allowing reduced light levels and costs when there isn't a need. LED lighting manufacturers have worked with UC Davis to create Bi-level LED fixtures that incorporate an occupancy sensor on the housing, that dims the area when it is unoccupied to 50% and immediately increases to 100% when occupancy is detected. The city has installed these types of fixtures at several city parks such as, Murdy, Manning and Edison parks. This feature has been shown by UC Davis to enhance perceptions of safety and reduce energy consumption. SCE elected not to participate with HB in these specific energy efficiency measures.

Figure 14. City of Huntington Beach Selected Top Users Municipal Energy Use

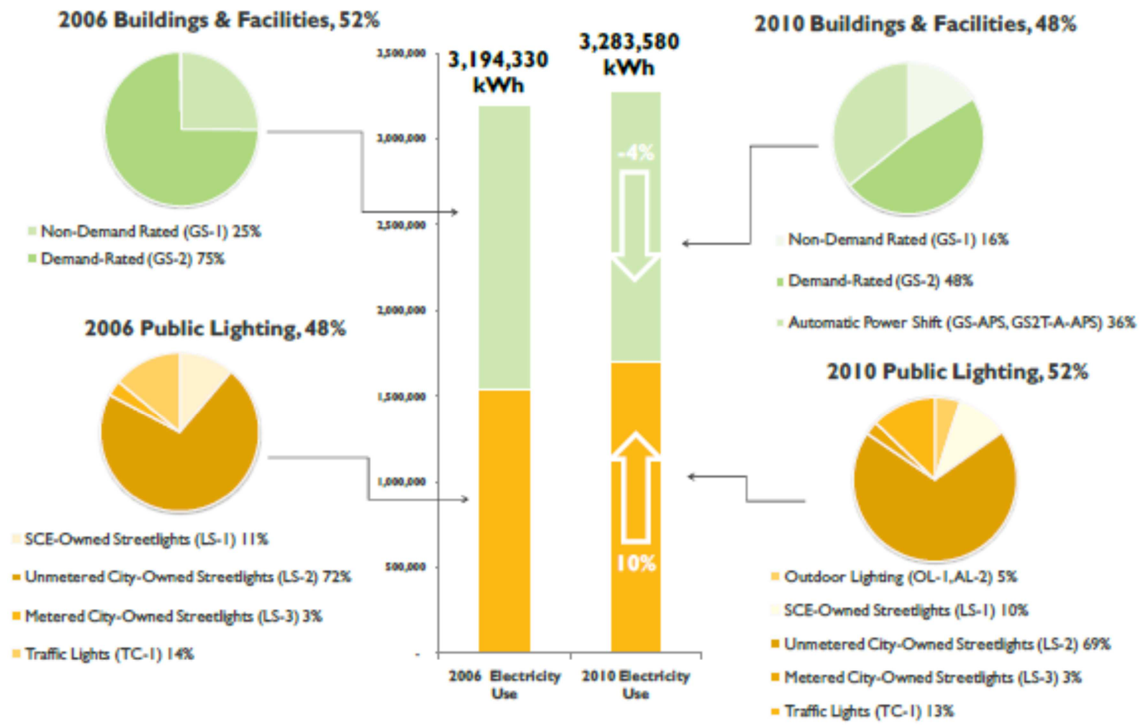
FY 08/09 Municipal Operations Electric Usage		
Municipal Facility	Energy Usage (kWh)	Annual Cost
Street Lights	9,444,035	$2,046,178
Water Pumping	5,445,792	$519,281
City Hall	4,834,000	$563,951
Central Library	3,244,890	$398,031
Traffic Lights	625,100	$89,547
Other	5,836,477	$835,783
Total	29,430,294	$4,452,771



City of San Gabriel Energy Action Plan Adopted EAP Energy Use Distribution

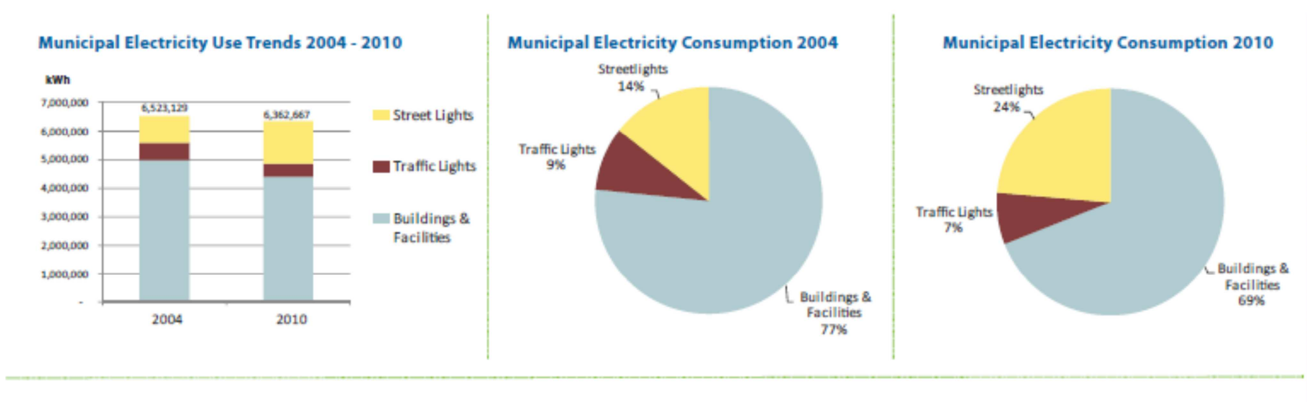
CITY OF SAN GABRIEL ENERGY ACTION PLAN ADOPTED NOVEMBER 20, 2012

Figure ES-7: Municipal Electricity Use by Account Type, 2006–2010



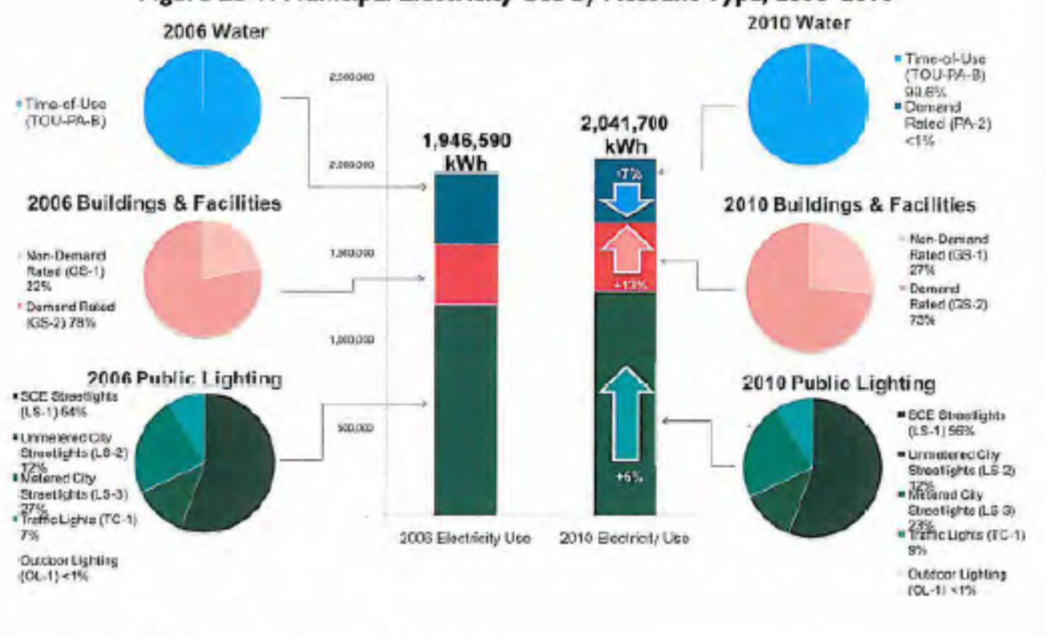
West Covina Energy Action Plan Adopted EAP Energy Use Distribution

TRENDS IN MUNICIPAL ELECTRICITY USE (BY SECTOR)



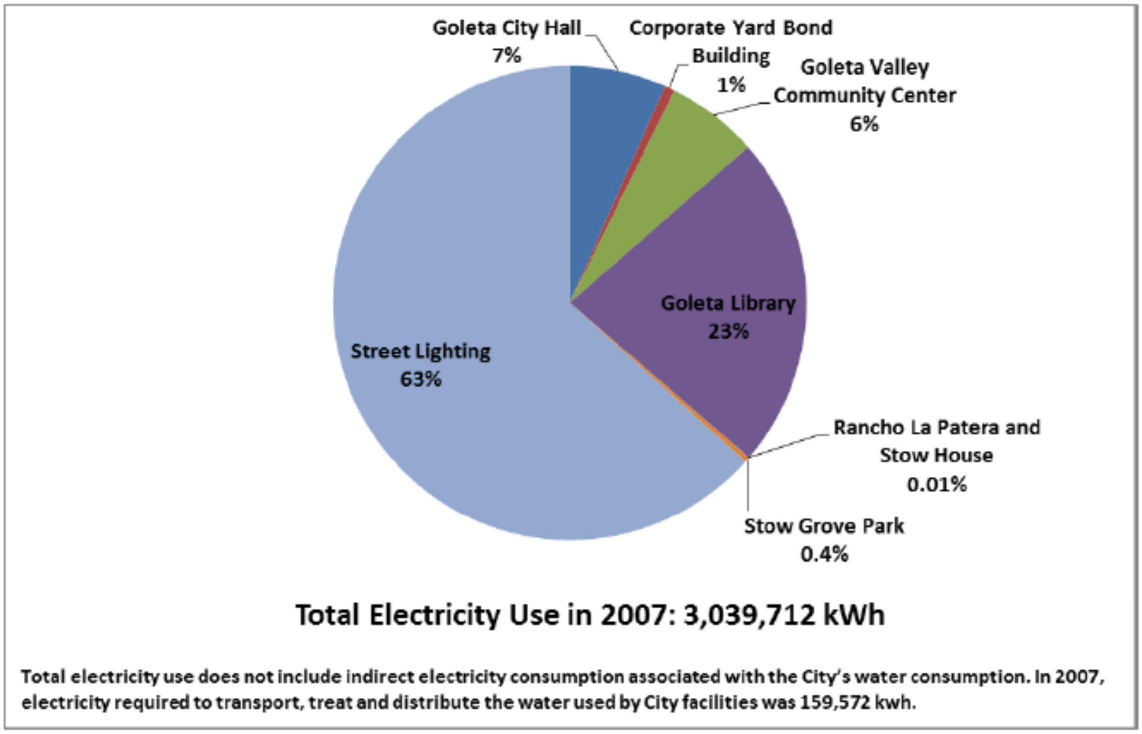
City of Temple City Energy Action Plan Adopted EAP Energy Use Distribution

Figure ES-7: Municipal Electricity Use by Account Type, 2006–2010



City of Goleta Energy Action Plan Adopted EAP Energy Use Distribution

Figure 3.1: Electricity Consumption in 2007 for All City Facilities



Newport Beach EAP Summary

Street lighting accounted for 39% of general fund expenditures in 2010 – 2011, or 21% of total electricity expenditures. Water pumping accounted for 100% of enterprise funds, or 47% of total electricity expenditures

Table 18. Newport Beach Electricity Use and Cost - by Fund

Fund Type	Electricity Use (kWh)	Electricity Cost ($)
Enterprise	9,849,324	$1,184,728
General	10,993,435	$1,406,817
TOTAL	20,842,759	$2,591,545

Figure 15. Newport Beach Electricity Use (kWh) - by Fund

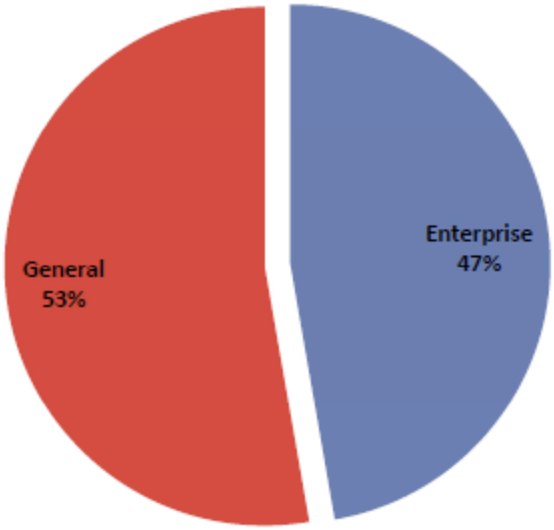


Table 19. Newport Beach Electricity Use and Cost - by Department

Fund	Department	Electricity Use (kWh)	Electricity Cost ($)
Enterprise	Municipal Operations (Enterprise Fund)	9,849,324	$1,184,728
	City Hall	986,260	$145,808
	Fire	568,281	$93,211
	Library Services	898,121	$150,671
General	Municipal Operations (General Fund)	5,540,048	$697,898
	Police	1,253,421	$145,602
	Public Works	886,207	$134,082
	Recreation and Senior Services	861,097	$39,547
TOTAL		20,842,759	$2,591,545

Figure 16. Newport Beach Electricity Use (kWh) - by Department

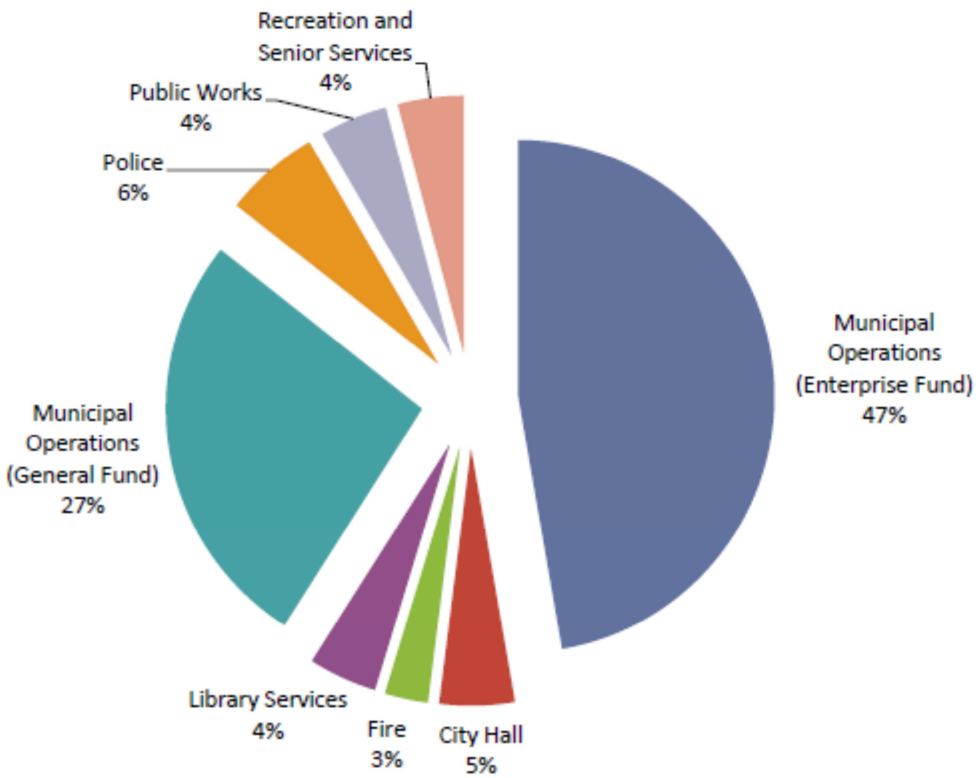


Table 20. Newport Beach Electricity Use and Cost - by Department Division (Enterprise Only)

Fund	Department Division	Electricity Use (kWh)	Electricity Cost ($)
Enterprise	Municipal Operations: Water Production	9,529,177	$1,120,488
	Municipal Operations: Wastewater	320,147	$64,240
TOTAL		9,849,324	$1,184,728

Figure 17. Newport Beach Electricity Use (kWh) - Enterprise Fund

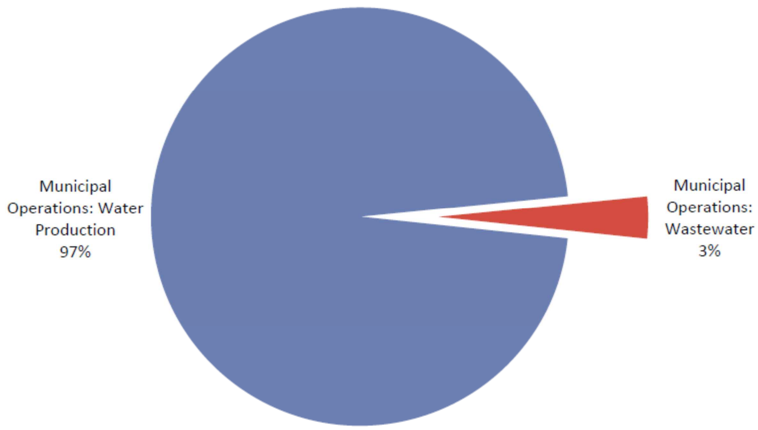
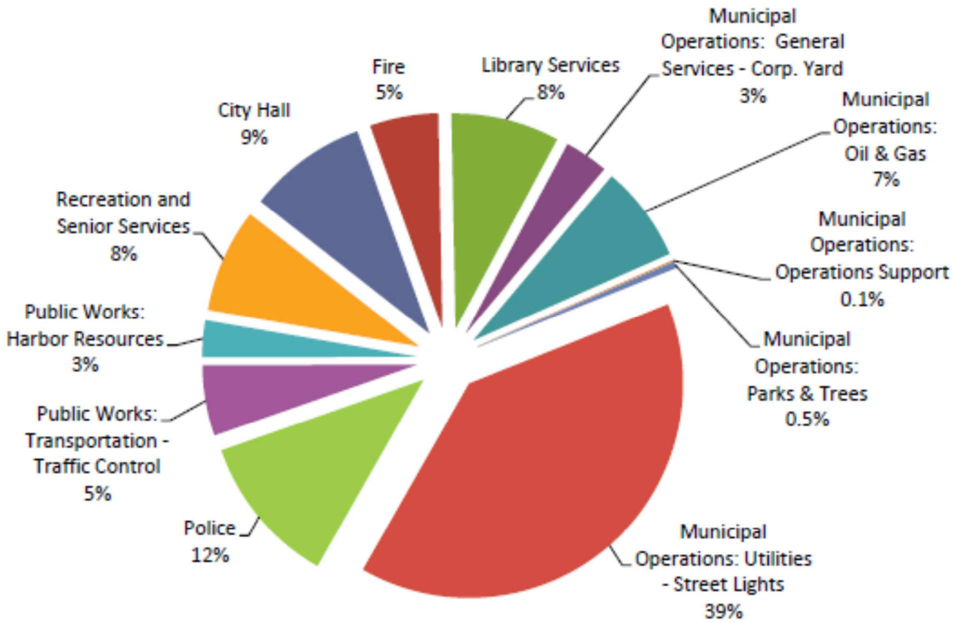


Table 21. Newport Beach Electricity Usage and Cost – by Department Division (General Fund Only)

Fund	Department Division	Electricity Use (kWh)	Electricity Cost ($)
General	City Hall	986,260	$145,808
	Fire	568,281	$93,211
	Library Services	898,121	$150,671
	Municipal Operations: General Serv. - Corp. Yard	362,054	$49,597
	Municipal Operations: Oil & Gas	795,559	$74,237
	Municipal Operations: Operations Support	11,501	$2,801
	Municipal Operations: Parks & Trees	51,600	$28,149
	Municipal Operations: Utilities - Street Lights	4,319,334	$543,114
	Police	1,253,421	$145,602
	Public Works: Transportation - Traffic Control	582,385	$94,535
	Public Works: Harbor Resources	303,822	$39,547
	Recreation and Senior Services	861,097	$39,547
TOTAL		10,993,435	$1,406,817

Figure 18. Newport Beach Electricity Usage (kWh) - General Fund



Appendix E1

Summary of Potential Model Approach to Street Lighting Sector Analysis

This appendix details the approach to developing inputs for the Street-Lighting sectors. All values in the PG study and Agricultural, Industrial, Mining, and Street Lighting Approach are based primarily on secondary research in addition to some primary data supplied by the investor-owned utilities (IOUs). This appendix includes tables detailing specific inputs that define the measures and the reader should refer to the Measure Input Characterization Sheets for more information and specific inputs.
The consultant divided the Street-Lighting sector into three main subsectors. Table J-2 describes each of these subsectors and indicates the statewide percent of total electricity (megawatt-hours [MWh]) consumed by each as a percent of the total Street-Lighting sector.

Table 22. Street-Lighting Subsectors and Relative Electric Energy Consumption

Subsectors	Technology Description	Statewide Electricity Consumption Distribution for Street-Lighting Sector
Streets	Lights used to illuminate roads and highways	86%
Signs	Lights used to illuminate road or highway signs	4%
Traffic Lights	Lights used in red, yellow, and green traffic signals	10%

Source: The consultant analysis of the following sources in Section J.13: [1] through [10]

The consultant estimated the lamp counts by subsector individually for each IOU using the IOU-supplied inventories and secondary sources. Table 23 describes the three main subsectors by the distribution of lamp counts in each IOU service territory.

Table 23. Portion of Lamps by Subsector for Each IOU

Subsectors	PG&E	SCE	SDG&E	Average Statewide Lamp Consumption (kWh/lamp/year)	Average Statewide Lamp Wattage (watts/lamp)
Streets	36%	36%	23%	555	115
Signs	1%	1%	1%	963	239
Traffic Lights	63%	63%	76%	36	10.3

Note: The operating hours differ for the Streets and Signs subsectors.

Efficient Measure Descriptions and Associated Baselines

To develop assumptions about the current saturation of efficient and baseline technologies, the consultant took a different approach for each of the subsectors:

- The consultant reviewed the inventories supplied by the IOUs for the Streets subsector. The Streets subsector includes incandescent, mercury vapor, low-pressure sodium, high- pressure sodium, metal halide, light-emitting diode (LED), and induction lamps. The consultant used this information to quantify the distribution of these technologies by lamp count across the Streets subsector. LEDs and induction lamps are considered efficient technologies while the remaining lamp types are considered baseline technologies.

- For the "Signs" subsector, the consultant leveraged the IOU-supplied street-light inventories and secondary sources to estimate the inventories of baseline and efficient lamps. The consultant assumed that the rate of efficient technology saturation within each IOU's Signs subsector is equivalent to the rate seen within each IOU's Streets subsector.
- For the "Traffic Lights" subsector, the consultant assumed that the use of LEDs is standard practice. As of January 1, 2006, California's Title 24 (in response to federal standards) requires all traffic signals to have maximum wattages no greater than 11 to 17 watts, depending on the lamp type (i.e., lamp size, color, and signal type).[9] Discussions with IOUs confirmed that all current installations are LEDs.[10]

The following sections detail the baseline and efficient technology characterizations. Table 24 shows the portion of lamps by technology and subsector for each IOU.

Table 24. Portion of Lamps by Technology and Subsector for Each IOU

Subsector	Technology	PG&E	SCE	SDGE
Streets	Incandescent	0%	0%	1%
Streets	Mercury vapor	0%	1%	1%
Streets	Low-pressure sodium	8%	3%	18%
Streets	High-pressure sodium	86%	93%	56%
Streets	Metal halide	1%	1%	0%
Streets	LED	2%	0%	4%
Streets	Induction	2%	1%	20%
Signs	Mercury Vapor	96%	99%	77%
Signs	LED	2%	0%	4%
Signs	Induction	2%	1%	20%
Traffic Lights	LED	100%	100%	100%

Table 25 shows the distribution of energy consumption for the same technologies and subsectors as shown in Table 25. The consultant used IOU-supplied inventories and the rate schedules associated with street lamps to estimate "streets" energy consumption per lamp. The majority of IOU street lamps are typically covered by rate schedules LS-1 and LS-2.[11] These rate schedules typically specify the wattage, lumens, operating hours, and monthly kWh charges associated with each lamp type. The consultant used secondary sources to estimate "signs" and "traffic lights" energy consumption per lamp.

Table 25. Portion of Consumption by Technology and Subsector for Each IOU

Subsector	Technology	PG&E	SCE	SDGE

[9] See the following source in Section J.12 : [18].

[10] See the following source in Section J.12 :: [19].

[11] See the following sources in Section J.13 :: [5] through [10].

Streets	Incandescent	1%	0%	0%
Streets	Mercury vapor	1%	3%	2%
Streets	Low-pressure sodium	8%	2%	15%
Streets	High-pressure sodium	87%	93%	67%
Streets	Metal halide	1%	1%	0%
Streets	LED	1%	0%	2%
Streets	Induction	1%	0%	14%
Signs	Mercury Vapor	99%	100%	89%
Signs	LED	1%	0%	2%
Signs	Induction	1%	0%	9%
Traffic Lights	LED	100%	100%	100%

Source: The consultant analysis of IOU-provided lamp inventories, Quarterly Fuel and Energy Report (QFER) data, and the following secondary sources in Section J.12: [1] through [19]

The consultant developed five measures for the Streets subsector, two measures for the Signs subsector, and one measure for the Traffic Lights subsector. Table 26shows the measures and associated baselines.

Table 26. Street-Lighting Measures and Baselines

Subsector	Measure Description	Baseline Description
Streets	Baseline street lights with advanced controls	Existing HPS, LPS, MH, MV, incandescents street lights (weighted by lamp count)*
Streets	LED street lights	Existing HPS, LPS, MH, MV, incandescents street lights (weighted by lamp count)*
Streets	LED street lights with advanced controls	Existing HPS, LPS, MH, MV, incandescents street lights (weighted by lamp count)*
Streets	Induction street lights	Existing HPS, LPS, MH, MV, incandescents street lights (weighted by lamp count)*
Streets	Induction street lights with advanced controls	Existing HPS, LPS, MH, MV, incandescents street lights (weighted by lamp count)*
Signs	LED street sign lights	Mercury vapor street sign lights
Signs	Induction street sign lights	Mercury vapor street sign lights
Traffic Lights	Advanced LED traffic lights	LED traffic lights

*HPS = high-pressure sodium; LPS = low-pressure sodium; MH = metal halide; MV = mercury vapor.

Source: The consultant analysis of IOU-provided lamp inventories, QFER data, and the following secondary sources in Section J.12: [1] through [19]

Streets Subsector. The consultant developed the measure characteristics for advanced controls by reviewing several secondary sources. The secondary sources included evaluations of pilot programs that have deployed advanced controls to support municipal Street-Lighting systems. Advanced controls are defined as controls beyond standard photocells, timers, and astronomical timers that generally include activity and motion-sensing, network connections for outage monitoring, and remote controlling. Advanced controls can be deployed on existing light installations (i.e., baseline street lights), or they can be installed along with new LEDs or induction lamps.[12] Advanced controls are only deployed for lights found within the Streets subsector.

The consultant defined the baseline for "streets" as the current mix of baseline lamp technologies: high-pressure sodium, low-pressure sodium, metal halide, mercury vapor, and incandescent. The consultant represented these baseline lamp types with a single lamp based on a weighted average. Additionally, the five measures shown in Table 26 are included in a single competition group and compete for the sockets occupied by these baseline lamps.

Signs Subsector. The consultant estimated that the majority of baseline sign lights are mercury vapor and that two measures are competing for those sockets: LED and induction lamps.

Traffic Lights Subsector. The consultant developed one measure for the "Traffic Lights" subsector and defines the baseline as current and standard LEDs. The measure level, or efficient case, is defined as advanced LEDs that have wattages significantly less than the wattages specified by the current Title 20 requirements.[13]

Emerging Technologies

The consultant considered emerging technologies for some of its measures within the Street- Lighting sector. For the Streets subsector, advanced controls and LEDs are considered emerging technologies. LEDs are also considered emerging technologies for the Signs subsector. Finally, advanced LEDs are considered an emerging technology within the Traffic lights subsector. These are differentiated from the baseline LEDs that will remain constant throughout the analysis time frame. The consultant estimated that the advanced LEDs will experience some measure of improvement in efficiency and cost as the technology matures and continues to develop during the course of the analysis period.

Measure Characteristics: Performance

The potential analysis relies on estimates for energy consumption (kWh) and peak demand (kW) for both baseline and efficient measures. Therefore, the consultant developed these performance characteristics for the Street-Lighting measures using IOU-provided data and secondary sources.

Energy Consumption

The consultant estimated the energy consumption of both baseline and efficient technologies within the Street-Lighting sector and reports consumption as kWh per year per lamp. The details of the approaches taken for each subsector follow:

- **Sources for energy consumption estimates.** Estimates for the Streets subsector relied on the IOU-provided lamp inventories that are tied to rate schedules (e.g., LS-1 and LS-2) that specify monthly kWh charges.[14] Energy consumption estimates for baseline and efficient technologies within the Signs and Traffic Lights subsectors relied on average values developed from various secondary sources. Secondary sources include program evaluations, technology assessments, and case studies including sources developed by the IOUs.[15]

---

[12] See the following sources in Section J.13 : [12], [20] through [24].

[13] See the following source in Section J.12 : [18].

[14] See the following sources in Section J.13 :: [2] through [10].

[15] See the following sources Section J.12 :. Signs: [2] through [10], [13], [14], [15], [16]; Traffic Lights: [17].

- **Consistency of energy consumption across IOUs.** Streets subsector energy consumptions vary across IOUs because each IOU inventory reported a different mix of lamp wattages for each technology. The reported consumptions reflect the averages of those mixes. Signs and Traffic Lights subsector energy consumptions are assumed to be equal across the IOUs because secondary sources used to estimate savings did not differentiate across those IOUs.[16] Table J-8 shows the annual consumptions estimated for this analysis.
- **Energy consumption for base and efficient cases.** There are currently no federal or California codes regulating equipment within the Streets and Signs subsectors; therefore, those baseline and code consumption levels are equal. Regulations currently exist for the Traffic lights subsector,[17] but the consultant estimated that all baseline equipment has been updated to match the current code.[18] Traffic lights energy consumption for the baseline and efficient case are equal in Table J-8 to reflect the efficient case prior to the saturation of the advanced LED emerging technology in later years.

Finally, Table 27shows the resulting energy consumption characteristics of lighting within the Streets subsector that is installed along with advanced controls.

Table 27. Baseline and Measure Annual Consumption Estimates (kWh/year)

Subsector	Baseline/Measure Description	PG&E	SCE	SDG&E
Streets	Baseline (existing HPS, LPS, MH, MV, incandescents street lights [weighted by lamp count])	552	578	553
Streets	Baseline street lights with advanced controls	394	412	394
Streets	Measure: LED street lights	330	195	270
Streets	Measure: LED street lights with advanced controls	236	139	192
Streets	Measure: Induction street lights	257	371	362
Streets	Measure: Induction street lights with advanced controls	183	264	258
Signs	Baseline (mercury vapor street sign lights)	992	992	992
Signs	Measure: LED street sign lights	359	359	359
Signs	Measure: Induction street sign lights	403	403	403
Traffic Lights	Baseline (LED traffic lights)	36	36	36
Traffic Lights	Measure: Advanced LED traffic lights	36	36	36

[16] See the following sources in Section J.13 :. Signs: [2] through [10], [13], [14], [15], [16]; Traffic Lights: [17].
[17] See the following source in Section J.12 :: [18].
[18] See the following source in Section J.12 :: [19].

Effective and Remaining Useful Lifetimes

The consultant also accounted for effective useful life (EUL) and RUL for the measures under consideration. The consultant developed baseline and efficient effective useful lifetimes by averaging values found in several secondary sources. RULs are estimated as half of the EUL for the given technology. This assumes an even mix of equipment ages among existing stocks. Lifetimes are also considered equivalent across the three IOUs, as shown in Table 28.
Similar to the previous discussions, the consultant assumed baseline and code values are equal.

Table 28. Baseline and Measure Equipment Lifetimes

Subsector	Baseline/Measure Description	EUL	RUL*
Streets	Baseline (existing HPS, LPS, MH, MV, incandescent street lights (weighted by lamp count))	5.9	2.9
Streets	Baseline street lights with advanced controls	5.9	N/A
Streets	LED streetlights	17.3	N/A
Streets	LED streetlights with advanced controls	17.3	N/A
Streets	Induction streetlights	24.7	N/A
Streets	Induction streetlights with advanced controls	24.7	N/A
Signs	Baseline (mercury vapor street sign lights)	6.2	3.1
Signs	LED street sign lights	17.3	N/A
Signs	Induction street sign lights	24.7	N/A
Traffic Lights	Baseline (LED traffic lights)	11.5	5.8
Traffic Lights	Advanced LED traffic lights	11.5	N/A

*The model only considers baseline/code RULs.
Source: The consultant analysis of the following sources in Section J.13: [12], [13], [14], [15], [27] through [33].

Measure Characteristics: Economic

The potential analysis also relies on economic characteristics that further describe measures. The remainder of this section discusses estimates for costs, including costs for material, labor, and operation and maintenance (O&M).

Costs

The consultant accounted for material costs, labor costs during installation, and O&M benefits (or costs). Material and labor costs are reported as the full costs and the model calculates the incremental costs depending on the assumed installation scenario (i.e., ROB, retrofit, or new construction). O&M benefits reflect the decrease in standard annual O&M requirements as a result of installing the efficient measure. A negative O&M benefit indicates an increase in O&M costs. O&M values reflect the annual benefit or cost per lamp. Table 29 and Table 30 show the material costs, labor costs, and O&M benefits.

The consultant estimated costs by averaging values reported by various secondary sources. The consultant also assumed that costs are equivalent across the three IOUs. Similar to the previous discussions, the consultant assumed baseline and code values are equal.

Table 29. Baseline and Measure Material and Labor Costs

Subsector	Measure Description	Baseline Description	Efficient Material	Efficient Labor	Baseline Material	Baseline Labor
Streets	Baseline street lights with advanced controls	Existing HPS, LPS, MH, MV, incandescents street lights (weighted by lamp count)	$441.85	$37.16	$235.42	$32.80
Streets	LED street lights		$680.63	$32.80		
Streets	LED street lights with advanced controls		$887.06	$37.16		
Streets	Induction street lights		$438.33	$32.80		
Streets	Induction street lights with advanced controls		$644.77	$37.16		
Signs	LED street sign lights	Baseline (mercury vapor street sign lights)	$391.06	$32.80	$100.00	$32.80
Signs	Induction street sign lights		$251.85	$32.80		
Traffic Lights	Advanced LED traffic lights	Baseline (LED traffic lights)	$101.50	$47.60	$101.50	$47.60

The O&M benefits reported for the Streets subsector reflect the benefits associated with advanced controls. The consultant estimated that remote monitoring and smart controls will reduce the cost to maintain road and highway lighting systems.

Table 30. Baseline and Measure O&M Benefits

Subsector	Measure Description	Baseline Description	O&M Benefit
Streets	Baseline street lights with advanced controls	Existing HPS, LPS, MH, MV, incandescents street lights (weighted by lamp count)	$6.00
Streets	LED street lights		$0.00
Streets	LED street lights with advanced controls		$6.00
Streets	Induction street lights		$0.00
Streets	Induction street lights with advanced controls		$6.00
Signs	LED street sign lights	Baseline (mercury vapor street sign lights)	$0.00
Signs	Induction street sign lights		$0.00
Traffic Lights	Advanced LED traffic lights	Baseline (LED traffic lights)	$0.00

Measure Characteristics: Market

Table 31 shows the lamp counts and Table 32 shows the corresponding densities as a percent of the total lamps in each subsector and vintage. For Table 32, the values within each competition group (distinguished by IOU, subsector, and vintage) sum to 1.00.

Table 31. Lamp Counts by Technology and Subsector for Each IOU

Vintage	Subsector	Baseline/Measure Description	PG&E	SCE	SDG&E
Existing	Streets	Baseline (existing HPS, LPS, MH, MV, incandescent street lights [weighted by lamp count])	723,682	772,209	113,304
Existing	Streets	Baseline street lights with advanced controls	0	0	0
Existing	Streets	LED streetlights	15,710	1,213	5,703
Existing	Streets	LED street lights with advanced controls	0	0	0

GANT

Existing	Streets	Induction street lights	12,819	5,678	29,037
Existing	Streets	Induction street lights with advanced controls	0	0	0
New	Streets	Baseline (existing HPS, LPS, MH, MV, incandescent street lights [weighted by lamp count])	1,396	506	252
New	Streets	Baseline street lights with advanced controls	0	0	0
New	Streets	LED street lights	769	89	41
New	Streets	LED street lights with advanced controls	0	0	0
New	Streets	Induction street lights	627	417	210
New	Streets	Induction street lights with advanced controls	0	0	0
Existing	Signs	Baseline (mercury vapor street sign lights)	19,137	24,048	5,723
Existing	Signs	LED street sign lights	415	38	288
Existing	Signs	Induction street sign lights	339	177	1,467
New	Signs	Baseline (mercury vapor street sign lights)	37	16	13
New	Signs	LED street sign lights	20	3	2
New	Signs	Induction street sign lights	17	13	11
Existing	Traffic Lights	Baseline (LED traffic lights)	1,258,791	1,350,580	481,992
Existing	Traffic Lights	Advanced LED traffic lights	0	0	0
New	Traffic Lights	Baseline (LED traffic lights)	2,336	876	819
New	Traffic Lights	Advanced LED traffic lights	2,336	876	819

Table 32. Densities by Technology and Subsector for Each IOU

Vintage	Subsector	Baseline/Measure Description	PG&E	SCE	SDG&E
Existing	Streets	Baseline (existing HPS, LPS, MH, MV, incandescents street lights [weighted by lamp count])	0.96	0.99	0.77
Existing	Streets	Baseline street lights with advanced controls	0.00	0.00	0.00
Existing	Streets	LED street lights	0.02	0.00	0.04
Existing	Streets	LED street lights with advanced controls	0.00	0.00	0.00
Existing	Streets	Induction street lights	0.02	0.01	0.20
Existing	Streets	Induction street lights with advanced controls	0.00	0.00	0.00
New	Streets	Baseline (existing HPS, LPS, MH, MV, incandescents street lights [weighted by lamp count])	0.50	0.50	0.50
New	Streets	Baseline street lights with advanced controls	0.00	0.00	0.00
New	Streets	LED street lights	0.28	0.09	0.08
New	Streets	LED street lights with advanced controls	0.00	0.00	0.00
New	Streets	Induction street lights	0.22	0.41	0.42
New	Streets	Induction street lights with advanced controls	0.00	0.00	0.00

Existing	Signs	Baseline (mercury vapor street sign lights)	0.96	0.99	0.77
Existing	Signs	LED street sign lights	0.02	0.00	0.04
Existing	Signs	Induction street sign lights	0.02	0.01	0.20
New	Signs	Baseline (mercury vapor street sign lights)	0.50	0.50	0.50
New	Signs	LED street sign lights	0.28	0.09	0.08
New	Signs	Induction street sign lights	0.22	0.41	0.42
Existing	Traffic Lights	Baseline (LED traffic lights)	1.00	1.00	1.00
Existing	Traffic Lights	Advanced LED traffic lights	0.00	0.00	0.00
New	Traffic Lights	Baseline (LED traffic lights)	0.50	0.50	0.50
New	Traffic Lights	Advanced LED traffic lights	0.50	0.50	0.50

Source: The consultant analysis of IOU-provided lamp inventories, QFER data, and the following secondary sources in Section J.12: [1] through [19], [24]

Measure Derating

After reviewing the measures and results developed by The consultant the team vetted them with stakeholders. These stakeholders, namely the IOUs, informed the consultant that lamps owned by the IOUs are likely not eligible to receive incentive funds through energy efficiency programs. The consultant summarizes the comments received:

- Comment 1: Approval and funding from the General Rate Case would be required before using incentive dollars for IOU-owned lamps. IOUs have historically refrained from using energy efficiency funds established for customers for the IOUs' own facilities.
- Comment 2: IOU-owned lamps are not replaced through customer energy efficiency programs. Instead funds must come from the General Rate Case.

The consultant reviewed IOU-supplied lamp inventories to quantify the distribution of lamps by ownership. Generally, ownership is distinguished by rate schedule where LS-1 includes IOU-owned lamps and LS-2 includes customer-owned lamps. The consultant views ownership distributions in terms of lamps counts and notes that this is approximately the same as comparing total energy consumption (kWh).

Table 33. Street Lighting Ownership, by Lamp Count

IOU	IOU-Owned	Customer-Owned
Statewide	57.1%	42.9%
PG&E	26.3%	73.7%
SCE	82.4%	17.6%
SDG&E	19.0%	81.0%

Source: The consultant analysis of the following sources in Section J.13: [2], [3], [4]

As a result, the consultant derated the initial potential results to only reflect those street lighting lamps owned by customers. At the statewide level energy efficiency potential is reduced by 57 percent.

Street Lighting Sector Results

This section provides the estimates of potential energy and demand savings at the statewide level for the street lighting sector.

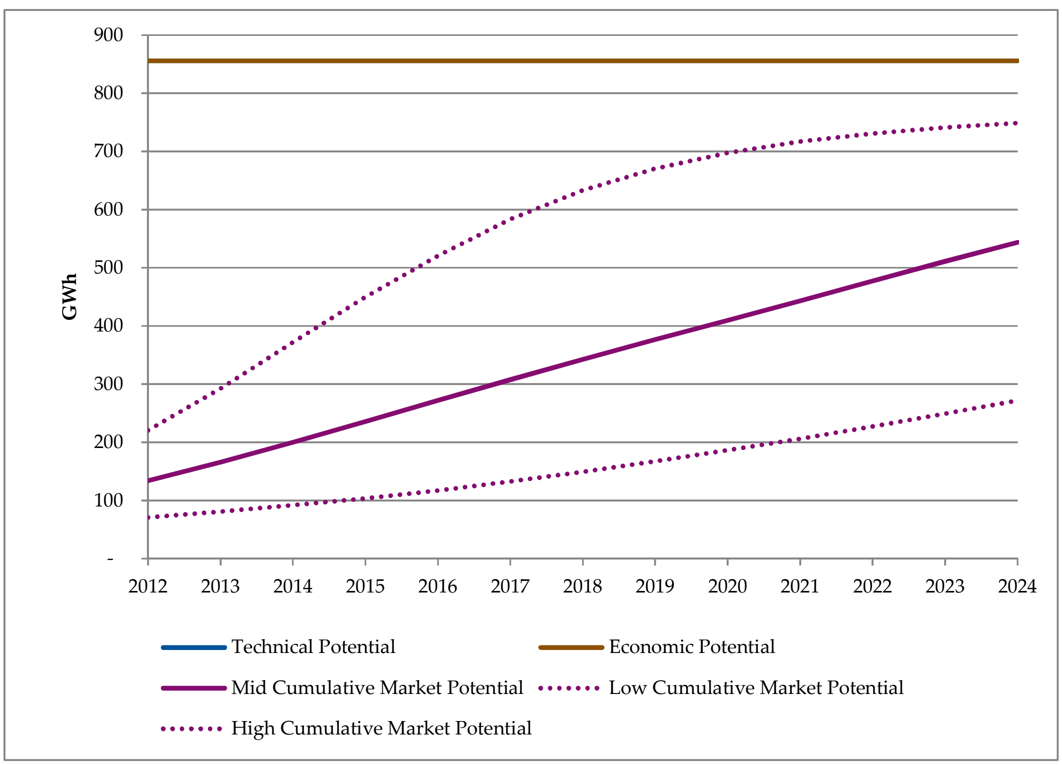
Overview

The potential energy savings in the street lighting sector do not include an assessment of the impact of upcoming codes and standards changes because, while some equipment deployed throughout the street lighting sector (e.g., traffic lights) may be subject to Federal standards, the majority of equipment are generally not subject to the same codes and standards (e.g., Title 24) that apply to the residential and commercial sectors. The street lighting sector includes on electric consuming measures. Therefore, this portion of the analysis excludes gas potential.

California Street Lighting Electric Energy Potential

As shown in Figure 19. California Street Lighting Gross Technical, Economic, and Cumulative Market Energy Savings Potential for 2012-2024 (GWh), the street lighting technical and economic energy savings potential remains constant from 2012 through 2024. Technical and economic energy savings potential in the state of California stay steady at 855 GWh from 2012 through 2024. Cumulative market energy savings potential trails economic and technical energy savings potential and increases from approximately 134 GWh in 2012 to 544 GWh in 2024.

Figure 19. California Street Lighting Gross Technical, Economic, and Cumulative Market Energy Savings Potential for 2012-2024 (GWh)

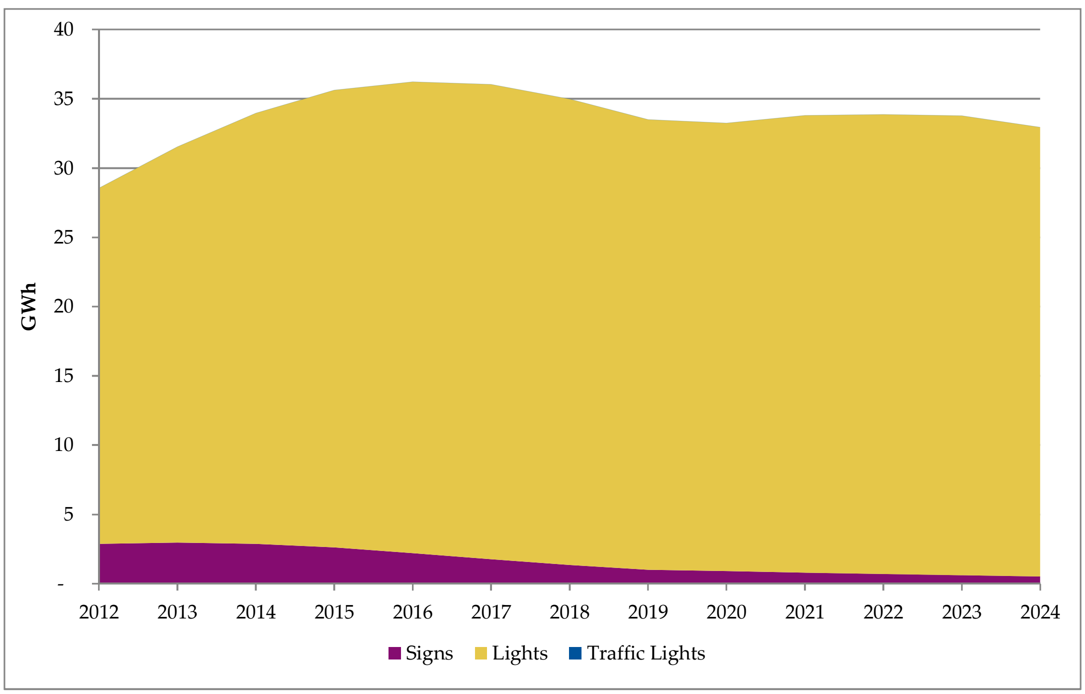


Source: PG model release February 2014

The consultant's street lighting cumulative market potential generally pertains to improvements for street lamps (highway and road illumination). Well over 80 percent of current lamps are high-pressure sodium and retrofits to LEDs and induction lamps provide significant potential savings and reductions in O&M costs due to extended lamp EULs. Additionally, emerging technologies for LEDs will further contribute to potential in future years.

The consultant examined the street lighting sector for demand (MW) potential. The consultant's analysis concluded that demand potential is negligible for this sector. Lamps within the streets subsector operate during nighttime hours and not during the peak demand period. Some street lamps do operate continuously in tunnels and other areas not exposed to daylight. However, The consultant estimates that the consumption and demand savings potential associated with those lamps are negligible. Additionally, traffic signals operate during the peak demand period. However, after accounting for low wattage LEDs, duty cycles, and coincidence factors The consultant concluded that this consumption and demand savings potential associated with these lamps are also negligible. Figure 20 presents the incremental market energy savings potential in the street lighting sector by end use. The incremental market potential remains fairly steady over the analysis period due to the significant presence of baseline street lamps and the significant savings opportunities present for these measures. Additionally, LED emerging technologies provide sustained energy savings potential for the sector, and cumulative market potential reaches 40 percent of consumption by 2024. Savings from traffic lights are negligible because the current stock is completely LED.

Figure 20. California Street Lighting Gross Incremental Market Energy Savings Potential for 2012-2024 (GWh)



Source: PG model release February 2014

California Street Lighting Electric Comparative Metrics

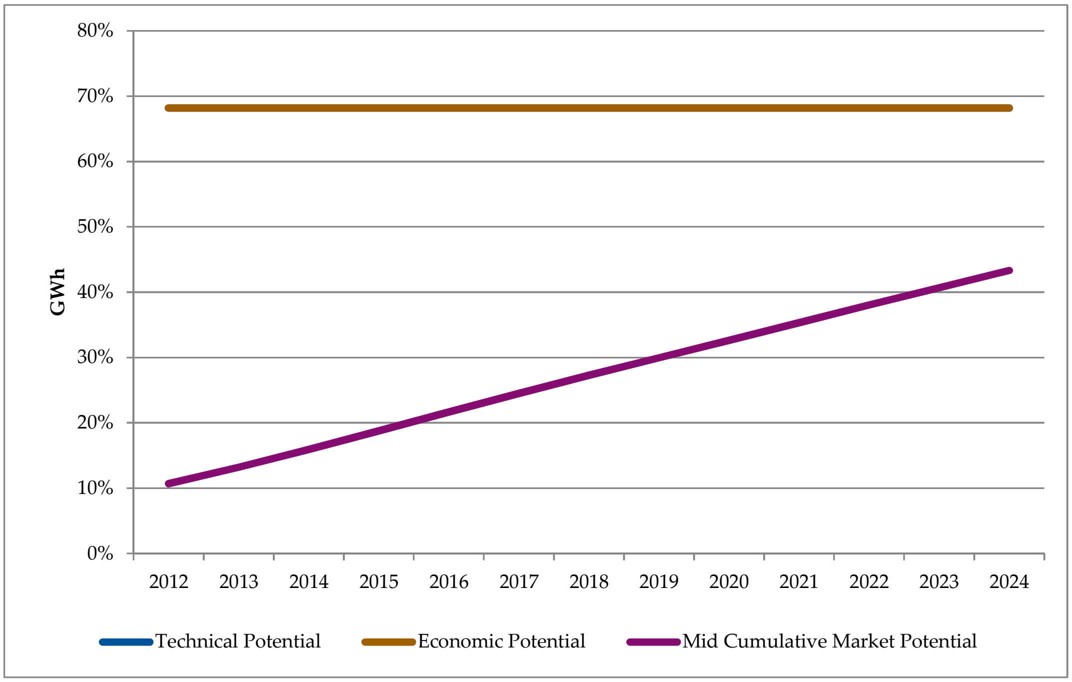
This subsection includes a series of comparative metrics that provide a context from which to assess the reasonableness of the results from the 2013 street lighting analysis. These comparisons also served as a quality control tool during the study and provide a road map for areas of focus for future utility portfolios. For street lighting, comparative metrics are limited because this analysis is the first time that street lighting is explicitly examined and few other third-party efforts have been conducted in the past. Additionally, the IOU compliance filing data provided to The consultant did not include data specific to the street lighting sector. The following comparative metrics are provided:

» Cumulative market potential as compared to the total CEC consumption forecast for the street lighting sector

CEC Forecast Comparative Metrics

CEC consumption forecasts are one of the foundational inputs for the 2013 potential study. Comparing savings as a percent of that CEC consumption forecast is an important comparative metric. Figure 21 Figure 21. California Street Lighting Savings Potential as a Percent of CEC Street Lighting Forecast (Technical, Economic, and Active Cumulative Market Potential)shows the technical, economic, and cumulative market potential savings as a percent of the CEC street lighting forecast. Technical and economic potentials are about 67 percent to 70 percent of the CEC street lighting consumption forecast in 2012 through 2024. Cumulative market potential rises from about 11 percent in 2012 up to 43 percent by 2024.

Figure 21. California Street Lighting Savings Potential as a Percent of CEC Street Lighting Forecast (Technical, Economic, and Active Cumulative Market Potential)



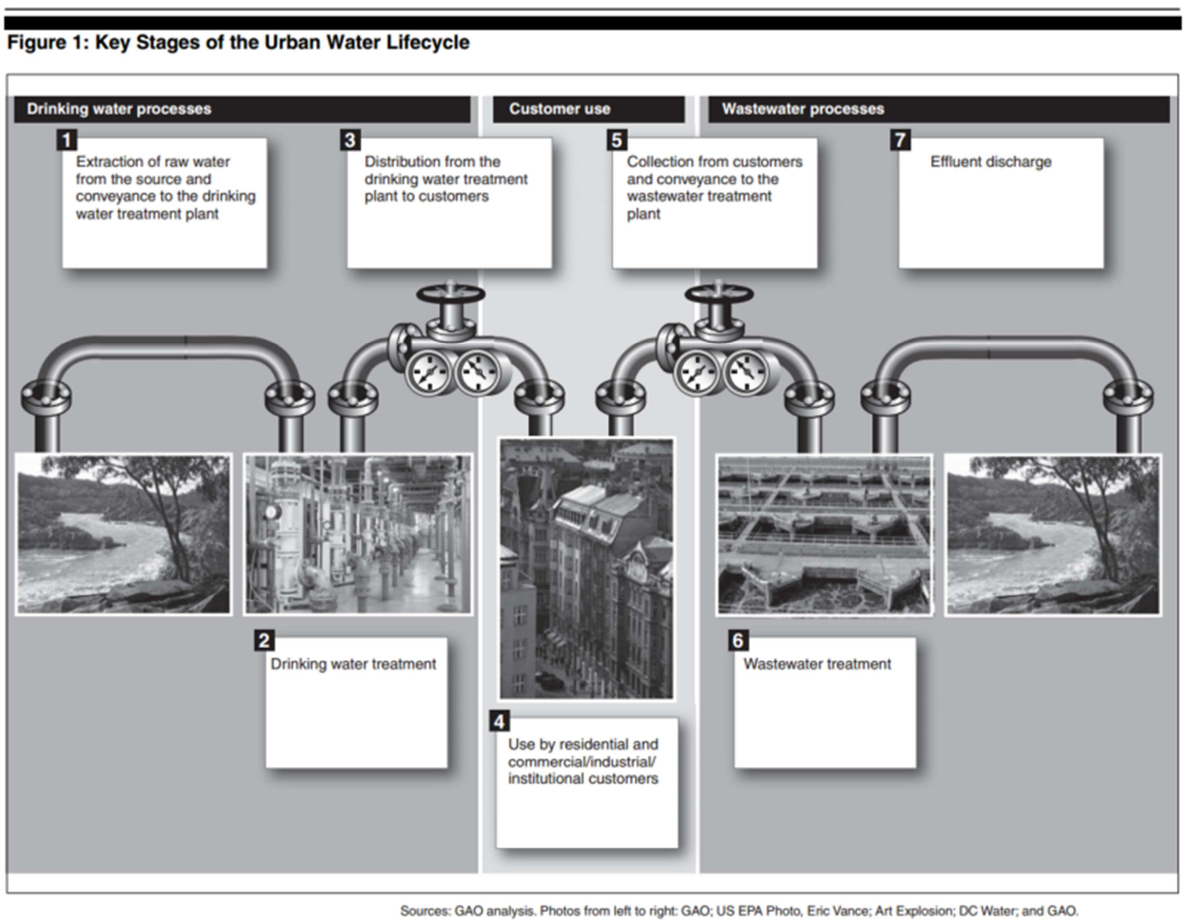
Appendix F1

Summary of Water Pumping Literature Review

Water and Wastewater Background

Approximately 3 to 4 percent of national energy consumption is used for drinking water and wastewater services and 80 percent of this energy consumption is used for pumping and distributing water and wastewater. [19] According to the Natural Resources Defense Council (NRDC), facilities which treat and distribute drinking water and collect and treat wastewater represent up to 35 percent of municipal energy use and have the potential to achieve 15 to 30 percent energy savings through energy conservation measures alone.[20] **Figure 22** below from the USGAO outlines the key stages of the typical urban water lifecycle:

Figure 22. Key Stages of the Urban Water Lifecycle



[19] 2011, Energy Efficiency Best Practices for North American Drinking Water Utilities, NYSERDA, http://www.waterrf.org/PublicReportLibrary/4223.pdf

[20] 2009, Water Efficiency Saved Energy: Reducing Global Warming Pollution Through Water Use Strategies, NRDC, http://www.nrdc.org/water/files/energywater.pdf

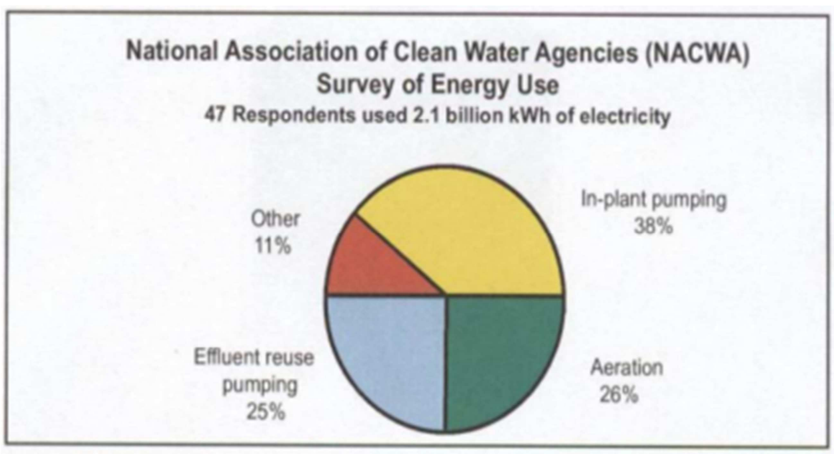
Pumping and aeration processes constitute a large portion of total water and wastewater facility-wide energy consumption. National average consumption statistics show that wastewater treatment facilities consume 1,200 kWh per million gallons (MG) of wastewater generated (1 MG of wastewater is generated by 10,000 people per day) while drinking water treatment plants consume 1,500 kWh per million gallons of water generated (1 MG of water is used by 5,000 people per day)[21]. Examination of utility-provided billing data by NAICS code in **Table 34** reveals that water treatment and distribution operations account for approximately 23% of California local government consumption.

Table 34. Distribution of Community Water System Energy Consumption by Sub-System

Sub-System	% Distribution Normal Year	% Distribution Dry Year	% Weighted Distribution
Supply/Conveyance	14%	36%	31%
Treatment	12%	41%	34%
Distribution	73%	23%	35%
Total	100%	100%	100%

As indicated in **Figure 23** below, a typical wastewater treatment plant's (WWTP) energy consumption profile is largely driven by in-plant pumping at 38 percent of consumption, effluent reuse pumping at 25 percent of consumption, and aeration at 26 percent of consumption. The end-use profile of drinking water plants follows wastewater treatment plants at about 80 percent of energy used for pumping.[22]

Figure 23. Wastewater Treatment Plant Survey of Energy Use



[21] 2009, Clean Energy Opportunities in Water and Wastewater Treatment Facilities Background and Resources, US EPA, http://www.epa.gov/statelocalclimate/documents/pdf/background_paper_wastewater_1-15-2009.pdf

[22] 2013, Energy-Water Nexus: The Water Sector's Energy Use, Congressional Research Service, http://aquadoc.typepad.com/files/crs_energy_water_nexus_water_sectors_energy_use.pdf

With more than 80 percent of facility consumption represented by motors and drives and most wastewater treatment plants reaching 30 to 50 years of age; the opportunities for energy efficiency savings in the municipal water supply sector are numerous and substantial.[23]

Potential for Electric Energy Savings

Water pumping technologies and support systems examined in this literature review include pumping system optimization, variable frequency drives (VFDs), supervisory control and data acquisition (SCADA), and improved motor efficiency. Both potable and non-potable water treatment facilities were reviewed for average potential facility-wide savings. Savings for measures reviewed were also cross referenced against current industry reports such as the KEMA Water and Wastewater Industry Industrial Sector Market Characterization to ensure baseline to efficient technology savings ranges were reasonable.[24] Efficient equipment saturation in the market was considered and applicability factors were applied to the end-use savings percentages to represent the eligible population of facilities for measures. Given the large diversity of wastewater treatment methods only conventional measures were examined for the scope of this assessment. Table 35 below presents the outcome of this effort and

Table 36 provides a list of information resources.

In conclusion, this literature review indicates that more than 4% of total LG sector water and wastewater electricity consumption may be realized through pumping and treatment system improvements alone. As a point of reference, EPRI's water and wastewater industry macroscale potential assessment approximated realistic achievable potential at 8% of baseline by 2030.[25] Taking into consideration the host of emerging and specialized equipment available and currently used in some water and wastewater facilities; the estimate of more than 4% of total LG sector water and wastewater electricity savings falls within a reasonable and conservative range.

---

[23] 2013, Emerging Technologies for Water & Wastewater Treatment, E3T, http://e3tnw.org/Portals/0/E3TFiles/E3T%20presentation%20Water%2016Oct2013_FINAL.pdf

[24] 2012, Industrial Sectors Market Characterization Water and Wastewater Industry, KEMA, http://www.calmac.org/publications/Final_Industrial_Sector_Market_Characterization_Water_Wastewater.pdf

[25] 2013, Electricity Use and Management in the Municipal Water Supply and Wastewater Industries, EPRI, http://www.waterrf.org/PublicReportLibrary/4454.pdf

Table 35. Top Energy Savings Opportunities for LG Water Management

Water Service	Measure	Description	End Use	Average Savings % of End-Use Consumption	Market Applicability Factor	End-Use to Sector Adjustment Factor	Applicable Average Savings % of Total Sector Consumption	Total Savings % of Total Sector Consumption
Potable & Non-Potable	Improved Motor Efficiency	Efficient motor retrofits	Pumping, Motors & Drives	4.0%	5.0%	80.0%	0.2%	4.3%
Potable & Non-Potable	Pump System Optimization	Pump size and flow optimization	Pumping, Motors & Drives	12.4%	10.0%		1.0%	
Potable & Non-Potable	VFDs	Electric energy savings ranges from 5-50% relative to other methods used to accommodate fluctuating flow demand (e.g. throttling or bypassing) depending on initial design	Pumping, Motors & Drives	27.5%	10.0%		2.2%	
Potable & Non-Potable	Supervisory Control and Data Acquisition (SCADA)	Realtime data acquisition and automated control of equipment operations, flow rates, and pressure	Pumping, Motors & Drives	15.0%	5.0%		0.6%	
Non-Potable	High Efficiency Aeration Blowers	Turbo blowers use advanced bearing design and include integrades VFD's and controls.	Aeration	35.0%	10.0%	8.8%	0.3%	
Potable & Non-Potable	Other	Includes facility lighting & HVAC not examined in this review	Other	NA		11.2%		
Potable & Non-Potable Total						100.0%		

Table 36. LG Water Management Information Resources

Water Service	Measure	Description	End Use	Source
Potable & Non-Potable	Improved Motor Efficiency	Efficient motor retrofits	Pumping, Motors & Drives	Energy Water for Local Governments (pg. 16); Indiana Energy Management Pilot actual wastewater treatment facility savings (pg. 19/20).
Potable & Non-Potable	Pump System Optimization	Pump size and flow optimization	Pumping, Motors & Drives	E3T Emerging Technologies for Water & Wastewater Treatment (pg. 16); Energy Efficiency Best Practices for North American Drinking Water Utilites (pg. 51); Indiana Energy Management Pilot actual wastewater treatment facility savings (pg. 2/20).
Potable & Non-Potable	VFDs	Electric energy savings ranges from 5-50% relative to other methods used to accommodate fluctuating flow demand (e.g. throttling or bypassing) depending on initial design	Pumping, Motors & Drives	Energy Water for Local Governments (pg. 16); Indiana Energy Management Pilot actual wastewater treatment facility savings (pg. 7/20).
Potable & Non-Potable	Supervisory Control and Data Acquisition (SCADA)	Realtime data acquisition and automated control of equipment operations, flow rates, and pressure	Pumping, Motors & Drives	Clean Energy Opportunities in Water and Wastewater Treatment Facilities Background and Resources (pg. 4); Energy Efficiency Best Practices for North American Drinking Water Utilites (pg. 33)
Non-Potable	High Efficiency Aeration Blowers	Turbo blowers use advanced bearing design and include integrades VFD's and controls.	Aeration	E3T Emerging Technologies for Water & Wastewater Treatment (pg. 16); AEP Ohio Overview of Water cycles, wastewater treatment processes, wastewater plant energy use and energy efficiency opportunities (pg. 20)