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DRAFT STAFF PAPER

Senate Bill 350 Energy Efficiency Target Setting for Utility Programs

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Energy Assessments Division

California Energy Commission

California Energy Commission

Edmund G. Brown Jr., Governor

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ABSTRACT

Senate Bill 350 (De León, Chapter 547, Statutes of 2015) requires the California Energy Commission to obtain input from the utilities and the California Public Utilities Commission to establish targets that contribute to the goal of a cumulative, statewide doubling of energy efficiency savings in final end uses by January 1, 2030. This staff paper describes the approach to developing utility energy efficiency savings targets that the Energy Commission will adopt as required by state legislation. Two energy efficiency potential studies – one for investor-owned utilities and one for publicly owned utilities – are adjusted in limited ways to develop preliminary targets. This approach implements the view that all entities delivering energy efficiency savings via market or programmatic activities should expect to enhance their efforts toward achieving the statewide doubling goal. The initial targets described in this paper will be revised in forthcoming proceedings following the periodic review required by SB 350.

Keywords: Energy efficiency, publicly owned utility, SB 350, conservation voltage reduction, fuel substitution, investor-owned utility

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EXECUTIVE SUMMARY

On October 7, 2015, Senate Bill 350: The Clean Energy and Pollution Reduction Act (De León, Chapter 547, Statutes of 2015) was signed into law by Governor Edmund G. Brown Jr. It identifies ambitious goals for energy efficiency and renewable electricity consumption. The legislation specifically requires the California Energy Commission to set annual targets for increasing energy efficiency savings and demand reduction to achieve a cumulative doubling of energy efficiency savings in electricity and natural gas final end uses of retail customers by January 1, 2030, to the extent doing so is cost-effective, feasible and will not adversely impact public health and safety. The Energy Commission is also required to report biennially to the Legislature about progress toward meeting the statewide goals and on the impacts by utility service area and on disadvantaged communities.

Working closely with the California Public Utilities Commission (CPUC), the Energy Commission's Energy Assessments and Efficiency Divisions held a series of workshops to solicit stakeholder feedback and to discuss data and analytical needs related to doubling projected energy efficiency savings. In January 2017, the Energy Commission published *Framework for Establishing the Senate Bill 350 Energy Efficiency Savings Doubling Targets, (Framework)* which provided a process and policy framework for establishing the energy efficiency targets that SB 350 requires. The *Framework* analysis projects that California's current energy savings efforts will fall short of the SB 350 doubling goal, pointing to the need to enhance their impacts and generate new sources of savings. Building upon the *Framework*, this staff paper identifies how the Energy Commission's Energy Assessments Division plans to establish the portion of SB 350 energy efficiency savings that can be achieved by electric and gas utilities. A companion staff paper by the Energy Commission's Efficiency Division focuses on savings from sources other than utility programs, also referred to as "nonutility" programs. The two papers will be combined into one document that defines and proposes the targets to be adopted by the Energy Commission as called for in SB 350.

In developing energy efficiency targets for utilities, Energy Commission staff analyzed two studies commissioned by the CPUC and publicly owned utilities, respectively. The studies provide electric and gas efficiency savings projections for 2018 and beyond for investor-owned and publicly owned utilities. Staff found that the studies lacked a uniform set of assumptions applicable to all utilities, resulting in inconsistent reporting of expected energy efficiency savings. With the wide variety of efficiency savings programs designed and marketed by utilities and other entities, there is the risk of double counting energy savings estimates. To remedy this problem both for SB 350 and the energy demand forecast, Energy Commission staff proposes specific adjustments to the savings estimates. These adjustments include:

- Counting codes and standards savings in the non-utility portion of targets.
- Adjusting reported savings for some publicly owned utilities from gross to net.
- Extrapolating net savings projections to 2027 out to 2030.
- Adding years 2015, 2016, and 2017 to the 2018-2030 utility projections.

The rationale for these adjustments is detailed in the following chapters.

CHAPTER 1: Introduction and Scope

Senate Bill 350: The Clean Energy and Pollution Reduction Act (De León, Chapter 547, Statutes of 2015) requires the California Energy Commission to set annual targets for increasing energy efficiency savings and demand reduction to achieve a cumulative doubling of energy efficiency savings in electricity and natural gas final end uses of retail customers by January 1, 2030. Targets are to be based upon a doubling of the midcase estimate of additional achievable energy efficiency savings as outlined in the *California Energy Demand Updated Forecast, 2015 – 2025*[1] and extended to 2030 using an average annual growth rate, in a manner that is cost-effective and feasible and imposes no adverse impacts on public health and safety. The Energy Commission is also required to report biennially to the Legislature about progress toward meeting the statewide goals and on the impacts by utility service area and on disadvantaged communities.

This paper focuses on targets for each investor-owned utility (IOU) and publicly owned utility (POU) within California. Utility energy efficiency programs are the most obvious of activities for which SB 350 targets could be established, but other entities implement efficiency programs as well. Utilities have designed, funded and evaluated energy efficiency programs for many years, and all expectations are that they will continue to do so. Even though the California Public Utilities Commission (CPUC) requires a substantial share of IOU programs to be implemented by third-party program administrators, IOUs will continue to bear ultimate responsibility for implementing energy efficiency programs. Similarly, some POUs use specialized third-party administrators for specific programs, while retaining overall responsibility for implementing energy efficiency programs.

The types of programs historically incorporated into IOU and POU savings goals vary considerably. As the variety of programs and number of program administrators increase, the risk of double counting savings claimed by both utilities and other entities grows. The most obvious illustration is estimating and attributing the portion of the savings from codes and standards that are expected to occur in a utility's service area as a result of the utilities' contributions to the development and implementation of Title 24 building standards, Title 20 appliance standards and the U.S. Department of Energy's appliance efficiency standards. Several municipalities have adopted more stringent building standards than those adopted by the Energy Commission. Where a municipality that is also a POU has established more stringent building standards through its local ordinances, extra attention to building standard savings will be important. Savings from non-utility programs are being discussed in the companion Efficiency Division paper.[2] Additional

1 Kavalec, Chris. 2015. *California Energy Demand Updated Forecast, 2015-2025. California Energy Commission. Publication Number: CEC-200-2014-009*-CMF http://www.energy.ca.gov/2014_energypolicy/documents/index.html#adoptedforecast.

2 Dietrich, William, Brian Samuelson, and Michael Kenney. 2017. *Draft Senate Bill 350 Energy Efficiency Targets for Nonratepayer Sources*. California Energy Commission. Publication Number: CEC-400-2017-009-SD.

non-utility programs examples include the California Clean Energy Jobs Act (Proposition 39) funding for retrofit of schools, the property assessed clean energy (PACE), or other nonutility financing programs. An example of an informational activity that could lead to new energy savings is the "benchmarking" disclosure program being developed by the Energy Commission as required by Assembly Bill 802 (Williams, Chapter 590, Statutes of 2015). When a nonutility entity is implementing an energy efficiency program that affects some utility customers, the potential for double counting exists, and savings projections must be reviewed and allocated appropriately.

This paper attempts to determine where such double counting may exist and ensure that energy efficiency savings targets for utilities are only those savings funded by the utility's ratepayers.[3] The balance of this section provides a brief overview of specific topics that will be addressed in detail in other chapters of this paper.

Utility Program Savings Potential Studies

Two important studies of energy efficiency savings potential are discussed in Chapters 3 and 4. The CPUC worked with Navigant Consulting (Navigant) to prepare *Energy Efficiency Potential and Goals Study for 2018 and Beyond* [4] (CPUC/Navigant), adhering to the methodology established in previous work. The objective of this study was to adapt the 2015 potential and goals to the requirements of AB 802 and SB 350, resulting in IOU programs using an "existing conditions" baseline as opposed to a "code baseline." Even though the CPUC/Navigant study did not attempt to double IOU savings, SB 350 directed that goals not be set based on past studies. Consequently, CPUC/Navigant study used a combination of different calibration and scenarios. The POUs, through the California Municipal Utilities Association (CMUA), contracted with Navigant Consulting, using a similar approach to prepare 10-year energy efficiency savings projections for each POU (CMUA/Navigant). These projections were submitted to the Energy Commission in March 2017 as required by The Public Resources Code (PRC) 25310(b).

Neither of these studies was specifically designed to identify how utilities might accomplish a large increase in savings associated with SB 350's doubling goal.[5] Rather, each of these studies appears to be designed to determine a market-based savings potential for voluntary, utility-incentive retrofit and new construction programs, given a set of assumptions. The study also calculated potential savings from existing and future C&S advocacy. The modeling tools used in both studies have significant sensitivity to fundamental input assumptions such as avoided costs, measure costs, retail rates, and customer sector growth through time. The range of program engagement strategies that predict voluntary customer participation includes targeted market segments, customer education indices, and incentive levels. Different assumptions can produce

3 Staff acknowledges savings resulting from codes and standards advocacy funded by ratepayers. These savings will be included as part of the C&S target to simplify accounting. However savings from to-code programs, that were by definition not realized by C&S, will be included in the "utility" targets.

4 California Public Utilities Commission. *Energy Efficiency Potential and Goals Study for 2018 and Beyond*. June 15, 2017, ftp://ftp.cpuc.ca.gov/gopher-data/energy_division/EnergyEfficiency/DAWG/2018andBeyondPotentialandGoals%20StudyDRAFT.pdf.

5 Staff does not believe that SB 350 requires the Energy Commission to assign such responsibility to utilities in establishing targets. As indicated in the *Framework* paper, staff expects numerous other "responsible entities" to also contribute toward achieving the doubling goal.

alternative projected savings through time. Staff understands that results for scenarios of alternative assumptions will be prepared by the CPUC/Navigant study for consideration by the CPUC in summer 2017. In contrast, the CMUA/Navigant study, completed in spring 2017, resulted in a base set of projections, which each POU then directed Navigant to modify using alternative assumptions, or other changes, for its own slice of the overall POU savings projection. The report submitted by CMUA to the Energy Commission includes the results of this exclusive modification by each POU of the base analysis prepared by Navigant, so there is no uniform set of assumptions common to all POUs nor have any alternative scenarios been prepared.[6]

Chapters 3 and 4 provide analyses of savings from the potential studies, adjustments to avoid double counting, and recommendations for SB 350 energy efficiency targets to be discussed in future *Integrated Energy Policy Report* (*IEPR*) cycles.

Net versus Gross Savings

The energy efficiency evaluation community uses the concept of net and gross savings to address program “free ridership”. Generally, gross savings include savings from consumers who would have implemented measures even if they were not participants in a program (free riders) and savings that extend beyond the time period assumed for specific measures promoted as incentives in a program (spillover). Net savings adjust for these two components of savings. There is no analytic method for computing net savings from gross savings. At the national level, there are numerous approaches for estimating net-to-gross ratios. The majority of California utility program savings are projected on a net basis. It is not useful to allow some utilities to count gross savings while others count net savings toward SB 350 targets, as it will create inconsistencies. Staff proposes to adjust the “gross” savings metric to “net” savings for those POUs who directed that CMUA/Navigant report “gross” savings. That said, the Energy Commission does think that it is important to track and report spillover effects from the state’s energy efficiency efforts that are not otherwise naturally occurring. The Energy Commission intends to develop methods to report on the overall impact of the state’s energy efficiency efforts and the growth of energy efficiency markets; however this staff paper does not include estimates of savings from spillover effects.

Chapter 4 of this paper describes how staff proposes to adjust savings for some POUs from “gross” to “net.”

Fuel Substitution Programs

In the *Framework*[7] paper, staff distinguished fuel substitution from fuel switching programs and clarified that fuel switching, such as transportation electrification, does not meet the definition of energy efficiency savings under SB 350, which must come from electricity or natural gas final end uses. PRC 25310(d)(10) specifies requirements that differ from the “three-prong test” that the

6 CMUA. *Energy Efficiency in California's Public Power Sector: 11th Edition – 2017*, March 15, 2017. http://www.ncpa.com/wp-content/uploads/2015/02/2017_POU_EE_Reportv2.pdf.

7 *Framework for Establishing the Senate Bill 350 Energy Efficiency Savings Doubling Targets* http://docketpublic.energy.ca.gov/PublicDocuments/17-IEPR-06/TN215437_20170118T160001_*Framework*_for_Establishing_the_Senate_Bill_350_Energy_Efficienc.pdf.

CPUC established decades ago for fuel substitution programs. These differences should be reconciled. Since no utility is pursuing fuel substitution programs at scale at this time, the Energy Commission has an opportunity to guide how fuel substitution can occur going forward. Chapter 5 addresses several questions about how fuel substitution programs might be designed to qualify in meeting SB 350 energy efficiency savings targets.

Conservation Voltage Reduction

PRC 25310(d)(9) expressly allows conservation voltage reduction (CVR) energy savings to count toward satisfying SB 350 energy efficiency savings targets. CVR installation results in energy savings for end-use customers and some reduction in distribution system line losses. CVR savings occur as a result of the installation of distribution system sensors and controls that are part of the family of hardware/software improvements known as *distribution system automation*. Distribution utilities implement these activities, not the end user, so there are no programs in which end users participate. It is expected that energy procurement will be reduced because of such activities, with a portion of the savings occurring as metered energy usage reductions by end users and another portion as reductions in distribution losses. The fundamental question for both IOU and POUs is whether investments in more sophisticated distribution equipment are less expensive than the present value of reducing energy consumption. If a distribution utility is not also providing generation services to some or all of the end users receiving distributions services, then the distribution utility will be less able to justify CVR investments since some savings will be "off the books" of the utility and excluded from a cost/benefit assessment. Given the evolving role of nonutility energy entities under the CPUC's jurisdiction, determining the cost-effectiveness of such activities is growing more complex. POUs do not face this challenge because they are vertically integrated and generally have not unbundled the services they offer to customers.

Chapter 6 provides an overview of CVR and lists a series of issues to be addressed in a subsequent round of SB 350 target-setting.

Energy Efficiency Reporting Requirements

PRC 25310(e) requires the Energy Commission to report to the Legislature every two years on progress toward achieving the doubling of energy efficiency savings targets. It also requires an assessment of the impact of such savings on electricity demand in local utility service territories and on disadvantaged communities. To determine progress toward achieving energy efficiency targets, the Energy Commission must establish reporting requirements for utilities and other responsible entities. Utilities will be expected to gather information not just on measured and expected savings from the initial round of target setting, but also the continuing and new impacts of their programs. Among these are 8,760 hourly impacts and impacts on disadvantaged communities. Through such information, the Energy Commission will learn what is working or not working, and whether further legislative action may be needed to authorize new energy efficiency implementation authority to achieve the statewide doubling goal.

Chapter 7 will elaborate on possible improvement in utility-reported data and on the need to revise reporting requirements.

CHAPTER 2: Setting Utility Energy Efficiency Savings Targets

SB 350 directs the Energy Commission to establish targets through doubling of the midcase estimate of additional achievable energy efficiency (AAEE), and through the targets adopted by POUs. SB 350 also requires the Energy Commission and the CPUC to "consider the results of energy efficiency potential studies that are not restricted by previous levels of utility energy efficiency savings."[8] The two most recent studies the Energy Commission is relying upon are clear improvements over previous analysis but are still insufficient to address SB 350 goals. Understanding these two studies and establishing improved goals in the future are a complex technical endeavor that requires acknowledgement of the fundamental differences in IOU and POU governance.

Utility Governance

The CPUC establishes numerical electricity and natural gas savings goals[9] for IOUs.[10] POU energy efficiency saving goals are set by the locally elected boards and/or city councils that govern POUs. There are significant disparities[11] in financial structure and regulatory oversight that result in POUs and IOUs approaching their investments in energy efficiency programs differently. **Appendix A**, **Table A-1**, summarizes the differences between POU and IOU characteristics that influence energy efficiency planning.

Community choice aggregators (CCAs) are governmental entities formed by cities and counties to serve the energy requirements of their local residents and businesses. From the regulatory perspective, CCAs can be categorized as entities somewhere between the IOUs and POUs. CCAs are asserting their right to acquire their own generation supplies, and that means that historical concentration of IOU energy efficiency planning, program design, operation, and evaluation may become more fragmented. CCAs report energy savings independently; however, CCAs savings projections are incorporated into the CPUC/Navigant potential study as part of IOU planning areas.

Potential Studies

The IOU and POU energy efficiency potential studies undertaken in 2016 – 2017 and submitted to the Energy Commission were designed and funded before planning to implement SB 350

8 Public Resources Code § 25310 (c)(4).

9 Some POUs provide natural gas to final end users; however, savings from natural gas efficiency programs is almost exclusively an IOU effort.

10 Original Goals Decision: D. 04-09-060; September 23, 2004,

http://docs.cpuc.ca.gov/word_pdf/FINAL_DECISION/40212.pdf.

11 Appendix A, Table A-1 of this report summarizes main differences between POUs and IOUs characteristics.

requirements was completed. Historically, potential studies determine savings through three successive filters to quantify the amount of electricity and/or natural gas savings that can be achieved through a given set of program mechanisms:

- Technical potential is defined as the amount of energy savings that would be possible if the highest level of efficiency for all technically applicable opportunities to improve energy efficiency were taken, including retrofit, replace-on-burnout, and new construction measures.
- Using the results of the technical potential analysis, the economic potential is calculated as the total energy efficiency potential available when limited to only cost-effective measures. All components of economic potential are a subset of technical potential.
- Market potential is defined as the amount of energy efficiency savings that could be expected in response to specific levels of incentives and assumptions about market influences and barriers. All components of market potential are a subset of economic potential.

Some studies further discount market potential by constraining this to a level thought to be "achievable" through a given set of program delivery mechanisms and consumer acceptance considerations.

Although both studies pursue energy efficiency potential from the same conceptual framework discussed above, there are differences between the study undertaken by CPUC/Navigant and a separate study undertaken by CMUA/Navigant on behalf of POUs. **Table 1** compares important elements of the two studies and notes some methodological differences and alternative assumptions.

Table 1: IOU and POU Potential and Goal Study Method and Assumptions

Topic	IOUs	POUs	Notes on Difference
EE Measure Scope	DEER[12] and non-DEER measures and IOU white papers on emerging technologies	TRM[13] and DEER modifications to POUs are common	TRM is a reduced scope of EE measures compared to DEER; emerging technologies are added to TRM based on the preferences of individual POUs[14]
EE Reporting and Cost-Effectiveness (C-E) Assessments	California Energy Data and Reporting System (CEDARS)	EE Reporting Tool	POUs use a simplified version: - reduced set of measures applicable to POUs

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12 Database of Energy Efficiency Resources.

13 Technical Reference Manual. POUs have been dissatisfied with DEER update process and measure savings correlation with POU EM&V results.

14 CMUA. *Energy Efficiency in California's Public Power Sector: 11th Edition – 2017*, Appendix B (LADWP section).

Topic	IOUs	POUs	Notes on Difference
	Cost-Effectiveness Tool (CET)		- TRM values rather than DEER - TOU periods rather than 8,760 profile
Software Package Developing Potential Model Calculations	CPUC Potential and Goal (P&G) model based on Analytica	Electric Resource Assessment Model (ELRAM) - Microsoft Excel® spreadsheets	ELRAM is a close analogue to the CPUC P&G model. ELRAM differs in ways that can be responsive to individual POU concerns. It has a more "conservative" market potential approach and is more readily customizable to the requirements of each POU client.
Baseline for Attribution Between Programs vs. C&S	Expanded existing conditions baseline scope	Each POU can specify its preference	POUs can elect to choose existing conditions or "to code" baseline[15]
C-E Criteria to Determine Economic Potential	Navigant is assessing four scenarios defined by various C-E tests, uses of GHG adder, and level of savings	TRC test using 2016 avoided cost estimates	CMUA report appears to argue against a societal test being considered by CPUC
Avoided Cost Assumptions	Updated annually	Default assumptions were not updated	Detailed avoided cost assumptions have not yet been provided
Market Adoption Approach[16]	Full life-cycle equipment costs and benefits	First cost measure payback and/or specific program budget	POUs are concerned that CPUC approach may not correctly include limitations of customer willingness to adopt when assessing market potential.[17]

15 See CU Report, Appendix B, comparing various POU descriptions. CMUA, TN217482 CMUA Annual Targets (Excel spreadsheet), see https://efiling.energy.ca.gov/Lists/DocketLog.aspx?docketnumber=17-IEPR-06.

16 Navigant. *Energy Efficiency Potential Forecasting for California's Publicly Owned Utilities, Feb. 2017, page 4.*

17 CMUA, page 18. (The CPUC has noted that the Navigant PG study incudes a decision-making algorithm for market adoption that takes into account payback in customer decision-making, which should address the customer willingness issue.)

Topic	IOUs	POUs	Notes on Difference
		constraints	
Types of Potentials	Technical, economic, market and program stranded	Technical, economic, market and program	POU study was undertaken earlier and thus was not designed to include stranded potential per AB 802 requirements.
Program Scope	Existing programs with revised incentive assumptions. Variable in general	Existing programs with revised incentive assumptions. Variable in general	POUs can elect to revise program scope and incentive levels at their discretion (see Appendix C, LADWP description).
Reporting Gross vs. Net Savings (Historical)	Report both gross and net	Most POUs report both gross and net savings, but some only gross	Unclear whether either study actually uses historic savings at the aggregate level to influence projections
Reporting Gross vs. Net Savings (Projected)	Both	Either gross or net	CMUA Report Appendix C describes projected savings as either gross or net at the discretion of the POU
Reporting on a with/without basis for C&S impacts	Have historically been reported	Introduced for 2017 report; previously not separated	POUs believed revealing C&S impacts was important[18]

Source: California Energy Commission, Demand Analysis Office, July 2017.

Net versus Gross Savings

The Energy Commission uses energy efficiency program savings in net terms because of its focus on demand forecasting and the need to reconcile price-induced savings with actual programmatic impacts.

The CPUC/Navigant potential study and most of the POUs included in the CMUA/Navigant report include separate values for net and gross savings. However, as discussed in Chapter 4, some POUs report only gross savings. Accepting gross savings from some utilities and net savings from other utilities would make comparison between utilities unfair and impossible. Since the majority of utility program savings developed in the two potential studies are projected on a net

18 Ibid, page 15.

basis, staff proposes adjustments to those POUs who directed CMUA/Navigant to report only gross savings.[19]

In addition, because the *Framework* paper introduced the idea of multiple “responsible entities” that might each contribute toward achieving of the doubling goal of SB 350, distinguishing between gross and net may become even more important as new entities attempt to promote energy savings in parallel to, or even in conjunction with, utility programs. As the number of participant entities increases, it is important to ensure that projected savings from utility and nonutility programs are comparable and additive. Otherwise, there will be double counting and a false sense of progress toward the doubling goal.

Energy Efficiency Savings from Codes and Standards

The two studies include the characteristics of codes and standards as an input in the energy efficiency modeling process. The CPUC/Navigant study describes the impact of codes and standards (C&S) occurring in two ways:[20]

- C&S affects savings measures in utility rebate programs. Assuming that C&S become more stringent, the savings estimate for IOU retrofit programs decrease.
- IOU can use an existing conditions baseline to calculate savings and claim a portion of savings from C&S through the officially established C&S advocacy programs.

The CPUC/Navigant study uses a method developed by a different consulting group funded by the CPUC to determine C&S attributable savings. This method attempts to determine the incremental impact on final adopted C&S requirements that can be attributed to utility efforts. Although staff does not expect changes to this aspect of the CPUC/Navigant study, other modeling changes resulting from AB 802 shifts from code conditions to existing conditions baselines suggest characterization of existing and prospective standards is important to utility programs savings projections.[21]

In contrast, the CMUA/Navigant study appears to use a less transparent approach and one for which each POU decided whether to incorporate C&S savings into the overall energy efficiency savings projections. Also, the CMUA/Navigant study addresses only electricity savings; the POU projections do not compute natural gas savings from C&S. Staff has conferred with Navigant Consulting, Northern California Power Agency (NCPA) staff, and utility representatives to learn about C&S attribution and how adjustments are made for POU savings projections.[22]

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19 In making this adjustment, the Energy Commission does not seek to preclude a POU from using “gross” savings in its own internal planning.

20 Navigant, *Draft Energy Efficiency Potential and Goals Study for 2018 and Beyond, page 21.*

21 CPUC/Navigant study assumed that IOU incentive programs could capture only stranded savings that would not also be attributed to IOU C&S programs, specifically to prevent double-counting between IOU voluntary incentive programs and IOU C&S advocacy program savings.

22 CMUA advised against trying to fully assess treatment of C&S in this cycle of the CMUA study. Instead, CMUA proposed this be a collaborative topic in designing the next POU potential study.

Staff asserts that treatment of current and future C&S savings cannot differ by utility. To have a uniform basis for understanding what is included in utility savings and to enable the estimation of the incremental savings from future C&S by the Energy Commission's Efficiency Division, Energy Commission staff recommends counting future C&S savings as nonutility savings, at least for this initial effort.[23]

Chapters 3 and 4 of this paper have specific subsections that address possible double counting of C&S savings for IOUs and POUs, respectively.

Main Constraints to Doubling Savings Targets

SB 350 directs the Energy Commission to "base the targets on a doubling of the midcase estimate of additional achievable energy efficiency savings, as contained in the California Energy Demand Updated Forecast, 2015-2025, adopted by the commission, extended to 2030 using an average annual growth rate, and the targets adopted by local publicly owned electric utilities pursuant to Section 9505 of the Public Utilities Code, extended to 2030 using an average annual growth rate, to the extent doing so is cost-effective, feasible, and will not adversely impact public health and safety." Below are explanations of these three terms.

Cost-Effective

Cost-effective is a standard feature of energy efficiency potential studies. The Public Resources Code (PRC) and Public Utilities Code (PUC) provide both broad and specific definitions of cost-effectiveness calculations.[24] The general definition of cost-effectiveness the Energy Commission uses is in PRC Section 25000.1(c):

> In calculating the cost-effectiveness of energy resources, including conservation and load management options, the [Energy Commission] shall include a value for any costs and benefits to the environment, including air quality. The [Energy Commission] shall ensure that any values it develops pursuant to this section are consistent with values developed by the Public Utilities Commission pursuant to Section 701.1 of the Public Utilities Code. However, if the [Energy Commission] determines that a value developed pursuant to this subdivision is not consistent with a value developed by the Public Utilities Commission pursuant to subdivision (c) of Section 701.1 of the Public Utilities Code, the [Energy Commission] may nonetheless use this value if, in the appropriate record of its proceedings, it states its reasons for using the value it has selected.

Traditionally, in various specific applications, energy efficiency impacts have been assessed through several avoided cost tests described in the California Standard Practice Manual[25] and via integrated resource planning (IRP).[26] Due to the IRP requirements of SB 350, this may change in

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23 This should not be in conflict with AB 802. IOUs should expect to fund C& S advocacy programs.

24 Source: Public Utility Code § 701.1 (c).

25 *Energy Efficiency Policy Manual Version 5* July 2013 http://www.cpuc.ca.gov/uploadedFiles/CPUC_Public_Website/Content/Utilities_and_Industries/Energy_-_Electricity_and_Natural_Gas/EEPolicyManualV5forPDF.pdf.

26 *Best Practices in Electric Utility Integrated Resource Planning* http://www.raponline.org/wp-content/uploads/2016/05/rapsynapse-wilsonbiewald-bestpracticesinirp-2013-jun-21.pdf.

the future, at least for CPUC jurisdictional entities. Utilities also use multiple ways to evaluate cost-effectiveness of energy efficiency, each differing from another in terms of calculation inputs and methods by which program costs and benefits are computed. Chapters 3 and 4 provide utility perspective on energy savings cost-effectiveness screening methods, including economic potential and other assumptions of their potential studies. A companion staff paper[27] describes specific cost-effectiveness calculations applicable to nonutility programs.

Feasible

Assuring that savings are feasible is another factor commonly built into potential studies. One statutory definition of "feasible" is contained in the California Environmental Quality Act: "Feasible means capable of being accomplished in a successful manner within a reasonable period of time, taking into account economic, environmental, social, and technological factors."[28] In the context of SB 350 energy efficiency targets, *feasible* can be interpreted as willingness of end users to participate in statewide or utility-specific programs. From the utility perspective, some considerations that may be relevant to determining feasibility of energy efficiency savings include expected consumer behavior. Chapters 3 and 4 discuss how utilities accomplish that through calculating market potential and taking into account other program incentive assumptions identified in their potential studies.

Aggregating Electricity and Natural Gas Targets

SB 350 provides the authority for the Energy Commission to aggregate, or combine, electricity and natural gas savings projections when establishing targets.

> The commission may establish targets for the purposes of paragraph (1) that aggregate energy efficiency savings from both electricity and natural gas final end uses. Before establishing aggregate targets, the commission shall, in a public process that allows input from other stakeholders, adopt a methodology for aggregating electricity and natural gas final end-use energy efficiency savings in a consistent manner based on source of energy reduction and other relevant factors.[29]

In this initial effort to establish targets, the Energy Commission has not exercised this authority. To do so implies considering relative cost-effectiveness of electricity versus natural gas savings potential, relative contribution of electricity versus natural gas in reducing GHG emissions, and the relationship of this authority to potential fuel substitution programs allowed by PRC 25310(d)(10). Whether to exercise this authority will be examined in future target-setting cycles.

27 Ibid, page 4.

28 PRC §21061.1.

29 PRC 25310(c)(2).

Adversely Impact Public Health and Safety

Finally, procurement of energy efficiency resources is required to be cost-effective, feasible, and reliable.[30] As discussed in the *Framework* paper, staff interprets "adversely impact on public health and safety" to mean primarily ensuring reliability of electricity supply.[31] Thus, the Energy Commission will evaluate the credibility of claimed savings and the effect different savings targets will have on overall grid reliability. In addition, the phrase is broad enough to allow the Energy Commission to assess the effect of targets on greenhouse gas (GHG) and other air pollutant emissions. Energy efficiency programs should reduce the need for power generation and result in fewer emissions of harmful air pollutants. However, if expected energy efficiency fails to occur, there could be a negative impact on the environment and public health. Neither CPUC/Navigant nor CMUA/Navigant energy efficiency potential studies address non-GHG environmental impacts, so testing the meaning of this constraint is left to a future update of targets.[32]

30 PUC 454.5 (b)(9)(C)(i), 454.56, and 9615 constrains IOU and POU procurement of electricity and natural gas savings to be cost-effective, feasible, and reliable.

31 PRC §25300 asserts that "reliable supply of energy [be] consistent with protection of public health and safety."

32 CPUC in the IDER proceeding is considering the use of the societal cost test that would include these impacts. CPUC staff report: http://docs.cpuc.ca.gov/SearchRes.aspx?DocFormat=ALL&DocID=173203676.

CHAPTER 3: Goal-Setting Process for Investor-Owned Utilities

Since the 1970s, California utilities have been offering energy efficiency programs to their customers in both the residential and non-residential sectors, including the agriculture and industrial segments. California electric and gas utilities offer a wide range of efficiency programs to their customers, including programs in lighting; heating, ventilation and air conditioning; small and large appliances; new construction programs for both residential and non-residential sectors; and energy audits. These programs often include financial incentives and rebates. These energy efficiency programs are important as they help reduce GHG emissions, are the lowest-cost energy resource option and the cleanest form of energy available, and play significant roles in meeting California's energy and climate policy objectives.

Approximately 75 percent of Californians receive their energy from IOUs and community choice aggregators (CCAs) or electricity service providers (ESPs) in IOU territories. The IOUs, CCAs, and ESPs are regulated, to various degrees, by the CPUC, which oversees the program design, funding, and evaluation for these entities. The IOUs, CCAs, and two networks of local governments called regional energy networks (RENs) offer energy efficiency programs that are funded by a fee included in all IOU customer bills. The CPUC authorizes approximately $1.3 billion per year to fund energy efficiency programs in IOU territories (including low-income programs and IOU codes and standards advocacy programs). Due to data limitations, the CPUC can develop goals only by IOU service territories rather than by program administrator, which means there are no separate goals for CCAs, RENs and ESPs.

Legislative Background

In response to the western U.S. energy crisis in 2000 and 2001, three entities – the Energy Commission, the CPUC and the now-defunct Consumer Power and Conservation Financing Authority - approved the first State of California Energy Action Plan in 2003, proposed by a subcommittee of the three agencies. The Plan establishes shared goals and specific actions to ensure that adequate, reliable, and reasonably-priced electrical power and natural gas supplies were provided through cost-effective and environmentally sound policies, strategies, and actions. A second plan was adopted in 2005, but new legislation, including the California Global Warming Solutions Act of 2006, rendered further development of the Energy Action Plan unnecessary. One of the significant features of the Energy Action Plan was to identify energy efficiency as the state's number one priority for procurement of new energy resources to meet California energy demand. Climate change legislation further accentuated the role of energy efficiency in the state's policy.

To promote increased energy efficiency in all California utility territories, Senate Bill 1037 (Kehoe, Chapter 366, Statutes of 2005) codified the pursuit of energy efficiency as the first priority among energy resources. The bill requires the CPUC, in consultation with the Energy Commission, to identify all potentially achievable cost-effective electric and natural gas energy efficiency for the IOUs, set targets for achieving this potential, and review the energy procurement plans of IOUs for consideration of supply alternatives such as energy efficiency. SB 1037 also requires all POUs to report historical investments in energy efficiency programs annually to their customers and to the Energy Commission.

Assembly Bill 2021 (Levine, Chapter 734, Statutes of 2006) (AB 2021) requires the Energy Commission, in consultation with the CPUC and POUs, to develop a statewide estimate of all potentially achievable cost-effective electricity and natural gas efficiency savings and establish targets for statewide annual energy efficiency savings and demand reduction for the next 10-year period. With the passage of AB 2021, POUs were also required to provide a forecast of energy efficiency savings. Under Public Utilities Code Section 9615(b), POUs are directed to identify all potentially achievable cost-effective electricity efficiency savings and establish annual targets for energy efficiency savings and demand reduction for the next 10-year period.

By November 1, 2017, SB 350 requires the Energy Commission to establish annual targets for statewide energy efficiency savings and demand reduction that will achieve a cumulative doubling of a specific set of previous energy efficiency saving projections among final electricity and natural gas end uses by 2030. SB 350 also requires these targets to be set in collaboration with the CPUC and local publicly owned utilities, in a public process that allows input from stakeholders.

AB 802, a companion bill to SB 350, authorizes program administrators of energy efficiency programs to provide incentives, rebates, technical assistance, and support to their customers to increase the energy efficiency of existing buildings considering existing conditions baseline. The bill also authorizes the use of normalized metered energy consumption to quantify savings and performance over time; to provide incentives for behavior, retrocommissioning, and operational savings and authorizes program administrators to recover the reasonable costs of these programs in their rates.

Energy Efficiency Goals for the Investor-Owned Utilities

Not to be confused with the statewide targets called for in SB 350, per PUC Section 454.5, the CPUC is mandated by the legislature to “meet unmet resource needs with all available energy efficiency and demand reduction that is cost-effective, reliable, and feasible.” To accomplish this mandate, the CPUC establishes energy efficiency goals for the IOUs. These goals are set every other year and are based on the findings of the energy efficiency potential studies. These potential studies use methodologies to estimate all of the potential energy savings that are available through different technologies.

IOUs conducted energy efficiency potential studies for many years, but beginning in the late 2000s, the CPUC undertook these studies, using a series of technical consultants. While the core approach for these studies has remained the same, there are improvements in methodology, input assumptions, and how the results of the studies are used that respond to specific CPUC issues important at the time of each study.

Net Savings and Cumulative Goals

After seven years of gross savings goals, the CPUC is returning to setting net savings goals for the IOU energy efficiency portfolios beginning in 2018. The reason for going back to net savings goals is that net savings numbers are used in many proceedings, including the CPUC's long-term procurement planning proceeding[33] and the Energy Commission's energy demand forecast[34] where net savings numbers are used for calculating the additional achievable energy efficiency projections.

The CPUC is considering setting cumulative goals starting in 2018. The CPUC set cumulative goals in the past but abandoned them as accounting for persistent savings over time became more complicated. No methods to address the previous accounting difficulties have emerged. Regardless, if the SB 350 objectives for reducing GHG emissions are to be met, the need for long-term sustainability of energy efficiency programs and measures should be emphasized, and having cumulative goals is one way to achieve this.

Energy Efficiency Portfolio Program Cycles

In past years, the CPUC approved three-year energy efficiency program cycles, with 2010–2012 being the most recent. Often, these three-year program cycles were followed by a one- or two-year bridge period, such as in 2013–2014. In November 2013, the CPUC released an order instituting rulemaking establishing a proceeding that would address post-2014 energy efficiency issues. CPUC Decision D. 14-10-046 first presented the idea of the Rolling Portfolio. While the decision did not formally lay out the framework for the Rolling Portfolio, it did establish annualized funding levels of approximately $1 billion per year for the first 10-year cycle (2015-2025).

The rolling portfolio process was adopted by the CPUC in October 2015 by Decision D.15-10-028. This decision directed program administrators to submit high-level business plans that describe how the program administrators will achieve energy efficiency portfolio goals over a 10-year time frame. This decision also authorized creation of the California Energy Efficiency Coordinating Council, a stakeholder-led process in which program administrators and other interested stakeholders would collaborate, with CPUC input, to develop program administrator business plans prior to filing the plans with the CPUC. In addition to providing guidance related to implementation of AB 802 vis a vis energy efficiency programs in 2017 and beyond, the decision identified a clear timeline for coordinating various activities in the regulatory process, including technical updates, program design and portfolio planning, program operations, and program reporting and evaluation. This approach will allow for different types of evaluation, measurement, and verification (EM&V) studies, including studies with faster turn-around times, and will allow EM&V results to be incorporated into the portfolio on a more frequent and timely basis. A subsequent decision, D. 16-08-019, directed program administrators to file their business plans via application on January 15, 2017. Business plans were filed on January 17, 2017, to be formally

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33 http://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M158/K663/158663325.PDF.

34 http://www.energy.ca.gov/publications/displayOneReport.php?pubNum=CEC-200-2016-016-CMF.

reviewed by CPUC staff as well as stakeholders. This initial round of review included comments and replies from both program administrators and stakeholders, as well as initial feedback from CPUC staff. A joint ruling issued on April 14, 2017, and later updated by the assigned commissioner and administrative law judge, laid out the remaining business plan review tasks anticipated for 2017, along with possible contingencies, and established a timeline for issuing a CPUC decision to approve the business plans by December 2017.

An additional CPUC decision, approving energy efficiency savings goals for program administrators that will be used in the Energy Commission's goal setting process in light of SB 350, is expected in late 2017.

Evaluation, Measurement, and Verification

The CPUC also decided to keep the EM&V budget at 4 percent of each of the utilities' total budgets, with 40 percent of this going to the program administrators for their evaluation activities and 60 percent going to CPUC staff for overseeing evaluation activities. Funding of evaluation activities for the CCAs and RENs are to be set up proportionally based upon their total program budget.

Existing Building Code Baseline

Another change that could affect goals is AB 802. Before passage of AB 802, there were limits placed on the credit utilities could receive for efficiency savings associated with bringing existing equipment and buildings into compliance with codes and standards. With the adoption of AB 802, opportunities to offer customers incentives for and "mine" below-code savings have been greatly expanded. Program administrators can now use existing conditions as the baseline (with a few exceptions, such as new construction, expansion of space, or the addition of new load, which will still have a code baseline).

AB 802 also directed that energy efficiency savings could be achieved not only through equipment installations but also through behavior and operational efficiency measures. Behavioral, retrocommissioning, and operational activities (BROs) are to be assigned an existing conditions baseline. These measures may either restore or improve energy efficiency and can be reasonably expected to produce multi-year savings. Behavioral programs have an effective useful life of two years, while retrocommissioning and operations programs have an effective useful life of three years.

Finally, AB 802 also directs utilities to consider the overall reduction in normalized metered energy consumption as a measure of energy savings.

Program Delivery Alternatives

Community Choice Aggregators and Regional Energy Networks

CCAs and RENs also play an important role in offering energy efficiency programs to their customers. CCAs are local government entities formed by cities and counties that procure electricity on behalf of their customers and often have higher renewable energy content than the IOUs. While CCAs are responsible for procurement, the IOUs still provide other services such as transmission and distribution, metering, billing and collection, and customer service. As of May 2017, there were 11 operational or soon-to-be-operational CCAs throughout California, 5 CCAs to be launched in 2018, and 16 cities/counties exploring the possibility of starting a CCA. The CCAs develop their own energy efficiency programs, which are then reviewed by the CPUC. MCE, originally known as Marin Clean Energy, is the only CCA authorized to administer its own energy efficiency programs.

There are two RENs that currently offer energy efficiency programs to customers—SoCal REN and Bay REN. Often, the RENs have special expertise and relationships with their customers that other utilities do not have and design their energy efficiency programs for underserved areas, hard to reach markets, and where the IOUs currently do not offer programs.

In D. 16-08-19, the CPUC decided the RENs will continue to offer their customers energy efficiency programs but that these programs would be on a pilot basis as there was not enough data yet to assess the success of these programs. This status could change as more EM&V studies are completed.

Third-Party Program Administrators

Currently, the CPUC requires that 20 percent of each IOU portfolio rely on competitively bid programs. In D. 16-08-019, the CPUC decided that by 2020, the IOUs must increase competitively bid third-party programs to a minimum of 60 percent of the IOUs' total budgeted portfolio, including administrative costs and EM&V. In this decision, the CPUC clarified that for a program "to be designated as third-party the program must be proposed, designed, implemented, and delivered by non-utility personnel under contract to a utility program administrator." The CPUC's reasoning behind this clarification is that often third-party programs can offer programs that encourage innovation and produce program delivery cost savings.

2018 California Public Utilities Commission/Navigant Potential and Goals Study

D.15-10-028 ordered CPUC staff to conduct a potential and goals study that assesses all of the potential different technologies and measures that the utilities could use to make up their energy efficiency portfolios.

The following are changes in methodology identified in the CPUC's 2015 potential and goals study *Energy Efficiency Potential and Goals Study for 2015 and Beyond*[35] and the 2018 potential and goals study *Energy Efficiency Potential and Goals Study for 2018 and Beyond*.[36]

General changes:

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35 California Public Utilities Commission, *Energy Efficiency Potential and Goals Study for 2015 and Beyond*, September 25, 2015, http://www.cpuc.ca.gov/WorkArea/DownloadAsset.aspx?id=4033.

36 California Public Utilities Commission, *Energy Efficiency Potential and Goals Study for 2018 and Beyond*, June 15, 2017, ftp://ftp.cpuc.ca.gov/gopher-data/energy_division/EnergyEfficiency/DAWG/2018andBeyondPotentialandGoals%20StudyDRAFT.pdf.

- 2016 avoided cost update
- Building stock, energy prices, total baseline energy forecast update
- Model calibration to 2013 – 2015 program data
- Program non-incentive costs update
- Assumptions developed to determine to-code free-ridership adjustment to account for program influence and avoid double counting with codes and standards savings

Model changes:

- Regrouped building types
- Map climate zones to match Energy Commission’s new zone system
- Codes and standards:
    - Include impact of planned new building and appliance standards through 2019
    - Develop methods to avoid double counting of savings between codes and standards and incentive programs that may claim to-code savings

Some of the changes to the 2018 potential and goals study include methodological changes to account for new legislative mandates such as AB 802, SB 350, and CPUC decisions.

AB 802:

- Consider existing conditions baseline.
- Refresh the whole building package characterization with a focus on existing building renovation and below-code savings.
- Expand measure list and characterization to include increased scope of AB 802.
- Include measures that present stranded potential which can now be incented due to change in code baseline policies.
- Place greater focus on behavior, retrocommissioning, and operational savings

SB 350:

- Forecasting savings not based on past studies
- Doubling of energy efficiency in 2030

CPUC Decision 16-08-019:

- Goals for 2018 should be net of free ridership
- Cumulative goals, if appropriate methods can be developed, in addition to first-year goals

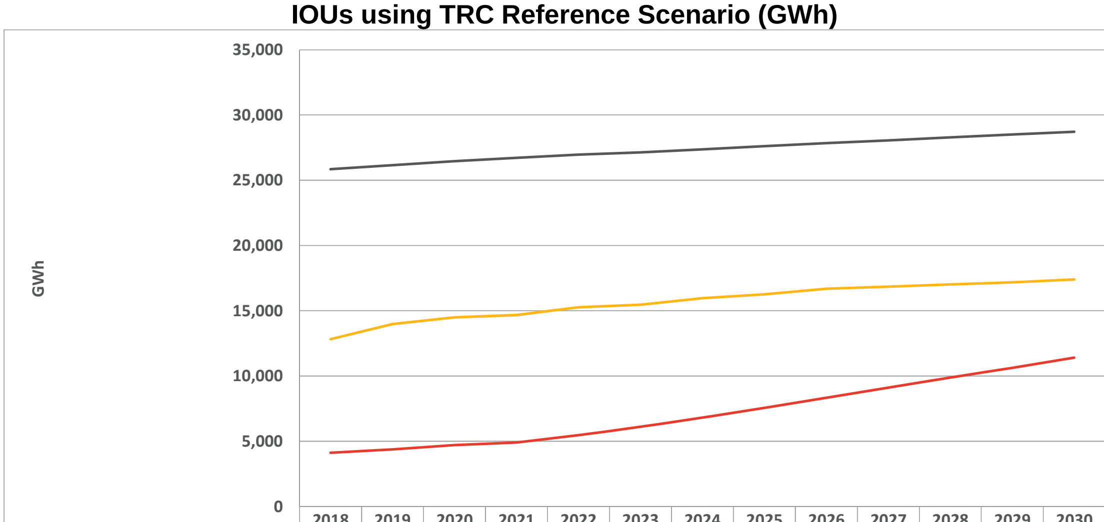
Technical, Economic, and Market Potential

Technical potential is defined as the amount of energy savings that would be possible if the highest level of efficiency for all technically applicable opportunities to improve energy efficiency were taken, including retrofit measures, replace-on-burnout measures, and new construction measures. The technical potential represents the total energy savings available each year that is above the baseline of the Title 20 and Title 24 codes and federal appliance standards.

As shown in **Figure 1** and **Figure 2**, using the results of the technical potential analysis, the economic potential is calculated as the total energy efficiency potential available when limited to only cost-effective measures. All components of economic potential are a subset of technical potential. Both technical and economic potential, as presented in the CPUC studies, are 'instantaneous", not "annualized." Assumptions about stock turnover rates are not applied annually to these categories of efficiency potential. Instead, efficiency improvements are assumed to be applied to all applicable equipment and systems in the first year that those improvements are available.

The final output of the CPUC/Navigant potential and goals study is a market potential analysis, which calculates the energy efficiency savings that could be expected in response to specific levels of incentives and assumptions about market influences and barriers. All components of market potential are a subset of economic potential. Some studies also refer to this as "maximum achievable potential." One significant difference between market potential and both technical and economic potential is that the former is annualized, whereas the latter two are instantaneous. The CPUC uses market potential to establish the IOUs' energy efficiency goals.[37] **Appendix B** shows the results of individual IOU's technical, economic, and market potential.

Figure 1: Electricity Technical, Economic, and Market Potential for IOUs using TRC Reference Scenario (GWh)

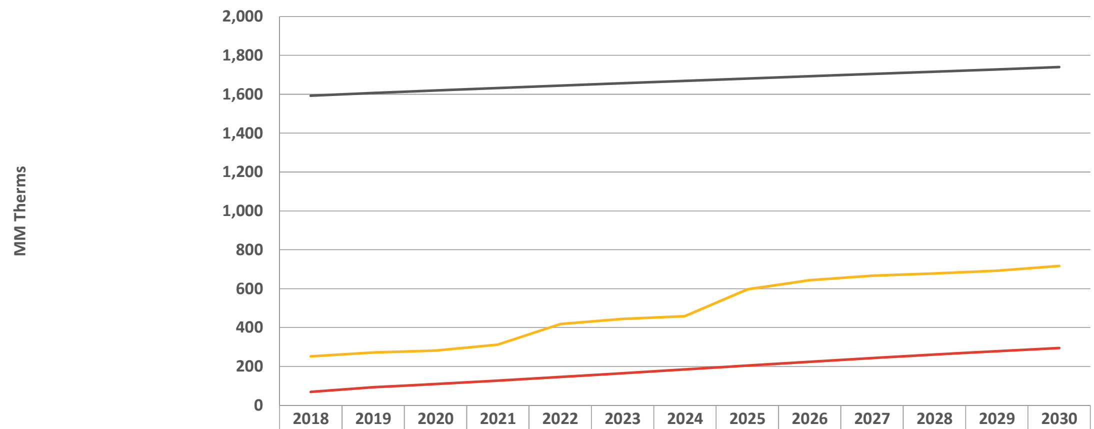


	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Technical Potential	25,854	26,169	26,455	26,721	26,979	27,137	27,376	27,617	27,842	28,064	28,287	28,508	28,727
Economic Potential	12,833	13,981	14,491	14,675	15,275	15,464	15,971	16,259	16,687	16,861	17,021	17,193	17,395
Cumulative Market Potential	4,126	4,381	4,716	4,903	5,469	6,104	6,820	7,562	8,325	9,137	9,876	10,629	11,407

37 CPUC/Navigant. Draft—*Energy Efficiency Potential and Goals Study for 2018 and Beyond*. June 2017.

Source: California Energy Commission, Demand Analysis Office, July 2017, based on CPUC/Navigant. Draft—*Energy Efficiency Potential and Goals Study for 2018 and Beyond*. June 2017. TRC1 Reference Scenario.

Figure 2: Natural Gas Technical, Economic, and Market Potential for IOUs using TRC Reference Scenario (MM Therms)



	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Technical Potential	1,592	1,606	1,619	1,632	1,644	1,657	1,669	1,682	1,693	1,704	1,716	1,727	1,739
Economic Potential	251	272	282	313	418	445	458	596	644	667	678	692	716
Cumulative Market Potential	69	93	109	128	146	166	183	203	225	244	263	278	295

Source: California Energy Commission, Demand Analysis Office, July 2017, based on CPUC/Navigant. Draft—*Energy Efficiency Potential and Goals Study for 2018 and Beyond*. June 2017. TRC1 Reference Scenario.

Incremental Market Potential

Incremental savings represent the annual energy and demand savings achieved by the set of programs and measures in the first year that the measure is implemented. Assumptions do not include the additional savings that the measure will produce over the life of the equipment. A view of incremental savings is necessary to understand what additional savings a year of energy efficiency programs will produce. This has been the basis for IOU program goals.[38]

In the 2011, 2013, and 2015 potential and goals studies, a single forecast of energy efficiency potential was produced for informing IOU goals. This forecast was calibrated to historical program activity. In these past studies, alternate scenarios were considered only in the AAEE forecast used by the Energy Commission. The AAEE scenarios were developed after the CPUC had established goals and were primarily driven by the needs of the Energy Commission. The 2018 potential and goals study considers multiple scenarios to inform goal setting.

SB 350 directed the CPUC to adopt goals based on energy efficiency potential studies that are not restricted by previous levels of utility energy efficiency savings. CPUC staff proposed to meet this direction by exploring scenarios reflecting alternative future outcomes based on variables that can be controlled by policy decisions or program influence. The 2018 potential and goals study considers scenarios primarily built around policies and program decisions that are under control of the CPUC and IOUs collectively; these scenarios are referred to as “internally influenced” variables. On the other hand, “externally influenced” variables were not considered in scenarios

38 CPUC/Navigant. Draft—*Energy Efficiency Potential and Goals Study for 2018 and Beyond*. June 2017.

that inform the goals. External variables are those that CPUC and IOUs collectively have no control over. A list of example internally and externally influenced variables can be found in **Table 2**.

Table 2: Variables Affecting Energy Efficiency Potential

Internally Influenced	Externally Influenced
• Cost-effectiveness (C-E) test • C-E measure screening threshold • Incentive levels • Marketing & Outreach • Behavior, Retro commissioning & Operational (BROs) customer enrollment over time • IOU financing programs	• Building stock forecast • Retail energy price forecast • Measure-level input uncertainties (unit energy savings, unit costs, densities) • Non-IOU financing programs

Source: CPUC/Navigant. *Draft - Energy Efficiency Potential and Goals Study for 2018 and Beyond.* June 2017.

Potential and Goals Study Draft Scenarios

CPUC staff worked with Navigant to develop draft scenarios for consideration in the goal-setting process. Each of the internally influenced variables in **Table 2** is expected to have an impact on the forecast of energy efficiency potential. The combined impact of these variables represents a scenario.

CPUC staff considered the following when advising Navigant on the draft scenarios:

- CPUC staff followed closely the developments in the integrated distributed energy resources (IDER) proceeding. These developments informed the alternative cost-effective tests to consider.
- On February 2017, CPUC staff released a Societal Cost Test (SCT) white paper with recommendations for parameters to support a SCT as well as potential modifications to the currently used TRC and PAC tests.[39]
- On April 2017, CPUC staff proposed a GHG adder curve as an interim value that could inform goal setting. The interim GHG adder proposal followed the methods proposed in the SCT staff white paper. The GHG adder curve was developed based on draft runs of the RESOLVE model in the IRP.[40]
- In the comments to the proposed interim GHG adder, the joint IOUs proposed an alternative GHG adder curve based on the Allowance Price Containment Reserve (APCR).[41] This curve is an extrapolation of preliminary values released by the California Air Resources Board (CARB) during the development of the CARB *AB 32 Scoping Plan Update*. Although the proposed allowance prices are not final and are subject to change, CPUC staff believes they are a reasonable alternative to the staff

[39] http://docs.cpuc.ca.gov/PublishedDocs/Efile/G000/M175/K295/175295886.PDF.

[40] http://docs.cpuc.ca.gov/PublishedDocs/Efile/G000/M182/K363/182363230.PDF.

41 Joint Opening GHG Adder Comments, page 6 http://docs.cpuc.ca.gov/PublishedDocs/Efile/G000/M185/K576/185576217.PDF. The curve is an extrapolation of the prices on ARB Staff Report *Initial Statement of Reasons*, Appendix C, August 2, 2016, Table 5. Available at https://www.arb.ca.gov/regact/2016/capandtrade16/appc.pdf.

proposal and will give stakeholders the chance to see how market potential changes when using alternative GHG adder values.

CPUC staff's intent was to keep the number of scenarios manageable but still provide a range of alternatives to bound market potential. Therefore, five scenarios were proposed and are listed in **Table 3**.

Table 3: Draft Scenarios for Energy Efficiency Potential – Summary

Scenario	Cost Effectiveness Screen	Program Engagement
TRC | Reference	TRC test using 2016 Avoided Costs	Reference
metric (GHG Adder #1) | Reference	TRC test using 2016 Avoided Costs + IOU proposed GHG Adder	Reference
mTRC (GHG Adder #2) | Reference	TRC test using 2016 Avoided Costs + CPUC staff proposed GHG Adder	Reference
PAC | Reference	PAC test using 2016 Avoided Costs	Reference
PAC | Aggressive	PAC test using 2016 Avoided Costs	Aggressive

Source: CPUC/Navigant. Draft—*Energy Efficiency Potential and Goals Study for 2018 and Beyond*. June 2017.

The "TRC | Reference" scenario represents "business as usual" and is a continuation of current policies. Three of the alternate scenarios continue to assume similar program design but apply different cost-effectiveness tests and avoided costs. The final scenario (PAC | Aggressive) is meant to show an upper bound of the combination of program engagement and cost-effectiveness screens. **Figure 3** and **Figure 4** show the five scenarios.

The following tests were used to help develop the scenarios:

Total Resource Cost Test (TRC)—The California Standard Practice Manual defines the *TRC test* as the measurement of the net benefits and costs that accrue to society (the program administrator and all its customers). It compares the benefits, which are the avoided cost of generating electricity and supplying natural gas, with the total costs, which include program administration and customer costs. The TRC does not include the costs of incentives.

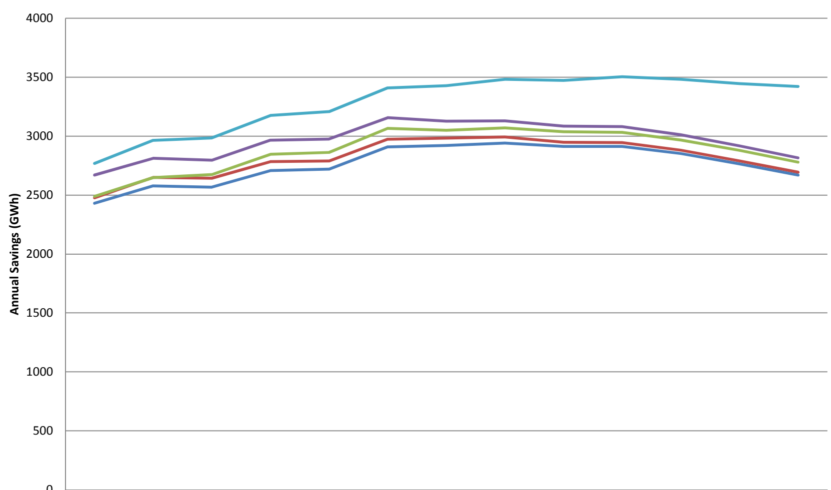
Modified TRC Test (mTRC)—The mTRC test builds upon the TRC test by including a greenhouse gas (GHG) adder along with the avoided cost of electricity and natural gas.

- GHG Adder #1—IOU Proposal for GHG Adder (CARB APCR price)
- GHG Adder #2—CPUC Staff Proposal for GHG Adder (based on preliminary RESOLVE model runs in the IRP proceeding)

Program Administrator Cost Test (PAC)—The California Standard Practice Manual defines the PAC test as the measurement of the net benefits and costs that accrue to program administrator. It compares the benefits, which are the avoided cost of generating electricity and supplying natural gas, with the total costs, which include program administration and incentive costs. The PAC does not include the out of pocket costs paid by customers.

- Reference—Existing Programs
- Aggressive—Existing Programs + Enhanced/Expanded Programs

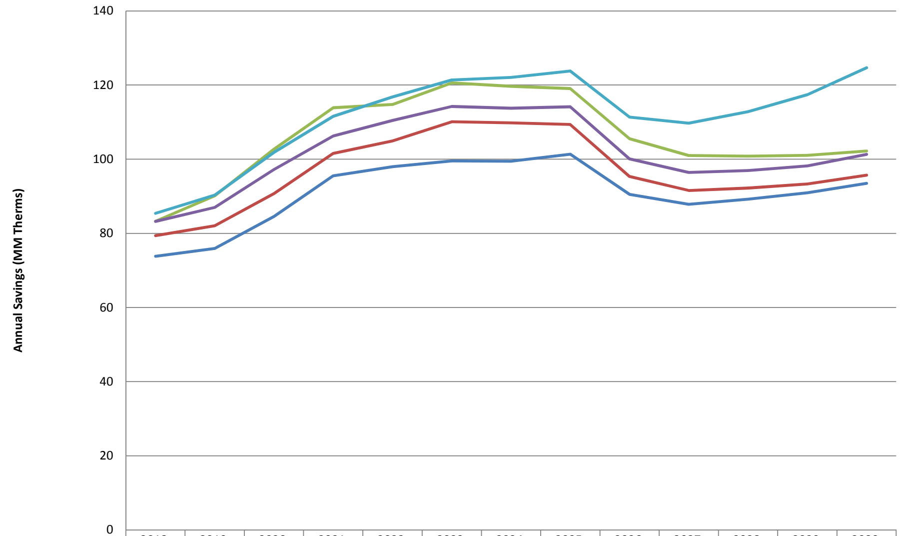
Figure 3: Electricity Savings—Five Scenarios (Including Codes and Standards)



	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
TRC-Ref	2430.73	2577.54	2567.17	2707.26	2720.11	2909.11	2921.09	2940.98	2913.25	2913.10	2852.02	2764.54	2670.37
mTRC-GHG1	2476.87	2649.98	2642.19	2784.01	2788.74	2974.46	2982.91	2993.41	2948.96	2945.10	2881.01	2790.88	2694.21
mTRC - GHG2	2489.32	2648.24	2674.59	2845.16	2862.26	3065.53	3049.44	3069.85	3038.02	3032.58	2966.87	2879.46	2779.17
PAC - Ref	2670.51	2811.92	2795.87	2965.63	2974.89	3156.28	3126.20	3130.18	3084.88	3080.98	3011.60	2917.91	2816.37
PAC - Aggr	2769.11	2964.78	2984.62	3174.98	3207.49	3409.40	3428.75	3482.99	3472.92	3504.60	3482.11	3445.82	3422.13

Source: California Energy Commission, Demand Analysis Office, July 2017, based on CPUC/Navigant. Draft—*Energy Efficiency Potential and Goals Study for 2018 and Beyond*. June 2017. TRC1 Reference Scenario.

Figure 4: Natural Gas Savings - Five Scenarios (Including Codes and Standards)



	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
TRC-Ref	73.81	75.89	84.57	95.54	97.94	99.51	99.44	101.34	90.52	87.84	89.21	90.97	93.48
mTRC-GHG1	79.40	82.05	90.73	101.56	104.90	110.11	109.79	109.37	95.36	91.58	92.21	93.31	95.70
mTRC - GHG2	83.27	90.12	102.71	113.86	114.74	120.56	119.66	119.04	105.51	101.01	100.81	101.07	102.21
PAC - Ref	83.22	87.02	97.22	106.29	110.43	114.21	113.74	114.13	100.09	96.45	96.98	98.16	101.31
PAC - Aggr	85.38	90.30	101.82	111.58	116.79	121.35	122.04	123.80	111.38	109.70	112.82	117.40	124.66

Source: California Energy Commission, Demand Analysis Office, July 2017, based on CPUC/Navigant. Draft—*Energy Efficiency Potential and Goals Study for 2018 and Beyond*. June 2017. TRC1 Reference Scenario.

California Public Utilities Commission Goals Adoption Process

The 2018 potential and goals study was released on June 15, 2017, and a workshop was held on June 20, 2017. Comments were due July 7, 2017, and reply comments were due on July 14, 2017. The CPUC may be adjusting the final projections based on party comments on the proceeding record.

The CPUC expects to release a proposed decision at the end of August 2017 with the proposed IOU energy efficiency goals. The proposed decision will undergo another round of comments. The CPUC commissioners should adopt the final goals at the end of September.

Although this year's potential and goals study included more measures than before, the IOUs' goals may ultimately be as much as 15 percent lower than the goals adopted from the 2015 study. This could imply a greater need for enhanced or new programs to achieve the doubling goal.

Proposed California Public Utilities Commission - Jurisdictional Savings Targets

This section identifies two adjustments to the projections of the CPUC/Navigant study that Energy Assessments Division staff proposes in identifying IOU SB 350 savings targets. This section concludes with graphs of cumulative electricity and natural gas savings, using the TRC-

Ref scenario as an example pending final CPUC decision, for the total savings from CPUC-jurisdictional entities.[42]

IOU Statewide Codes and Standards Program

The CPUC adopted a Statewide Codes and Standards Program as part of the original energy efficiency strategic plan in 2008. This program includes several elements – building and appliance standard advocacy for more stringent requirements, compliance improvement, reach codes, and planning and coordination. A substantial budget has been allocated to these efforts, but the benefits are great, since adopting and realizing more stringent standards affect all customers, and there is no direct measure implementation cost to the utility. In D.16-08-019, numerous parties proposed reforms for this program in light of the AB 802 requirements to shift toward use of existing baselines. However, the CPUC decided it was premature to revise these programs and instead asked CPUC staff to work with the Energy Commission in various forums to devise improved methods for code savings quantification.[43]

As shown in **Figure 5** and **Figure 6**, using the TRC-Ref scenario as an example, projections of attributable savings from various codes and standards activities is the single largest of the four categories of savings in the draft CPUC/Navigant potential study. Now that the Energy Commission is producing its own estimates of savings from future tightening of codes and standards, staff is concerned that there is increased potential for double-counting between the CPUC/Navigant projections and Energy Commission staff projections documented in the separate Efficiency Division paper. Therefore, as an interim accounting mechanism, Energy Assessments Division staff is excluding CPUC/Navigant attributable codes and standards savings from proposed IOU savings for SB 350 purposes. As discussed in Chapter 8, staff anticipates that this issue will receive explicit attention in later phases of this proceeding and in inter-agency staff efforts to prepare for the next cycle of target setting.

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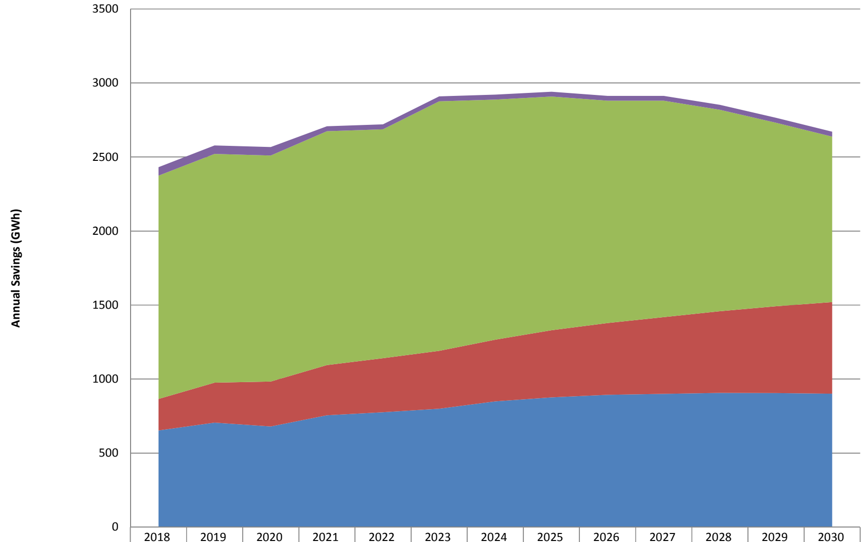
42 All analyses reported here use the IOU distribution utility service area as the basis for analysis. To the extent that the CPUC decides to allow CCAs to undertake an expanded scope of energy efficiency activities through time, then partitioning savings projections appropriate to multiple entities may be appropriate for SB 350 purposes.

43 CPUC, D.16-08-019, page 31. See http://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M166/K232/166232537.PDF.

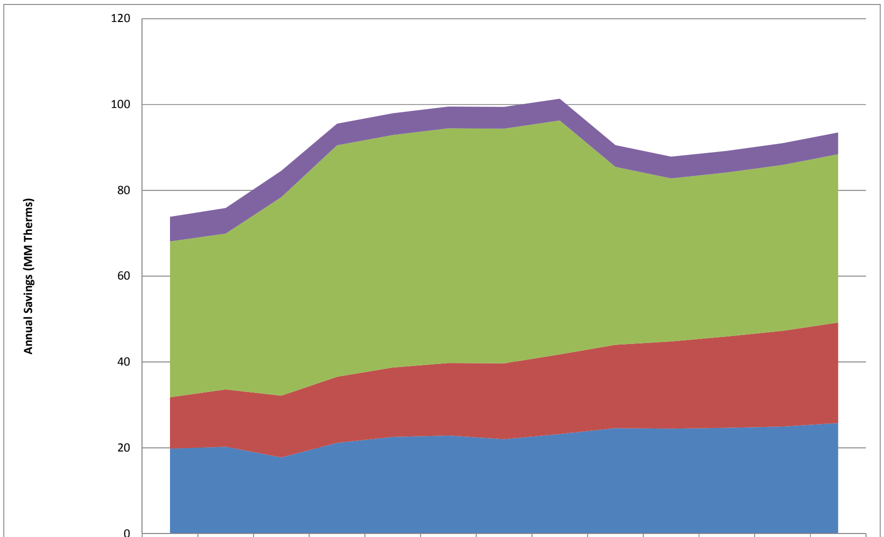
Figure 5: Electricity Savings – TRC Reference Scenario with Four Program Types



	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Low-Income	56.84	57.25	57.02	32.71	32.71	32.71	32.71	32.71	32.71	32.71	32.71	32.71	32.71
Codes & Standards	1507.87	1544.82	1527.33	1580.06	1546.38	1686.33	1622.57	1578.18	1501.60	1461.67	1360.58	1239.92	1118.11
BROs	213.33	270.17	302.75	338.90	365.07	390.30	416.60	454.08	485.61	518.34	551.83	586.66	618.32
Utility Rebates	652.68	705.29	680.07	755.59	775.95	799.77	849.21	876.01	893.33	900.38	906.90	905.24	901.24

Source: California Energy Commission, Demand Analysis Office, July 2017, based on CPUC/Navigant. Draft—*Energy Efficiency Potential and Goals Study for 2018 and Beyond*. June 2017. TRC1 Reference Scenario.

Figure 6: Natural Gas Savings – TRC Reference Scenario with Four Program Types



	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Low-Income	5.74	5.97	6.15	5.06	5.06	5.06	5.06	5.06	5.06	5.06	5.06	5.06	5.06
Codes & Standards	36.32	36.33	46.30	53.96	54.20	54.71	54.71	54.53	41.47	37.99	38.20	38.66	39.25
BROs	11.97	13.36	14.37	15.37	16.15	16.89	17.66	18.55	19.43	20.34	21.31	22.32	23.40
Utility Rebates	19.79	20.22	17.76	21.15	22.53	22.85	22.01	23.20	24.55	24.45	24.64	24.93	25.77

Source: California Energy Commission, Demand Analysis Office, July 2017, based on CPUC/Navigant. Draft—*Energy Efficiency Potential and Goals Study for 2018 and Beyond*. June 2017. TRC1 Reference Scenario.

Staff Proposed Adjustments to the Potential Study

The Energy Commission is making two non-substantive adjustments to the final CPUC savings projections for the IOUs. Because SB 350 uses 2015 as its base year, Energy Commission staff will be adding years 2015, 2016, and 2017 to the 2018-2029 projections to the cumulative savings. Energy Commission staff will also exclude savings from most codes and standards effective after 2019 to avoid double counting with independent estimates by the Efficiency Division for future standard impacts.

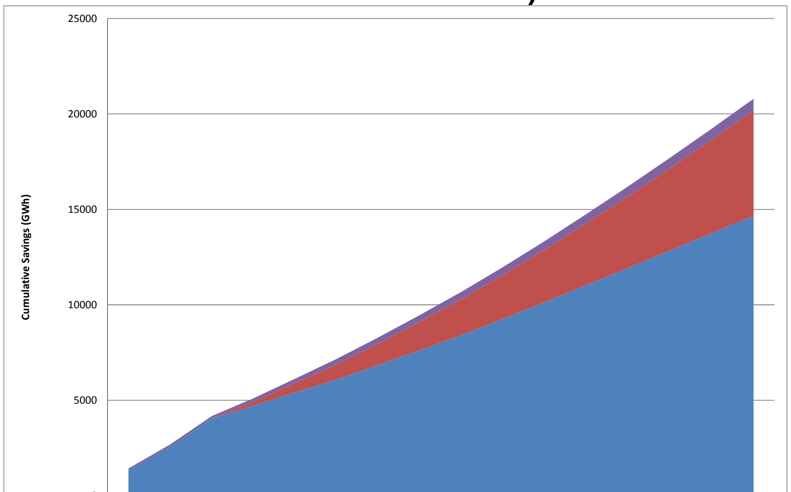
Energy Efficiency Savings in Historical Years

Staff understands that SB 350 establishes 2015 as the base year for cumulative projections. The CPUC/Navigant study only reported 2018 to 2030. This means that energy efficiency savings from 2015-2017 must be added to the CPUC/Navigant analyses that covered 2028 through 2030. The CPUC has not released final evaluations of program savings for 2015-2016, and 2017 is still unfolding. Energy Assessments Division staff developed its own estimates of historic savings for the four program categories as an interim measure. Those values are reported in **Figure 7** and **Figure 8**. Energy Commission staff understands that CPUC staff will endeavor to provide improved estimates as part of preparing values for consideration by the CPUC when it adopts final energy efficiency program savings in September 2017.

Proposed CPUC-Jurisdictional SB 350 Savings Projections

Figure 7 and **Figure 8** report proposed combined CPUC-jurisdictional energy efficiency savings from 2015 through 2029 for electricity and natural gas, respectively, using the TRC-Ref scenario for illustration. In contrast to **Figure 3** and **Figure 4**, the exclusion of attributable codes and standards savings reduces the aggregate amounts and shifts the emphasis to utility rebate programs as the dominant source of savings.

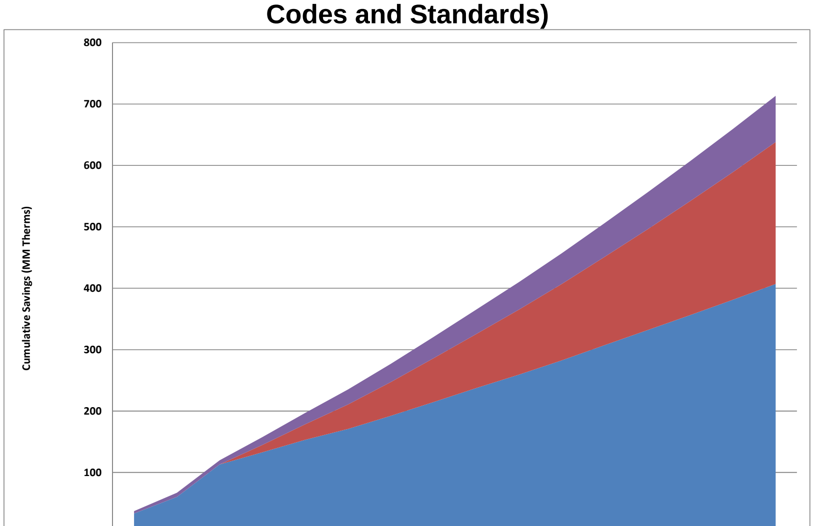
Figure 7: Electricity Savings – TRC Reference Scenario by Program Type (Excluding Codes and Standards)



	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Low-Income	63.72	120.63	120.63	177.47	234.72	291.75	324.46	357.17	389.89	422.60	455.32	488.03	520.74	553.46	586.17	618.89
BROs	0.00	0.00	0.00	213.33	483.50	786.25	1125.16	1490.22	1880.53	2297.13	2751.21	3236.82	3755.16	4306.99	4893.64	5511.96
Utility Rebates	1363.38	2564.49	4058.49	4711.17	5416.46	6096.53	6852.11	7628.06	8427.83	9277.04	10153.0	11046.3	11946.7	12853.6	13758.9	14660.1

Source: California Energy Commission, Demand Analysis Office, July 2017, based on CPUC/Navigant. Draft—*Energy Efficiency Potential and Goals Study for 2018 and Beyond*. June 2017. TRC1 Reference Scenario.

Figure 8: Natural Gas Savings – TRC Reference Scenario by Program Type (Excluding Codes and Standards)



	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Low-Income	4.04	6.80	6.80	12.54	18.51	24.66	29.72	34.78	39.84	44.90	49.95	55.01	60.07	65.13	70.19	75.25
BROs	0.00	0.00	0.00	11.97	25.33	39.70	55.07	71.22	88.11	105.77	124.32	143.76	164.10	185.41	207.73	231.13
Utility Rebates	32.99	60.28	113.13	132.92	153.14	170.90	192.05	214.58	237.43	259.44	282.64	307.19	331.64	356.28	381.21	406.98

Source: California Energy Commission, Demand Analysis Office, July 2017, based on CPUC/Navigant. Draft—*Energy Efficiency Potential and Goals Study for 2018 and Beyond*. June 2017. TRC1 Reference Scenario.

Summary

In this chapter, Energy Assessments Division has summarized the CPUC/Navigant projections included in the draft 2018 potential study. In contrast to past potential studies, this study cycle makes five projections attempting to illustrate the numeric consequences of different key study assumptions that have surfaced in the CPUC's IDER proceeding and that are not yet resolved at this time. Energy Assessments Division staff has proposed two adjustments to CPUC/Navigant projections that are intended to resolve differences in the framework used for the CPUC/Navigant study versus that appropriate for SB 350 projections. These are subject to change for two reasons. First, the CPUC intends to resolve which of the five scenarios reflects its intentions for integrating demand-side planning across a wide range of single-subject proceedings. Second, Energy Commission staff has made two types of adjustments that may be improved later in this Energy Commission target-setting process or in subsequent future cycles of the target setting process.

CHAPTER 4: Publicly Owned Utility Energy Efficiency Target-Setting Process

POU Electricity Savings Targets

The *Framework*[44] concluded that past and projected future energy savings from known efforts alone would fall short of the SB 350 doubling goal, as it is currently proposed. Stakeholder comments identified two main concerns related to interpretation of the legislative language applicable to POUs savings targets. On one hand, there is a concern that it is unreasonable to require POUs to double their savings targets. On the other hand, if POUs continue business as usual[45] the statewide goal would not be accomplished.

Staff interprets the intent of SB 350 to be that utilities should do more to "achieve a cumulative doubling of statewide energy efficiency savings in electricity and natural gas final end uses of retail customers by January 1, 2030."[46] At the same time, POUs should not be expected to double savings compared to their own 2013 or 2017 projections. Additional entities implementing new programs can fill some of the gap between the likely savings from utilities and other existing program implementers and the cumulative doubling goal.

PRC Section 25310 (d) non-restrictively identified 11 implementation mechanisms to achieve targets established in subdivision (c) through a variety of existing programs[47] including:

> Programs of local publicly owned electric utilities that provide financial incentives, rebates, technical assistance, and support to their customers to increase energy efficiency pursuant to Section 385 of the Public Utilities Code.

The Energy Commission staff will continue working with POUs to achieve more energy efficiency savings than they have in the past. Staff proposes to establish SB 350 targets for larger POUs identified as an Integrated Resource Planning (IRP) group[48] and thus will request enhancements of POU electricity savings reporting so that the biennial reporting to the Legislature can be complete and accurate.

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44 http://docketpublic.energy.ca.gov/PublicDocuments/17-IEPR-06/TN215437_20170118T160001_*Framework*_for_Establishing_the_Senate_Bill_350_Energy_Efficienc.pdf.

45 Comments received February 15, 2017, http://docketpublic.energy.ca.gov/PublicDocuments/17-IEPR-06/TN216055_20170215T163019_Lourdes_JimenezPrice_Comments_SMUD_Comments_on_the_Energy_Effic.pdf.

46 https://leginfo.legislature.ca.gov/faces/codes_displaySection.xhtml?lawCode=PRC&sectionNum=25310.

47 PRC 25310(d).

48 California Public Utilities Code Section 9622 requires the Energy Commission to review IRPs of largest 16 POUs. The IRP group consists of LADWP, SMUD, Anaheim, Burbank, Glendale, IID, Modesto, Palo Alto, Pasadena, Redding, Riverside, Roseville, San Francisco PUC, Silicon Valley, Turlock and Vernon.

Legislative Background

As discussed in Chapter 2 and illustrated in Appendix A, POUs are different than IOUs in many ways. The CPUC does not regulate POUs, and the Energy Commission's statutory oversight is much more limited than that of the CPUC over IOUs. POU governing boards have more flexibility and independence over their self-imposed energy efficiency mandates.[49] Public Utilities Code Section 9505(b) requires a POU on a four-year cycle to identify feasible and cost-effective energy efficiency savings and establish energy efficiency savings and demand reduction for the next 10-year period.[50] Public Utilities Code Section 9505(d) requires each POU to provide to its customers and the Energy Commission the results of evaluation studies that measure and verify claimed demand reduction and energy savings. The modifications of SB 350 regarding energy efficiency provide a modest expansion of Energy Commission oversight of POU energy efficiency efforts.

Similar to the approach taken to report POUs' annual electricity savings accomplishments, the CMUA, in partnership with the NCPA and the Southern California Public Power Authority (SCPPA), collaborated on developing POU 10-year electricity savings technical, economic and market projections for establishing electricity savings targets.

POU Electricity Savings Program Coverage

Similar to IOUs, POU electricity savings programs provide subsidies and incentives to the final end users. POU incentive programs range from cash rebates for the purchase of higher-efficiency products and home energy upgrades to customized financial incentives and awareness and education campaigns that improve customer energy use behavior. POU electricity savings program incentives can be designed for customers and power purchase transactions or can be directed further upstream in larger consumer market supply chains to encourage manufacturers, retailers, contractors, and builders to influence how consumers choose building designs or buy and operate home appliances. Larger POUs like LADWP and SMUD have the geographic scope to influence local markets, but smaller POUs are unlikely to accomplish market transformation in the manner that the CPUC expects of IOUs.

POUs also administer load management programs that provide technical assistance and customer incentives to install automated demand response equipment, voluntarily scheduled load reduction mechanisms, and peak-day and time-of-use incentives. **Table C-4** in **Appendix C** summarizes the results of 39 POUs' 2018-2027 demand reduction goals.

Figure 9 shows the POU electricity savings accomplishments. POU net electricity savings from first-year efficiency measure installations totaled around 575 GWh in 2016, a slight increase of 2

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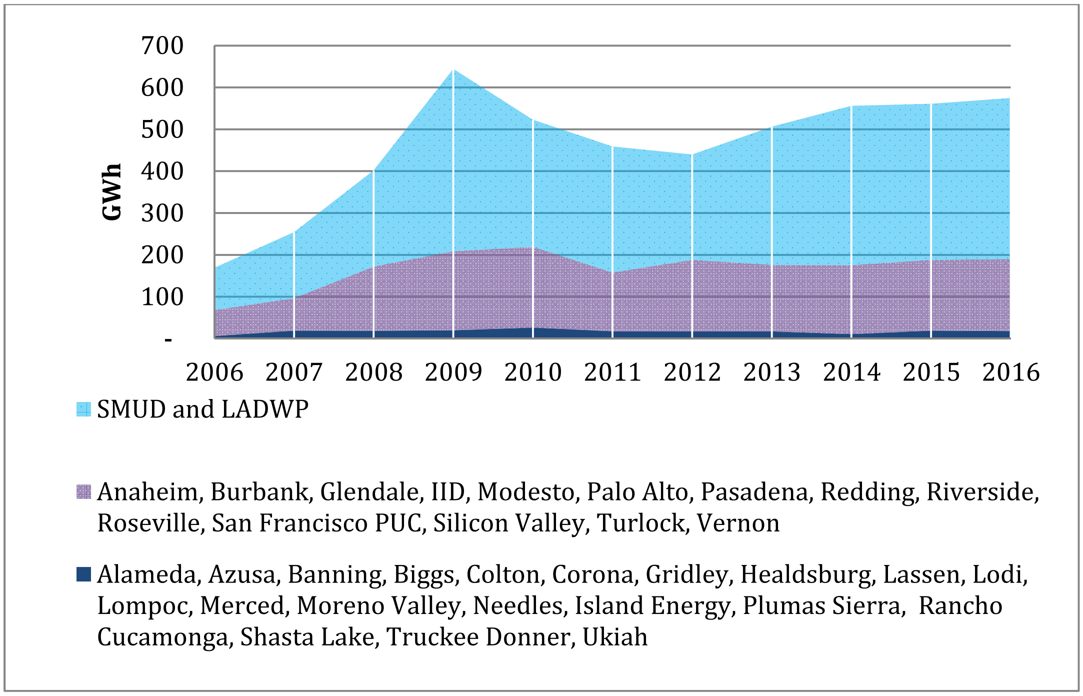
49 California Code of Regulations Title 20 Section 1311 requires each POU to report to the Energy Commission its annual investments in energy efficiency and demand reduction programs.

50 The AB 2021 preamble states that all load-serving entities shall procure all cost-effective energy efficiency measures so that the state can meet the goal of reducing total forecasted electrical consumption by 10 percent over the next 10 years.

AB 2227 amended the POU target cycle to align more closely with the IEPR timeline and consolidates reporting requirements into a section of the Public Utilities Code, making compliance easier for POUs.

percent over 2015. Cumulatively, for the past 10 years POUs reported more than 5,000 GWh in net electricity savings. POUs' electricity savings have been increasing steadily since 2012.

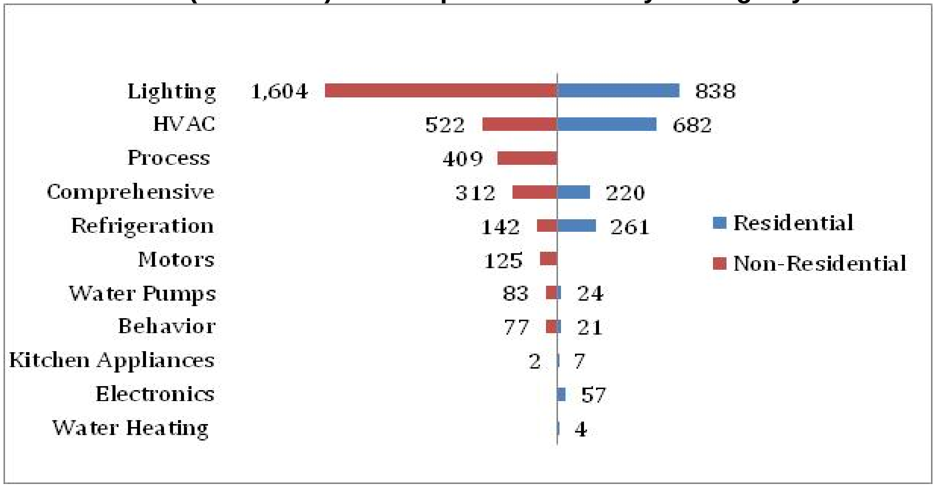
Figure 9: POU Reported Electricity Savings



Source: California Energy Commission, Demand Analysis Office, July 2017, based on *Energy Efficiency in California's Public Power Sector* Status Reports, http://www.ncpa.com/policy/reports/energy-efficiency/

The POU electricity savings by end use in both residential and nonresidential sectors are shown in **Figure 10**. Two of the largest end uses – lighting and heating, ventilation, and air conditioning (HVAC) equipment – account for the majority of savings. **Figures 11** and **Figure 12** show reported electricity savings in residential and nonresidential sectors grouped by POU size.

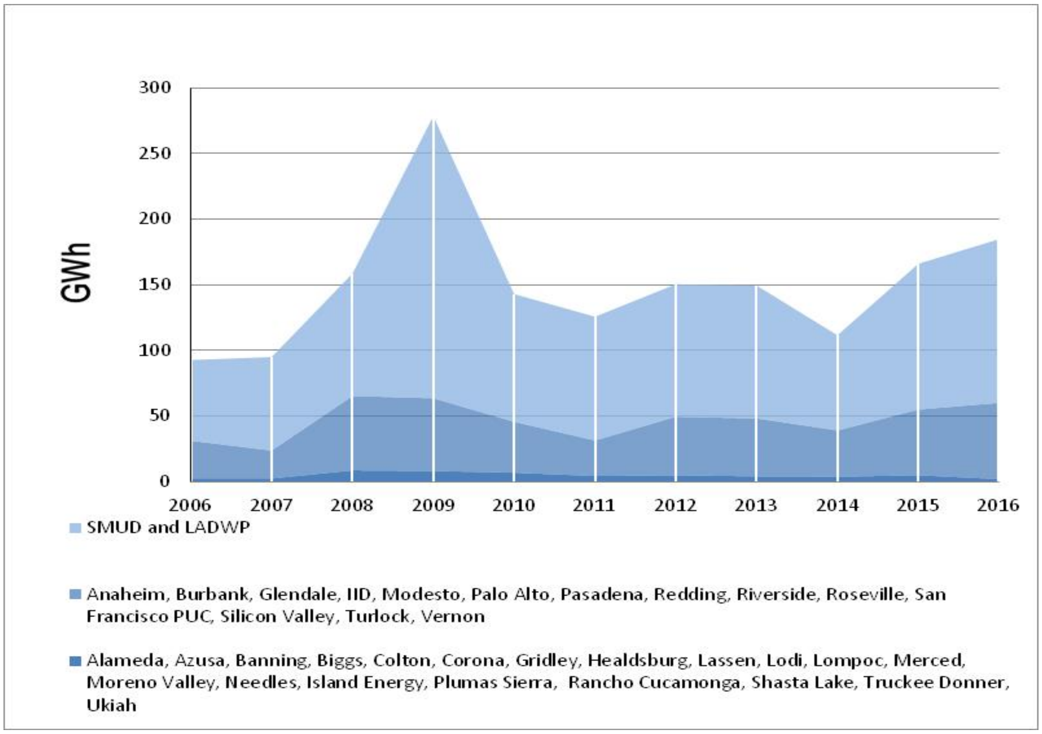
Figure 10: Combined (2006-2016) POU Reported Electricity Savings by End Use in GWh



Source: California Energy Commission, Demand Analysis Office, July 2017, based on *Energy Efficiency in California's Public Power Sector* Status Reports, http://www.ncpa.com/policy/reports/energy-efficiency/.

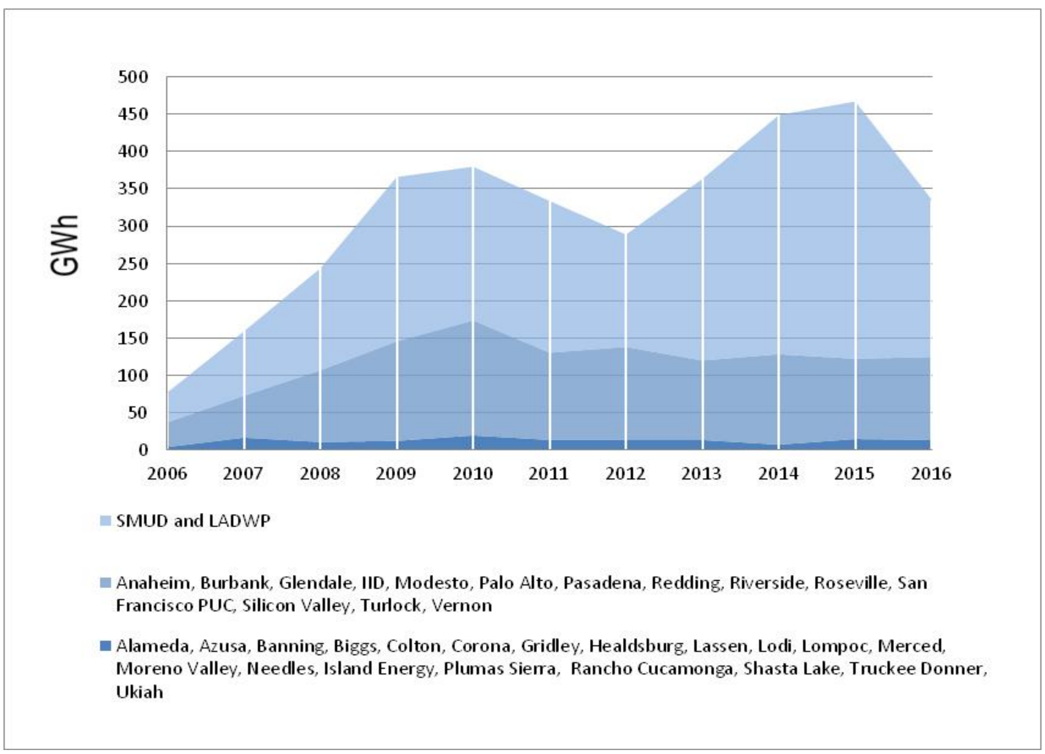
Figures 11 and **Figure 12** illustrate historical POU program savings accomplishments for the residential and nonresidential sectors, respectively. Variations over this period are more irregular than when reported in aggregate for both sectors. Further, much of the overall variability in savings can be traced to just the Los Angeles Department of Water and Power (LADWP) and Sacramento Municipal Utility District (SMUD). These are the two largest POUs by far, and as their programmatic savings fluctuate, they dominate aggregate statistics for the sum of all POUs. It is also clear that the general upward trend in annual, incremental savings for all POUs seen in **Figure 12** is largely because of greater nonresidential savings from LADWP and SMUD in recent history.

Figure 11: POU Reported Electricity Savings in Residential Sector



Source: California Energy Commission, Demand Analysis Office, July 2017, based on *Energy Efficiency in California's Public Power Sector* Status Reports, http://www.ncpa.com/policy/reports/energy-efficiency/.

Figure 12: POU Reported Electricity Savings in Nonresidential Sector

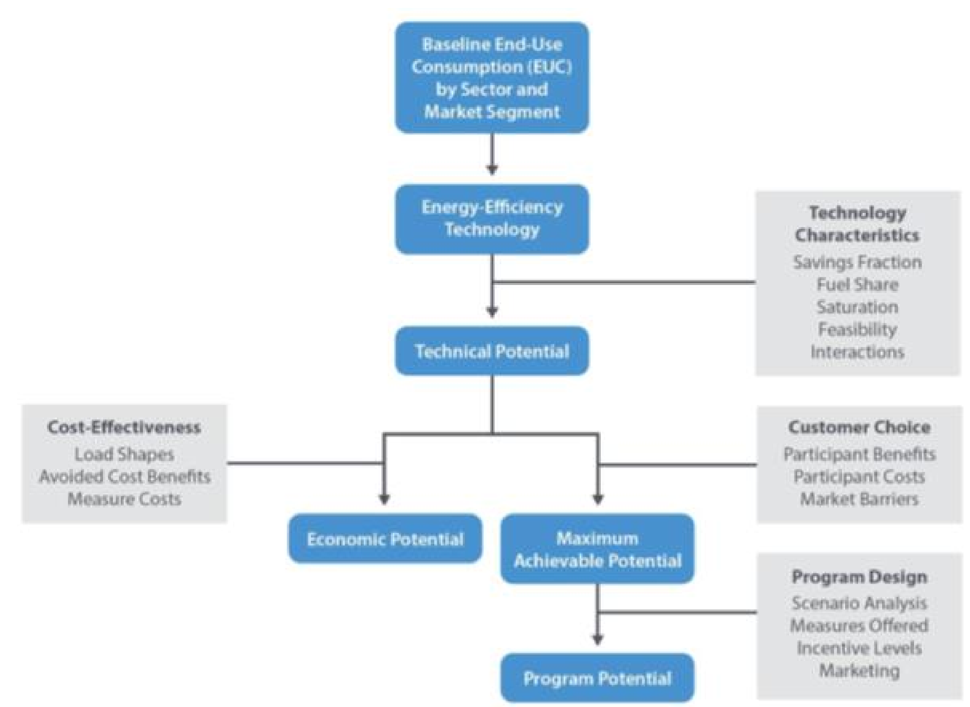


Source: California Energy Commission, Demand Analysis Office, July 2017, based on *Energy Efficiency in California's Public Power Sector* Status Reports, http://www.ncpa.com/policy/reports/energy-efficiency/.

POU Electricity Resource Assessment Model

Chapter 2 provided an initial comparison of the differences in inputs and some important methodological elements of the potential model used by the POUs to develop the projections submitted in 2017 from those prepared by the CPUC for IOUs. POUs used a tool developed by Navigant Consulting called the *Electricity Resource Assessment Model* (ELRAM). ELRAM is an Excel spreadsheet model designed to estimate technical, economic, and market potentials. ELRAM estimates electricity savings and demand reduction as a function of projected electricity sales. **Figure 13** below provides a representation of the major modules and flow of computations within ELRAM. Each POU provided its total baseline system electricity sales projections, and the model compared results after energy efficiency programs implementation assumptions are applied. Adjustments to the model to accommodate POU's unique set of inputs are common. Since the initial development in 2007, the model has been used by CMUA, its members, and more than 50 electric utilities nationwide.

Figure 13: ELRAM Concept



Source: *LADWP Territorial Potential 2014-2023, Draft Report Volume I. Nexant, Inc. June 2014*. http://dawg.info/sites/default/files/meetings/6.LADWP%20EE%20Potential%20Study%20Vol%20I%20Draft%20-%2024June14.pdf.

Table 4 below provides the savings projection summed for all POUs from their potential studies for the past four cycles. Although the studies resulting from these four versions of ELRAM show increasingly large technical and economic potential, the market gross potential and proposed savings targets have been more stable.

Table 4: Comparison of POU 10-Year Forward Potentials in GWh

	2007	2010	2013	2017
Technical	13,687	10,693	20,950	30,115
Economic	10,553	9,525	15,999	25,374
Market Gross	5,907	6,206	10,952	5,371
Electricity Savings Target	6,630	7,403	7,366	7,969

Source: California Energy Commission, Demand Analysis Office, July 2017, based on *Energy Efficiency in California's Public Power Sector* Status Reports, http://www.ncpa.com/policy/reports/energy-efficiency/.

Technical Potential

ELRAM technical potential conceptually is similar to the IOU model. As described in Chapter 2, technical potential provides a starting point for determining achievable levels of cost-effective market potential. It is calculated as a product of the electricity savings per unit of a measure, the quantity of applicable efficiency units in each facility, and the number of facilities in a utility service territory. The quantity of applicable units per year is determined by measuring effective useful life. Table 5 shows the difference in POU technical potential levels among 10 ‑ year periods analyzed in 2007 (2007—2016), in 2010 (2011—2020) in 2013 (2014—2023), and 2017 (2018—2027). The estimate of all 38 POUs technical energy savings potential is 30,117 GWh in 2027. This estimate is 44 percent higher than the 2013 estimate. The list of ELRAM-recognized measure types are provided in **Appendix C**, **Table C-1**.

Economic Potential

Similar to the IOU model, POU economic potential represents a portion of the technical potential if a utility installs measures selected by the results of the cost-effectiveness screening. As described in Chapter 2 and 3, cost-effective measures are those with a test result of 1 or greater of the Total Resource Cost (TRC) and the Program Administrator Cost (PAC). POUs provide TRC and PAC test results, using a benefit/cost ratio, derived from the E3 Reporting Tool. Descriptions of the ELRAM cost/benefit screening are provided in **Appendix C**, **Table C-2**. Historically, economic potential is around 80 percent of technical potential. The economic potential estimated for the POUs in the 2017-2028 study is 60 percent higher than 2013 estimate.

Market Potential

CMUA, in its annual report, formulated a foundational principle for POU energy efficiency efforts – that the customer is central to realizing energy savings, implying that a final end user is ultimately responsible for the decision to comply, invest, or otherwise implement an energy efficiency measure. "Customers are ultimately responsible for achieving savings from energy efficiency. To fully realize potential energy savings, policies and programs must aim to remove barriers and encourage voluntary action by customers to reduce energy usage."[51]

Market potential is further limited by such factors as program design, the magnitude of utility incentives, and rebates. Efficiency savings are estimated in response to specific levels of incentives and assumptions about policies, market influences, and market barriers. When the cost-effectiveness screening value at the measure level is less than 1.0, it is common to assess for market feasibility. POU market potential varies significantly based on local policy and program assumptions. Some of the POU-specific methods differ in whether the estimates are considered net of naturally occurring efficiency or free riders. In addition to gross and net estimates, market potentials are estimated on incrementally and cumulatively. The gross market potential estimated for the POUs in the 2017-2028 study is 60 percent lower than 2013 estimate.

51 *Energy Efficiency in California's Public Power Sector: A 2016 Status Update* p.25.

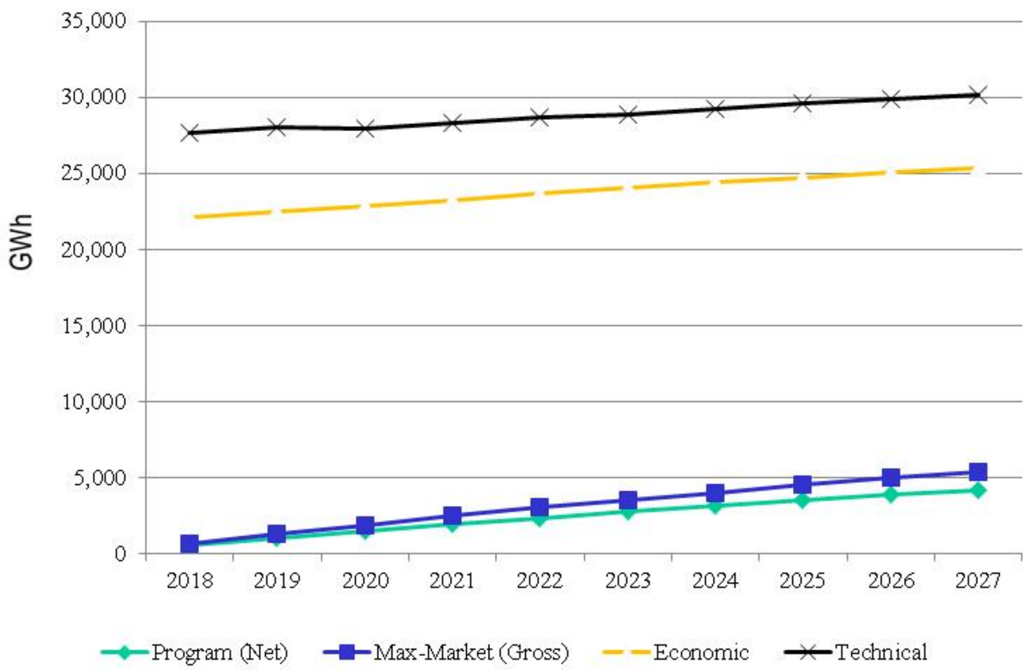
Natural Gas Savings Potential

Only two POUs, both small, provide natural gas service to end-use customers.[52] The ELRAM tool does not address natural gas savings; thus, savings projections for natural gas are not reported in the main CMUA report submitted in March 2017. The CMUA report, provided to the Energy Commission because of a data request, provides a limited description of natural gas savings projections for the City of Palo Alto. Natural gas service by the two POUs is a small fraction of the scale of natural gas service provided by IOUs to end users across the state; thus, natural gas savings from energy efficiency measures are due to of CPUC-supervised IOU activities. Natural gas savings projections for IOUs are discussed in Chapter 3.

ELRAM 10-Year Electricity Savings Projections

Figure 14 provides results of the ELRAM projections for the composite of all POUs. Technical and economic potential are relatively constant through time, reflecting the definition of these concepts described above. Market potential and net program savings projections grow through time as year-by-year savings accumulate. However, by the end of the 10-year period, only limited amounts of economic potential have been achieved.

Figure 14: POU Ten-Year ELRAM Projections



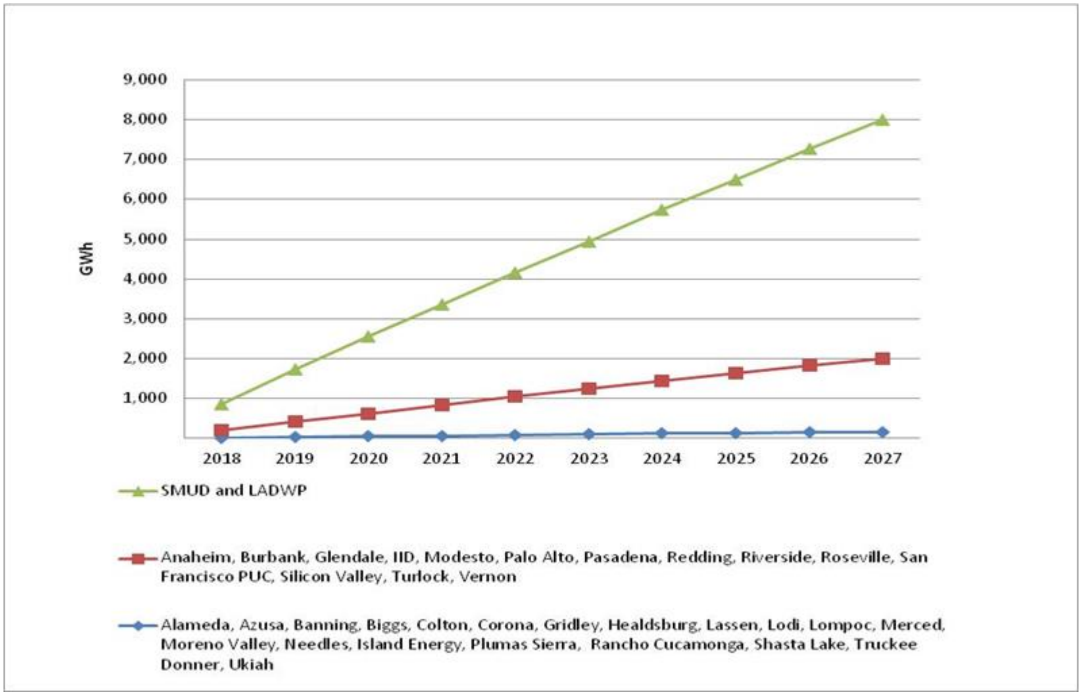
Source: California Energy Commission, Demand Analysis Office, July 2017, based on *Energy Efficiency in California's Public Power Sector* Status Reports, Appendix C http://www.ncpa.com/policy/reports/energy-efficiency/.

Figure 15 provides a view of projected cumulative 10-year savings for all POUs combined into three size groups. LADWP and SMUD alone account for more than half of total cumulative

52 The City of Palo Alto provides both electricity and natural gas service to end-use customers. The City of Long Beach provides natural gas service to end users.

savings. The 14 medium-sized POUs account for about a quarter of the cumulative savings.[53] The remaining 20 POUs collectively account for a very small share of composite POU savings.

Figure 15: Ten-Year Cumulative Targets by POU group



Source: California Energy Commission, Demand Analysis Office, July 2017, based on *Energy Efficiency in California's Public Power Sector* Status Reports, Appendix C http://www.ncpa.com/policy/reports/energy-efficiency/.

Adjustments to POU-Proposed Projections

Staff proposes to make a series of adjustments to the energy efficiency targets submitted by the POUs in March 2017. As described earlier, the CMUA process that engaged Navigant Consulting to develop an energy efficiency potential study allowed each POU to customize the final targets projections. Many POUs took advantage of this opportunity and the composite projections described earlier do not use a uniform basis for developing future savings projections. As described in Chapter 2, staff does not believe that such customized definitions can be the basis for SB 350 energy efficiency targets, although the decisions that POUs have made can continue to be used for each POUs' own internal planning.

Three types of changes to POU projections as submitted are proposed:

- Exclude code and standard savings from utility targets and include such savings in the nonutility program savings group.
- Shift from gross to net basis for calculating historical and future savings.

53 The large and medium-sized POUs are the 16 utilities for which the integrated resource planning requirements of SB 350 apply. These are the 16 POUs for which historical energy sales are 700 GWh per year or larger.

- For SB 350, add historical savings for 2015-2017 and extrapolate savings from 2027 through 12/31/2029.

Table 5 provides an overview of how these adjustments apply to each of the 16 large and medium-sized POUs. Clearly all POUs' projections are adjusted to add historical years and to extend projections to 2029. This reflects a mismatch in the portions of the law establishing requirements for POUs to submit projections to the Energy Commission and the SB 350 mandates for the Energy Commission to adopt targets from 2015 to January 1, 2030. Eight of 16 POUs need to have savings adjusted from a gross to net basis. Six POUs need to have savings projections adjusted to exclude savings from codes and standards. The effect of the combined adjustments for all POUs is generally larger than is the case for most utilities because LADWP and SMUD – the two largest POUs in California - are projected to receive all adjustments.

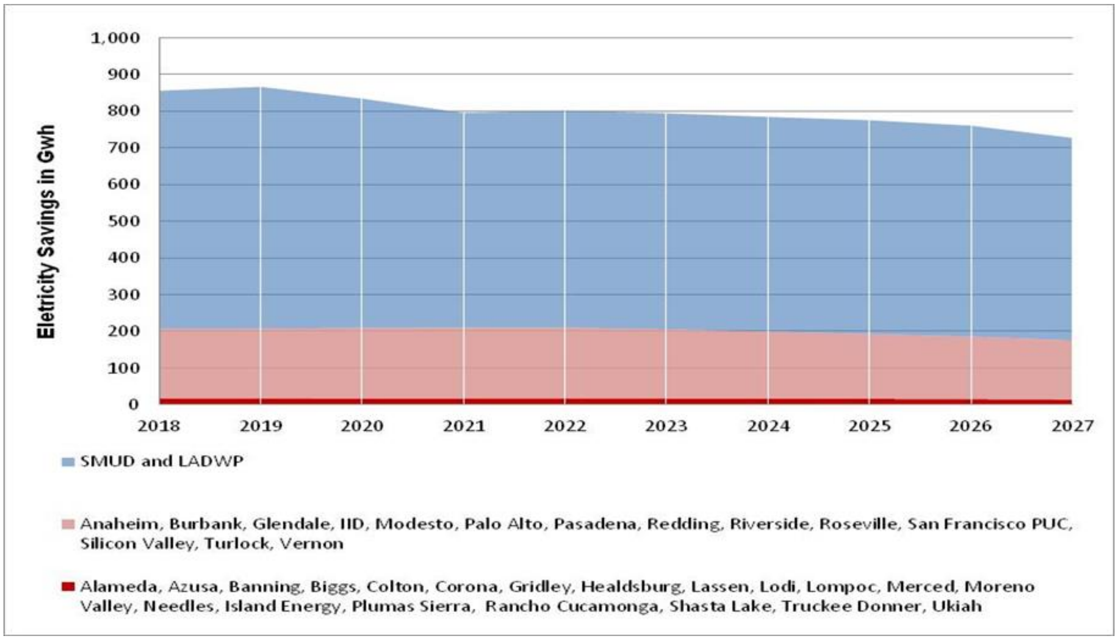
Table 5: Adjustments to POU-Submitted Targets

	Description of POU Submitted Target	Adjust for Net	Adjust for C&S	Added Years
LADWP	Market Gross + C&S	✓	✓	✓
SMUD	Market Gross + C&S	✓	✓	✓
Imperial	Market Net + C&S		✓	✓
Anaheim	Market Gross + C&S	✓	✓	✓
Riverside	Market Gross: 1% Avg. Annual	✓		✓
Pasadena	Market Gross: 1.25% Avg. Annual	✓		✓
Turlock	Market Net + C&S		✓	✓
Santa Clara	Market Net			✓
Glendale	Market Net + C&S		✓	✓
Burbank	Market Gross	✓		✓
Modesto	Market Net			✓
Roseville	Market Gross	✓		✓
Palo Alto	Market Net			✓
Vernon	Market Net + C&S		✓	✓
Redding	Market Gross	✓		✓
San Francisco PUC	Market Net			✓

Source: California Energy Commission, Demand Analysis Office, July 2017.

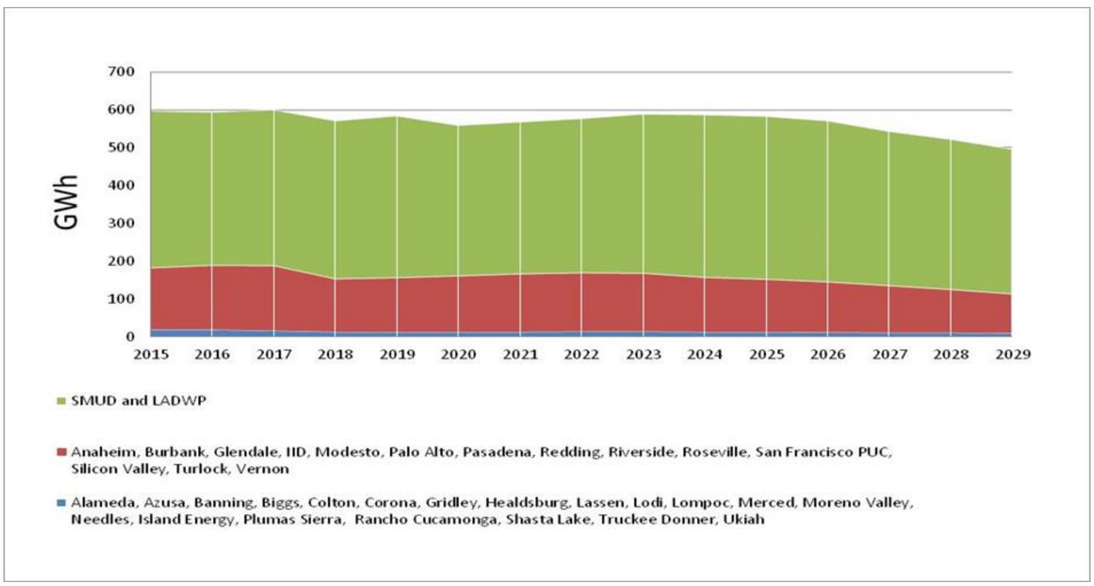
The effect of these adjustments on the three aggregate groups of POUs can be seen by comparing **Figure 16** and **Figure 17**. Both figures report annual, incremental savings and generally both report reductions in annual savings going forward. The most important difference between the two figures is that **Figure 16** begins in 2018, while **Figure 17** begins in 2015. This difference reflects the requirement of SB 350 to use 2015 as the base year. The second most important difference is that all the annual incremental values in **Figure 17** are scaled down about 200 GWh per year compared to the corresponding values in **Figure 16**. This reflects the exclusion of C&S savings and the replacement of gross by net savings.

Figure 16: POU Annual Incremental Electricity Savings Targets



Source: California Energy Commission, Demand Analysis Office, July 2017, based on *Energy Efficiency in California's Public Power Sector* Status Reports, Appendix C http://www.ncpa.com/policy/reports/energy-efficiency/.

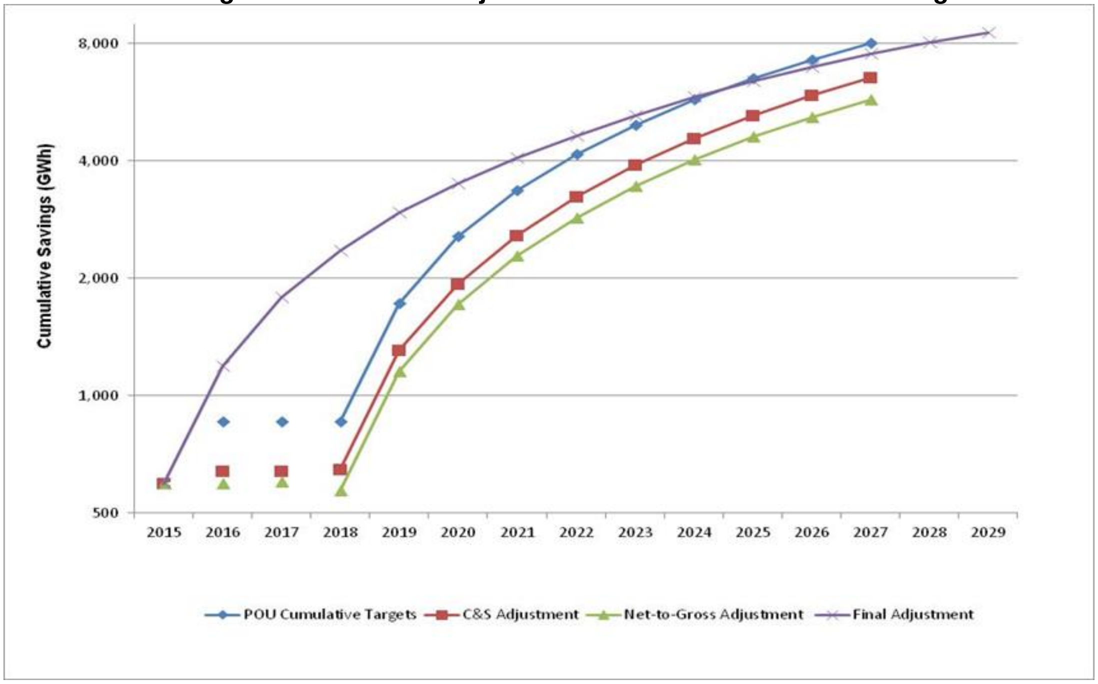
Figure 17: POU Annual Incremental Targets with Adjustments



Source: California Energy Commission, Demand Analysis Office, July 2017.

Figure 18 depicts the cumulative effect of these proposed adjustments on the original POU projections as submitted in March 2017. The blue line represents the cumulative savings for all POUs for the period submitted within the CMUA report – 2018 to 2027. Since the annual savings decrease through time (as shown in **Figure 16** and **Figure 17**), the cumulative line adds less to the cumulative total in each successive year, so the slope of the blue line diminishes. The red line indicates the adjustment to remove C&S savings – all annual values on the red line are lower in each year than for the blue line. The green line represents the effect of eliminating gross savings and replacing them with net savings. As with the first adjustment, all green line values are lower in each year than the corresponding red line values. Finally, the purple line represents the results of adding savings in the historical years of 2015 and 2016 (and estimated savings for current year 2017), so the value for each year is always higher in 2018 to 2027 reflecting adding a constant value to the original POU projections.

Figure 18: Effect of Adjustments to POU Cumulative Savings



Source: California Energy Commission, Demand Analysis Office, July 2017.

Summary

Staff has assessed the energy efficiency savings projections provided in March 2017 by the POUs through the CMUA report. Additional information was obtained from CMUA and some POUs through data requests and two webinars. Staff understands that the flexibility of the energy efficiency potential study administered by CMUA for POUs has resulted in a set of projections for the POUs that does not use a uniform set of assumptions or accounting rules. While this study design benefits POUs, it works at cross purposes for the SB 350 energy efficiency target-setting process. Staff proposes three types of adjustments using data provided largely by POUs themselves that enable more uniform calculations for future energy efficiency savings projections that better match those prepared by the CPUC/Navigant potential study.[54] Such adjustments have been implemented by staff and described in chapter 4. Detailed results for each POU are reported in **Appendix C**, **Table C-5**.

54 There are further POU-specific directions to Navigant that "customized" the basic ELRAM results that are still not fully understood by staff or are feasible to adjust for in the time frame of this initial round of the SB 350 target-setting process. Staff intends to work with CMUA, the POU community, and consultants to delve more deeply into these secondary factors in preparation for further adjustments in a forthcoming cycle of the SB 350 process.

CHAPTER 5: Fuel Substitution Programs

PRC 25310(d) enumerates a variety of mechanisms that can be used to satisfy the aspirational doubling goal. Subsection (10) reads: "Programs that save energy in final end uses by using cleaner fuels to reduce greenhouse gas emissions as measured on a lifecycle basis from the provision of energy services." Staff interprets this complex subsection to allow a limited set of programmatic efforts that substitute one fuel for another.

In the F*ramewor*k paper, fuel substitution is defined as the following: "Fuel substitution measures involve substituting one utility-supplied/interconnected energy source (for example, electricity and natural gas) for another." Fuel switching was defined as the following: "Fuel switching measures involve shifting from an energy source that is not utility-supplied/interconnected (for example, petroleum) to a utility-supplied/interconnected energy source (including roof-top solar)."[55] Energy Commission staff proposed that some fuel-substitution program savings be allowed, but fuel-switching program savings be excluded. Energy Commission staff interprets the precise language of PRC 25310(d) (10) to require that **both** end-user energy savings **and** GHG emission reductions be accomplished for any fuel-substitution program that satisfies SB 350 requirements. Utilities would be free to pursue other fuel-substitution and fuel switching programs (for example, vehicle electrification) when they consider them appropriate and oversight bodies concur.

The Efficiency Division staff paper on non-utility efficiency efforts does include a preliminary estimate for fuel substitution energy savings. These estimates are limited to replacing natural gas water heating, space heating and clothes drying equipment with electric heat pump equipment. The remainder of this section on fuel substitution summarizes the topics that need further deliberation by the Energy Commission and its stakeholders going forward.

Site Energy and Source Greenhouse Gas Emissions

Previous efforts to assess the impacts of fuel substitution programs have introduced two key terms – site and source.[56] *Site* refers to the location of the end user consuming energy to obtain an energy service. *Source* refers to the location(s) of the production or generation of the fuel consumed at the end user's site. In most applications, *site* energy consumption for specific program participants is unambiguous; however, the complexities of electric generation mean that source energy and emissions to provide electric energy to the end user introduce numerous analytic uncertainties. To satisfy the energy savings requirements of PRC 25310(d) (10), the end-use *site* energy consumed for equal energy service delivered must be lower with an electric appliance versus a natural gas appliance. To satisfy the GHG emissions requirement, the site

55 *Framework* paper, page 21.

56 For example, CPUC D.05-04-051, pp. 16-17. See http://docs.cpuc.ca.gov/PublishedDocs/WORD_PDF/FINAL_DECISION/45783.PDF.

natural gas GHG emissions must exceed the expected electric generation *source* production emissions.[57] Reducing *site* GHG generally implies electric heat pump technologies replacing direct combustion natural gas technologies. Converting energy consumption for electric and natural gas appliances to British thermal units (BTUs) will enable this energy consumption comparison. Reducing *source* GHG emissions means comparing GHG emissions from site natural gas combustion with the GHG emissions characteristics of the electricity resource mix serving the end-use customer. Natural gas end-use *source* GHG emissions are only slightly higher than natural gas *site* GHG emissions and change only with the efficiency of the end-user combustion process.[58] Electric *source* GHG emissions will change through time as the resource mix shifts toward renewable generation and away from generating technologies that produce GHG emissions.

A companion paper by the Efficiency Division in this proceeding discusses estimated energy savings in electricity and natural gas from fuel substitution programs for 2015 through 2029. Staff's estimated potential savings was included with other nonutility programs because no utility submitted fuel-substitution program savings projections.

Staff believes that its proposed approach addresses concerns raised by PG&E and the Natural Resources Defense Council (NRDC) in comments submitted following the January 23, 2017, workshop. Both proposed requiring a reduction in *source* energy rather than *site* energy. Use of *site* energy as the basis for energy reduction is critical since staff interprets the energy restriction of PRC 25310(d) (10) to require end-user energy savings. An analysis that relied upon a source energy reduction requirement, in the face of a massive shift to renewable generation through time, could mistakenly infer a site energy reduction when only energy consumed in the generation, transmission, and distribution was reduced.

Staff believes that using a production simulation model will capture electricity changes in generation, transmission, and distribution losses in the analysis of GHG emission impacts. So, the difference between site and source energy would be captured in this portion of the analysis. Further, a production simulation model explicitly models each hour chronologically so that the projection of electric system emissions will inherently address the specific hours that load would be increased by fuel-substitution impacts and the mix of renewables and GHG-emitting resources that is the least-cost dispatch to satisfy that load increase given an assumed resource mix. Staff proposes that the net GHG emission reduction requirement be examined using:

a) An analysis of the hourly shifts in load from penetration of electricity fuel substitution measures.

b) A production simulation model with proper inputs for performance of renewable generation.

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57 Natural Resource Defense Council's (NRDC) Comments submitted following the January 23, 2017, workshop appear to misunderstand the *Framework* paper – both energy savings and projected GHG emission reductions are required by the language of PRC 25310(d)(10).

58 The difference between site and source GHG emissions from end-user consumption is distribution losses. This has historically been estimated at about 2 percent of annual usage.

c) A resource mix that accurately matches the end-use customers expected to participate in the fuel substitution program.

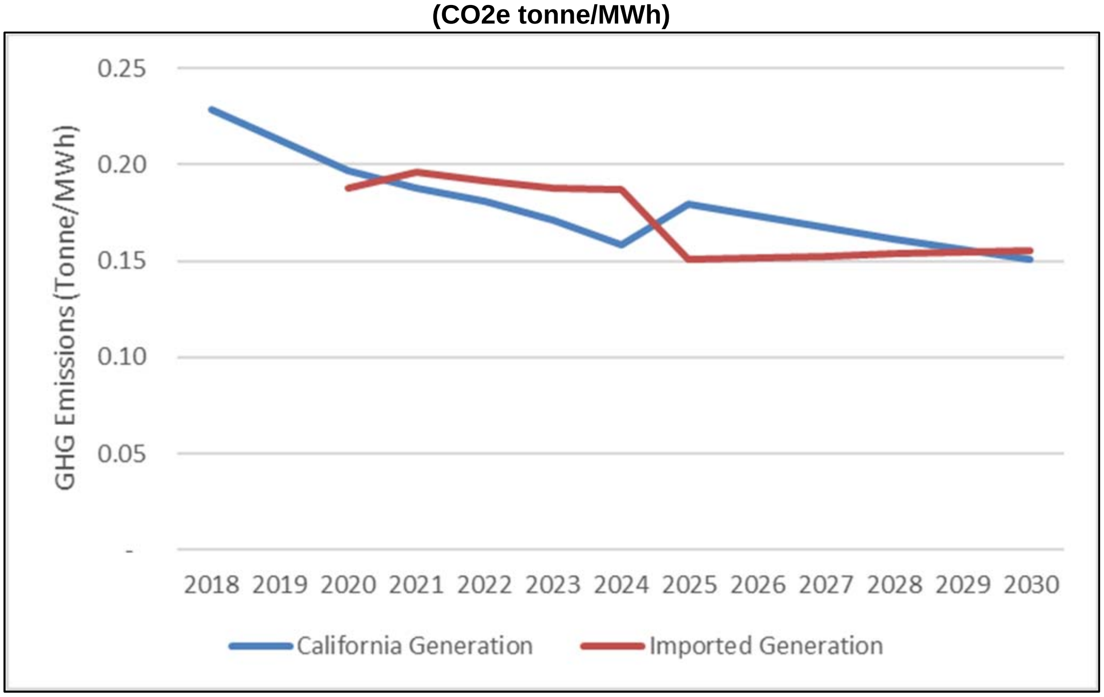
Properly constructed, such an analysis would identify how efficient electric heat pump technologies would satisfy the two requirements of PRC 25310(d) (10) in two use cases: (1) replacing existing natural gas appliances and (2) installing electric appliances in new construction.

Energy Commission staff has developed projected GHG emissions from an evolving electric generation resource mix that complies with SB 350's target of generating 50 percent of total retail sales of electricity in California from eligible renewable energy resources by January 1, 2030. The 8,760 hourly results from the production simulation modeling are then averaged together to provide an annual CO_2e/MWh value. This analysis projects gradual reduction in GHG emissions per MWh of electric generation as the overall resource mix serving California load shifts toward lower GHG emission technologies, both those within California and imports from out of state. **Figure 19** provides an annualized summary of these GHG emission patterns through time.

The Energy Commission needs to address the following issues:

- Should a utility wishing to demonstrate that a fuel-substitution program satisfies SB 350 criteria be required to use a broad, California wide electric generating system or a narrow utility-specific resource analysis of expected electric generation GHG emissions?
- Should a utility be required to use an Energy Commission staff analysis using the POU's expected resource mix, or may the utility provide an analysis using its own expected resource mix that the Energy Commission staff would review?

Figure 19: Projected Electricity Generation Emission Factor Through Time (CO2e tonne/MWh)



Source: California Energy Commission, Supply Analysis Office, TDV Analyses, 2016.

Requirements for Fuel Substitution Technologies

Palo Alto proposes that the Energy Commission determine that high-performance space-heating and water-heating heat pumps are designated as eligible fuel substitution technologies.[59] Further, Palo Alto suggests specific minimum efficiency standards be designated at some later phase of the SB 350 energy efficiency target-setting proceeding. Staff generally supports Palo Alto's recommendation. Not all heat pump technologies may satisfy the energy savings requirements of PRC 25310(d)(10). Palo Alto's comments suggest that differences may exist for retrofit applications versus new construction applications, at least in part because of the disparity of the natural gas appliance performance that a heat pump would replace.[60]

Palo Alto's recommendation highlights important procedural questions that the Energy Commission must resolve before fuel substitution programs can be designed that would be expected to satisfy SB 350 energy efficiency targets. These include:

1. What regulatory mechanism would be used to establish guidelines for acceptable heat pump performance in various end-use applications for purposes of satisfying PRC 25310(d)(10)?
2. What assumptions are appropriate for identifying the performance of natural gas appliances that would be replaced in retrofit applications and for hypothetical natural gas appliances that, without a fuel-substitution program, would have been installed in new construction applications?

Special Cost-Effectiveness Considerations

Since IOU service territories represent 75 percent of electricity demand the majority of fuel-substitution may occur within the four IOU service areas, it is logical to first consider the CPUC requirements for fuel substitution then discuss additional or different criteria needed to meet the requirements of SB 350.To augment the basic Standard Practice Manual, the CPUC established an *Energy Efficiency Policy Manual* to guide actual implementation of the basic cost-effectiveness test codified in the Standard Practice Manual.[61] In the practice manual the CPUC establishes the three-prong test for fuel substitution programs. **Table 6** includes the CPUC description of each of three elements and Energy Commission staff interpretations on how the basic requirements of PRC 25310(d)(10) compare to these elements.

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59 Palo Alto, *City of Palo Alto Comments on Framework for Doubling Energy Efficiency Savings, Feb. 15, 2017,* page 1.

60 Ibid., pp. 2-3.

61 CPUC, *Energy Efficiency Policy Manual – Version 5, 2013*, pp. 24-25. See http://www.cpuc.ca.gov/uploadedFiles/CPUC_Public_Website/Content/Utilities_and_Industries/Energy/Energy_Programs/Demand_Side_Management/EE_and_Energy_Savings_Assist/EEPolicyManualV5forPDF%20(1).pdf.

Table 6: Fuel Substitution Program Three-Prong Test and SB 350 Energy Efficiency Target-Setting Process

Fuel-Substitution Three-Prong Test Element	SB 350 EE Considerations
a. The program/measure/project must not increase source-BTU consumption. Proponents of fuel substitution programs should calculate the source-BTU impacts using the current CEC-established heat rate.	Site energy reduction in BTU is proposed to track energy savings, but GHG impacts will also be tracked, and these align closely with source BTU impacts.
b. The program/measure/project must have TRC and PAC benefit-cost ratio of 1.0 or greater. The TRC and PAC tests used for this purpose should be developed in a manner consistent with Rule IV.	Following a review of a series of use cases with program-specific inputs assumptions for hypothetical fuel substitution programs, the staff will establish equipment performance standards for utility fuel substitution programs
c. The program/measure/project must not adversely impact the environment. To quantify this impact, respondents should compare the environmental costs with and without the program using the most recently adopted values for avoided costs of emissions. The burden of proof lies with the sponsoring party to show that the material environmental impacts have been adequately considered in the analysis.	Net GHG emission reduction is a functionally equivalent requirement that takes into account hourly assessments of GHG impacts into future years.

Source: CPUC *Energy Efficiency Policy Manual, Version 5,* and EAD Staff. Table 6 shows some differences between the current CPUC 3-prong test elements and SB 350 fuel substitution requirements as EAD staff understands PRC 25310(d)(10).

Instead of using an Energy Commission-determined heat rate, staff proposes use of a production simulation model that will develop 8,760 hourly GHG emissions per unit of electric generation through time. Since fuel substitution in the natural gas-to-electric direction eliminates site natural gas combustion emissions and RPS requirements dictate an increasingly lower amount of natural gas combustion emissions in the electric generation sector, staff believes environmental impacts element of the three-prong test can be replaced by a more straightforward GHG emission assessment. The second element of the three-prong test cannot be addressed generically since it depends upon specific program design features. Staff proposes that several use cases be developed and assessed to understand how sensitive cost-effectiveness results are to different program design features.

One or more fully developed fuel substitution programs are needed to evaluate whether the two requirements of PRC 25310(d)(10) are sufficient to satisfy the three-prong test and to determine where there are differences in outcome. The Natural Resources Defense Council (NRDC) and numerous other entities filed a motion raising concerns in the CPUC's Integrated Distributed

Energy Resource (IDER) proceeding about the three-prong test being a barrier to fuel-substitution programs,[62] but an ALJ ruling denied the motion and suggested it be refiled in the energy efficiency rulemaking.[63]

The Energy Commission needs to address the following policy issues:

- What mechanism should be used to elicit one or more fully specified fuel-substitution programs to examine how the three-prong test compares to PRC 25310(d) (10) requirements?
- Is a staff workshop process a useful mechanism to identify issues for resolution by policy decision-makers?
- How should the Energy Commission coordinate with the CPUC to determine whether there are different requirements of PRC 25310(d) (10) versus those of the existing three-prong test? To the extent that there are differences, how should the CPUC and Energy Commission resolve these differences?

Inter-utility Departing Load/Gaining Load Considerations

Historically, the CPUC has been addressing fuel substitution programs where the issues focused on competing interests of SCE and SCG and ultimately resolved them by creating the three-prong test. The CPUC will continue to have a strong interest in this issue within (PG&E and SDG&E) and between (SCE and SCG, or PG&E versus CCAs) its jurisdictional entities. However, the language of SB 350 as embodied in PRC 25310(d)(10) appears to limit the extent to which fuel substitution programs can be used to satisfy the doubling goal. Further, it is clear that at least some electric-only POUs are interested in fuel-substitution programs in ways they were not two or three decades ago. Since there are five natural gas distribution utilities and more than 50 electric distribution utilities, fuel substitution raises the issue of an IOU natural gas utility losing sales and a wholly separate, financially independent POU electric utility gaining electric sales. Of course, the natural gas utility is expected to lose load through natural gas energy efficiency programs, but unlike traditional energy efficiency programs, fuel substitution causes electric load to increase. When the financial and regulatory issues are confined to a single entity (PG&E, SDG&E, or Palo Alto), a clear-cut assessment is feasible. When two independent organizations are involved – a natural gas utility regulated by the CPUC and an electric utility regulated by its own governing board - then a variety of financial and regulatory complications arise.

The Energy Commission needs to address the following issues:

- Which utility obtains credit toward SB 350 EE target compliance – the natural gas utility with departing load or the electric utility gaining load?

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62 CPUC Docket R.14-10-003, Motion of the Natural Resources Defense Council (NRDC), Sierra Club, The Solar Energy Industry Association (SEIA), and The California Energy Efficiency Industry Council (CEEIC) Seeking Review and Modification of the Three-Prong Fuel Substitution Test, February 28, 2017.

63 CPUC Docket R.14-10-003, ALJ Ruling denying the Motion filed by NRDC et al. See http://docs.cpuc.ca.gov/PublishedDocs/Efile/G000/M185/K576/185576452.PDF.

- How should the Energy Commission coordinate with the CPUC to address cross-jurisdictional issues resulting from POU fuel substitution programs that reduce IOU natural gas consumption and add POU electric consumption?

CHAPTER 6: Conservation Voltage Reduction

Background and Historical Conservation Voltage Reduction Efforts in 1970s and 1980s

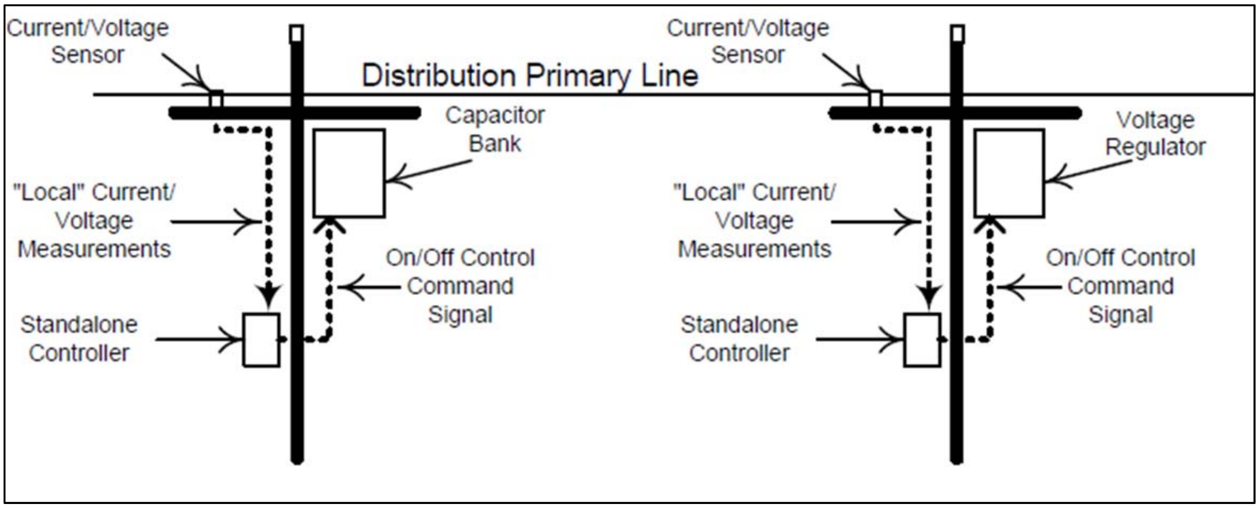
Conservation voltage reduction (CVR) technology has been around since the 1970s. Since reducing energy consumption and equipment protection are both enhanced by maintaining distribution voltage in narrow limits, utilities install equipment that seeks to keep voltage in the bottom end of the acceptable range to reduce energy consumption and to avoid high voltage spikes that damage equipment. Sensors detect distribution voltages, and voltage regulation equipment is triggered when voltages exceed preset limits. The benefits from reduced energy consumption (metered end-user usage and distribution losses) and avoided equipment damage through time must exceed the investment and operating costs for CVR to make sense from an economic perspective. CVR is explicitly included within the possible programmatic activities listed in PRC 25310(d) that may be used to satisfy the SB 350 doubling goal.

CVR reduces energy consumption resulting by a reduction in feeder voltage. A variety of techniques accomplish this feeder voltage reduction, including tap-changing transformers, line drop compensators, generator excitation controls, voltage regulators, line-switchable capacitor banks, static VAR compensators, circuit reconfiguration, and load control. CVR is a technique for improving the efficiency of the electrical grid by reducing average voltage on the feeder lines that run from secondary distribution equipment to homes and businesses, saving energy at the point of consumption. By controlling voltage on a distribution circuit to the lower end of the tolerance bands, efficiency benefits can be realized by consumers and the distribution utility. End-user electricity consumption is reduced when certain end-use loads draw less power at lower voltages, and distribution system losses are reduced by the combination of less electricity consumption incurring losses and lower losses per unit of consumption when voltage is regulated in a tighter range.

In the United States, regulations require that voltage be made available to consumers at 120 volts (V) plus or minus 5 percent, yielding a range of 126 V to 114 V. The key principle of CVR operation is that the standard voltage band between 114 and 126 volts can be compressed via voltage regulation equipment to the lower half (114–120) instead of the upper half (120–126), producing considerable energy savings at low cost and without harm to consumer appliances. Electrical equipment including air conditioning, refrigeration, appliances, and lighting is designed to operate most efficiently at 114 V. Power delivered at higher voltage wastes energy. On feeder lines, voltage on the line gradually decreases as the number of customers (cumulative load) on the line increases, also known as *line drop*. Power is often transmitted at higher voltages to ensure that the voltage at the last house is at least 114 V.

CVR was initially popular in the late 1970s and early 1980s as the benefits of this class of distribution equipment were realized. **Figure 20** (taken from an EPRI Power Point presentation)[64] provides a simple schematic of a distribution line segment and the two types of equipment (voltage regulator and capacitor bank) that would respond through preset controllers responding to measured line voltage and current.

Figure 20: Early Distribution Voltage Control Configuration



Source: EPRI, Uluski Power Point, 2011, page 13.

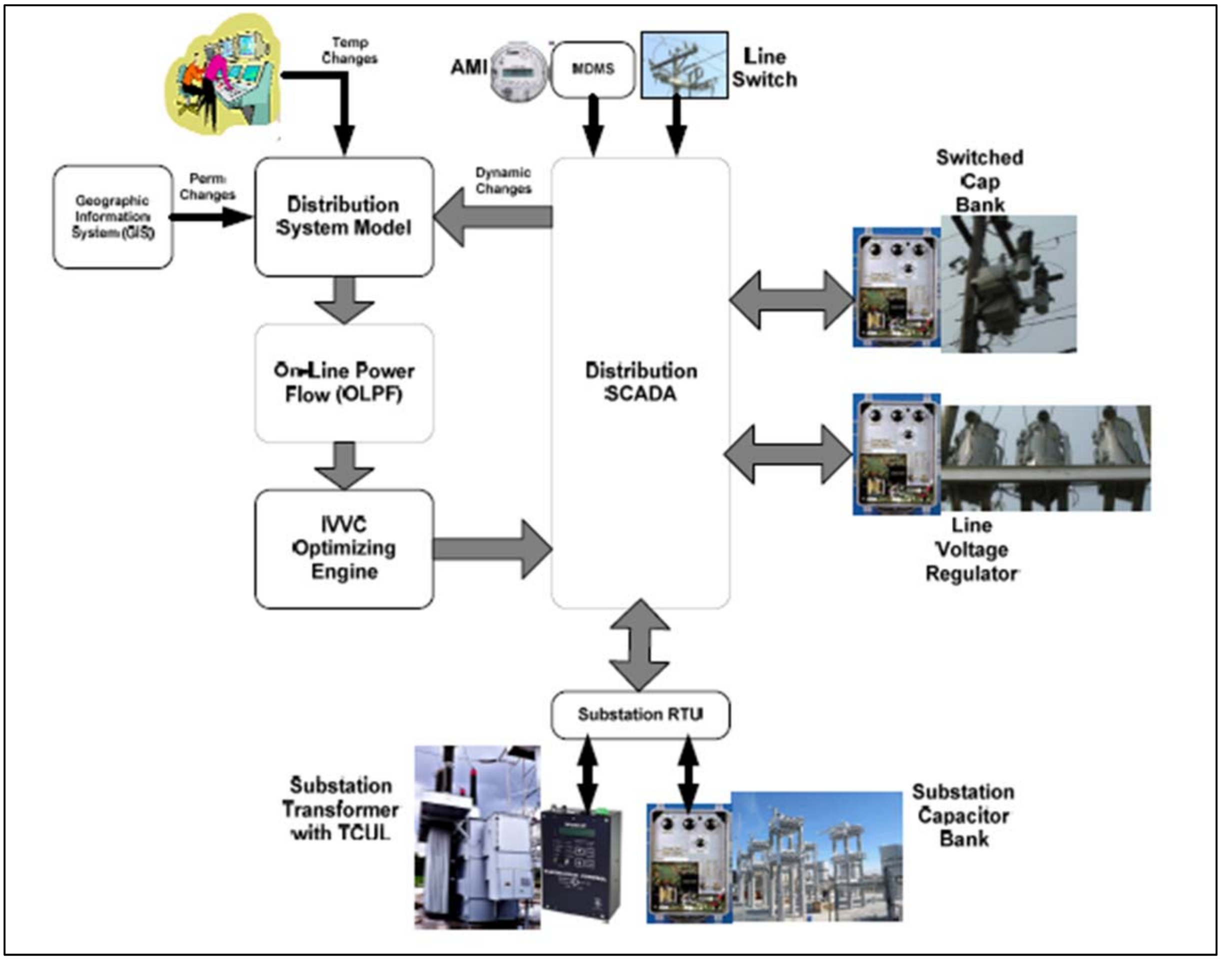
Unfortunately, the limitations of existing equipment at the time were encountered, and only limited penetration took place. The inability to monitor distribution line voltages in real time and to install and operate equipment that responded to dynamic conditions meant that simulations using stylized conditions were used to determine whether net benefits were expected. Of course, this resulted in performance that did not actually match expectations.

Modern CVR Capabilities

Advances in data acquisition capabilities, computer processing, and general sophistication about dynamic, real-time control have fundamentally changed the CVR picture of the 1970s. **Figure 21** portrays a modern approach to CVR.

64 Electric Power Research Institute, Robert Uluski Power Point presentation, Volt/VAR Control and Optimization Concepts and Issues, 2011.

Figure 21: Modern CVR/VVO Equipment Configuration



Source: EPRI, Uluski Power Point, 2011, page 33.

Several important changes from **Figure 21** should be noted. First, a distribution supervisory control and data acquisition (SCADA) system collects real-time, short-interval data about the distribution system and forwards them to a distribution control center for use.[65] This means that control systems can be designed to address near-real-time conditions rather than stylized assumptions. Second, line voltage regulators and switched capacitor banks can respond to signals sent from the distribution control center rather than preset responses to readings from sensors wired to the controller. Third, distribution system models can be developed that integrate readings from many sensors and respond to trends in readings through time (and perhaps anticipated conditions for the near future) to generate signals to send to specific voltage regulators and capacitor banks. In effect, the condition of a large segment of the distribution system can be understood and signals sent in near–real time to optimize overall response to these conditions.

65 Supervisory control and data acquisition is a control system architecture that uses computers, networked data communications, and graphical user interfaces for high-level process supervisory management. Typically used at the transmission level, it is being implemented for distribution systems.

Another issue of growing importance is the need to understand and control reactive power. In recent years, the types of equipment in customer premises have shifted toward items that consume or generate reactive power. Reactive power versus real power imbalances creates power quality problems that were less important, and certainly less appreciated, in the historical period. Tighter control over reactive power can expand distribution system capacity to provide real power to end users, thus allowing greater use of existing distribution system capacity and thereby reducing or delaying equipment upgrades. Generally, CVR nomenclature has been replaced by volt-VAR optimization or sometimes CVR/VVO to reflect this interest in reactive power control.

Recent Utility Efforts

Several research/demonstration projects in California utility service areas were funded by DOE through the American Recovery and Reinvestment Act of 2009. Among them are CVR projects at Glendale Water and Power (GWP) and Sacramento Municipal Utility District (SMUD) that were part of distribution system improvement efforts. Palo Alto undertook a self-funded project specifically oriented to using CVR as an end-user energy savings project.

GWP undertook a pilot project in 2014-15 testing a software product patented by Dominion Voltage, Inc. The software uses AMI data to understand short-time-interval reductions in energy consumption by end users along with distribution line equipment measurements to determine total energy consumption reductions when various control strategies are implemented.[66] GWP was sufficiently convinced of the merits of CVR/VVO to undertake a full-scale implementation of these technologies on its system. GWP expects to deploy these technologies on 12 kV feeders serving about one-third of its end-use customers by the end of 2017. Whether CVR/VVO is cost-effective for lower voltage feeders is still being assessed.[67]

SMUD undertook a multifaceted distribution system research project as part of its DOE-funded SmartSacramento® project. A volt/VAR optimization was part of this effort. In 2011, SMUD assessed how six feeders would respond to triggering of capacitor banks or one of several voltage settings. While SMUD obtained favorable results, there was some diversity among the circuits. SMUD intended to pursue a larger demonstration to refine the control strategy of the initial demonstration.[68]

Palo Alto's CVR project was designed to examine the impacts of CVR on end-user energy consumption and to determine whether energy savings on the Palo Alto system matched those found on other utility distribution systems.[69] Given some differences of the Palo Alto system from those examined in previous studies, the expected impact of CVR was unclear. A simple engineering study manually assessed impacts on several feeders and confirmed that further reductions of distribution feeder voltage would induce end-user energy savings. According the

66 City of Glendale, City Council Agenda, Agreement with Dominion Voltage, Inc., January 28, 2014.

67 GWP representative, personal email, June 1, 2017.

68 Energy Commission, Sacramento Municipal Utility District SCADA Retrofit, CEC-500-2014-078, September 2014, Appendix A.

69 Plaxico, Final Report: Evaluation of Conservation Voltage Reduction (CVR) Potential on City of Palo Alto Distribution System – Early Experimental Results, 2013.

consultant study, Palo Alto's implementation of CVR on its system may depend partly upon whether there are any energy efficiency mandates for which CVR savings could contribute. Now that SB 350 energy efficiency targets can use CVR as a compliance mechanism, Palo Alto may be interested in pursuing CVR implementation.

PG&E[70] and SCE[71] have pursued similar efforts under various smart grid initiatives that are heavily motivated by distributed energy resource (DER) issues. A principal issue for these IOUs has been development of improved abilities to predict where the existing distribution system can accept DER exports back into the distribution grid. Such exports create voltage and power quality issues affecting other end users on nearby segments of the distribution system, so direction from the CPUC to improve abilities to guide DER development has accelerated interest in modern CVR/VVO systems. Both SCE and PG&E pursued expansion of deployment efforts in recent general rate cases. A settlement agreement scaled back the expansion initially proposed by PG&E for at least the near term,[72] and SCE's general rate case is under review.

Implementation Issues

Two implementation issues are known to Staff. Others may surface in response to comments about this staff paper.

First, a significant issue distinguishes how IOUs might approach CVR/VVO implementation compared to POUs. IOUs are under constant threat of losing the provision of generation services for bundled service end-use customers by a shift to alternative suppliers – electricity service providers (ESP) under direct access policies or local government-based entities under community choice aggregation (CCA) policies. This is important because the energy savings to the end user (reducing generation supply requirements by the ESP or CCA) can no longer be counted as a benefit to the distribution utility that installs the CVR/VVO equipment. Research studies show that most energy consumption reductions are metered energy usage reductions by the end user rather than distribution loss reductions.[73] This means that the distribution utility loses a major element of the financial benefits that are needed to offset costs.

Second, no utility has proposed to use CVR/VVO as a method of satisfying its SB 350 energy efficiency target. The energy efficiency potential studies that are the basis for long-term projections do not include CVR/VVO since it is outside the scope of what has historically been considered "energy efficiency." Thus, there is no entity championing this issue in this initial establishment of utility-specific energy efficiency targets. Perhaps that will change when the Energy Commission revisits target setting at some future time.

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70 PG&E, 2017 General Rate Case Prepared Testimony On Electric Distribution, Exhibit (PG&E-4), pages 13-2, and 13-35 through 13-42, September 2015. See http://pgera.azurewebsites.net/Regulation/ValidateDocAccess?docID=346362.

71 SCE, *2018 General Rate Case Testimony, Transmission & Distribution (T&D) Volume 11 – Grid Technolog*y, Exhibit SCE-02, Vol. 11, September 2016, pages 43-49. See http://www3.sce.com/sscc/law/dis/dbattach5e.nsf/0/EE6E8ADC1D78B5CF882580210068F916/$FILE/SCE02V11.pdf.

72 Personal communication via email, Simon Baker, February 09, 2017.

73 Pacific Northwest National Laboratory, Evaluation of Conservation Voltage Reduction (CVR) on a National Level, PNNL Report 19596, 2010. Page 40.

These issues raise the following policy questions:

1. Is additional research/demonstration needed to determine whether various CVR/VVO technologies are cost-effective in loading conditions of feeder configurations?
2. Would a "use case" analysis be helpful to better understand how CVR/VVO cost-effectiveness differs under alternative generation service supply and distribution service provision arrangements?
3. Are further statutory changes warranted to encourage CVR/VVO in those instances when it appears to be cost-effective?

CHAPTER 7: Reporting Requirements

When SB 350 was enacted, PRC 25310(e) specified that the Energy Commission was to report biennially to the Legislature about progress toward the statewide goal and on the impacts by utility service area and on disadvantaged communities. The Energy Commission can provide accurate reports to the Legislature only if the existing energy efficiency reporting requirements of utilities (both IOUs and POUs) are strengthened, since it is impractical for the Energy Commission to independently evaluate each utility's program savings on an ongoing basis.

This section addresses two related topics – annual reporting of historical savings estimates and periodic projections to understand whether recent trends can be expected to continue. Both the development of future year savings targets and the required evaluation suggest to staff that some aspects of utility reporting must be revised. The two data types that should be consider are (1) hourly estimates of programs savings impacts and (2) disaggregation of savings estimates to separate impacts in disadvantaged communities from those for other program participants in the utility service area.

Annual Savings Reports

All utilities provide energy efficiency program savings reports to the Energy Commission, the CPUC, or both. POUs provide annual reports to the Energy Commission in March of each year for the previous year – usually a fiscal year concluded about nine months earlier.[74] These reports address both the level of activity and estimated savings. IOUs report level of activity to the CPUC at least quarterly, with nominal savings estimates prepared using approved *ex ante* savings values, and the CPUC staff conducts an extensive evaluation, measurements and verification (EM&V) using contractors.[75] Ultimately, the CPUC develops *ex post* savings estimates. The nature of the EM&V is that final *ex post* savings estimates lag 2-3 years behind reported energy efficiency activity. Incomplete and/or preliminary versions of many variables are available earlier but will ultimately be revised once *ex post* values are complete.

Impact on Disadvantaged Communities

If a utility includes an area that has been defined to be a disadvantaged community, then the utility reporting requirements must be modified to segregate impacts in such communities from those of all other participating customers. It would require reporting historical savings for each of these two subsets separately. Energy Commission staff will have to work with utilities to determine how this can be accomplished most easily, and whether simplified methods should be used initially while more definitive methods are gradually implemented.

74 Public Utilities Code Section 9505.

75 *Ex ante* are anticipated energy savings projected by a program implementer before the energy efficiency activities are implemented. *Ex post* are claimed savings reported by a program implementer, using their own staff and/or an evaluation consulting firm, after the energy efficiency activities have been completed.

Some utilities will have no such disadvantaged communities, others will have one or a few such communities, and a few utilities will have many of these communities. There may be interest in data from utility reports of activity in disadvantaged communities apart from the direct estimation of energy savings. Reporting that includes measures of activity can be used to determine whether participation in disadvantaged communities differs from that of the overall participant pool.

The Energy Commission must resolve several questions about reporting savings from disadvantaged communities:

1. Should savings from participants in disadvantaged communities be reported precisely, for example, from actual data for all participating customers located within disadvantage communities or estimated using statistical techniques?
2. Should required reporting include measures of activity (utility marketing, participation rates in individual programs, and so forth) apart of direct savings estimates?
3. Should historical savings for each disadvantaged community be reported individually, or should impacts on all disadvantaged communities in the POU service area be reported in total?

Hourly Savings Impacts by Service Area

Broadly speaking, POUs do not report nor do they estimate energy efficiency hourly savings, while IOUs do estimates such savings. As explained in the POU report submitted March 2017, the POU EE Reporting tool is an adaptation of the E3 Calculator that was initially developed for IOUs.[76] Although similar in concept to the E3 tool used by IOUs in the past, the EE Reporting Tool used by POUs has been simplified to eliminate some of the information that is needed by the Energy Commission to comply with legislative mandates. The POUs use of six TOU periods for reporting measure savings, while making reporting easier for POUs, is now a barrier to developing 8,760 hourly projections of impacts.

The Energy Commission must resolve several questions about reporting savings for all 8,760 hours per year:

1. Should POUs be expected to provide data at the 8,760 hourly level of temporal disaggregation or should the Energy Commission staff devise techniques to accomplish this disaggregation?
2. If POUs provide hourly savings, should savings be directly measured on a temporal basis for program participants, disaggregated from annual savings estimates to 8,760 hourly values using measure/end-use load profiles obtained from studies of other end-users in that POU service area, or measured by some other means?[77]

76 CMUA Report, page 10.

77 Due to cost and other considerations, consulting firms frequently develop 8,760 hourly “estimates” using load shapes drawn from one utility’s data to complete demand-side studies for a different utility.

3. If there is requirement for hourly savings, should it be limited to larger POUs, for example, those meeting the IRP requirements cutoff?

Timely, Standardized Historical Savings Estimates

As noted in this paper, staff recommends that utility targets be adopted that use two adjustments (1) using a net savings perspective rather than the gross savings perspective and (2) eliminating savings attributable to codes and standards. POU reporting templates as submitted in March 2017 are designed to allow the reporting of both net and gross savings, but not all POUs have reported in the consistent format. For example, numerous POUs have reported “gross” and “net” savings that are identical, which is conceptually flawed. POUs must be encouraged to report both “gross” and “net” savings to the Energy Commission, even if they wish to use the “gross” reporting convention for their own internal planning and evaluation.

Since SB 350 targets are anchored in 2015, as time passes, increasingly large proportions of the aggregate savings trajectory will be defined by savings estimates for historical years. In the case of IOUs, the lag in *ex post* saving estimates means that all of savings identified for 2015 are subject to change.[78] Both IOU and POU projections begin in 2018, but there are uncertainties about how programs will be implemented and what levels of customer participation can be accomplished in 2016-2017, so there are even greater uncertainties for calendar year 2017 savings than for other historical years. Staff is attempting to overcome the omission of this issue for both IOUs and POUs through special requests.[79]

Future Energy Efficiency Savings Projections

As explained in the *Framework* paper, the Energy Commission will periodically revise targets established for each responsible entity. This means that savings projections from utilities and other responsible entities will flow through the target-setting process multiple times before 2030 is reached. The experience of this initial cycle of the SB 350 process means that utilities, POUs in particular, will be asked to report their projections using specific convention

For example, as discussed elsewhere in this paper, staff proposes that the Energy Commission adopt targets that are net savings and exclusive of future codes and standards impacts. If this differs from the package that utilities choose to adopt for their own EE planning, the Energy Commission expects that POUs will report using both conventions.

In addition, staff expects to discuss with POUs other conventions affecting energy efficiency projected savings. One example is whether savings are computed using an AB 802-inspired “existing” baseline or a “to code” baseline. These conventions affect the attribution of savings and perhaps even the total amount of total savings. Resolving these issues was not possible given the mismatch in timing between the launch of the CMUA-contracted effort with Navigant Consulting and its submission to the Energy Commission, but they should be resolved before the next filing requirements for energy efficiency projections.

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78 CPUC has not evaluated 2016 savings.

79 The 2017 programs are underway, mostly unchanged, with exceptions of high opportunity project and programs.

The Energy Commission must resolve two questions about reporting projected savings:

1. Should Energy Commission staff work with POUs and the CPUC staff to assure that potential savings studies are designed in a manner that promotes use in the Energy Commission SB 350 energy efficiency target-setting process in addition to satisfying the internal needs of the POUs and the CPUC?
2. What guidance should the Energy Commission provide to POUs and the CPUC to ensure collaboration in designing such potential studies?

Changes to Reporting Requirements

For 2018 reporting, staff proposes to work with utilities informally to obtain additional information. Changes to the energy efficiency reporting requirements contained in the Energy Commission's regulations are likely to be included in Phase 2 of the ongoing data collection rulemaking (Docket 16-OIR-03).

Finally, in the *Framework* paper, staff proposed to use the IRP size threshold to delineate different treatment of POUs. If the Energy Commission decided to use this threshold for energy efficiency target setting, staff would propose exempting the smaller POUs from the additional reporting requirements.

CHAPTER 8: Conclusions and Next Steps

SB 350 requires the Energy Commission, in collaboration with the CPUC, and beginning in 2017, to establish ongoing, annual targets for achieving a cumulative doubling of statewide energy efficiency savings by January 1, 2030. Every two years, the Energy Commission will need to assess the progress of this effort in the *Integrated Energy Policy Report*. During this first round of study, staff assessed each of the utilities' current reporting practices, identified inconsistencies, and adjusted reported savings as needed for target setting purposes. Utility attributable savings from C&S advocacy were excluded from utility energy efficiency targets and are being counted toward savings in non-utility programs instead. In addition, reported savings were adjusted from gross to net savings for some POUs for the purposes of calculating historic and future savings. With these adjustments, historic savings for 2015-2017 were added and savings were extrapolated from 2027 through December 31, 2029. Staff highlights these two adjustments and proposes that stakeholders explicitly address these two topics in comments on this paper.

Staff needs new information from utilities in order to evaluate the differences in impacts between disadvantaged and non-disadvantaged communities by March 2018 to support the SB 350 evaluation required for the 2019 IEPR. We anticipate discussions with utilities to identify and obtain this additional information in the near future. Phase 2 of the data collection rulemaking (Docket 16-OIR-03) will address the need to identify specific additional energy efficiency information that utilities would be required to report on an on-going basis. As part of this process, staff recommends considering whether any or all additional reporting requirements should be imposed upon the smaller POUs.

Staff will continue to review methods for analyzing EM&V studies and will propose recommendations for improvements as well as strategies for collaboration and consistency in potential studies among utilities and other entities. Staff will also assess energy efficiency potential study models for their strengths and weaknesses with the intention of expanding upon the range of future energy savings programs. Staff plans to include assessment of the effectiveness and feasibility of energy efficiency savings strategies beyond traditional utility incentive programs and building and appliance standards, including opportunities for the expansion of fuel substitution and conservation voltage reduction technologies.

ACRONYMS

Acronyms	**Original Term**
AAEE	Additional Achievable Energy Efficiency
AB 2021	Assembly Bill 2021 (Levine, Chapter 734, Statutes of 2006)
AB 802	Assembly Bill 802 (Williams, Chapter 590, Statutes of 2015)
APCR	Allowance Price Containment Reserve
BEH	Behavioral programs
BROs	Behavioral, Retrocommissioning, and Operational Programs
C&S	Codes and Standards
CARB	California Air Resources Board
CCA	Community Choice Aggregators
C-E	Cost-effectiveness
CMUA	California Municipal Utilities Association
CMUA/Navigant	Publicly Owned Utility *Energy Efficiency Potential and Goals Study*
CPUC	California Public Utilities Commission
CPUC/Navigant	Investor-Owned Utility *Energy Efficiency Potential and Goals Study for 2018 and Beyond*
CVR	Conservation Voltage Reduction
DEER	Database of Energy Efficiency Resources
DER	Distributed Energy Resource
DUB	Dual baseline
EE	Energy efficiency
ELRAM	Electric Resource Assessment Model
EM&V	Evaluation, Measurement, And Verification
Energy Commission	California Energy Commission
ESP	Energy Service Provider
EUL	Effective Useful Life

Acronyms	**Original Term**
Framework	*Framework for Establishing the Senate Bill 350 Energy Efficiency Savings Doubling Targets*
GHG	Greenhouse Gas
GWh	Gigawatt-hour
GWP	Glendale Water and Power
HVAC	Heating, Ventilation, And Air Conditioning
IDER	Integrated Distributed Energy Resources
IEPR	*Integrated Energy Policy Report*
IOU	Investor-Owned Utility
IRP	Integrated Resource Planning
LADWP	Los Angeles Department of Water and Power
mTRC	Modified Total Resource Cost
Navigant	Navigant Consulting
NCPA	Northern California Power Agency
NRDC	Natural Resources Defense Council
P&G	Potential and Goal
PAC	Program Administrator Cost
PACE	Property Assessed Clean Energy
PCT	Participant Cost Test
PG&E	Pacific Gas and Electric Company
POU	Publicly Owned Utility
PRC	Public Resources Code
PUC	Public Utilities Code
REN	Regional Energy Networks
RIM	Ratepayer Impact Measure Test
ROB	Replacement on Burnout
RUL	Remaining Useful Life
SB 1037	Senate Bill 1037 (Kehoe, Chapter 366, Statutes of 2005)

Acronyms	**Original Term**
SB 350	Clean Energy and Pollution Reduction Act (Senate Bill 350) De León, Chapter 547, Statutes of 2015)
SCADA	Supervisory Control And Data Acquisition
SCE	Southern California Edison Company
SoCal Gas	Southern California Gas Company
SCPPA	Southern California Public Power Authority
SCT	Societal Cost Test
SDG&E	San Diego Gas & Electric Company
SMUD	Sacramento Municipal Utility District
TOU	Time Of Use
TRC	Total Resource Cost
TRM	Technical Reference Manual
V	Volts

Appendix A Utilies’ Comparison Table

Table A-1: Comparison of POU and IOU Characteristics in California

	POU	IOU
Ownership	Locally owned by municipal government body, an independent district, or customers/members of the rural cooperative utility residing within the local service area.	Privately owned by shareholders or investors. Not limited to the service area.
Structure/ Management	Nonprofit public entity managed by locally elected officials/ public employees.	Shareholder-elected board appoints management team of private sector employees.
Rate Setting and Regulation	Customer rates are set by each utility's governing body or city council in a local public forum.	For profit means investors receive rate of return adding a cost element different from POUs. Customer rates are set and regulated by California Public Utilities Commission (CPUC) through a public process that includes some customer participation, esp. through customer advocacy groups.
Mission/Goals	Optimize benefits for local customers usually in the form of lower energy rates.	Optimize return on investment for shareholders subject to policy goals set by the Legislature and/or CPUC.
Financing	Public utilities have access to tax-free bonds and co-ops have access to low-interest loans usually at the local level.	Stockholders (investors), the sale of bonds and bank borrowing help finance the utility's operations. Allows recovery through rate structure.
Profit/Net Revenue	Rates are set to recover costs and earn additional return to maintain bond ratings and invest in new facilities.	Utility rates are set to recover costs and earn a reasonable return as profits for investors in return for the risk they bear for investing in new facilities.
Size/Heterogeneity	Although POUs dramatically differ in geographical size and number of customers they serve, most are small or mid-sized with the exception of LADWP and SMUD.	Very large in size and number of customers. Complex, heterogeneous customer mix.

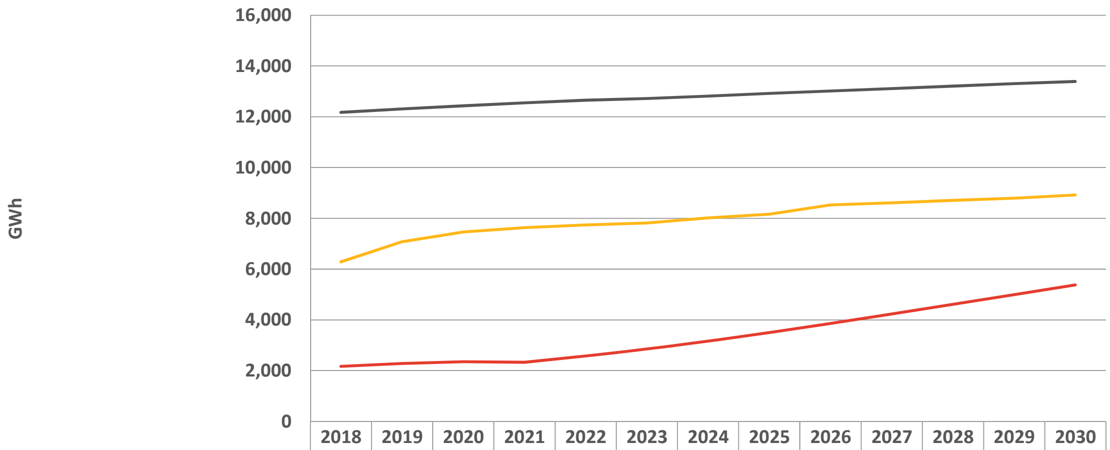
	POU	IOU
Planning and Procurement of Power Generation Resources	POUs develop plans to meet resource requirements and then either develop or contract for new supplies. Operate their own generation facilities or purchase power through contracts.	A combination of CPUC-centric and IOU planning. The CPUC has used a biennial LTPP proceeding to evaluate the utilities' need for new generation resources and establishes rules for rate recovery of procurement transactions. Under SB 350, an integrated resource planning process will replace the LTPP approach.
Transmission	Some larger POUs, like LADWP, SMUD, Imperial, and Turlock Irrigation Districts, own, control, and manage their own transmission grids. Smaller POUs are part of IOU planning area.	IOUs own transmission lines, but ISO controls and manages the three IOUs' transmission grids as a single open-access system. IOU generation has no more access to the system than competing generators and marketers.
Retail Service	Some POUs such as Silicon Valley Power, cities of Corona, Lompoc, Colton, and Plumas-Sierra Rural Electric provide direct access[80] load within city limits.	All IOUs provide direct access and bundled service, which includes all aspects of service—electricity generation, sales, administration, and deliveries.

Source: California Energy Commission Demand Analysis Office, July 2017.

80 Direct access means the ability of a retail customer to purchase electricity or other energy sources directly from an energy supplier.

Appendix B Electricity And Natural Gas Potential For The Investor-Owned Utilities

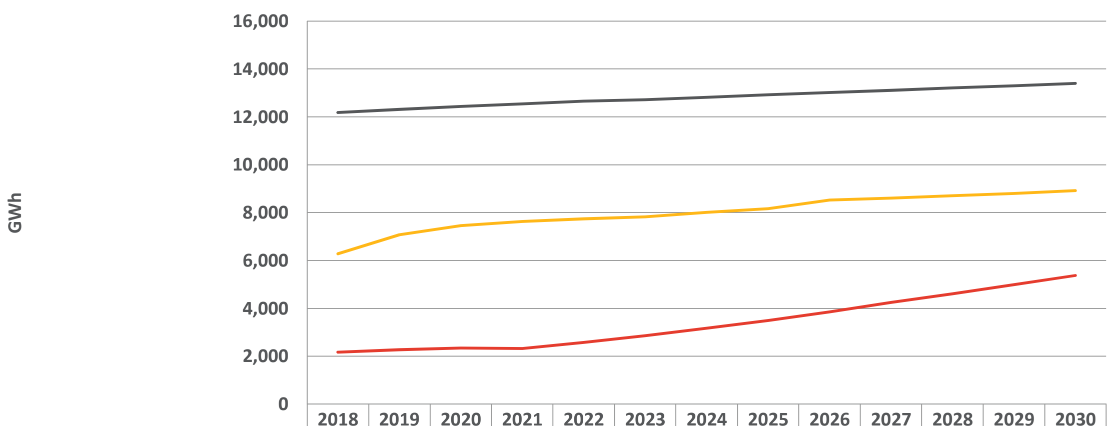
Figure B-1: PG&E Electric Technical, Economic, and Market Potential (GWh)



	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Technical Potential	12,178	12,311	12,434	12,546	12,655	12,717	12,818	12,920	13,015	13,110	13,206	13,300	13,394
Economic Potential	6,287	7,081	7,464	7,634	7,744	7,821	8,018	8,166	8,526	8,611	8,711	8,794	8,918
Cumulative Market Potential	2,171	2,279	2,350	2,326	2,577	2,859	3,167	3,497	3,857	4,244	4,609	4,989	5,379

Source: California Energy Commission, Demand Analysis Office, July 2017, based on CPUC/Navigant. Draft—*Energy Efficiency Potential and Goals Study for 2018 and Beyond*. June 2017. TRC1 Reference Scenario.

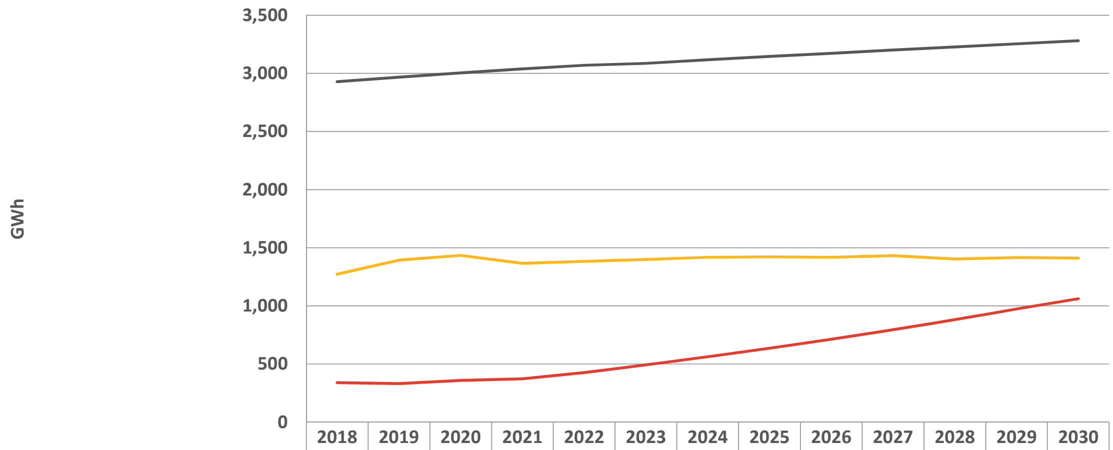
Figure B-2: SCE Electric Technical, Economic, and Market Potential (GWh)



	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Technical Potential	12,178	12,311	12,434	12,546	12,655	12,717	12,818	12,920	13,015	13,110	13,206	13,300	13,394
Economic Potential	6,287	7,081	7,464	7,634	7,744	7,821	8,018	8,166	8,526	8,611	8,711	8,794	8,918
Cumulative Market Potential	2,171	2,279	2,350	2,326	2,577	2,859	3,167	3,497	3,857	4,244	4,609	4,989	5,379

Source: California Energy Commission, Demand Analysis Office, July 2017, based on CPUC/Navigant. Draft—*Energy Efficiency Potential and Goals Study for 2018 and Beyond*. June 2017. TRC1 Reference Scenario.

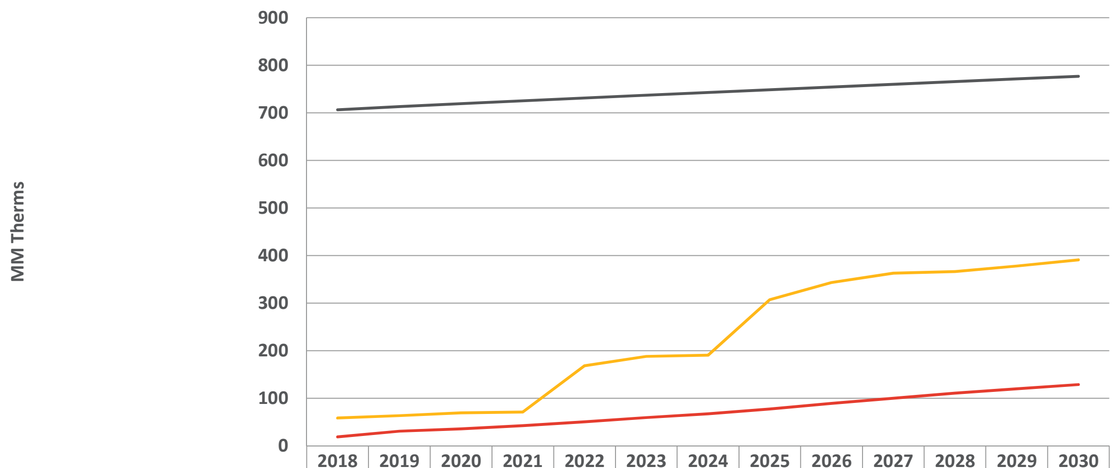
Figure B-3: SDG&E Electric Technical, Economic, and Market Potential (GWh)



	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Technical Potential	2,927	2,967	3,004	3,037	3,069	3,086	3,115	3,144	3,172	3,199	3,226	3,253	3,280
Economic Potential	1,273	1,393	1,433	1,367	1,382	1,399	1,417	1,422	1,417	1,431	1,403	1,416	1,411
Cumulative Market Potential	339	332	358	372	426	492	563	636	712	793	882	972	1,062

Source: California Energy Commission, Demand Analysis Office, July 2017, based on CPUC/Navigant. Draft—*Energy Efficiency Potential and Goals Study for 2018 and Beyond*. June 2017. TRC1 Reference Scenario.

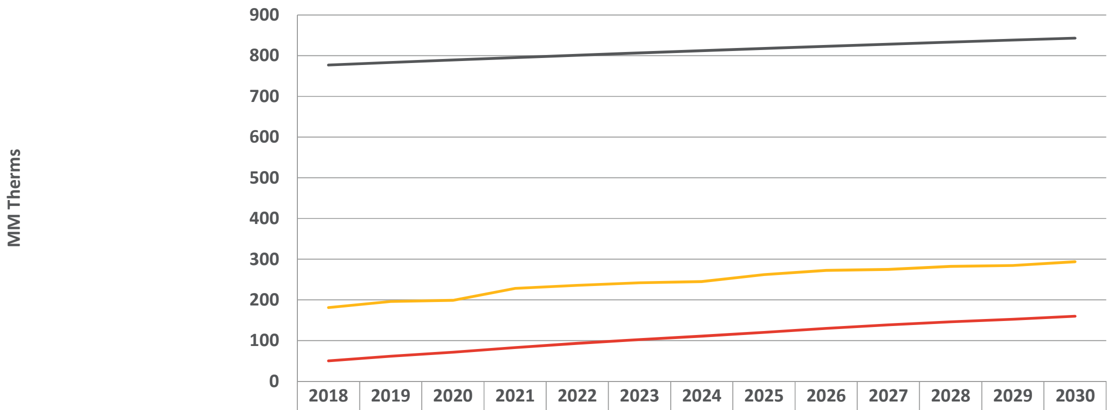
Figure B-4: PG&E Natural Gas Technical, Economic, and Market Potential (MM Therms)



	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Technical Potential	706	713	719	725	731	737	743	749	754	760	765	771	777
Economic Potential	58	63	69	70	168	188	190	307	343	363	366	378	391
Cumulative Market Potential	18	30	36	42	50	59	67	77	89	100	111	119	128

Source: California Energy Commission, Demand Analysis Office, July 2017, based on CPUC/Navigant. Draft—*Energy Efficiency Potential and Goals Study for 2018 and Beyond*. June 2017. TRC1 Reference Scenario.

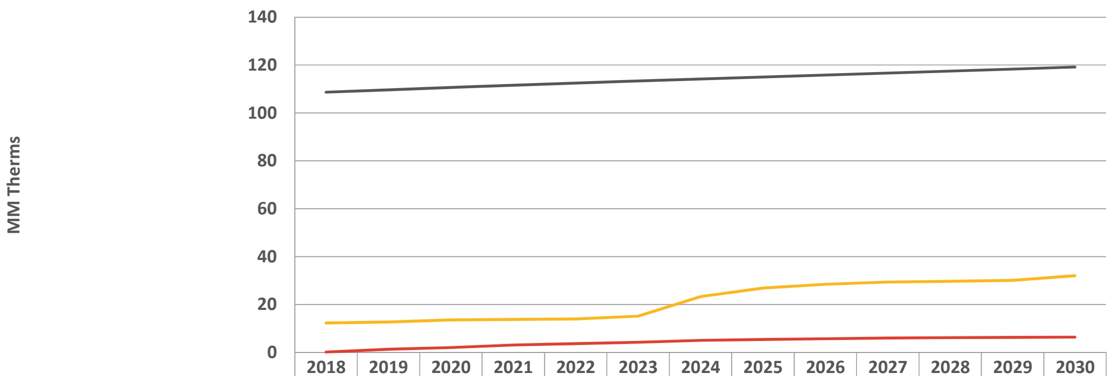
Figure B-5: SoCal Gas Natural Gas Technical, Economic, and Market Potential (MM Therms)



	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Technical Potential	777	783	789	795	801	807	812	818	823	828	833	838	843
Economic Potential	181	196	199	228	236	242	245	262	273	275	282	285	294
Cumulative Market Potential	50	62	71	83	93	103	111	120	130	138	146	153	160

Source: California Energy Commission, Demand Analysis Office, July 2017, based on CPUC/Navigant. Draft—*Energy Efficiency Potential and Goals Study for 2018 and Beyond*. June 2017. TRC1 Reference Scenario.

Figure B-6: SDG&E Natural Gas Technical, Economic, and Market Potential (MM Therms)



	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Technical Potential	109	110	111	112	112	113	114	115	116	117	117	118	119
Economic Potential	12	13	14	14	14	15	23	27	28	29	30	30	32
Cumulative Market Potential	0	1	2	3	4	4	5	5	6	6	6	6	6

Source: California Energy Commission, Demand Analysis Office, July 2017, based on CPUC/Navigant. Draft—*Energy Efficiency Potential and Goals Study for 2018 and Beyond*. June 2017. TRC1 Reference Scenario.

Appendix C Electricity Potential And Targets For The Publicly Owned Utilities

Table C-1: POU Technical Potential Groups of Measures

Measure Group	Description
Replacement on burnout (ROB)	Implementation of an energy-efficient measure after the existing equipment fails.
Retrofit (RET)	Immediate installation of an energy-efficient measure that improves the efficiency of an existing technology. The lifetime of the base technology is not a factor as retrofit measures generally do not replace existing technologies. The energy impact is therefore only the amount of improvement to the existing technology.
Dual Baseline (DUB)	The dual-baseline measure type is an early replacement that replaces an existing technology before the end of useful life; however, savings are calculated using a less efficient "as-found condition" baseline for the first part of the remaining useful life (RUL), and a "code condition" for the second portion of the RUL. These result in higher initial energy savings under the first baseline and lower savings under the second baseline once the measure would have reached the end of the effective useful life (EUL). Measure costs are also adjusted to reflect the change in baselines.
Behavioral Programs (BEH)	Programs designed to influence consumer behavior through the provision of training and/or information. As with emerging technologies, achievable potential is calculated using a Bass diffusion model rather than the traditional measure payback.
Low-Income	Measures that are implemented as part of utility administered low-income program.
New Construction	Installation of a measure or package of measures at the time of construction.
Demand Response	Strategies specifically designed to reduce peak demand. There is generally very little energy savings associated with these strategies.

Source: Navigant and California Energy Commission, Demand Analysis Office, July 2017.

Table C-2: Economic Screening of Measures

Test	Description
Total Resource Cost (TRC)	This test includes all quantifiable costs and benefits of an energy efficiency measure that may accrue to participants or the utility. For example, a measure passing the TRC test is cost-effective if the sum of the avoided costs and other benefits accruing to participants or the utility are greater than the sum of the measure costs and the utility's administrative costs.
Program Administrator Cost Test (PAC)	This test measures the costs of an energy efficiency program based on the costs incurred by the utility (including incentive costs) and excluding any net costs incurred by the participant. For example, a measure passing the PAC test is cost-effective if the sum of the avoided costs (costs avoided by energy and demand savings of the measure) and other utility benefits are greater than the utility's costs to promote the measure, including incentives provided to customers.
Ratepayer Impact Measure Test (RIM)	This test measures what happens to a dwelling or business' electric bills or rates due to changes in utility revenue and operating costs caused by the program. For example, a measure passing the RIM test is cost-effective if the avoided costs are greater than the sum of the utility's costs and the "lost revenues" caused by the measure.
Participant Cost Test (PCT)	This test measures the quantifiable benefits and costs to the customer due to participation in the program. For example, a measure passing the PCT test is cost-effective if the reduced electric costs to the participating customer from the measure exceed the after-incentive cost of the measure to the customer.
Customer Payback	This measurement calculates the incremental technology cost divided by the incentive and the reduction in the electric bill. If multilife benefits and costs are considered, it also includes the PV of future technology costs and future incentives and bill reductions.
Levelized Measure Cost/kWh	This metric multiplies the energy efficiency measure costs by the Capital Recovery Factor and divides by the first-year kWh savings.

Source: California Energy Commission, Demand Analysis Office, july 2017.

Table C-3: POU Energy Efficiency Targets (GWh)

POU	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	Total
IRP Group											
LADWP	499	504	461	410	408	402	404	414	417	406	**4,324**
SMUD	150	155	164	175	184	187	181	169	158	146	**1,669**
Imperial	33	34	34	32	31	29	28	27	25	22	**295**
Anaheim	28	28	27	26	26	25	24	23	22	20	**249**
Riverside	23	23	23	23	23	23	23	23	23	24	**233**
Pasadena	14	14	14	14	14	14	14	14	14	14	**137**
Turlock	16	15	15	15	14	14	13	12	11	10	**134**
Santa Clara	13	13	14	15	15	15	13	12	12	11	**132**
Glendale	15	15	15	14	14	14	12	12	11	10	**131**
Burbank	11	11	11	12	13	13	14	14	13	13	**124**
Modesto	9	10	11	12	13	13	14	14	13	12	**121**
Roseville	8	9	9	10	10	10	9	9	8	8	**89**
Palo Alto	7	7	8	8	8	8	9	9	9	9	**82**
Vernon	5	5	6	6	6	5	5	4	4	4	**48**
Redding	4	4	4	4	4	4	4	4	4	3	**40**
San Francisco	4	4	4	4	4	4	4	3	3	3	**38**
Non-IRP Group											
Small POUs[81]	13	13	12	13	12	12	13	12	12	11	**123**
Combined POUs	**852**	**864**	**832**	**793**	**798**	**792**	**782**	**773**	**758**	**725**	**7,969**

Source: *Energy Efficiency in California's Public Power Sector* Status Reports, Appendix C. Electricity savings is rounded to the nearest GWh.

81 Small POUs group include Colton, Lodi, Merced, Moreno Valley, Alameda, Truckee Donner, Shasta Lake, Banning, Healdsburg, Rancho Cucamonga, Lassen, Lompoc, Corona, Pittsburg, Ukiah, Victorville ,Plumas-Sierra, Gridley, Needles, Biggs, Trinity, Azusa.

Table C-4: POU Demand Reduction Goals (MW)

POU	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	Total
IRP Group											
LADWP	108	112	104	89	88	88	89	91	91	91	**951**
SMUD	30	32	35	38	39	41	41	39	38	38	**371**
Imperial	10	10	10	10	9	9	9	8	8	7	**89**
Riverside	8	8	8	8	8	8	7	7	6	5	**72**
Anaheim	7	7	7	7	7	7	7	7	7	6	**69**
Burbank	3	4	4	4	4	4	4	4	4	4	**39**
Santa Clara	3	3	3	3	3	3	3	2	2	2	**25**
Glendale	3	3	3	3	3	3	2	2	2	2	**25**
Pasadena	3	2	2	2	2	2	2	2	2	2	**23**
Turlock	3	3	3	3	2	2	2	2	2	2	**23**
Modesto	2	2	2	2	2	2	2	2	2	2	**21**
Redding	1	1	1	1	1	1	1	1	1	1	**11**
Palo Alto	1	1	1	1	1	1	1	1	1	1	**10**
Vernon	1	1	1	1	1	1	1	1	1	-	**9**
Roseville	1	1	1	1	1	1	1	-	-	-	**7**
San Francisco	-	-	-	-	-	1	1	1	1	1	**5**
Non-IRP Group											
Small POUs[82]	3	3	3	3	3	3	3	3	3	3	**30**
Combined POUs	**186**	**191**	**187**	**175**	**175**	**176**	**176**	**174**	**172**	**168**	**1,781**

Source: *Energy Efficiency in California's Public Power Sector* Status Reports, Appendix B.

82 Small POUs group include Colton, Lodi, Merced, Moreno Valley, Alameda, Truckee Donner, Shasta Lake, Banning, Healdsburg, Rancho Cucamonga, Lassen, Lompoc, Corona, Pittsburg, Ukiah, Victorville ,Plumas-Sierra, Gridley, Needles, Biggs, Trinity, Azusa.

Table C-5: POU Energy Efficiency Adjusted Cumulative Targets (GWh)

POU	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029
LADWP	255	510	762	1,082	1,412	1,713	2,010	2,304	2,609	2,926	3,254	3,586	3,909	4,230	4,546
SMUD	160	310	470	568	666	763	868	982	1,098	1,211	1,314	1,408	1,493	1,569	1,636
Anaheim	26	51	77	92	108	124	140	157	174	190	206	221	235	248	260
Riverside	21	38	58	79	100	120	139	157	175	191	206	220	233	245	255
Imperial	12	25	42	58	74	91	109	127	145	162	179	195	209	221	231
Santa Clara	12	31	51	64	77	91	106	121	136	149	161	173	184	194	203
Pasadena	17	32	45	58	71	84	97	110	123	135	146	157	167	176	184
Modesto	14	25	40	49	59	70	82	95	108	122	136	149	161	172	182
Burbank	14	26	37	47	57	67	78	89	101	113	125	137	148	159	169
Glendale	17	35	47	56	65	74	83	93	103	112	120	128	135	141	147
Turlock	5	18	31	40	49	59	69	79	89	99	108	116	124	132	140
Roseville	9	26	34	42	51	60	70	80	90	99	108	116	124	132	139
Palo Alto	6	12	18	26	34	43	52	61	70	78	86	94	102	109	116
Vernon	6	8	12	15	18	21	25	29	32	35	38	41	44	46	48
Redding	2	3	6	9	12	16	20	24	27	30	33	36	39	42	44
San	2	3	7	10	13	16	19	22	25	27	29	31	33	35	37
Small	19	38	54	67	80	93	106	120	134	147	160	172	183	194	204
Combined	597	1,191	1,791	2,362	2,946	3,505	4,073	4,650	5,239	5,826	6,409	6,980	7,523	8,045	8,541

Source: California Energy Commission, Demand Analysis Office, July 2017.

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83 Small POUs group include Colton, Lodi, Merced, Moreno Valley, Alameda, Truckee Donner, Shasta Lake, Banning, Healdsburg, Rancho Cucamonga, Lassen, Lompoc, Corona, Pittsburg, Ukiah, Victorville ,Plumas-Sierra, Gridley, Needles, Biggs, Trinity, Azusa.