CALIFORNIA PUBLICLY OWNED UTILITIES ENERGY EFFICIENCY REPORTING GUIDELINES

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PREPARED BY: ENERGY AND RESOURCE SOLUTIONS

AUTHORS: DAVID REYNOLDS, PE
TODD WINNER, CEM

PREPARED FOR: CALIFORNIA MUNICIPAL UTILITIES ASSOCIATION (CMUA)
NORTHERN CALIFORNIA POWER AGENCY (NCPA)
SOUTHERN CALIFORNIA PUBLIC POWER AUTHORITY (SCPPA)

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BRYAN COPE, SCPPA
JONATHAN CHANGUS, NCPA
DAN GRIFFITHS, BRAUN BLAISING SMITH WYNNE, P.C.

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1 INTRODUCTION

The overall objective of the California Publicly Owned Utilities (POUs) Energy Efficiency Reporting Guidelines (Guidelines) is to identify best practices and provide parameters and principles for utility energy efficiency program administrators to consistently and reliably report the results of efficiency program achievements.

Energy savings and its related GHG emission reductions are calculated values based on a given methodology or set of rules and assumptions. The magnitude of the savings estimates is directly related to the underlying methodology used to produce the estimate. If different methodologies are used across utilities, then savings estimates will not be consistent or comparable in any meaningful way. Establishing a common set of guidelines will help to ensure that program energy savings across multiple utilities are comparable and, when they are combined, will accurately represent the collective program achievements.

The Guidelines are intended to serve as an overarching set of documented accounting principles for reporting the impact of efficiency programs. This approach is similar to financial accounting practices based on the consistency principle. In short, using generally accepted accounting principles and consistently applying those principles is vital to producing reliable, comparable, and meaningful results for all utilities.

The Guidelines are presented in seven sections. Each section, except for the baseline section, presents guidelines for different topics relevant to program reporting. The Guideline appendices provides additional details and background information that were used in establishing each section's guidelines. The baseline guidelines presented in Appendix G represent a comprehensive baseline framework for estimating energy efficiency measure savings.

2 Reporting Costs and Savings For Energy Efficiency Programs

Reporting costs and savings for energy efficiency programs should be done in a consistent manner. This applies to both programs funded through public goods charges (PGC) and programs funded through non-public goods charges. The following guidelines provide the key principles for reporting program costs and savings for regulatory compliance reporting. Additional background and supporting information is provided in Appendix A.

2.1 Cost Reporting Guidelines

- Include all utility energy efficiency program cost and savings in the POU reporting tool.
- Include all costs applicable for administrating the energy efficiency program portfolio. Applicable cost categories include, but are not limited to: program management, marketing and outreach, rebate processing, site inspections, technical assistance, measurement and verification, third party evaluation, and IT support. Each cost category may consist of fully-loaded labor costs, non-labor costs, and support subcontractors.
- Report costs and savings separately for programs that are subject to different cost-effectiveness assessments. A spreadsheet is provided (as a supplement to this report) that illustrates how costs and savings can be grouped and reported. Table 1 illustrates the approach.

Table 1. Cost Summary

Program Area	Total Costs	Admin Costs	Incentives	TRC	PAC	$/kWh
Residential programs	$125,000	$50,000	$75,000	1.1	1.4	0.08
C&I programs	$125,000	$25,000	$100,000	1.5	1.8	0.04
C&S advocacy program	$5,000	$5,000	$0	3.5	5.2	0.03
C&S local code program	$5,000	$5,000	$0	3.5	5.2	0.03
Subtotal	**$260,000**	**$85,000**	**$175,000**	**1.8**	**2.2**	**0.04**
T&D	$50,000					
Water efficiency	$5,000					
Low income	$50,000					
Others	$0					
Total	**$365,000**					

2.2 Cumulative Savings Reporting Guidelines

Legislative and regulatory policies are driving a shift to the use of cumulative savings for reporting energy efficiency program goals and achievements. POU guidelines in this area, which are still under development, will cover key accounting concepts, such as savings decay factor, limitations to effective useful life, discounted lifecycle savings, and handling of additional, achievable, energy efficiency (AAEE).

3 CODES AND STANDARDS SAVINGS

Utilities may track and report energy savings from their efforts to help strengthen building energy codes and appliance standards. Although the CEC will track and report codes and standards (C&S) savings separately as a nonutility program, POUs may wish to report the impact for their respective service territories. This section provides guidance for energy utility program administrators on tracking and reporting codes and standards program savings. A more detailed explanation on the recommended approach and methodology is provided in Appendix B.

3.1 Codes and Standards Reporting Guidelines

- Report C&S advocacy and local code program savings separately from other programs (see the example in Table 1, Section 2.1).
- If co-funding Codes and Standards Enhancement Initiative (CASE) studies, use the methodology described in Appendix B for reporting program savings. Use CEC estimates for savings potential and use the CPUC methodology for estimating gross and net savings. For preliminary estimates of gross and net savings, use the savings adjustment factors listed in Table 2.
- To determine each funding utility's savings as a percentage of the statewide savings estimated from CASE studies, use the utility electric retail sales percentage listed in Table 3.
- For locally adopted building energy code programs, savings should be determined from local building code records for number of buildings constructed (or altered) after the code has gone into effect. Project savings can be estimated from submitted Title 24 documentation when the performance compliance approach is used. For buildings submitted under the prescriptive approach (or when performance compliance documentation is not available), savings can be estimated based on the original savings estimates or the required program savings eligibility thresholds.

Reporting and Documentation

The methodology used to estimate savings should be documented and reported. Savings are claimable after the code update goes into effect. Savings and costs should be analyzed over a 3-year period to align with the triennial cycle of code updates. Savings for each cycle of codes and standard updates should be tracked separately and then summed to show the overall savings achieved in any given year. For estimating cost-effectiveness, the analysis should include the costs of code advocacy over the 3-year period leading to the code update. Annual savings are from the first year after adoption.

Table 2. Savings Adjustment Factors

Savings Type	Title 24 Building Energy Efficiency Standards	Title 20 Appliance Efficiency Regulations
Gross savings	88%	94%
Net savings – naturally occurring	78%	48%
Net savings – utility influence	60%	59%

Note: adjustment factors are applied sequentially. The gross savings factor is applied to potential savings estimate, naturally occurring savings factor is applied to the net gross savings, and the utility influence savings factor is applied to the net naturally occurring savings.

Table 3. POU Electric Retail Sales as a Percentage of Statewide Retail Sales

Utility	Percentage	Utility	Percentage
Alameda	0.13%	Palo Alto	0.36%
Anaheim	0.92%	Pasadena	0.42%
Azusa	0.10%	Pittsburg	0.01%
Banning	0.05%	Plumas-Sierra	0.06%
Biggs	0.01%	Port of Oakland	0.02%
Burbank	0.42%	Rancho Cucamonga	0.03%
Colton	0.14%	Redding	0.29%
Corona	0.03%	Riverside	0.83%
Glendale	0.41%	Roseville	0.45%
Gridley	0.01%	San Francisco	0.38%
Healdsburg	0.03%	Silicon Valley Power	1.23%
Imperial	1.28%	Shasta Lake	0.07%
LADWP	8.94%	SMUD	4.01%
Lassen	0.05%	Trinity	0.04%
Lodi	0.17%	Truckee Donner	0.05%
Lompoc	0.05%	Turlock	0.77%
Merced	0.18%	Ukiah	0.04%
Modesto	0.95%	Vernon	0.43%
Moreno Valley	0.07%	Victorville	0.03%
Needles	0.02%		

Note: Based on utility retail sales data from CEC and EIA (2015).

4 Avoided Energy Costs

Avoided energy costs are used to assess the cost effectiveness of energy efficiency programs. Avoided costs are the marginal electricity energy and capacity costs associated with the reduction of energy use from energy efficiency programs. As the cost and mix of a utility's portfolio of energy resources change, those changes should be reflected in the avoided energy costs used to assess the cost effectiveness of energy efficiency.

This section provides guidance for updating the POU energy efficiency reporting tool's avoided energy costs. See Appendix C for relevant background information and a list of options for updating avoided costs.

4.1 Avoided Energy Costs Guidelines

- ❑ Utilities should retain the option to use their own avoided energy costs in the POU reporting tool. When utility-specific costs are used, the utility should document how the costs were developed.
- ❑ Continue to use the default avoided energy costs in the POU reporting tool as an interim solution until: a new avoided cost methodology is adopted in May 2018, a new cost effectiveness framework is established, or POUs develop utility-specific avoided energy costs as part of their 2019 integrated resource planning.

5 Greenhouse Gas Emission Reductions

POUs track and report the reduction of (GHG) emissions from energy efficiency programs. Investment in energy efficiency combats global climate change and contributes to the state's long-term goals of reducing GHG emissions. This section provides key principles for reporting GHG emission reduction through the POU energy efficiency reporting tool. See Appendix D for relevant background information and a discussion on various approaches to establishing the tool's emission rates.

5.1 GHG Emission Reduction Guidelines

- ❑ The default GHG avoided emission rates for energy efficiency programs should be updated with emission rates for each year from 2018 through 2030, or beyond. The emission rates should reflect state mandates for clean renewable energy resources.
- ❑ Program administrators should use GHG avoided emission rates that are consistent with any avoided emission rates developed by their utility for GHG emission reporting. If utility-specific emission rates are available, the should be used to override the reporting tool's default emission rates. Otherwise, the default values should be used.

6 Gross and Net Savings

Energy efficiency can be measured and reported as either gross or net savings. Each has its role in valuing the performance of an energy efficiency program. However, a consistent approach is needed for collectively tracking energy efficiency program savings at the state level.

This section provides guidance on reporting gross and net program savings. Supporting information is available in Appendix E.

6.1 Gross and Net Savings Guidelines

- ❑ For the purposes of regulatory compliance reporting, POUs should provide both gross and net savings estimates to the CEC.
- ❑ The use of stipulated NTG factors is the simplest approach to developing net savings estimates and should continue to be used as the default method in the POU energy efficiency reporting tool.
- ❑ Where utility program administrators have program-specific results for net impacts, the results should be used to override the tool's default NTG factors. Documentation should be provided that substantiates the NTG factors used in a manner that is consistent with current efficiency program policy and theory. If the program-specific results include market effects, or spillover, the adjustment should be documented and reported. See Appendix E.3 for current study findings on market effects.
- ❑ For each reporting utility, regulatory compliance reporting to the CEC should include, at the very least, a comparison of annual portfolio goals to actual results from the respective portfolio. The comparison should be made in a consistent manner (i.e., net savings goals compared to net savings results). To the extent feasible, POUs should provide a comparison of annual goals to actual results on a customer segment basis to further inform resource planning and future program offerings.

7 WATER CONSERVATION ELECTRICITY SAVINGS

Energy utilities funding water efficiency measures may report the energy savings associated with the reduction of water use. For every gallon of water saved, there is an embedded energy component that represents the energy needed to extract, convey, treat, and distribute the water. This section provides guidelines for reporting electric energy savings from water efficiency measures. Appendix F provides additional information on quantifying embedded energy in water for use in reporting electric energy savings.

7.1 Guidelines for Reporting Electric Energy Savings from Water-Saving Measures

- ❑ **Report energy savings separately from other energy efficiency programs** – The POU reporting tool's cost-effectiveness calculations are not appropriate for water efficiency measures. Water efficiency energy savings should be reported as a separate line item showing annual energy savings, life-cycle energy savings, GHG emission reductions, and costs for program administration and incentives. No cost-effectiveness calculations should be provided until an appropriate cost-effectiveness framework is developed for water efficiency measures. Water energy savings accrue to multiple energy suppliers; to the extent possible, the savings reductions specific to the POU should be calculated.
- ❑ **Document source of water efficiency savings** – Supporting documentation should be provided indicating the source of the savings. The documentation should list the elements that are included in energy savings estimates, such as wholesale agency and wastewater treatment energy intensity (EI) rates. If water agency EIs were used, indicate how the estimates were developed and which elements (extraction, conveyance, distribution, treatment) are included or not included.

7.2 Guidelines for Developing a Water Efficiency Technical Reference Manual

- ❑ **Use the CPAU water efficiency TRM as a starting point** – The City of Palo Alto Utilities developed a water efficiency TRM (wTRM) for reporting water savings. The TRM includes typical measures and is structured in a format consistent with the CMUA TRM for energy efficiency program reporting. Sources of savings estimates and assumptions are documented and based on credible sources. It's possible they will need to be expanded to account for different regional usage patterns. In addition, embedded energy savings estimates would also need to be added.

- **Use regional EIs as the default embedded energy rates** – The wTRM should initially include energy savings estimates based on the regional EIs developed by the CPUC.
- **Allow for custom EIs** – Where water agency-specific EIs are developed, they should take precedence over the default regional EIs. Including a semi-custom calculator in the wTRM will simplify this approach.
- **Include hot water energy savings** – Indoor measures, such as faucet aerators, reduce the use of hot water heating for the end user. These savings should also be included in the measure energy savings estimates.

8 ENERGY EFFICIENCY BASELINE GUIDELINES

The energy efficiency baseline guidelines presented in Appendix G document an energy efficiency baseline framework that enables energy savings to be estimated consistently. This in turn makes it possible to sum the savings from multiple utility programs so that, when combined, they accurately represent the collective program performance.

Specifically, the baseline guidelines address the use of existing conditions baselines. Existing conditions baselines may be used for estimating energy efficiency savings. However, certain practical limitations must be set to prevent double-counting of savings and minimize high levels of free ridership[1].

POUs should collectively use the baseline definitions listed in Section G.3 and follow the methods for applying baselines to energy efficiency measures as outlined in Section G.4.

[1] For example, there is no program influence for a customer installing a minimally code-compliant HVAC unit to replace a failed unit.

Appendix A

Reporting Costs and Savings for Energy Efficiency Programs

Most residential, commercial, and industrial program offerings to utility customers are subject to the Total Resource Cost (TRC) and Program Administrator Cost (PAC) tests that are used in the POU reporting tool. The tests are also applicable to a codes and standards program, but the program results should be broken out from the other traditional program offerings. This allows the impact of the codes and standards program on the overall portfolio to be assessed (by the utility) and it allows utility program savings to be incorporated into a statewide estimate of efficiency savings (by the CEC).

Other efficiency program results and costs should be reported separately where the POU reporting tool cost tests are not applicable or a different measure of cost efficiency is more appropriate. As stated by the CEC in its SB 350 proceedings, low income programs are not necessarily subject to cost-effectiveness tests given that the programs focus on bringing energy efficiency (and safety) improvements to customers or communities that otherwise could not afford them. Water energy efficiency savings programs should be assessed to ensure that they are beneficial to ratepayers, but the complexity of the associated benefits and costs is not sufficiently captured by the traditional TRC and PAC tests. Other efficiency offerings may not be customer-specific or have co-funding and shared benefits, or they are already counted at the state level (e.g., GGRF-funded programs through the Department of Water Resource [DWR] and the Department of Community Services and Development [CSD]). The cost efficiency of these programs should be assessed separately.

A.1 Using the POU Reporting Tool to Report Program Costs Separately

Currently, the Summary Report in the POU reporting tool is used to provide efficiency program results to the CEC. The report provides cost breakdowns by end-use categories; however, utilities do not track or manage programs by these categories. In addition, the end-use estimates are based on weighted averages of measure life-cycle costs, which is not representative of how costs are allocated. Given the likely misrepresentation and unnecessary detail, the cost breakdown should be eliminated from the Summary Report.

Reporting program costs separately is consistent with IOU annual program reporting. It also helps to clarify which costs are being used in program cost-effectiveness tests. This method of reporting requires changes to the POU reporting tool; a spreadsheet is provided (as a supplement to this report) with the recommended improvements to the reporting tool. It includes new definitions for program areas, simplified and more consistent end-use categories, a revised Summary Report table, and a cost worksheet that provides options for utilities to track and report program costs.

Appendix B
Codes and Standards Savings

Utilities may track and report energy savings from their efforts to help strengthen building energy codes and appliance standards. Although the CEC will track and report C&S savings separately as a nonutility program, POUs may wish to report the impact for their respective service territories. Some states have started, or are considering, enabling utilities to claim codes and standards savings. The primary methodology used to attribute savings to utilities is based on the CPUC methodology developed in 2006. The methodology has been refined since it was developed, and it represents the best practice for utilities claiming and reporting savings from codes and standards programs.

Currently, the California IOUs operate five codes and standards programs, but only two are attributed with energy savings: Building Codes Advocacy, and Appliance Standards Advocacy. The three other programs – Compliance Improvement, Reach Codes, and Planning and Coordination – are considered non-resource programs, thus no savings are claimed. The Reach Codes program promotes local governments’ adoption of CALGreen, the state’s voluntary green building code. Although it is possible to substantiate savings for this program, the CPUC as of yet has not allowed IOUs to claim savings.

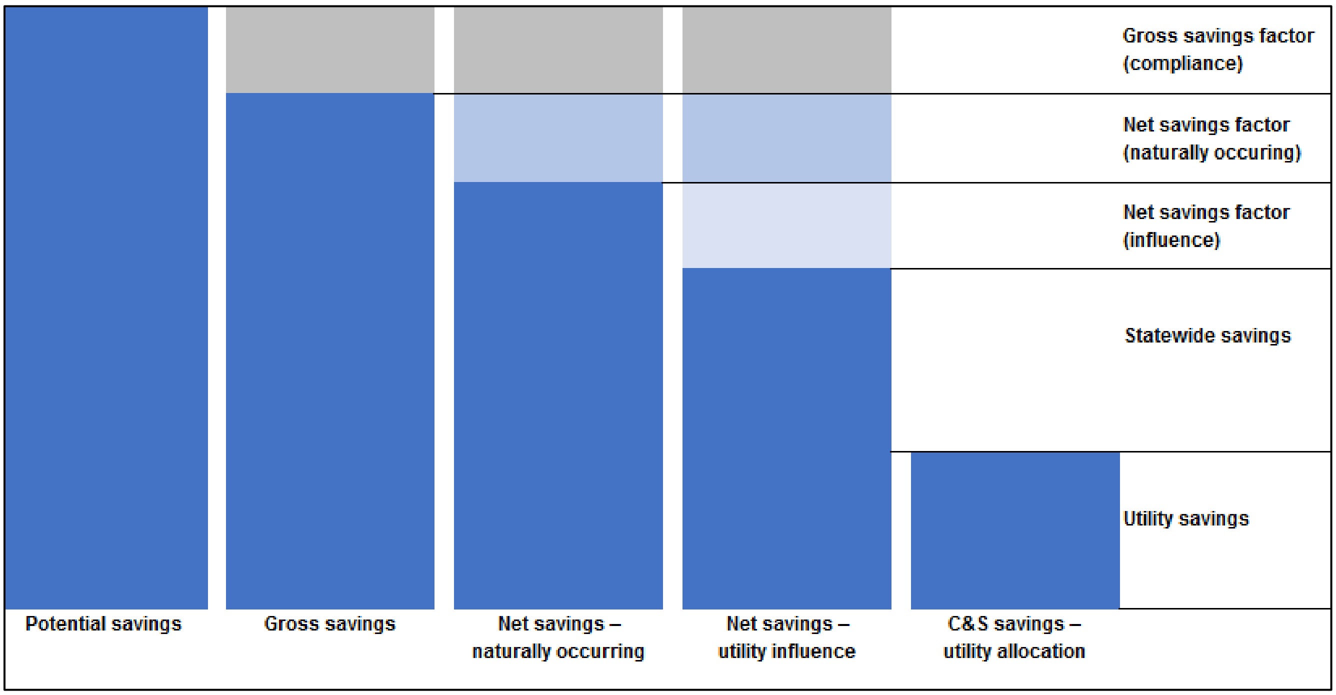
Last, it should be noted that claiming codes and standards savings is more challenging than it is for traditional efficiency programs. Utility program savings for codes and standards differ from other utility efficiency programs in that the utility costs occur years before the savings can be claimed. This requires different accounting practices than are used for traditional program reporting.

B.1 Methodology and Approach

Energy savings associated with building energy codes reflect the difference in energy consumption between a building built according to the current building energy code and a building built under the previous building energy code. Similarly, energy savings associated with appliance standards reflect the difference in energy consumption between an appliance meeting the current state or federal appliance standards compared to one meeting the previous state or federal standard. Where a previous appliance standard does not exist, the most common efficiency of the appliance prior to the effective date of the standard is used as the baseline.

The methodology for utilities to claim savings consists of five steps. The first step is to establish the statewide savings potential. The second step adjusts the savings to account for the degree of code compliance occurring in the market. The third and fourth steps adjust savings to account for natural market adoption practices and utility influence. The final step is to convert statewide savings into savings achievable within a utility's service territory. Utilities claim the savings after the new code goes into effect. The savings adjustments are illustrated in Figure B-1.

Figure B-1. Codes and Standards Savings Attribution



The results for utility contributions to the 2013 Title 24 Building Energy Efficiency Standards, 2013 Appliance Efficiency Regulations, and Federal appliance standards are shown in Table B-1.

Table B-1. 2013–2015 Savings (GWh) from Utility Contributions to Codes and Standards

Description	2013 Title 24	Title 20 Appliances	Federal Appliances
Statewide potential	1,484	2,671	351
Gross savings	1,307	2,507	285
Net savings	607	703	78
Utility allocation	435	503	56

Note: The utility allocation shown is for IOU percentage of electric retail sales (71.6%).

B.2 Potential Savings

Potential savings estimates represent the initial estimate of statewide savings attributable to new codes and standards. For building energy codes (Title 24), the estimate consists of the proposed updates to code, code update savings potential, and the annual construction activity of buildings impacted by the code updates.

Previous approaches to estimating potential savings include developing unit energy savings estimates (savings per square foot of building floor area) that are multiplied by estimates of new construction activities based on the statewide floor stock. However, this approach likely overestimates savings. For example, the IOUs' estimated potential savings for the 2013 Title 24 updates were determined to overestimate savings, as they do not account for interactive effects. Because of this issue, the IOUs adjusted their initial estimates, based on the CEC code impact analysis report. The CEC report is based on whole-building analysis of measures adopted into code, which accounts for the measure interactive effects.

Savings potential for appliance standard updates is based on unit energy savings estimates and estimates of unit sales for the impacted products. The estimates are developed from a variety of market data resources. For federal appliance standards, the estimates are limited to the percentage of product sales in the California market.

See Section B.8 for current savings potential projected by the CEC.

B.3 Gross Savings

Gross savings are estimates of the energy savings realized in buildings permitted under the new code requirements. They are a measure of how the as-built building performs (consumes energy) compared to the estimated energy consumption allowed by code.

For appliances, it is a measure of the actual percentage of products meeting the standard compared to the total number of products sold in the state.

The simplest approach for estimating gross savings is to multiply the potential savings by a gross savings adjustment factor. The best source for estimating the adjustment factor usually comes from the results of previous codes and standards programs. The most current benchmark available is from the recent evaluation of the California IOU programs. For the IOUs' contribution to the 2013 Title 24 building energy codes, the gross energy savings adjustment factor is 88%. For the Appliance Regulations (T20) the factor is 94%, and for federal standards the factor is 81%.

B.4 Net Savings

There are two steps to estimating net program savings: the first is to estimate and adjust for the impact of naturally occurring savings and the second is to estimate and adjust for utility influence.

Naturally occurring savings adjustments are for savings that were likely to happen anyway due to market trends and/or market adoption rates of efficient products and practices. This estimate is similar to free ridership adjustments made to traditional energy efficiency programs. The difference is that the adjustment for codes and standards programs is based on the collective opinion from experts in the field.

Program influence adjustments are based on the utility's contribution to development of the new codes and standards. It is a measure of influence of other stakeholders who also shape the codes and standards updates.

The most current benchmark available for net savings adjustment factors is from the recent evaluation of the California IOU programs. For the IOUs' contribution to the 2013 Title 24 building energy codes, the naturally occurring adjustment factor is 78% and the program influence adjustment factor is 60%. For the Appliance Regulations (T20) the naturally occurring adjustment factor is 48% and the program influence adjustment factor is 59%. For federal standards the naturally occurring adjustment factor is 84% and the program influence adjustment factor is 33%.

B.5 Locally Adopted Energy Codes

Local jurisdictions may choose to adopt building energy codes that exceed state code, such as CALGreen. In order to do so, the jurisdiction must submit an application to the CEC that includes the energy standards being proposed by the jurisdiction, the jurisdiction's findings and supporting analyses on the energy savings and cost-effectiveness of the proposed energy standards, a statement by the local jurisdiction that the local energy standards will require buildings to be designed to consume no more energy than permitted by Title 24, and any related findings, determinations, or declarations, such as any negative declaration or environmental impact report per the California Environmental Quality Act.

Once these local codes are adopted, buildings constructed or altered under the local code will be more energy efficient than a building built according to the statewide code. Savings could be estimated using a similar methodology to the one used for code advocacy programs, as previously described in this section. However, there are no readily available examples.

B.6 Recommended Approach

The following recommendations for reporting codes and standards savings are based on the above findings.

B.6.1 Potential Savings Estimates

Use the CEC estimates for codes and standards savings potential for the 2019, 2022, 2025, and 2028 code updates (see Section B.8). Utilities that included codes and standards in their energy efficiency program potential studies should compare the CEC estimate to their study estimate to ensure that there are no significant discrepancies.

B.6.2 Gross Savings Estimates

Where the Codes and Standards Enhancement Initiative (CASE) studies are funded and supported, gross savings is the percentage of savings potential that is attributable to the CASE-recommended measures multiplied by a savings adjustment factor for estimated code compliance. For code compliance, use the gross savings adjustment factors from recent program results to adjust gross savings. In the case of funding stand-alone studies that promote a specific set of measures for adoption, develop unit energy savings estimates for each proposed measure. For building energy codes, use new building permit estimates of the impacted buildings for estimating annual savings. For building alterations under the building energy code, use CEC estimates of existing floor stock. For appliance standards, use estimates of annual product sales from market research data.

B.6.3 Net Savings Estimates

Use the naturally occurring and program influence adjustment factors from recent program results.

B.6.4 Savings Allocation

Use percentage of retail sales for allocating savings to each participating utility. This method is sufficient for a small subset of measures identified through a stand-alone study, as long as the study has taken into consideration the market potential for each participating utility.

B.6.5 Reporting and Documentation

The methodology used to estimate savings should be documented and reported. Any differences from the CPUC methodology should be highlighted. Savings are claimable after the code update goes into effect. Savings and costs should be analyzed over a 3-year period to align with the triennial cycle of code updates. Savings for each cycle of codes and standard updates should be tracked separately and summed to show the overall savings achieved in any given year. For estimating cost-effectiveness, the analysis should include the costs of code advocacy over the 3-year period leading to the code update. Annual savings are from the first year after adoption, and the effective useful life (EUL) is either from the studies conducted or a default EUL of 20 years. Alternatively, use a default of 20 years for commercial buildings and a default of 30 years for residential buildings.

B.6.6 Locally Adopted Building Energy Codes

The potential energy savings from locally adopted codes can be estimated using similar methods as those used for the building energy codes and appliance standards. Gross savings can be estimated based on the number of buildings constructed or altered after the code goes into effect, using local building permit data.

B.7 Statewide Electric Retail Sales

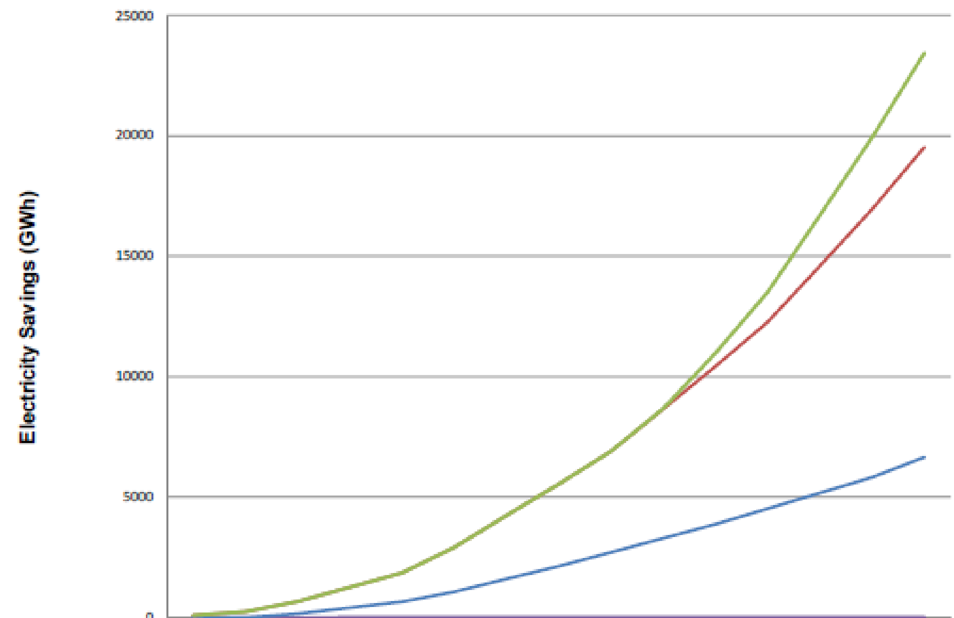
POU retail sales are shown as a percentage of the statewide total retail sales. The 2015 statewide total (261,170,437 MWh) is obtained from the EIA and POU retail sales are from both CEC and EIA for 2015 (https://www.eia.gov/electricity/state/california/).

Utility	2015 Retail Sales (MWh)	Percent	Utility	2015 Retail Sales (MWh)	Percentage
Alameda	347,728	0.13%	Palo Alto	932,922	0.36%
Anaheim	2,414,146	0.92%	Pasadena	1,097,387	0.42%
Azusa	257,361	0.10%	Pittsburg	24,646	0.01%
Banning	143,121	0.05%	Plumas-Sierra	146,214	0.06%
Biggs	15,030	0.01%	Port of Oakland	49,356	0.02%
Burbank	1,108,597	0.42%	Rancho Cucamonga	72,748	0.03%
Colton	355,648	0.14%	Redding	749,875	0.29%
Corona	77,784	0.03%	Riverside	2,179,429	0.83%
Glendale	1,060,141	0.41%	Roseville	1,183,362	0.45%
Gridley	33,993	0.01%	San Francisco	992,877	0.38%
Healdsburg	75,074	0.03%	Silicon Valley Power	3,201,675	1.23%
Imperial	3,350,076	1.28%	Shasta Lake	187,165	0.07%
LADWP	23,336,197	8.94%	SMUD	10,473,799	4.01%
Lassen	128,514	0.05%	Trinity	103,318	0.04%
Lodi	440,600	0.17%	Truckee Donner	140,346	0.05%
Lompoc	134,009	0.05%	Turlock	2,011,258	0.77%
Merced	461,961	0.18%	Ukiah	109,075	0.04%
Modesto	2,482,740	0.95%	Vernon	1,121,253	0.43%
Moreno Valley	179,395	0.07%	Victorville	86,019	0.03%
Needles	57,641	0.02%			

B.8 CEC Codes and Standards Energy Savings Forecast

Figure B-1 is from the CEC final report on doubling energy efficiency savings (Senate Bill 350, Doubling Energy Efficiency Savings by 2030). It provides the projected cumulative codes and standards savings through 2029. A breakdown between residential and nonresidential savings can be found in the report's supporting spreadsheet workbooks, which are available for download from the CEC website.
https://efiling.energy.ca.gov/Lists/DocketLog.aspx?docketnumber=17-IEPR-06

Figure B-1. CEC Codes and Standards Cumulative Savings Projections



	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029
Federal Appliances	0	0	0	0	0	0	0	0	0	23	551	1244	2103	2981	3906
Appliance Regulations	92	242	502	851	1200	1848	2630	3411	4190	5365	6554	7742	9424	11134	12865
Building Standards	0	0	158	399	651	1061	1598	2122	2697	3276	3862	4507	5154	5802	6638
CalGreen	1	1	3	4	6	7	8	9	11	12	14	16	18	19	19

Source: California Energy Commission staff, Efficiency Division. Based on work in Appendix B by NORESCO August 2017.

The projected savings are based on numerous assumptions and should be considered preliminary estimates. Future iterations of the C&S code savings potential by the CEC will likely produce a more accurate estimate of the savings associated with each code cycle.

Appendix C
Avoided Energy Costs

Avoided energy costs are used to assess the cost-effectiveness of energy efficiency programs. Avoided costs are the marginal electricity costs associated with the reduction of energy from energy efficiency programs. As the cost and mix of a utility's portfolio of energy resources change, those changes should be reflected in the avoided energy costs used to assess the cost-effectiveness of energy efficiency. This section provides background information relevant to the update of the POU energy efficiency reporting tool.

C.1 POU Energy Efficiency Reporting Tool

The POU energy efficiency reporting tool (often referred to as the E3 reporting tool) is used by POUs to report the performance of utility energy efficiency programs to the CEC. The CEC includes the data in its development of statewide estimates of energy savings.

The reporting tool, which was first developed in 2006, estimates program cost-effectiveness (benefits-to-cost ratio), which is one indicator of the relative success of the programs. The benefits are based on avoided cost data in the reporting tool. The avoided costs represent the marginal cost of energy that is reduced by energy savings measures.

C.2 Reporting Tool Avoided Energy Costs

The reporting tool uses default avoided costs that come from the 2011 CPUC avoided cost calculator. Avoided costs were updated in 2016, but the reporting tool has not been updated to include the new costs data.

The avoided costs are marginal energy and capacity electricity costs associated with the reduction of energy from energy efficiency programs and measures. The 2011 IOU hourly avoided energy costs are averaged into seasonal TOU rates, which are then multiplied by measure TOU load reduction profiles to estimate annual avoided costs. Avoided costs are provided from 2009 through 2072 (extrapolated after 2040). Costs escalate by 2%–3% per year from 2018 through 2030.

The reporting tool's 2011 avoided costs are significantly lower than the 2016 avoided costs. For comparison, the 2011 average avoided cost (used in the reporting tool) for a climate zone 12 utility is $0.1312/kWh and the 2016 avoided cost is $0.0936/kWh, which indicates a 29% decrease in costs. However, when time-weighted avoided costs and seasonal equipment load profiles are included, the avoided cost difference widens. For measures with significant summer energy usage (e.g., HVAC), the cost difference can exceed 40%.

A table of GHG emission costs is shown in the tool but is not used in any of the calculations. The costs range from $15.84 to $27.34 per ton from 2018 through 2030. The GHG costs used in the reporting tool are embedded in the avoided energy costs. The GHG cost component is not documented in the reporting tool, but it is available from E3.

C.3 CPUC Avoided Energy Costs

The current avoided costs used for distributed energy resources, including energy efficiency, are from the CPUC 2016 avoided cost calculator (developed by E3). The calculator is an 8,760-hour model capable of producing annual and hourly forecasts of avoided costs. The GHG costs in the 2016 calculator range from $14 to $52 per ton for the period from 2018 through 2030.

A CPUC decision (D.16-06-007) in August 2017 delayed updates to the calculator until May 2018. However, another CPUC decision (D.17 08 022, 8/24/17) requires an interim update to the calculator to revise its GHG cost component. The GHG cost will be based on CARB's cap and trade price ceiling, the Allowance Price Containment Reserve (APCR). The rationale for the change is that the GHG costs in the 2016 calculator do not reflect the impact of new GHG reduction goals set in SB 32. Furthermore, an update is needed by the CPUC to set IOU program goals in 2017. The interim calculator update is good through May 1, 2018, but it may be extended another year. It should be noted that stakeholders have recommended that avoided costs be determined in the ongoing IRP proceedings[1].

The 2016 avoided energy costs are significantly lower than the 2011 costs. For a given efficiency program portfolio, using the 2016 costs would result in a lower cost-effectiveness compared to the 2011 costs (potentially up to a 40% reduction). The interim updated calculator will raise the overall avoided costs, but not to the level of the 2011 costs.

C.4 CEC SB 350 Target-Setting

The CEC staff report on energy efficiency target-setting for the state (SB 350 report) provides analysis and conclusions that are relevant to potential avoided costs updates to the POU energy efficiency reporting tool. In Chapter 7 of the staff paper, the CEC asserts that it cannot meet its legislative reporting requirements unless utility energy efficiency program reporting is

[1] CPUC issued a Proposed Decision in its IRP rulemaking proceedings (16-02-007) that includes revised GHG cost adders (Table 6 of PD)

strengthened. Regarding avoided energy costs, the CEC poses the question of whether the POUs should provide 8,760 hourly savings data. To meet this expectation, the POU energy efficiency reporting tool would need to the revised to include hourly avoided cost data.

C.5 Recommendations

The POU EE reporting tool's avoided costs should be updated by one of the of the following options:

1. Retain the use of the current 2011 avoided costs in the reporting tool until updated cost data is available. The 2011 avoided costs are higher than the 2016 or 2017 avoided costs, so it could be argued that the use of 2011 data will overestimate program cost-effectiveness. However, it is anticipated that the CPUC May 2018 update will raise avoided costs to be closer to the 2011 values. If this happens, then the 2011 avoided costs may be used as an interim solution until the CPUC adopts new avoided costs, a new cost-effectiveness framework is established, or POUs develop utility-specific avoided costs from their IRP analysis.
2. Use updated GHG avoided costs based on CARB APCR price forecasts. This could be done by revising the reporting tools' avoided costs to be based on pending CPUC cost updates. The impact will be a reduction in program cost-effectiveness for POUs.

The following points concerning avoided energy costs should be noted:

1. If the 2016 avoided costs are used to replace the 2011 costs, utility efficiency program cost-effectiveness would significantly drop unless higher GHG avoided costs were also included.
2. Utilities should retain the option to use their own avoided costs in the reporting tool. If they choose this option, they should provide documentation substantiating how the numbers were developed.

Appendix D

Greenhouse Gas Emission Rates for Reporting Energy Efficiency Savings

There are pending updates for the POU energy efficiency reporting tool. The following provides relevant background information for updating the tool's greenhouse gas (GHG) emission rates.

D.1 POU Reporting Tool Greenhouse Gas Emission Rates

GHG emission rates in the reporting tool are from a 2004 report: *Methodology and Forecast of Long Term Avoided Costs for the Evaluation of California Energy Efficiency Programs, E3*. The reporting tool includes the heat rate of generating plants. The data is limited to CO_2 only and does not include other GHG gas CO_2 equivalents.

The GHG emission rates are stated in units no longer widely used. Data is provided in units of standard tons CO_2/MWh. For comparison purposes, Table D-1 converts the values to $MTCO_2$/MWh (the metric used by CARB). Note that the POU estimates are assigned by climate zones, and the climate zones are assigned a set of time-of-use (TOU) values associated with an IOU area.

Table D-1. EE Reporting Tool Seasonal Avoided Emission Rates ($MTCO_2$/MWh)

Climate Zone	Summer On-Peak	Summer Mid-Peak	Summer Off-Peak	Winter On-Peak	Winter Mid-Peak	Winter Off-Peak
PG&E	0.73955	0.66887	0.54554		0.62511	0.52724
SCE	0.79889	0.69688	0.53598		0.69663	0.53839
SDG&E	0.75751	0.64016	0.51861	0.76882	0.68151	0.53879

Note: although SDG&E emission rates are listed in the table, they are not used in the reporting tool.

To report the life-cycle GHG emission reductions, the reporting tool uses a weighted average, which is the product of TOU emission rates (in the above table) multiplied by the measure savings in each TOU period. Life-cycle GHG savings are based on fixed emission rates that do not change over time. The reporting tool summary table (which is provided to the CEC) provides life-cycle GHG savings estimates.

When compared to more current values, the reporting tool's GHG avoided emission rates are much higher. The most relevant comparisons are the CARB quantification methodology estimate of 0.303 $MTCO_2e$/MWh and the CEC estimate in the recent SB 350 target-setting report (0.24 – 0.15 $MTCO_2e$/MWh).

D.2 CEC SB 350 Target-Setting

The CEC staff report on energy efficiency target-setting for the state (SB 350 report) provides analysis and conclusions that are relevant to the reporting of POU GHG emission rates.

In Chapter 5 of the staff paper on efficiency target setting for utility programs, the CEC provides a summary of its GHG emission forecasts. The forecasts come from a production simulation model, using 8,760-hour data. GHG emission rates are forecasted for the period of 2018 through 2030 and are based on an evolving resource mix that reaches 50% renewables by 2030, consistent with SB 350 targets. The model produces annual average avoided emission reduction rates in units of CO_2e tonne/MWh (tonne is equivalent to $MTCO_2e$).

The model predicts a gradual reduction in GHG emissions as the resource mix shifts towards lower GHG emission sources. The results are presented in a graph that shows lower emission rates over time. For California resources, the GHG emission rates range from 0.24 – 0.15 CO_2e tonne/MWh, and for imported power the range is from 0.18 – 0.15 CO_2e tonne/MWh.

D.3 California Air Resources Board

California Air Resources Board (CARB) data that is relevant to potential updates to the POU energy efficiency reporting tool includes trade allowance pricing that may serve as a proxy for GHG abatement costs and annual estimates of GHG emissions used by state agencies for efficiency program reporting.

D.3.1 GHG Cap and Trade Allowance Pricing

Table D-2 provides the Allowance Price Containment Reserve (APCR) price from the CARB 2016 staff report (scoping plan update).

Table D-2. CARB APCR Emission Cost Cap ($ per $MTCO_2e$)

	2015	2021	2026	2031
Allowance price	$56.51	$76.22	$80.70	$86.41

The CPUC decision for updating avoided costs calls for a linear extrapolation of the CARB data to develop GHG avoided emission costs from 2018 through 2030. To do so requires subtracting out the GHG avoided costs already included in the avoided cost calculator.

D.3.2 GHG Emission Quantification Methodology

CARB developed a methodology for estimating GHG emission reductions from efficiency programs for two state agencies, the Department of Water Resources (DWR) and the Department of Community Services and Development (CSD). The agencies receive funding from the CARB cap and trade fund and use the methodology to report GHG emission reductions to CARB. The methodology was developed in collaboration with the two state agencies; see the 2016 Greenhouse Gas Reduction Fund quantification methodology report.

The methodology uses 2013 statewide inventory data, producing a single annual average GHG emission rate. The emission rate is calculated by dividing the state total annual emissions reported to CARB by the state total electricity consumption. The tradeoff for this simplicity is accuracy: a grid-level average emission rate does not represent the marginal avoided emission rate that is associated with energy use reductions through energy efficiency.

DWR has a calculator tool that is available for estimating electricity, water, and GHG reductions. Both CSD and DWR use an emission rate of 0.303 MTCO2e/MWh.

D.4 Recommendations

The following recommendations are provided for reporting GHG emission rates:

1. The reporting tool default GHG emission rate should be updated to reflect one of the more current methods used to estimate avoided emission rates.
2. Reporting tool users (program administrators) should have the option to override default emission rates with utility-specific avoided emission rates.
3. The reporting tool summary table should be revised to calculate life-cycle GHG reductions using forecasted emission rates from 2018 through 2030. Currently, the tool uses fixed rates from 2011.

The options for revising the reporting tool's GHG avoided emission rates are as follows:

1. Use CEC forecasted emission rates. This would consist of either using the CEC forecast of annual emission rates or working with the CEC to consolidate its hourly cost data into seasonal time-of-use data. However, it's uncertain whether the CEC would be willing to provide seasonal averages consistent with the tool's reporting structure.
2. Use the CARB GHG quantification methodology emission rates used by the state agencies. Given its simplicity and relative inaccuracy, this option would not likely meet the CEC's expectations.

1. Develop POU-specific GHG avoided emission rates in either an annual or TOU format suitable for the reporting tool. This may be a cost-prohibitive option for most utilities, and so default values will still be needed in the reporting tool.
2. Develop avoided emission rates based on the latest E3 analysis for IOUs.

Appendix E
Reporting Gross and Net Savings

Appendix E provides relevant background information for the reporting of gross and net savings.

E.1 Utility Energy Efficiency Program Theory

The concept of net savings is based on the economic theory of a market intervention. To assess the cost-effectiveness of utility efficiency programs as a market intervention requires estimating the impact of the program. That is, what would have happened in the marketplace if the intervention did not exist? What level of efficiency would have been implemented without the program? The theory recognizes that efficiency improvements will be influenced by market forces outside of utility efficiency programs. The counterfactual (no efficiency programs) cannot be known and traditional methods used to assess impact (net savings for efficiency programs) have produced results with a high degree of uncertainty. But no matter the difficulty, it is prudent (and preferred by state regulators) to estimate a utility program's impact for assessing the program's relative value to ratepayers and to society.

E.2 POU Energy Efficiency Reporting Tool Methodology for Assessing Net Savings Impact

The reporting tool allows utilizes stipulated values[2] of program impact, or program influence. The tool assigns default net-to-gross (NTG) factors from similar programs (obtained from DEER). It allows the user to override the default factors with program-specific NTG factors but does not provide guidance on how the program-specific NTG factors should be developed. The program summary table, provided to the CEC, reports both gross and net savings. The net savings is used in the tool's cost-effectiveness tests (TRC and PAC), which are the primary measures of program cost-effectiveness.

[2]For more information, see the Energy Efficiency Program Impact Evaluation Guide, State & Local Energy Efficiency Action Network, DOE, December 2012.

E.3 CPUC Policy

The CPUC requires IOUs to report both gross and net savings. A recent CPUC decision (D.16.08.019) established the use of net savings for setting IOU program goals.

Regarding to net savings adjustments, a CPUC (Decision D.12-11-015) authorized a portfolio-level adjustment to net savings of 5% to account for spillover, or market effects. A recent CPUC study to validate the adjustments indicates the adjustment should be further broken down by program sectors, program participants, and nonparticipants. The report acknowledges that more research is needed and that the recommended spillover rates (1.7% for residential and 6.7% for nonresidential electric savings) represent the lower bound of additional savings influenced by efficiency programs. At present, it is unknown if the CPUC will adopt any of the report's recommendations.

E.4 CEC SB350 Efficiency Target-Setting

The CEC has suggested that, in order to develop statewide targets, it needs utilities to use a uniform set of accounting rules for reporting utility energy efficiency program savings. The CEC intends to use net savings as the basis of setting statewide savings targets. If a POU does not provide net savings estimates, then the CEC will adjust the reported gross savings to estimate net savings. As of yet, it is unclear as to how those adjustments will be made.

E.5 Recommendations

The following are recommendations for POU reporting of gross and net savings.

- For the purposes of regulatory compliance reporting, POUs should provide both gross and net savings estimates to the CEC. Doing so helps to minimize regulatory assumptions and requests for additional information.
- The use of stipulated NTG factors is the simplest approach to developing net savings estimates and should continue to be used as the default method in the POU energy efficiency reporting tool.
- The POU reporting tool should incorporate a market effects adjustment of 5% for the purposes of reporting net savings and calculating the program cost-effectiveness. The impact will be to increase the program's overall cost-effectiveness by increasing the program net savings. The adjustment should be updated as better information becomes available.

- Where utility program administrators have program-specific results for net impacts, the results should be used to override the tool's default NTG factors. Documentation should be available that substantiates the NTG factors used in a manner that is consistent with current efficiency program policy and theory.
- An NTG factor of one assumes that there is no naturally occurring efficiency in the marketplace, which is highly unlikely. Programs that have a great deal of influence will have very high NTG factors (0.9 to 0.95), which acknowledges the existence of naturally occurring savings. Programs claiming savings where net is equal to or exceeds gross should make available the supporting analysis substantiating the net savings estimates.
- For each reporting utility, regulatory compliance reporting to the CEC should include, at the very least, a comparison of annual portfolio goals to actual results from the respective portfolio. The comparison should be made in a consistent manner (i.e., net savings goals compared to net savings results). To the extent that it's feasible, POUs should provide a comparison of annual goals to actual results on a customer segment basis to further inform resource planning and future program offerings.

Appendix F
Water Conservation Electricity Savings

Energy utilities funding water efficiency measures may report the energy savings associated with the reduction of water use. For every gallon of water saved, there is an embedded energy component that represents the energy needed to extract, convey, treat, and distribute the water.

Appendix F provides an overview on how embedded energy is quantified for use in reporting energy savings and provides recommendations for POUs reporting energy savings from water-saving measures.

F.1 Overview of State Efforts to Quantify Embedded Energy Savings

The CEC and CPUC have studied the embedded energy in California water delivery systems since 2005 due to the significant amount of energy consumed in moving water throughout the state. The effort has led to attempts to quantify the energy intensity of water and how water efficiency measures can contribute to state energy efficiency goals. The most recent efforts and best available data comes from CPUC studies that investigate how to assess the cost-effectiveness of water efficiency measures in the context of utility efficiency programs. To date, no cost-effectiveness framework has been established due to the complexity of obtaining appropriate avoided cost data and benefits that accrue to multiple energy utilities and water agencies. However, data and methods have been developed that enable the energy intensity of water to be estimated for different regions of the state.

Energy intensity (EI) estimates were developed by the CPUC for the 10 hydrologic regions identified by the California Department of Water Resources (DWR). The regions differ by water supplies, climate, and hydrology. Energy estimates were developed based on the historical mix of water supplies for each region by determining the EI for wholesale water agencies that deliver water over long distances. The agencies are the DWR's State Water Project (SWP), the federally operated Central Valley Project (CVP), and the Colorado River Aqueduct (CRA) operated by the Metropolitan Water District. EI estimates were also developed for all other conveyance systems and local distribution systems upstream of the end user. Downstream EIs account for the energy used to collect and transport wastewater for treatment and the energy used to treat wastewater for safe discharge.

EI values were developed that include all energy sources, including power supplied by IOUs, POUs, irrigation districts, and state wholesale water agencies. EIs were calculated to estimate the annual average energy rates (kWh/AF). In addition, estimates of marginal energy (that is, the incremental water/energy saved by efficiency measures) were also estimated using recycled water as the marginal water source saved. Marginal avoided energy estimates are limited to IOU-supplied power.

Figure F-1 and Table F-1 provide the EI estimates by hydrologic region.

Figure F-1. DWR Hydrologic Regions

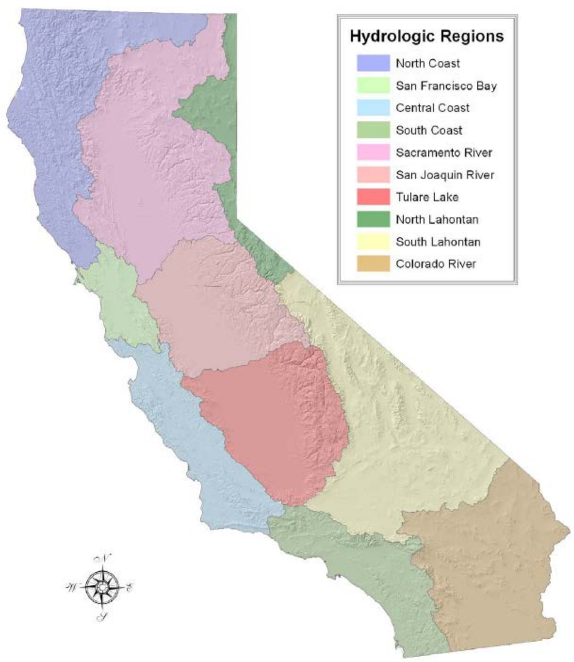


Table F-1. Energy Intensity (EI)

Hydrologic Region	EI Annual Average (kWh/AF)	EI Avoided Energy (kWh/AF)
North Coast	2,170	2,058
San Francisco Bay	2,864	2,557
Central Coast	2,337	2,032
South Coast	3,727	2,161
Sacramento River	1,754	1,668
San Joaquin River	1,753	1,646
Tulare Lake	1,835	1,633
North Lahotan	1,754	1,670
South Lahotan	2,683	2,016
Colorado River	1,856	1,710

Source: CPUC Water/Energy Cost-Effectiveness Analysis, Navigant, 2015

F.2 Recommendations for Reporting Energy Savings from Water-Saving Measures

The following are recommendations to enable consistency and transparency in the collective reporting of water efficiency energy savings by POUs.

F.2.1 Report Energy Savings Separately from Other Energy Efficiency Programs

The POU reporting tool's cost-effectiveness calculations are not appropriate for water efficiency measures. Water efficiency energy savings should be reported as a separate line item showing annual energy savings, life-cycle energy savings, greenhouse gas emission reductions, and costs for program administration and incentives. No cost-effectiveness calculations should be provided until an appropriate cost-effectiveness framework is developed for water efficiency measures. Water energy savings accrue to multiple energy suppliers; to the extent possible, the savings reductions specific to the POU should be calculated.

F.2.2 Document Source of Water Efficiency Savings

Supporting documentation should be provided indicating the source of the savings. The documentation should list the elements that are included in energy savings estimates, such as wholesale agency and wastewater treatment EI rates. If water agency EIs were used, indicate how the estimates were developed and which elements (extraction, conveyance, distribution, treatment) are included or not included.

F.3 Recommendations for Development of a Water Efficiency Technical Reference Manual

Currently, there is no technical reference manual available to provide a centralized set of default savings estimates for use by POUs in reporting water efficiency savings. Development of a water efficiency TRM (wTRM) would enable consistency and transparency in the collective reporting of water efficiency energy savings by CMUA energy utility members. Recommendations for a wTRM are as follows:

F.3.1 Use the CPAU TRM as a Starting Point

The City of Palo Alto Utilities developed a water efficiency TRM for reporting water savings. The TRM includes typical measures and is structured in a format consistent with the CMUA TRM for energy efficiency program reporting. Sources of savings estimates and assumptions are documented and based on credible sources. It's possible that they will need to be expanded to account for different regional usage patterns. In addition, embedded energy savings estimates would also need to be added.

F.3.2 Use Regional EIs as the Default Embedded Energy Rates

The wTRM should initially include energy savings estimates based on the regional EIs developed by the CPUC.

F.3.3 Allow for Custom EIs

Where water agency-specific EIs are developed, they should take precedence over the default regional EIs. Including a semi-custom calculator in the wTRM will simplify this approach.

F.3.4 Include Hot Water Energy Savings

Indoor measures, such as faucet aerators, reduce the use of hot water heating for the end user. These savings should also be included in the measure energy savings estimates.

Appendix G
Energy Efficiency Baseline Guidelines

Appendix G provides an energy efficiency baseline framework that enables energy savings to be estimated consistently. This in turn makes it possible to sum the savings from multiple utility programs so that, when combined, they accurately represent the collective program performance. The baseline guidelines are focused on nonresidential energy efficiency measures, but the same theory applies to residential measures.

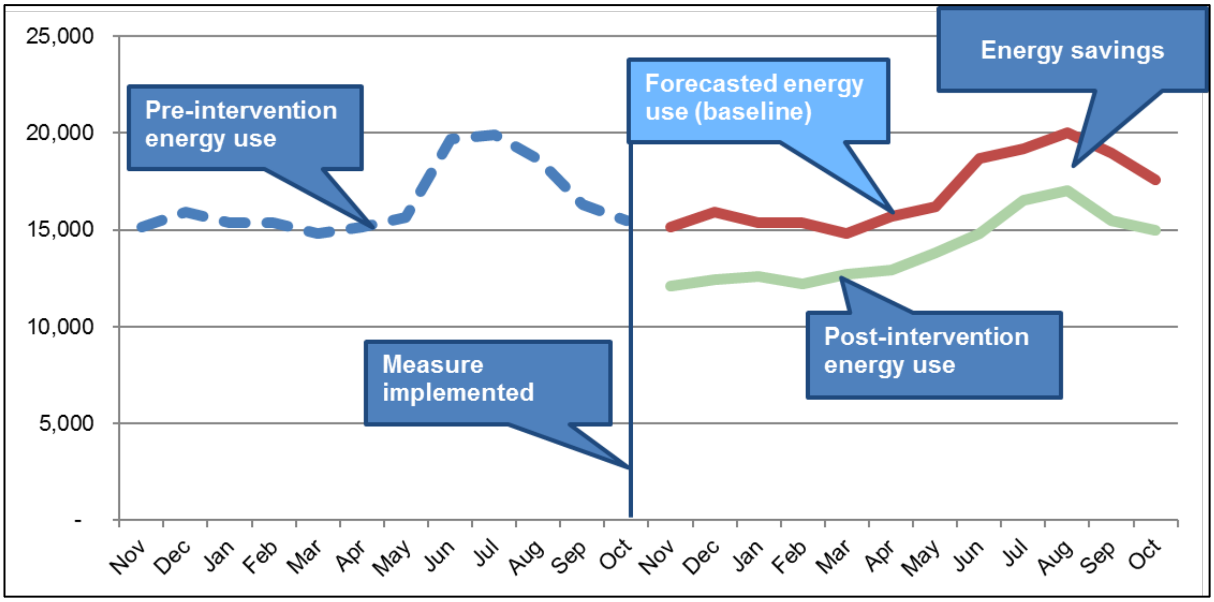
The baseline guidelines address the use of existing conditions baselines. Existing conditions baselines may be used for estimating energy efficiency savings. However, certain practical limitations must be set to prevent double-counting of savings and minimize high levels of free ridership[3].

G.1 What is a Baseline?

Baseline is a key accounting term used in estimating energy savings attributable to energy efficiency measures and utility energy efficiency programs. Energy savings are the result of an intervention (energy efficiency measure) that produces an observable outcome (post-intervention energy use). Energy savings are the difference between post-intervention energy use and the forecasted energy use of what would have happened if the intervention did not occur. The forecasted energy use is the baseline. Figure G-1 illustrates this concept.

[3]For example, there is no program influence for a customer installing a minimally code-compliant HVAC unit to replace a failed unit.

Figure G-1. Estimating Energy Savings



G.2 Current Baseline Definitions Used in CMUA TRM

The CMUA TRM includes the following definitions for energy use baselines.

Energy use baseline – Energy use that is compared to the efficient-case energy use for the purposes of estimating future annual energy savings. The baseline is identified as being one of the four following types:	
Natural replacement – code	Describes an energy use baseline that is based on current minimum energy efficiency code requirements as established by the applicable local, state, or federal jurisdiction.
Natural replacement – current practice	Describes an energy use baseline that is based on standard industry practice or market availability.
Natural replacement – preexisting conditions	Describes the projected energy use baseline that is based on the energy performance of the existing systems or equipment that was in place before a measure was implemented. This baseline is applicable if retaining the preexisting conditions over the entire effective useful life of the measure is a realistic option.
Dual baseline – early retirement	Describes the use of two energy use baselines to determine energy savings where equipment with remaining useful life (RUL) is replaced. In general, the first baseline is based on preexisting conditions and the second baseline is one of the three types of natural replacement. See Section 16.1 of the TRM for a description of how a dual baseline is used in estimating measure cost-effectiveness.

The definitions are used in the TRM to inform users on how measure savings estimates were calculated. They do not provide any further guidance or direction on how to determine the appropriate baseline to use for any given project or measure. Therefore, guidelines are needed to provide clear and practical direction for assigning baselines in energy savings calculations. Future updates to the TRM will be made to align definitions between the manual and the guidelines.

G.3 Baseline Definitions

The following terms and definitions are used in the baseline guidelines:

G.3.1 Existing Conditions Baseline

An existing conditions baseline is based on the energy use associated with the operation of the preexisting equipment[4] prior to its replacement. Since a baseline is an estimate of future energy use, it is necessary to adjust the preexisting energy use to account for post-installation (energy efficient) operating conditions. Therefore, an existing conditions baseline refers to the preexisting conditions adjusted for comparison to post-installation operating conditions. This definition is consistent with the adjusted baseline approach documented in the International Performance Measurement and Verification Protocol (IPMVP).

For example, when a manufacturing plant increases its productivity after an energy efficiency retrofit has taken place, the baseline energy use is adjusted so that it can be compared to the post-installation energy use. Preexisting energy use is normalized by dividing by the unit of product delivered before the retrofit. The energy per unit of product is then multiplied by the product delivered after the retrofit to provide an adjusted baseline energy use that can be used to estimate energy savings.

In certain circumstances, the existing baseline energy use will be adjusted to account for the equipment's inability to meet the facility's requirements, especially when it is expected that the retrofitted or new equipment will meet the facility's requirements. An example is an HVAC system that is unable to sufficiently cool a space to the desired temperature due to the degraded state of the system. Although the system may be inefficient, it does not necessarily waste energy. In fact, it is possible that when compared to the energy use of a new and efficient HVAC system, the inefficient system uses less energy because it was incapable of consuming the energy needed to provide the desired space temperature, and it may have experienced significant downtime due to ongoing repairs to keep it operational.

[4] Equipment is used in the guidelines to mean energy-consuming equipment, systems, or processes.

An existing conditions baseline is not applicable when there is no reference operation for existing conditions and/or the preexisting conditions are no longer applicable to the facility. For examples, see the new construction, major renovation, and tenant improvement applications in Section G.4.

G.3.2 Code Baseline

A code baseline is an estimate of energy use as defined by the applicable code or standard. This includes: state building energy codes, state appliance efficiency standards, federal code of regulations, or any other applicable state code requiring equipment modification or replacement in order to meet health, safety, or environmental regulations. Although some codes, such as safety, may not define an efficiency standard, they may require equipment modification or replacement that impacts equipment/system efficiency. In that sense, they impact the estimate of future operating conditions and baseline energy use.

Where code requirements do not exist, a current practice baseline is used.

G.3.3 Current Practice Baseline

A current practice baseline is an estimate of energy use as defined by industry standard practice, equipment availability, or other market conditions that define or limit customer options. Current practice baselines are relevant to the anticipated functional, technical, and economically feasible needs of the customer. For comparison purposes, the equipment defining the baseline should provide a comparable level of performance and service as that provided by the energy efficient option.

G.3.4 Early Retirement Baseline

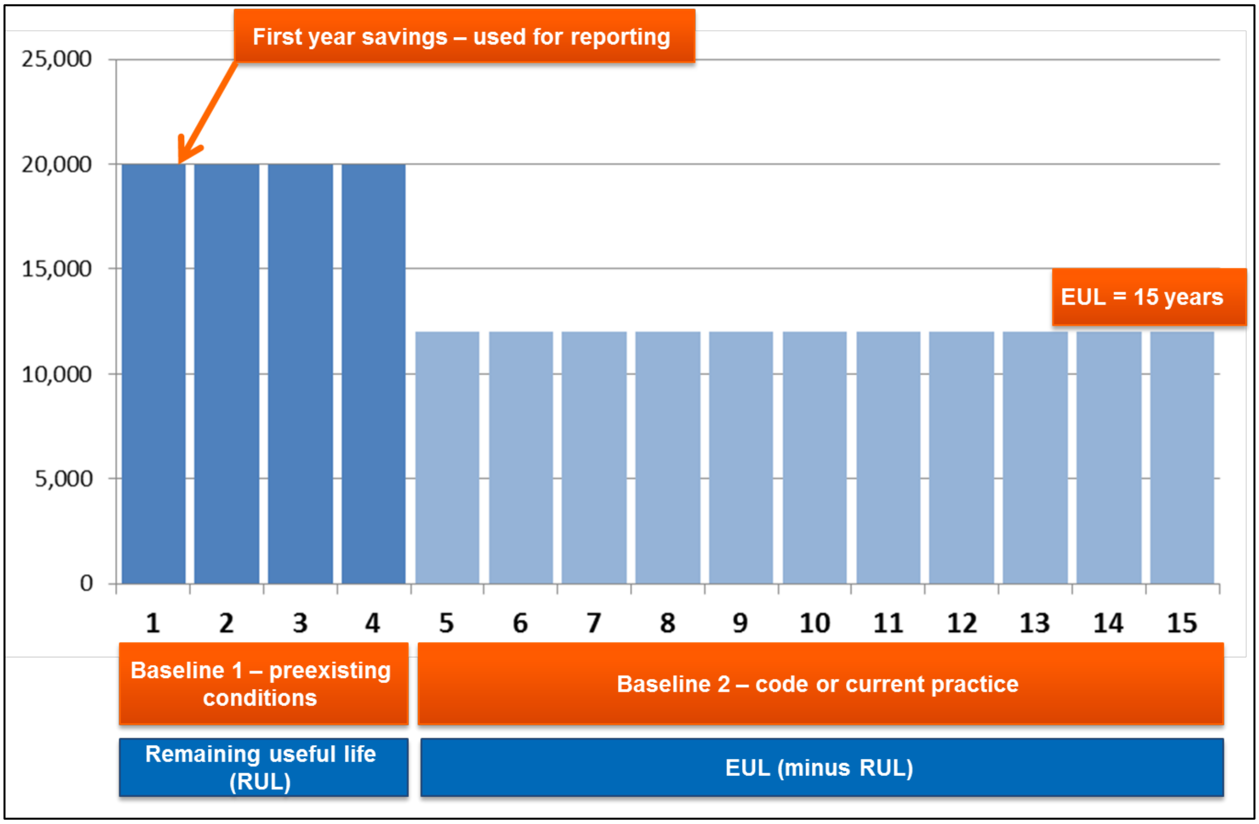
An early retirement baseline, or accelerated replacement baseline, is used where equipment is replaced under the following conditions: a) the existing equipment/systems would have remained in operation for at least 1 year, and b) the equipment would have continued to meet the facility's requirements, or continued to meet current service level requirements[5].

An early retirement baseline uses two baselines to define the energy use estimate over the life of the equipment. As Figure G-2 illustrates, the first baseline period is the remaining useful life of

[5] *Service level requirements* refers to the equipment's functional and technical requirements. Assessment of service level requirements can be accomplished by answering the following questions: Does it meet design intent? Is it capable of providing the level of service expected or needed? Can minor repair work return it to its original level of service?

the existing equipment and the second baseline period starts after the remaining useful life (RUL) and ends with the effective useful life (EUL) of the equipment. The first baseline is an existing conditions baseline, but there may be exceptions where a code or current practice baseline is more appropriate (e.g., where equipment modification is mandated to meet air quality requirements). The second baseline is either a code or current practice baseline. The first-year energy savings are used for reporting program performance against annual goals. Both the first-period and second-period baselines are used to estimate the measure or program's cost-effectiveness.

Figure G-2. Early Retirement with Two Baselines



G.3.5 Effective Useful Life

Effective Useful Life (EUL) is an estimate of the median number of years that equipment is expected to be installed, operable, and capable of meeting the facility's requirements. In general, the EUL is equal to a point where 50% of the equipment installed is still installed and functional. It is not equivalent to a manufacturer's estimate of equipment longevity; however, such an estimate may be used when an applicable EUL value is not available.

The approach to estimating EULs is to use a documented EUL for similar equipment from a credible or regulatory-vetted source (e.g., EULs documented in DEER). If a project consists of multiple measures each with different EULs, the project EUL can be selected conservatively (set to the lowest measure EUL) or set equal to the weighted (to savings contribution) average value of all measures. If the measure installed is add-on equipment (see definition), then the EUL is the smaller of: a) the equipment EUL, or b) the RUL of the host equipment.

G.3.6 Remaining Useful Life

The remaining useful life (RUL) is an estimate of the median number of years that that equipment is expected to remain in place and would have continued to meet the facility's requirements, or the equipment's current service level requirements. It is determined by subtracting the age of the equipment from the equipment EUL, or is set to the default value of one-third of the EUL.

G.3.7 Remaining Useful Life When Equipment Age is Past its EUL

If the equipment age is past its EUL and can be proven to be functional and capable of meeting the facility requirements, then the RUL value is set to one-third of the equipment EUL. Otherwise, the RUL is zero. Substantial proof that the equipment is still functional and capable should be obtained to ensure that an RUL is feasible and thus can be accurately used to estimate savings.

The method or approach used to obtain proof will vary by utility program or program offering. It could be a list of equipment known to operate well beyond its expected lifetime, such as a large boiler. Or it could be program eligibility rules requiring evidence of continued and viable operation. Section G.5 provides a reference list of evidence or data that may be collected as proof of RUL viable operation.

G.3.8 Add-on Equipment

An add-on equipment measure is when new equipment is added onto an existing piece of host equipment to improve the efficiency of the host equipment. The existing host equipment can operate without the add-on equipment, and the host equipment is capable of meeting the service level requirements without the add-on equipment.

G.4 Selection and Application of Baselines

Selection of the appropriate baseline helps to ensure that energy savings are accurately calculated. This section provides guidance on the most typical energy efficiency measure types for utility programs.

G.4.1 New Construction, Expansion, and Added Load

These are types of projects for which there is no reference operation for existing conditions or the preexisting conditions are not applicable. Therefore, a code baseline or current practice baseline is used.

In the case of tenant improvements and major renovations, an existing conditions baseline is used if there is an applicable and comparable preexisting baseline available for comparison. This may not be the case if the functional use of the space has changed, or if there are substantial (defined as one-third or more) changes in occupancy. If not, then a code or current practice baseline is used.

G.4.2 Building Weatherization Alterations in Existing Buildings

Building weatherization includes insulation for wall/roof/ductwork/piping and window replacements. These alterations do not burn out and the building can function without them. They are not typically replaced unless there is a major building renovation. Therefore, an existing conditions baseline is used if there is an applicable preexisting baseline for comparison. Otherwise, a code or current practice baseline is used.

G.4.3 Behavioral, Retrocommissioning, Strategic Energy Management, and Operational Programs

This class of programs includes measures that either restore or improve energy efficiency. Therefore, these programs use an existing conditions baseline.

Note that defining what constitutes an eligible program is not addressed in this guideline.

G.4.4 Lighting System Retrofits

Lighting system retrofits (fixtures, bulbs, ballasts, and controls) are subject to complex building code alteration requirements (Building Energy Efficiency Standards, Title 24, Section 141, Alterations). Overall lighting code requirements, including power allowances and mandatory control requirements, have been aggressively increasing in stringency and are expected to continue to do so over the next decade. However, the requirements are generally not invoked until a retrofit takes place. Whether or not a retrofit takes place is influenced by utility programs and the service providers who promote the utility rebate program offerings. Over time, customers will eventually have little choice but to retrofit or replace existing lighting with code-mandated lighting efficiencies.

Therefore, lighting system retrofits can use an early retirement baseline. The 2017 version of the CMUA TRM 400 lighting calculator includes a simplified method for using and reporting lighting retrofits with an early retirement baseline. It uses default EUL and RUL values and existing conditions baseline for the RUL period. It estimates the savings for the second baseline (code baseline) based on assumptions about typical retrofit conditions, and estimates the participant costs for the second baseline from full installation costs. It also allows the assumptions and resulting values to be overridden based on project-specific inputs.

The default EUL is 15 years, based on averages derived from TRM LED lighting measures and default operating hours by space end-use type. A measure-specific EUL can be determined by dividing the lamp's effective rated life by the lighting annual operating hours, limited to a maximum of 15 years. Program-average values can also be determined retrospectively through program evaluation.

The default RUL is one-third of the EUL, or 5 years.

The second baseline energy savings is estimated by multiplying the first-year savings by a reduction percentage factor. The factor and assumptions are list in Table G-1.

Table G-1. Second Baseline Savings Reduction Factor

Existing Fixture Type	Savings Reduction Factor	Assumptions
T5 lamp	0%	Preexisting fixture meets/exceeds code requirements.
LED	0%	Preexisting fixture meets/exceeds code requirements.
CFL	0%	Preexisting fixture meets/exceeds code requirements.
T8 lamp	10%	T24 control requirements apply and reduce savings potential for majority of rebated projects.
HPS, MH	20%	Older fixtures are replaced and T24 requirements apply.
Incandescent	100%	Measure installed is required by code or is current standard practice.
T12 lamp	100%	Measure installed marginally meets code requirements or is current standard practice.
All others	100%	Measure installed is required by code or is current standard practice.

If the preexisting fixture is already likely to meet code (such as a T5 lamp fixture), then the savings reduction factor is zero and the second baseline energy use is equal to the first baseline energy use (all savings estimated are above code). Preexisting fixtures with first- or secondgeneration T8 lamps are likely to already meet code power allowances. However, their preexisting controls likely do not meet all code requirements, and so the savings for the second baseline are reduced by 10% (compared to the first baseline savings) to account for upgrading controls to meet code. Fixtures with T12 lamps do not meet code and would eventually be required to be updated to meet code. Assuming that the first baseline savings are all below code, the savings reduction factor of 100% eliminates savings for the second baseline.

G.4.5 Lighting Retrofit Costs for Early Retirement Measures

To estimate measure cost-effectiveness for early retirement lighting measures, the participant's measure cost is needed for both the first and second baseline. The first baseline cost (existing conditions baseline, based on the California Standard Practice Manual) is the full measure cost. This includes labor, material, equipment costs, and other direct costs associated with the retrofit. This cost is generally documented and readily available from the program participant. The second baseline cost is not readily available as it represents a future cost that did not happen. It is the incremental cost of the energy efficiency lighting measure compared to what would have been installed. Labor costs are assumed to be equal, and so they are not included. For use in cost-effectiveness tests, the participant cost is determined from the following formula:

$$PC = FMC - \frac{FMC - IMC}{(1+i)^{RUL}}$$

where,

PC = Participant cost used in cost-effectiveness tests in POU reporting tool

FMC = Full measure costs

IMC = Incremental measure cost at the end of the RUL

i = Discount rate, 5% from POU reporting tool

RUL = Remaining useful life of the preexisting fixtures, where the default is one-third of EUL

To estimate the incremental measure cost, assumptions were made about the relationship between full equipment cost and incremental equipment costs for different types of retrofits, and then a weighted average is used to determine the typical incremental cost as a percentage of the full measure cost. The weighted average of 50.6% is used (and assumptions documented) in the TRM 400 calculator. This estimate can be revised once better market data becomes available.

G.5 Proof of Viable Operation for the RUL Period

Table G-2 provides a list of the types of evidence that can be collected to demonstrate functional and viable operation of preexisting equipment when its age has exceeded its EUL.

Table G-2. Examples of Evidence of Viable Operation

Evidence	Source	Description
Equipment services its current load – strong evidence	Rebate participant, program third-party M&V contractor	Pre-installation metered data that demonstrates that the capacity needs are met
Equipment services its current load – moderate evidence	Rebate participant, program third-party technical consultant	Site inspection report that confirms equipment operation is satisfactory to meet capacity needs or service level requirements. Inspection should include photos of equipment, control system screenshots of operating conditions, and design operating parameters.
Equipment services its current operating load – corroborative evidence	Rebate participant	Inspection report, with photos of equipment, that confirms satisfactory operation and that capacity needs are met
Equipment cannot meet its current load, is broken, or is poorly operating – evidence of nonviable operation	Program staff or third-party technical consultant, third party implementer feasibility study	High repair costs, equipment broken or poorly operating after emergency repairs, unacceptable performance problems reported by staff
The operating load is expected to remain the same through the RUL period – strong evidence	Operating personnel or site facility manager	Interview of staff backed up with independent analysis of historical and projected trends of use/production
The operating load is changing – evidence of nonviable operation	Program staff or third-party technical consultant, third-party implementer feasibility study, company capital expenditure plans	Remodel plans call for changes to load or productivity. Regular capacity expansion is required, and site-collected data demonstrates that the increased load is beyond current equipment capacity.
The operating load is expected to remain the same through the RUL period – moderate evidence	Program staff or program third-party technical consultant	Site inspection and assessment that confirms facility use is not changing
The operating load is expected to remain the same through the RUL period – corroborative evidence	Third-party implementer	Signed customer statement or email stating that no changes are planned for the facility